unavoidable. First, the index is based on a very small number of countries—but this is OK for a first attempt to create such an index. The author might spur others to try to develop an index for other countries. Second, to some degree data availability determines what can be included in the index. That is usually the case since economists cannot always dictate which data are collected. In any case, it is useful to get this particular index out into the literature as follow-up studies might find more appropriate data.

In some cases it appears that the weighting used for the index is rather arbitrary. However, the author shows that alternative weightings do not have a big impact on the results—at least in those cases reported.

Measuring Macroprudential Risk through Financial Fragility: A Minskian Approach

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Measuring Macroprudential Risk through Financial Fragility: A Minskian Approach

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**Introduction**

Over the past decade, economists have progressively recognized that macroprudential analysis is an important tool for financial regulation and supervision. In the United States, the Financial Stability Oversight Council 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 aims at contributing to the development of this framework by using the analytical framework of Hyman P. Minsky. Several authors have already used Minsky’s analysis to develop indicators of financial fragility. A first set of studies analyzes the trend of several variables and checks how they help to explain recessions. A 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 studies, 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 in total assets. In her study of the Great Depression, Isenberg (1988, 1994) finds that, instead of being recorded at the aggregate level, the fragilization of the economy occurred within the most dynamic part of the non-financial business sector. In his own study of the Great Depression, Minsky (1984) notes that the household and government sectors were key contributors to the growing risk of a debt deflation. 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 (Schroeder 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 reliance on position making (De Paula and Alves 2000).

The paper contributes to that research program by developing an index of financial fragility for housing finance in the United States, the United Kingdom, and France. The paper also contributes to the measurement of macroprudential risk by complementing the existing literature that has been focused on measuring the risk and size of financial disturbances such as default or liquidity problems. The index focuses on detecting a risk of amplification of a disturbance by analyzing the interaction between asset prices and debt during long periods of economic prosperity; these periods that may record moderate recessions that do not significantly impact the state of expectations (e.g., the Great Moderation). During these periods, financial fragility may grow given credit and liquidity risks, as underwriting procedures change in such a way that a greater emphasis is put on refinancing and asset liquidation to service debts. Ponzi finance is a state of credit that is highly reliant on such a means to service debts.

The paper shows that financial fragility in housing finance started to grow from the late 1990s in the United Kingdom and the United States, and rapidly grew after the 2001 recession in the United States. France did not have as loose housing finance practices at that time and so did not record an increase in financial fragility until the second part of the 2000s. The index is also used to build a heat map similar to the one used by the International Monetary funds. The heat maps shows that financial fragility was abnormally high in residential housing from 2004 in the US, 2005 in the UK, and 2007 in France. Finally, the paper also provides a road map for future research on the construction of indexes of financial fragility. Notably, better datasets should be developed to measure the refinancing needs of different sectors of the economy, and the prevailing underwriting practices in the financial sector. These datasets would be used to detect defensive position making needs and asset-based lending.

The first part of the paper defines financial fragility 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 fourth part suggests some extensions and 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. In this paper, we use the Minskian conception of financial fragility which is broadly defined by Minsky in the following way:

The robustness or fragility of the financial system depends upon the size and strength of the margins of safety and the likelihood that initial disturbances are amplified. (Minsky 1986: 209)

The overall fragility-robustness of the financial structure, upon which the cyclical stability of the economy depends, emerges out of loans made by bankers. […] An emphasis by bankers on the collateral value and the expected values of assets is conducive to the emergence of a fragile financial structure. […] One measure of the riskiness of financial instruments is the expected source of the funds that are needed to fulfill financial contracts. (Minsky 1986: 234-236)

The source of the disturbance can be default, rising interest rate, disruption in refinancing sources, a natural disaster, or any other “shocks” that affect either the cash inflow or cash outflow of an economic unit. While a lot of work has been done to identifying the sources of disturbance (especially credit risk and liquidity risk), the goal in this paper is to focus on the risk of amplification of the shock induced by underwriting practices. In the Minskian framework, this amplification goes through a snowball effect between asset price and debt on the upside (a debt inflation) that, if left unchecked, leads to a debt deflation.

In order to measure the risk of debt deflation, Minsky made a difference between three different degrees of financial fragility induced by indebtedness: Hedge finance, Speculative finance, and Ponzi finance. Hedge finance means that an economic unit is expected to be able to pay its liability commitments (*CC*) with the net cash flow it generates from its routine economic operations (work for most individuals, going concern for companies) (*NCFO*). Thus, when a debt contract is signed (time 0), the following state of expectation in terms of cash flows from routine operations prevails:

*E0*(*NCFOt*) > *E0*(*CCt*) ∀*t*

In addition, the available cash balance (*M*) is large enough to meet most unforeseen deficiencies in realized net cash inflows from routine operations, and most unforeseen adverse changes in cash outflows from liability commitments (there are cases where that might not be the case but they can be ignored for the sake of generalization):

*NCFOt* + *Mt* > *CCt* ∀*t*

This implies that net cash flow from what Minsky calls defensive position making (*NCFPM*)—borrowing(∆*LR*) and sales of non-liquid assets (*∆*(*PAQA*) = 0) to service debts—are not expected and are not needed when cash flow expectations from routine operations are not met:

*E0*(*NCFPMt*) = *NCFPMt* = ∆*LRt + ∆*(*PAtQAt*) = 0 ∀*t*

Thus, even though indebtedness may be high (even relative to income), an economy in which most economic units rely on Hedge finance is less prone to a debt deflation. However, as Minsky noted, besides unusually large adverse changes in cash flows, there is still one important channel through which a debt deflation can occur with Hedge finance. If expectations regarding net cash flow from operations are too reliant on data available during a smooth economic period (not-unusually large adverse changes in cash flows are not considered in the building of margins of safety to meet unforeseen deficiencies) (Kregel 1997), unrealistic and/or fraudulent (recently the case for low-documentation mortgages) (Pendley et al. 2007; Kindleberger 1996), and/or highly reliant on output-price inflation (Minsky 1983), the economy is relatively more fragile. Of course, these aspects of the state of expectation also apply to the following categories, and are more prone to occur during the boom phase of the Financial Instability Hypothesis.

Speculative finance means that routine net cash flows are expected to be large enough to meet the income component of liabilities contracts (*iL*) but not the capital component of liabilities (principal service, margin call and others) (*aL*). Thus, at the time a debt contract is signed (time 0), the following state of expectation prevails for routine cash flows:

*E0*(*NCFOt*) < *E0*(*CCt*)

*E0*(*NCFOt*) > *E0*(*iLt*) ∀*t*

*E0*(*NCFOt*) < *E0*(*aLt*)

In addition, the available cash balance is not large enough to meet foreseen deficiencies in realized net cash inflows from routine operations. As a consequence, it is expected that position making will be needed to meet part, or all, the capital servicing on liabilities, and usually that means that it is expected that debts will be rolled over. However, while position making is needed, the size of cash flow from position making relative to outstanding debts (*L*) should stay constant or decline:

*E0*(*NCFPMt*) = *NCFPMt* > 0 and *d*(*E*(*NCFPM*)/*L*)/*dt* ≤ 0

The ratio will stay constant if position making is needed to meet all capital servicing. The length of time during which routine cash flows are expected to fall short of capital repayment depends on the economic unit. The business model of banks is such that position making is usually needed to meet the capital component of liabilities, as such banks need a reliable and cheap refinancing source. Other businesses may only have a temporary need for position making.

Ponzi finance means that an economic unit is not expected to generate enough net cash flow from its routine economic operations, nor to have enough monetary assets to meet the capital and income services due on outstanding financial contracts. At time 0, it is expected that the following applies until a date *n* in terms of cash flow from routine operations:

*E0*(*NCFOt*) < *E0*(*CCt*) ∀*t* < *n*

*E0*(*NCFOt*) < *E0*(*iLt*) ∀*t* < *n*

*E0*(*NCFOt*) < *E0*(*aLt*) ∀*t* < *n*

This implies that Ponzi finance relies on an expected growth of refinancing loans, and/or an expected full liquidation of asset positions at a growing asset prices (*PA*) in order to meet debt commitments on a given level of outstanding debts (*L*):

*E*(*NCFPM*) = ∆*LRt + ∆*(*PAtQAt*) > 0 and *d*(*E*(*NCFPM*)/*L*)/*dt* > 0

At the macroeconomic level, if a critical portion of economic units is involved in Ponzi finance, the economic system is highly prone to debt-deflation. As Minsky put it:

An increase in the ratio of Ponzi finance, so that it is no longer a rare event, is an indicator that the fragility of the financial structure is in a danger zone for a debt-deflation. (Minsky 1986: 379)

Thus, a high reliance on net cash flows from position making the macroeconomic level is what amplifies an initial disturbance. Without this reliance on position making, the impact of defaults and other disturbances will be contained, and limited government involvement will be needed to promote financial stability.

Leaving aside fraud (which can occur at any stage of financial fragility), Hedge, Speculative and Ponzi finance must have a positive net worth over the life of the funding project to be implemented; otherwise an honest banker would not consider funding the project. The main difference between the financial configurations is based on the degree to which position making is needed to get a positive net worth. Hedge finance is not expected to require any position making; Ponzi finance is expected to require growing position making. This should be differentiated from the existence or not of a “bubble.” The categorization does not aim at measuring the accuracy (however, defined) of the price of assets (*PA*) used to service liability commitments.

As the second quote at the beginning of this section suggests, another way to understand the H/S/P classification is in terms of the underwriting characteristics underlying each financial scheme:

Loans based on the value of pledged collateral are different in kind from loans based on the value of the cash flows that are expected from income-earning operations. True, in structuring a loan that is mainly based on prospective cash flows the loan officers may insist on a margin of safety in the form of pledged collateral. But this would not be the primary consideration […]. The viability of loans mainly made because of collateral, however, depends upon the expected market value of the assets that are pledged. […] Thus, the overall fragility-robustness of the financial structure, upon which the cyclical stability of the economy depends, emerges out of loans made by bankers. […] An emphasis by bankers on the collateral value and the expected values of assets is conducive to the emergence of a fragile financial structure.

(Minsky 1986: 233)

Hedge finance involves income-based lending, that is lending in which the creditworthiness of a borrower is heavily reliant on its routine income. Collateral may still be used to determine the profitability of a loan but its role is to protect a bank against an unexpected credit event, instead of being the expected source of debt servicing.

Ponzi finance involves, partially or fully, asset-based lending, that is, lending based solely on the expected price of assets. More precisely, income-based Ponzi finance involves financial contracts that contain a period of time during which rising refinancing is needed to cover debt services until routine income is high enough to cover debt services. Minsky always emphasized that capital equipment with a long period of maturation may involve such Ponzi financing. Such lending involves a decline in net worth while Ponzi finance exists, followed by an increase in net worth as assets produce an income greater than debt services. Asset-based Ponzi finance, also called a pyramid scheme, contains underwriting expectations such that routine income will never be high enough to service debts (*n* tends toward infinity in the routine cash flow condition). The only means to generate a positive net worth is to sell assets at a price high enough to cover debt payments and generate a profit. In this case net worth will first grow as asset prices increase fast enough to more than compensate for the increase in debt.

The important point for the paper is that Ponzi finance can be detected even though defensive position-making operations have not yet occurred. As long as asset-based lending occurs, underwriting includes expectations of position making operations and so the interdependence between debt and asset prices increases on the upside; thereby creating the condition for a debt-deflation on the downside.

Finally, one may note that this categorization is not a measure of the use of external funding, i.e. of the size of leverage; but rather, a measure of the quality of the leverage. This quality is measured by focusing on the means used by debtors to service debts instead of ability to service debt per se (i.e. credit risk). Indeed, it is not because the ability to pay is high (low credit risk) that financial fragility is low, because low credit risk may be possible only if refinancing sources stay open and asset prices continuously rise. This is what we observed during the past financial crisis, when both prime and non-prime borrowers relied on rising home prices to sustain their rising indebtedness. Similarly, low ability to pay (high credit risk) may not be a major source of instability if this high credit risk is mainly based on income instead of refinancing and asset sales. Subprime mortgages have a much higher probability of default than prime mortgages but they are not a major concern if underwriting is done properly to verify income, cash reserves and jobs and if enough collateral is sought by banks.

One can conclude from this brief discussion of Minsky’s theoretical framework is that, as an economic unit (be it an individual, an economic sector, or an economy) transfers from hedge to Ponzi finance, one should observe that debt burden rises (the ratio of debt service to routine income rises), defensive refinancing needs and/or asset-based lending rise, asset prices rise, and the amount of liquid assets relative to liabilities declines. This should happen simultaneously if financial fragility is rising. This growth in financial fragility can occur even though net worth in all economic sectors is rising, economic growth is smooth and strong, businesses are highly profitable, and default rates are declining.

**Financial Fragility Index: Construction, Interpretation and Data Analysis**

*Construction*

In order to construct the index, the theory presented above indicates that one needs data that reflect asset-based lending, asset prices, positing-making needs and debt burden. While the United States is the most data rich country, the paper also attempts to an index for France and the United Kingdom by using similar data or constructing proxies. The latter two countries do not provide as much data partly because it is not available, and partly because some of the lending practices existing in the US are marginal or nonexistent in these countries. For example, revolving home equity lending was forbidden in France until very recently when Article 24 of the 2005 Confidence and Economic Modernization Act (Loi pour la Confiance et la Modernisation de l’Economie) allowed the government to reform mortgage lending in order to introduce revolving home equity lending and reverse mortgages. These have become legal in March 2006 via ordinance 2006-346 but have been marginal since that time (Lamoussière-Pouvreau and Masset-Denèvre 2007).

The index contains the following variables when available: home mortgage of households relative to GDP (L), home price index (P), mortgage-financial-obligation ratio or interest-obligation ratio (MOR), the proportion of home equity loans in all mortgages (HELOC), the cumulative value of home equity withdrawals (HEW), the proportion of cash-out refinance mortgage among refinance mortgages (COR), and the ratio of mortgage debt to monetary assets (MMR). The main idea behind the index is that the risk of debt deflation grows as a result of a combination of factors, namely rising debt burden, rising position-making needs,and rising asset-based lending. The section focusing on the data analysis will expend on this idea.

Once the needed variables are obtained, the next step is to assign a weight to each of them. Minsky’s framework gives us some clues about the ordinal importance of different variables to measure fragility, but does not provide any clue about their cardinal importance. In addition, the importance given to a variable should depend also on how well the data reflects refinancing needs and liquidation needs. This paper follows three approaches to set a weight structure. One structure gives the same weight to all the variables, another approach uses a statistical method, and a final approach relies on the author uses of Minsky’s theory and reliability of the data to set the weight. In this last approach, more weight is given to the debt-service ratio, liquidity ratio and refinancing needs (see annex 1 for the actual weight structures).

All variables are seasonally adjusted and the year 1996 is used as a base to calculate an index for all variables. Each index is then combined to calculate an index of financial fragility attributing to each variable a weight wi:

*IHFUS* = w1*IL* + w2*IP* + w3*ICOR* + w4*IHELOC* + w5*IMMR* + w6*IMOR*

*IHFUK* = w1*IL* + w2*IP* + w3*IHEW* + w4*IMOR* + w5*IMMR*

*IHFF* = w1*IL* + w2*IP* + w3*IHELOC* + w4*IMOR* + w5*IMMR*

The index of home finance (*IHF*) is equal to 100 in average for year 1996 which was a period of relative calm in the housing market for all countries.

*Data Analysis*

For households, the net cash flow from routine operations is their disposable labor income and financial earnings less living expenses necessary to maintain their current standard of living. This net cash flow needs to be compared to mortgage debt services to get a first idea of financial fragility in housing finance. A dataset that comes close to compare the two cash flows is the mortgage debt-service ratio, which is available in the United States but not in France or the United Kingdom. The Federal Reserve Board publishes quarterly data that is shown in Figure 1 and the ratio is defined as mortgage debt service over after-tax income. For the two other countries, the mortgage debt-service ratio can be proxied, albeit quite imperfectly, by the interest-obligation ratio on all debts, that is the ratio of interest payments on all debts relative to disposable income. The most significant debt among households is their mortgage so the dynamic of the interest-service ratio is highly influenced by this specific debt. However, this dataset cannot capture the burden induced by the servicing of the principal.

FIGURE 1 HERE

There are several limitations to the mortgage-service ratio for our purpose (Dynan, Johnson, and Pence 2003). One of the main limits is that it is a measure of actual cash flow ratio rather than a measure of expected cash-flow ratio. As a consequence, financial fragility will be captured with a delay and does not capture the motivation or cause behind the growth of debt service:

Some households may increase their ratios by borrowing more because they are appropriately optimistic about their future income prospects and their corresponding ability to repay debt. Other households may increase their ratios because they have suffered an unanticipated misfortune that necessitates borrowing to cover their extra expenses. An increase in the DSR indicates good news for the economy in the first example and bad news in the second. (Dynan, Johnson, and Pence 2003: 417-418)

Beyond the role expectation, the debt-service ratio uses after-tax income as a denominator when what really matters is the “free” after-tax income, i.e. what is left after necessary expenditures on goods and services. These limitations of the debt-service ratio imply it is best not to look at it alone. A rising debt-service ratio will be of concern if it occurs simultaneously with other financial trends. Indeed, two central features of financial fragility are that refinancing for the purpose of servicing debts grows and liquidity buffers shrink; therefore, rising debt-service ratio together with declining liquidity ratios and growing refinancing needs provide a better indicator of rising financial fragility at the macroeconomic level.

Regarding liquidity buffers, the amount of monetary assets relative to the amount of debts has decreased dramatically over time in all countries. Figure 2 shows that US households used to have almost twice as many monetary assets as mortgage debts in the middle of the 1980s. By the end of the 2000s they held as many monetary assets as their outstanding mortgage debt. Similar trends occurred in France and the United Kingdom. Thus, the capacity of households to respond swiftly and smoothly without external help to a situation where routine income is insufficient to meet debt service has decreased dramatically, which creates a greater dependence on defensive position making.

FIGURE 2 HERE

In the index, the inverse of this ratio is used to make sure that all variables move in the same direction to indicate the same change in financial fragility.

Regarding refinancing operations, in the United States the Federal Home Loan Mortgage Corporation and the Federal Housing Finance Agency provide datasets about mortgage refinance. Figure 3 shows that, from the early 2000s the amount of refinance mortgages—either to lower mortgage cost (term-rate refinance) or to extract cash (cash-out refinance)—usually represents the majority of mortgage originations (the rest is what the mortgage industry calls “purchase mortgages,” that are used to buy a house). Within refinance mortgages, term-rate refinance usually represents the main kind of refinancing activity except in the mid 2000s when cash-out refinance dominated.

For our purpose, the most interesting refinancing datasets are those that relate to the growth of asset-based underwriting because they provide a glimpse of the change in the expectations underlying mortgage funding. A rapid growth in term-rate refinance does not provide such signal because it may rise only once payment difficulties have materialized, and/or because rates are lower so mortgagors find it beneficial to refinance (it is not a defensive operation). Thus, term-rate refinance does not provide a clear clue about financial fragility or it does so only once the problems have began to accumulate beyond repair, which is what was observed during the Great Recession. In addition, term-rate refinance does not provide a clue that asset-based lending is rising, while cash-out refinance does. From the middle of 2004, cash-out refinance mortgages represented the majority of refinance mortgages and their proportion among all mortgages peaked at about 70 percent of all refinance mortgages. One may observe that from 1999 their proportion also grew rapidly and reached about 55 percent in 2000 right before the 2001 recession.

FIGURE 3 HERE

The datasets available about cash-out refinancing are of limited help because they relate mainly to conforming mortgages that are overwhelmingly prime mortgages. This means that a good part of the growing fragility going on in the 2000s (in the subprime and alt-A sectors) cannot be captured through this data; however, even the prime mortgage business in the US became dependent on position making with a high reliance on low-documentation mortgages and expectations that home prices would continue to rise (Zelman 2007).

Another limit of the dataset is that, as in the case of the debt-service ratio, the motivations underlying the trend of cash-out refinancing are unknown. While the cash extracted may be used to repay other debts, it may be used also for other purposes like home improvements or vacations. At the same time, however, cash-out refinancing good proxy for asset-based lending.

The Federal Reserve provides a complementary dataset about asset-based lending in housing that records the outstanding amount of revolving home equity loans. Figure 4 shows the proportion of revolving home equity loans in all mortgages.

FIGURE 4 HERE

This U.S. dataset provides a somewhat similar picture as the proportion of cash-out refinance. Both datasets suggest a rapid increase in asset-based lending from the early 2000s.

As explained above, home equity lending was nonexistent in France until 2006 and can be considered to be zero for the entire period during which the index is constructed. In the United Kingdom, home equity withdrawal provides an imperfect proxy for asset-based lending. Home equity withdrawal, a flow variable, measures the net change in the amount of home equity. Home equity is withdrawn when house equity declines (because home prices decline or mortgage-related debts rise) and when someone sells a home. Given that first-time home buyers inject equity in the house and home sellers withdraw equity, and given that home sellers have usually more equity in the house than home buyers, home equity withdrawal is usually positive and closely follows the turnover in housing market (Reinold 2011). Thus, home equity withdrawals may have nothing do with housing refinance even though it is positively affected by it. In addition, the data does not tell which type of refinancing affects equity withdrawals, when cash-out refinance is really what matters to detect asset-based lending.

While understanding the limit of the data, the cumulative value of the home equity withdrawals can help to measure financial fragility, and rising equity withdrawal in the UK means that a majority of homeowners either refinance or sell their home; possibly to repay their outstanding mortgages. Figure 5 shows home equity withdrawal and its cumulative value. Two periods stand out in the UK, the 1980s and the 2000s that both recorded rapid increases in home equity withdrawals. Figure 6 shows the proportion of cumulative home equity withdrawal relative to all mortgages, which is the variable used in the index to provide a proxy for the relative importance of asset-based lending. This proportion was high in the mid 1980s and early 2000s

FIGURE 5 HERE

FIGURE 6 HERE

Again, the datasets do not provide a direct observation of the motivations behind the change in home equity withdrawals; some people may sell their home because they have to repay an unaffordable mortgage, others just want to rent instead of owning or maybe have other reasons. Thus, like for all other datasets, instead of looking at the data in isolation it should be compared with other signs of financial fragility.

Finally, the index of financial fragility requires some data about how the underlying collateral or asset used to sustain an economic activity behaves. In the case of residential home mortgages, the measurement of financial fragility relies partly on how home prices behave overtime. For asset-based lending to thrive, collateral value must be rising (if a long position is taken, which is the case for housing) so a period during which the outstanding volume of mortgages and home prices rise simultaneously is a necessary, but not a sufficient, indicator of growing financial fragility. Figure 7 shows that, in the United States, home prices grew tremendously from the late 1990s and dropped rapidly in the second part of the 2000s. Similar trends were observed in the United Kingdom.

FIGURE 7 HERE

This overview of each individual variable shows that they all have some limits for the purpose of measuring financial fragility. For our purpose the main limit may be that the motivations and expectations behind the behavior of each variable are unknown, when the index aims at capturing defensive position-making needs and asset-based lending. However, by combining the datasets and looking how they behave simultaneously, this paper argues that one can get an idea of the trend of financial fragility in house funding.

**The Index of Financial Fragility in Housing**

When combined together in the way presented above, the variables provide a view of how financial fragility has evolved relative to the base year of 1996, which is shown in Figure 8. All countries experienced a rapid increase in home prices in the first part of the 2000s, however, financial fragility grew on average much less rapidly in France compared to the United States and the United Kingdom. Tighter mortgage regulation limited the capacity of French banks to underwrite mortgages on the basis of rising home prices instead of income. However, the financial fragility index for France did rise by about 35 percent from 2005 to 2008, due to the combination of a decline in liquidity buffers, rising outstanding mortgages, rising home prices and rising debt services relative to disposable income. Households owning a property in France did experience a brief decline in financial fragility from 2008 and 2009, but fragility seems to be on the rise again. Given that revolving home equity lending has been authorized, unless underwriting standards stay strong, one may expect a rapid increase in the financial fragility of French households if the economic conditions become favorable.

In the United Kingdom, financial fragility in housing finance declined during the first half of the 1990s but started to go back up again from the end of the 1990s. Home prices grew very rapidly, as did mortgage lending, home equity lending (as proxied by home-equity withdrawal), and the debt-service ratio. At the same time, the liquidity buffer of households declined and the combination of all these trends made households more vulnerable to financial difficulties induced by unemployment, declines in home prices, rising interest rates, rising amortization rates, and decline in the availability of refinancing loans. As a consequence, financial fragility grew by almost 70 percent from 1996 to 2008 and about 50 percent from the early 2000 until 2008. The UK did not have any recession from early 1990s to 2008, which provided a fertile ground for the growth of financial fragility, and financial fragility did so at an accelerated rate as Figure 9 shows. Since 2008, financial fragility has declined dramatically as housing finance is “simplified” (as Minsky used to say) through foreclosures, house sales, and the issuance of term-rate refinance and purchase mortgages at more affordable terms and with tighter underwriting standards.

Similar trends are observed in the United States. As in the UK, financial fragility in housing funding grew from the late 1990s. Some members of the Federal Open Market Committee, namely Gramlich and Jordan, became worried about the deterioration of household finances:

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.

(Jordan, FOMC Transcripts, February 1999, page 123)

Gramlich was worried about predatory lending and made his views known to Greenspan who did not consider it to be a significant problem. Greenspan seemed to be vindicated by the pause in the growth of fragility that occurred in the early 2000s because of the bursting of the dot-com bubble in 2000 and a minor recession in 2001. However, from 2003, financial fragility grew very rapidly for the same reason as in the United Kingdom. Households in the United States were the first to experience a decline in financial fragility from 2007, followed by the United Kingdom and France. The decline in fragility has been the most dramatic in the US and household fragility is almost back to its level of 2003, when most of the Ponzi financing in housing had not occurred.

FIGURE 8 HERE

FIGURE 9 HERE

Overall, this index provides some insights into the funding methods used by households to purchase and hold a house. It implies that the decline in housing underwriting standards started at least by the end of the 1990s in the US and the UK and lasted until the second half of the 2000s. Some FOMC members in the United States were right to worry about the dangerous, albeit early, funding trends occurring in the housing market.

**Extending the Analysis: Comparing Financial Fragility across Countries and Heat Map**

The previous index was constructed to measure the change in financial fragility in a given country relative to a given period of time. One may also want to compare financial fragility across countries. For example, Figure 2 shows that the liquidity ratio is much higher in France relative to other country so, given everything else, it must mean that the risk of debt deflation originating from French housing finance is smaller than the other two countries. In order to build such an index one needs to have the same variables available across countries. Annex 2 shows how the index is built and Figure 10 shows the results of this procedure, which are similar to the previous index in terms of trends. As expected, Figure 10 shows that the risk of financial instability coming from French housing finance is much lower than in the United States.

FIGURE 10 HERE

The main drawback of this procedure is that the very limited availability of homogenous data across country that represents refinancing pressures and asset-based lending. Thus, some important aspects of financial fragility cannot be captured properly for cross-country comparisons.

Another extension of the index is to use it to create a heat map similar to the one the IMF constructed for different markets in its *Financial Stability Report*. Figure 11 shows the heat map for the three countries for the residential mortgage market.

FIGURE 11 HERE

The color changes depending on deviation from the means. If the index value is at or below one standard deviation from the means of the index, the color is light grey. If the index value is above one but at or below 1.5 standard deviation from the means the color is dark grey. If the index value is greater than 1.5 standard deviation from the means of the index, the color is black. This heat map shows that financial fragility was abnormally high first in the US in the mid 2004, followed by the UK in 2005 and France in 2007. Financial fragility was really high from the mid 2005 in the US, mid 2006 in the UK, and early 2008 in France. Since 2009, the financial fragility index has declined back to its means in the UK and the US but is still relatively high in France.

**Conclusion**

The paper constructs an index of financial fragility based on Minsky’s framework of analysis. In this approach financial crises are endogenous occurrence induced by changes in funding practices.

This index is constructed for the household sector in three countries and detects how the financial practices used to fund homeownership changed overtime in way that is conducive to a debt deflation. This helps regulators and supervisors to get an idea of the financial sustainability, or lack thereof, over a period of economic prosperity. Currently the focus has been mainly on credit risk, and more recently (via Basel III) liquidity risk, to assess financial instability and this index aims at complementing that approach by focusing on amplification risk induced by default, the closing of refinancing sources, or financial disturbance. The risk of amplification is high when the main purpose of refinancing and asset liquidation is to service debts, that is, when asset-based lending instead of income-based lending becomes a common way to fund asset positions.

It is clear from the index that the growth of homeownership in the past decade was not sustainable because its funding was unsustainable, regardless of credit risk. 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.

One implication of the construction of the index is that it sets a very specific research agenda. The amount of data available regarding sources of refinancing needs, debt-service ratio, cash inflow sources and cash outflow sources is currently extremely limited and that affects the quality of the index. While datasets are more abundant in the United States, they are far from perfect. Once one leaves that country the availability of data rapidly dwindles, which leads the inquirer to recourse to unsatisfying approximations at times. Better datasets, quantitatively and qualitatively speaking, are needed to be able to extend the methodology presented in this paper to other economic sectors and other countries. Some research efforts should be oriented toward improving our knowledge of the funding practices of economic units and the motivations and expectations behind them. As such, the indexes constructed in this paper should be appreciated for the trend they generate rather than their absolute value.

Annex 1: Indexes with different weight structures

Figures A1.1 to A1.3 show the index for the United States, the United Kingdom and France under different three different weight structures, one based on theory, one based on equal weight and one based on a statistical method called Principal Component Analysis (PCA). One may note that all the weight structures have drawbacks and in the end assigning weight always involves some arbitrariness (Howe et al. 2008).

Overall the trend of the index is mostly unchanged by the weight structure, except for France when the PCA weight structure is used. For the United States, where the data is the most reliable, the structure of the weight has a very limited impact in terms of amplitude. The other two countries the amplitude of the index (and so its growth rate) is significantly affected by the PCA weight structure. This is especially so in France where the data about home equity lending was inferred and set at zero for the entire period, and so was given a zero weight in the PCA structure.

TABLE 1 HERE

FIGURE A1.1 HERE

FIGURE A1.2 HERE

FIGURE A1.3 HERE

**Annex 2: Cross-Country Index**

Relatively homogenous variables that can be computed across all three countries are the house price (P), the mortgage-debt to monetary asset ratio (D/M), the interest-rate service ratio (ISR), the proportion of home equity loan in mortgages (HELOC) and the mortgage-debt to GDP ratio (D/GDP). The HELOC dataset is set to zero for the entire period in France, and is proxied in the UK by the share of the monetary value of new loans secured on dwellings for other purposes than remortgaging and purchase of homes (the dataset starts in 1997).

In order to normalize all these datasets across countries a common procedure is to use the following formula:

*Xij* is the variable *i* for country *j*, *Ximin* is the minimum value of a variable *i* across countries and *Ximax* is the maximum value of a variable *i* across countries. Each index is then aggregated to give the following financial fragility index in housing finance based on theory:

*IHFj* = 0.3\**IISRj* +0.25\**ID/Mj* +0.175\**IPj* +0.175\* *ID/GDPj* +0.1\**IHELOCj*

A different weight structure shifts the index curve but does not change the ranking among the three countries.

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Figure 1. Debt Service Ratio, Percent.

Source: Federal Reserve Board (FRB), Office for National Statistics (ONS), Institut National de la Statistique et des Etudes Economiques (INSEE).

Note: The homeowner mortgage financial obligation ratio includes payments on mortgage debt, homeowners’ insurance, and property taxes.



Figure 2. Monetary Assets relative to Mortgage Debt of Households

Source: FRB, ONS, INSEE.



Figure 3. Proportion of Refinance Mortgage Origination in All Mortgages and Share of Cash-Out Refinance in Refinance Mortgages, United States, Percent.

Source: Financial Housing Finance Agency



Figure 4. Proportion of Revolving Home Equity Loans in Outstanding Mortgages in the United States.

Sources: Federal Reserve Board.



Figure 5. Home Equity Withdrawal, Millions of Sterling Pound.

Source: Bank of England



Figure 6. Ratio of Cumulative HEW to Mortgages

Sources: Bank of England, Office for National Statistics.



Figure 7. Home Price Indexes. (Base Year: 1996)

Sources: Standard and Poor’s, Nationwide, INSEE.



Figure 8. Index of Financial Fragility, Base Year 1996



Figure 9. Two-Quarter Moving Average of the Annualized Growth Rate of the Index.



Figure 10. Financial Fragility Index Across Country



Figure 11. Residential Mortgage Heat Map.

Note: The index with equal weights was used. Results are unchanged with other weight structures for US. The PCA method changes UK and France heat map. For the UK, the dark grey area continues until the end of 2010. For France, the black area moves to the end of 2010.

Table 1. Weight Structures

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| DATA | US | | UK | | France | |
|  | Theory | PCA | Theory | PCA | Theory | PCA |
| HOME EQUITY LENDING | 0.15 | 0.179 | 0.20 | 0.092 | 0.100 | 0.000 |
| HOUSE PRICE | 0.1 | 0.181 | 0.15 | 0.291 | 0.175 | 0.329 |
| MORTGAGE TO GDP | 0.1 | 0.180 | 0.15 | 0.293 | 0.175 | 0.331 |
| MORTGAGE TO MONEY | 0.2 | 0.176 | 0.25 | 0.296 | 0.275 | 0.335 |
| DEBT SERVICE RATIO | 0.3 | 0.145 | 0.25 | 0.027 | 0.275 | 0.006 |
| CASH OUT | 0.15 | 0.139 |  |  |  |  |
| TOTAL | 1 | 1 | 1 | 0.999 | 1 | 1.001 |

Note: Rounding may lead to value different than one in total.



Figure A1.1. United States Financial Fragility Index in Households Housing Funding.



Figure A1.2. France Financial Fragility Index in Households Housing Funding.



Figure A1.3. United Kingdom Financial Fragility Index in Households Housing Funding.

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