The Self-Defeating Pursuit of Stability

Minsky's contention that stability is destabilising has profound implications for the conduct of stabilisation policy. The pursuit of price stability by central banks rests on the assumption that (price-level) stability begets financial stability. However, that hypothesis has been violated in recent years by the increasing incidence and severity of financial bubbles during the most remarkable period of prolonged economic stability in recent memory. Using an uncontroversial two-step estimation procedure, this paper demonstrates that periods of stability variously defined have led to increased corporate leveraging in the US since the 1970s. If one accepts that a firm's ability to service its debts decreases as the ratio of debts to income increases, *ceteris paribus*, the results provide strong support for the Minskyan view.

La paradoja de Minsky de que la estabilidad es desestabilizadora tiene implicaciones en las políticas de estabilización de los bancos centrales. El objetivo de la estabilidad de precios de los bancos centrales reside en el supuesto de que ésta engendra a su vez estabilidad financiera. Sin embargo, la hipótesis de Schwartz ha sido refutada en los últimos años por la creciente incidencia y gravedad de las burbujas financieras durante los periodos de prolongada estabilidad económica en los últimos años. A partir del método de estimación en dos etapas, este artículo demuestra que periodos de estabilidad definidos de forma diversa han conducido a crecientes niveles de endeudamientos corporativos en los EE.UU. desde los años setenta. Si se acepta que la capacidad de una empresa para afrontar sus deudas disminuye a medida que el ratio de deudas sobre el volumen de ventas o cifras de negocio, los resultados ofrecen un fuerte respaldo a la visión de Minsky.

Minskyren paradoxak dio egonkortasuna desegonkortzailea dela, eta paradoxa horrek eraginak ditu banku zentralen egonkortze-politiketan. Banku zentralen prezioen egonkortasunaren helburuak hipotesi honetan dauka oinarria: prezioen egonkortasunak finantza-egonkortasuna eragiten du. Hala ere, Schwartzen hipotesia ezeztatu egin da azken urteetan, finantza-burbuilek eragin eta garrantzi handia izan baitute azken urteetan egonkortasun ekonomiko luzeko epeetan. Bi etapatan kontuan hartzeko metodoa oinarri hartuta, artikulu honek frogatu egiten du hainbat eratan definitutako egonkortasun-aldiek gero eta handiagoak diren korporazio-zorpetzeak eragin dituztela AEBetan hirurogeita hamarreko hamarkadatik. Onartzen baldin bada enpresa batek bere zorrei aurre egiteko duen gaitasuna gutxiagotu egiten dela salmenta-bolumenaren edo negozio-zifraren gaineko zorren ratioa hazten den heinean, emaitzek babestu egiten dute Minskryren ikuspegia.

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1. **INTRODUCTION**

Hyman Minsky's principle contribution to macroeconomic thought was the realisation that continuing economic stability is associated with increasing financial fragility (Minsky, 1976; 1982; 1986). The key conjecture underlying the Financial Instability Hypothesis (FIH) is that prolonged periods of prosperity and tranquillity engender increasingly optimistic expectations among both borrowers and lenders. This euphoria should not be dismissed simply as short-termism but must be considered in the context of Keynesian conventional valuation. As Hayes (2006) notes, in a setting of Keynesian uncertainty, the rational investor must act upon the expected duration of any particular pricing convention rather than its basis *per se*. The confidence of both borrowers and lenders increases in periods of prolonged economic stability as the weight attached to the previous bust in the construction of forecasts gradually declines, and it is consigned to the annals of history (Tymoigne, 2009, pp. 119-121). Hence, there is a fundamental upward instability in capitalist systems: economic stability will gradually transform into a speculative investment boom (Minsky, 1976, p. 127; De Antoni, 2007).

The investment boom is associated not only with increased lending but also with the reduction of the margins of safety of both firms and their banks (Minsky, 1974, p. 267). The maintenance of prudential reserves and financial buffers is not costless, and in periods of stable growth they may be viewed as excessive and needlessly costly. This leads to a general rightward shift through the hedge-speculative-Ponzi spectrum as firms

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increasingly undertake loans which they will be unable to service should the economy turn down. Thus, the average quality of the loan portfolio decreases at the same time that the safety measures in place to contain loan defaults are reduced. When the economic reality eventually fails to live up to expectations, the probability of default among these financially fragile firms is high and the ability of banks to absorb the resultant losses is reduced. As expectations become pessimistic, new credit and refinancing become difficult and expensive to obtain and a recession ensues.

Anecdotal evidence in support of the FIH is readily forthcoming. Indeed, the resonance of the Minskyan mechanism is particularly profound in the current context of an ongoing financial crisis born of a period of remarkable economic stability that has come to be hailed as the 'Great Moderation'. Hence, it is perhaps not surprising that the FIH has become a darling of the financial media (*e.g.* Lahart, 2007). However, despite the relatively widespread informal acceptance of the FIH, direct empirical evidence is limited. This lacuna is remarkable given that the majority of modern central banks are committed to the pursuit of economic (and particularly price-level) stability. This policy framework is based, at least implicitly, on the assumption that economic and financial stability are at a minimum compatible and even complementary (*c.f.* Schwarz, 1988; 1998).

This paper contributes to the debate by investigating the link between economic stability and corporate borrowing in the US between 1971q2 and 2008q4. Estimation is conducted using an uncontroversial two-step approach. Firstly, the conditional variance of the interest rate, the rate of output growth and the level of pre-tax corporate income are estimated by fitting GARCH(1,1) models. In the second stage, the relationship between these estimated variance series and the debt/income ratio is analysed. These secondary regressions are formulated using both the ubiquitous OLS-in-levels model and the ARDL-ECM approach of Pesaran and Shin (1998). The results indicate that economic stability has been associated with increased corporate borrowing in the US. Moreover, the results are remarkably robust to the disaggregation of corporate credit market liabilities into those originated by banks and those issued directly by firms. To the extent that the debt/income ratio accurately proxies for financial fragility, the results are strongly supportive of the Minskyan position. The observed positive association between economic stability and financial fragility leaves policymakers in a quandary, as it suggests that the pursuit of stability may be ultimately self-defeating.

The paper proceeds in five sections. Section 2 reviews the literature, paying particular attention to the contention that stability is destabilising. Section 3 develops proxies for the volatility of the three indicators mentioned above and presents the results of simple static modelling of the debt/income equation. Section 4 extends the modelling to the dynamic case and to account for the nonstationarity of a subset of the regressors. Section 5 offers some concluding remarks.

2. ECONOMIC STABILITY AND FINANCIAL FRAGILITY

Recent years have seen a remarkable convergence in the theory and practice of

monetary policymaking around the theme of inflation-targeting (IT). By stabilising the rate of growth of the price level, monetary policy may provide a nominal anchor for the expectations of private agents (*e.g.* Mishkin, 2007). In addition to this concern with inflation, Taylor's (1993) rule holds that the monetary authority must also attempt to smooth deviations of output from potential. Hence, the role of the central bank in this setting is to maintain economic stability by manipulating the cost of borrowing and the reward to saving in order to control the equilibrium in the loans market.

However, long before central banks were charged with the responsibility for *economic* stability, they acted to ensure *financial* stability (*c.f.* Meltzer, 2002, ch. 2). These two goals may not seem inherently incompatible; indeed, the Schwarz Hypothesis (Schwarz, 1988; 1998) holds that price stability begets financial stability, as it reduces the degree of uncertainty faced by economic agents making long-lived investment decisions. However, Minsky (1976, 1982, 1986) stresses that prolonged periods of economic stability or tranquillity are associated with increasing financial fragility, as investors and lenders become increasingly euphoric, overestimating the probability of continuation of the boom and underestimating the riskiness of their investments[1].

Minsky conceptualised this fragility in terms of the so-called *Minskyan trinity*, a three-way typology of firms' financing structures. In order of increasing fragility, these are hedge, speculative and Ponzi financing (*c.f.* Minsky, 1986, pp. 335-341). Vercelli (2000) and Sordi and Vercelli (2006) offer a simple definition of these three financing structures in terms of the *current* and *intertemporal financial ratios*, k_{it} and k_{it}^{*}, respectively:

$$k_{it} = e_{it} / y_{it} \quad \text{and} \quad k_{it}^{*} = \frac{\sum_{t=0}^{t=n}\left[\frac{e_{it+n}^{*}}{(1+\rho)^{it}}\right]}{\sum_{t=0}^{t=n}\left[\frac{y_{it+n}^{*}}{(1+\rho)^{it}}\right]}$$

where e_{it} denotes cash inflows of firm i in period t, y_{it} cash commitments, e_{it}^{*} expected cash inflows, y_{it}^{*} expected cash outflows and ρ the discount rate. It follows that the firm is insolvent if $k_{it}^{*} < 1$. The financing strategy of the *i*-th firm is defined by the values of k_{it} and k_{it}^{*} (*c.f.* Vercelli, 2009). A firm is operating a hedge financing strategy over the horizon h if $k_{it}^{*} > 1$ and $k_{it}^{*} > 1$ for $t=1,2,\ldots,h$ (*i.e.* their current and expected cash inflows exceed their cash commitments). Speculative units operate with $k_{it} < 1$ for $t=1,2,\ldots,s$ and $k_{it}^{*} > 1$ for $t=1,2,\ldots,h$ where $s < h$ (*i.e.* their short-term cash outflows may exceed inflows but their expected cash-flow is positive over a given horizon). Finally, Ponzi units operate with $k_{it} < 1$ for $1 \le t \le h-1$ and $k_{it}^{*} < 1$ for $1 \le t \le h$ and are, as such, dependent on refinancing to service their debts over this horizon. In this example, Ponzi financing is only a valid strategy if the firm achieves sufficient cash-flow growth that $k_{it} << 1$ in period h. Otherwise, the firm faces certain bankruptcy.

The transition between these financing arrangements is the essence of the FIH (*e.g.* Minsky, 1982, pp. 66-8). Minsky (1976, p. 127) notes that:

> "Stability – even of an expansion – is destabilizing in that more adventuresome financing of investment pays off to the leaders, and others follow. Thus, an expansion will, at an accelerating rate, feed into the boom."

[1] Tymoigne (2009, p. 120) refers to this as the 'new era convention', in reference to the frequently offered 'new economy' justification for inflated asset prices (see also Greenspan, 1998).

This 'adventuresome' financing involves firms undertaking ever more onerous debt burdens and banks imposing lower collateral requirements. At an aggregate level, this euphoria is reflected in a rightward shift through the hedge-speculative-Ponzi financing spectrum. Tymoigne (2009, pp. 119-121) notes that this is the result of a change of convention, whereby financing arrangements that were previously considered risky come to be viewed as acceptable (and even cautious). This change in the evaluation of risk is accompanied by both firms and banks placing increasing emphasis on the expectation that earnings growth will eventually allow the servicing of the resulting loans without refinancing (*i.e.* more weight is given to k^{*}_{it} than to k_{it} in the financing decision)[2]. Moreover, just as firms come to operate with thinner safety margins in order to exploit apparently profitable investment opportunities, banks seek new ways of increasing the ratio of income generating positions relative to reserves and precautionary investments (Minsky, 1974, *op. cit.*). The reduction of the safety buffers of both parties to the loan renders the financial system increasingly susceptible to even relatively minor economic perturbations. For Minsky, the trigger of a financial crisis is an increase in the rate of interest which, he argues, will occur inevitably in an economic boom (*c.f.* Fazzari, Ferri and Greenberg, 2008). Under current monetary policy arrangements, such a rate hike may result from the inflation targeting policies of central banks.

The Minskyan understanding of the relationship between macroeconomic stability and financial fragility can be discussed in terms of the risk attitudes of economic agents. In turbulent times, the discounted present value of a firm's income stream is subject to considerable uncertainty and it will, therefore, seek to reduce its cash commitments in order to lower the probability of bankruptcy. By contrast, in the context of economic tranquillity which is expected to continue indefinitely, the firm will be willing to increase its reliance on debt in order to exploit profitable opportunities, confident that its expected future cash-flows will permit the servicing of the loan. The acceptable lag with which the expected cash-flow must become positive is determined by the managerial risk preference, with risk-seekers engaging in Ponzi financing, the risk-averse maintaining hedge positions and the risk-neutral pursuing speculative strategies (a similar point is made by Vercelli, and Sordi and Vercelli, *op. cit.*). None of these strategies is irrational, nor do they rely on informational asymmetries. Rather, the economic models upon which agents base their decisions are not sufficiently accurate to provide them with enough warning of the transition between a stable and a more volatile regime. Hence, agents act rationally and process the available information to the best of their ability but their economic models tend to overestimate the probability of continued economic stability (see Tymoigne, 2009, p. 119, and the references therein)[3].

[2] Moreover, the acceptable horizon over which to operate a speculative or Ponzi strategy may be increasing. It is important to note that the longer that the economic outlook remains tranquil, the more entrenched this euphoria becomes. Minskyan agents are myopic in the sense that they fail to appreciate the implications of economic cyclicality; their belief in the sustainability of the boom leaves them poorly prepared for its eventual and inevitable end.

[3] Equally, in many cases it could be argued that agents underestimate the duration of the cyclical downswing.

In light of the preceding discussion, it should be clear that the issue is not that stabilisation policy has been ineffective in recent years. On the contrary, it could be argued that it has worked *too well*, reducing volatility (and perceived uncertainty) to such a degree that a recession on the scale of that which currently grips the developed world came to be regarded as a '3σ event'[4], despite the fact that at least two (and arguably more) deep recessions have occurred in the USA in the last 80 years. The resulting underpricing of risk or, more accurately, the inadequate measurement of risk has, and is still having, calamitous effects on the World economy. Hence, the FIH should not necessarily be considered a critique of stabilisation policy *per se*, but rather as an observation of an apparent paradox in macroeconomics that stability cannot exist without instability. Not only is any equilibrium accompanied by disequilibrating forces, but the very forces that are at work during an economic boom are those that precipitate the eventual bust (Minsky, 1986, p. 183). If stabilisation policy is to enjoy even moderate success in smoothing the business cycle over anything but the short- to medium-term, policymakers must attempt the management of these destabilising forces. Minsky's approach to stabilisation policy was the advocacy of "Big Government" and the "Big Bank" (Kregel, 1992), policies to which many developed economies have recently turned to extricate themselves from the continuing economic malaise. Whether the pursuit of stability is inherently self-defeating remains to be seen, but what is clear is that the currently dominant paradigm may inadvertently exacerbate the financial frailties of the economy.

3. EMPIRICAL ANALYSIS OF THE FIH

The remarkable sequence of asset bubbles of increasing magnitude during the past two decades of price stability can be seen as a violation of the Schwarz Hypothesis and a validation of the Minskyan position. Indeed, that the ongoing financial crisis was born of a period of remarkably low and stable inflation is strikingly consistent with the Minskyan view. Similarly, the controversy surrounding the mispricing of risky assets and the prevalence of sub-prime loans in the last years of the boom has an air of Minskyan euphoria about it. However, while such anecdotal generalisations have captivated the financial media in recent years (*e.g.* Lahart, 2007), attempts at empirical validation of the FIH are scarce[5]. Fazzari (1999) argues that much recent micro-founded modelling in financial economics is complementary to Minsky's work and that the related empirical literature provides indirect support for Minsky's Financial Keynesianism (see Hubbard, 1998, for a survey). Similarly, the FIH can be discussed in terms of a strongly countercyclical external financing premium in the context of Bernanke, Gertler and Gilchrist's (1996) financial accelerator theory. In this way, Minskyan theory can be linked to the expansive empirical and theoretical literature on the credit channels of monetary policy transmission. However, papers attempting *direct* analysis of the

[4] That is three standard deviations from the mean, implying that the probability of a shock of this scale was thought to be just 0.26% under the assumption of normality.

[5] This is not to deny the existence of a growing literature on model-based simulation of Minskyan systems. Notable examples include Taylor and O'Connell (1985); Delli Gatti, Gallegati and Gardini (1993); and Fazzari, Ferri and Greenberg (2008).

linkage between macroeconomic stability and financial fragility are largely absent from the literature. Moreover, those papers that do address the FIH directly have typically focused on the growth of financial fragility through time or over the business cycle (*e.g.* Lavoie and Seccareccia, 2001) rather than the relationship between volatility and leveraging *per se*. It is precisely this lacuna that the current paper hopes to address.

In line with the preceding discussion, the FIH may be summarised crudely as the belief that periods of economic stability lead to increasing financial fragility. This may be represented by a simple relationship of the form:

$$L = f\left(\underline{x}, \underline{\Psi}^{x}\right) \tag{1}$$

where L denotes financial fragility, $\underline{x}$ a vector of macroeconomic and financial variables and $\underline{\Psi}^{x}$ a vector of their time-varying volatilities. Under the FIH, $L \propto 1/\underline{\Psi}^{x}$, a hypothesis that can be readily tested by OLS estimation of (1). Framing the FIH in this way highlights two fundamental issues that must be addressed in any empirical analysis: the definition and measurement of financial fragility and also of stability.

Minsky's reliance on the trinity of financing structures defined above provides a simple framework for addressing the former in terms of the relationship between cash commitments and cash inflows. In the current paper, this will be proxied by the ratio of corporate credit market liabilities to pre-tax corporate income[6]. Three definitions of the liability ratio are employed in this paper: (i.) the *overall leverage ratio* (defined as total credit market liabilities/pre-tax income); (ii.) the *loan ratio* ({bank loans + mortgages}/income); and (iii.) the *bond ratio* ({bonds + paper}/income). These three ratios are henceforth referred to collectively as the *liability ratios* and are identified by name only when the distinction is required.

This subdivision of corporate debt into bank and non-bank sources of funds may provide interesting insights. In particular, it permits the analysis not just of the effect of uncertainty on the *level* of corporate debt, but also on the preferences of firms for different sources of funds depending on the degree of perceived uncertainty. It is relatively widely accepted that bank financing is more flexible than bond financing as it is often possible for firms to renegotiate the terms of a loan *ex post* should the economic outlook change. Hence, in times of uncertainty, firms may select in favour of bank-financing. Of course, this increased flexibility is typically reflected in a positive interest rate differential between bank-financing and bond-financing, and so firms may rely increasingly on the latter in times of economic stability in order to exploit the lower cost-of-capital.

With regard to the measurement of economic and financial stability, the time-varying volatility of a series may be approximated by the conditional variance estimated using a GARCH specification. This paper considers three facets of stability: (i.) stability of the relevant interest rate given the choice of liability ratio; (ii.) stability of the rate of real GDP growth; and (iii.) stability of pre-tax corporate income.

[6] The use of nominal pre-tax income is motivated by the fact that debt repayments are made out of pre-tax income. Similarly, no allowance is made for dividends as these are legally subordinated to debt (*i.e.* firms must give priority to debt servicing over dividend payments). The sources of all data used in estimation are gathered in the Appendix. The dataset and associated computer programmes are available from the author on request.

Various other indicators can be entertained but these three account for the major sources of uncertainty that one may expect to inform the investment decision[7].

3.1. **Estimation of the Conditional Variance**

Engle (1982) noted that many economic time series exhibit autoregressive conditionally heteroskedastic (ARCH) behaviour. That is to say that the variance of many time series is not constant, exhibiting periods of tranquillity and periods of volatility (as observed by Mandelbrot, 1963). The ARCH(*q*) model is defined as follows:

$$y_t = \underline{x}_t \underline{\beta} + \varepsilon_t \tag{2}$$

$$\varepsilon_t = \upsilon_t \sigma_t \tag{3}$$

$$\sigma_t^2 = \beta_0 + \sum_{j=1}^{q} \beta_j \varepsilon_{t-j}^2 \tag{4}$$

where $E(\varepsilon_t) = 0$, $E(\varepsilon_t^2) = \sigma^2$, $E(\varepsilon_t \varepsilon_{t+s}) = 0 \ \forall s \neq 0$, $\upsilon_t \sim iid(0,1)$ and σ_t^2 is the conditional variance. Note that $\beta_j > 0$ for all $j = 0,1,...,q$ is required for non-negativity of the conditional variance and that $\sum_{j=1}^{q} \beta_j < 1$ ensures dynamic stability. Bollerslev (1986) generalised the ARCH(*q*) model by specifying an ARMA(*p,q*) process for the error variance, resulting in the GARCH(*p,q*) model where (3) is replaced by:

$$\sigma_t^2 = \beta_0 + \sum_{j=1}^{q} \beta_j \varepsilon_{t-j}^2 + \sum_{j=1}^{p} \mu_j \sigma_{t-j}^2 \tag{5}$$

It is straightforward to show that non-negativity in this case requires that $\beta_0 > 0$ and that both $\beta_j \geq 0$ and $\mu_j \geq 0$ for all $j = 0,1,...,m$ where $m = \max(p,q)$. Moreover, ε_t^2 is covariance stationary if $\sum_{j=1}^{m} (\beta_j + \mu_j) < 1$.

GARCH has the advantage that it is generally more parsimonious than ARCH, with the GARCH(1,1) model proving sufficient in most cases (*c.f.* Bollerslev, Chou and Kroner, 1992, p.10). More generally, it is common practice to select a sufficiently rich lag structure to ensure that both ε_t and ε_t^2 are white noise processes. This can be verified using a portmanteau test such as the Ljung-Box (1978) *Q*-statistic.

In both the ARCH and GARCH models, the unconditional variance is constant while the conditional variance captures the heteroskedasticity. Hence, the conditional variance can be interpreted as a measure of the time-varying volatility of the series under scrutiny. This approach to the analysis of risk has become common practice in the empirical finance and exchange rate literature (*c.f.* Engle and Bollerslev, 1986, for an early example and Bollerslev *et al.*, 1992, for a survey).

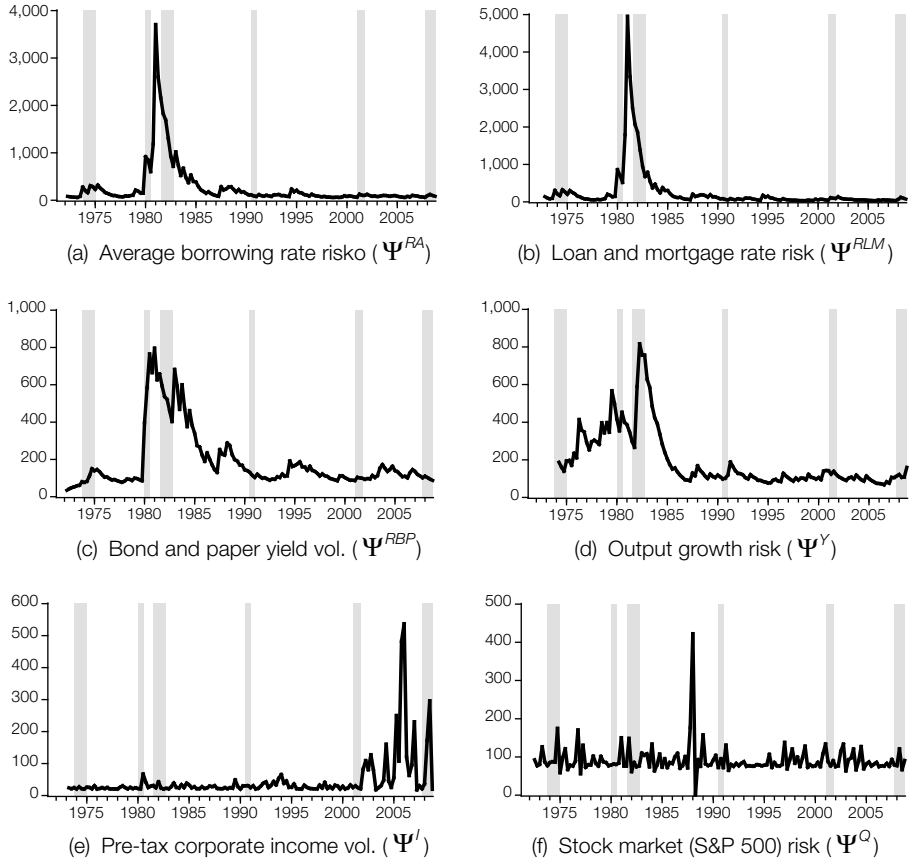
For the purposes of the present paper, GARCH(1,1) models prove suitable in all cases, with the mean equation specified as a simple autoregressive process containing sufficient lags (often non-sequentially) to remove serial correlation according to the *Q*-statistic at the 5% level. The estimated time-varying volatility series are presented in Figure 1[8]. Note that three interest rates are considered: the weighted average of the prime loans rate, the 30 year mortgage rate, the AAA corporate bond yield and the

[7] Initial testing with stock market volatility rather than that of pre-tax income suffered from inflated standard errors due to the noisiness of the data. Similarly, while it may seem as though the volatility of real GDP and pre-tax income capture the same effect, the resulting conditional variance series differ markedly, as discussed below.

[8] Note that the conditional variance series have been indexed (2002Y=100). These indexed values are used in estimation of the second stage regressions in order to remove any issues of scaling.

Figure 1

Conditional Variance Series (2002Y=100, NBER recessions shaded)



Source: Made by the author.

AA corporate paper yield, R_t^A; the weighted average of the loan and mortgage rates alone, R_t^{LM}; and the weighted average of the bond and paper yields alone, R_t^{BP}. These interest rates relate to the overall leverage ratio, the loan ratio and the bond ratio, respectively[9].

A number of trends are readily identifiable. Firstly, the three interest rate risks all exhibit a profound spike during the Volcker disinflation, reflecting the remarkable interest rate hikes brought about by the Federal Reserve in its attempts at controlling inflation. It is interesting to note that the volatility of the bond/paper yield is considerably lower than that of the loans/mortgages rate during this period. This

[9] See the Appendix for details of the weighting procedure.

suggests that banks tended to allow their lending rates to track the Federal Funds Rate closely during the disinflation while the bond market regarded the policy with some incredulity and paid greater attention to fundamentals, to adopt the financial parlance. The existence of such differences suggests that it may be preferable to treat bank-financing and bond-financing separately.

The volatility of output growth indicates a marked and prolonged period of stability starting in the mid 1980's (the so-called 'Great Moderation'). Finally, the volatility of pre-tax income increases markedly at the turn of the century, initiated by the inflation and subsequent bursting of the dotcom bubble, as well as the tragic events of September 11th, 2001. It is interesting to note, however, that this income volatility persists through the subsequent recovery, exhibiting a marked spike in 2008. The conditional volatility of the growth rate of the S&P 500 index is included in panel (f) for comparative purposes as it proved an inferior indicator to income volatility during initial experimentation with the data. This poor performance is rooted in the inflated error variances induced by the noisiness of the stock market data[10].

[10] The presence of outlying values in these series could potentially render OLS inefficient in the estimation of (6), although they pose no threat to its unbiasedness or consistency. However, thorough analysis of the results of regressions which include these series as independent variables (including those reported below) revealed that the residuals are typically approximately normal. Moreover, the inclusion of intercept and trend-shifting dummies picking out the extreme values, as well as various interaction terms, did not usually change the pattern of significance markedly and in no case did it change the sign of the estimated coefficient on any of the conditional variance series. Furthermore, the dummies and interaction terms were invariably statistically insignificant at any traditional confidence level.

3.2. **Static Modelling**

The time-varying volatility series estimated above can now be included in (1) and the relationship estimated by the ubiquitous static linear regression model:

$$L_t^{(k)} = \gamma_0 + \gamma_1 R_t^{(k)} + \gamma_2 Y_t + \gamma_3 Q_t + \gamma_4 \Psi_t^{R(k)} + \gamma_5 \Psi_t^{Y} + \gamma_6 \Psi_t^{I} + \sum_{i}^{n} \gamma_{(i+6)} L_{t-i}^{(k)} + e_t \quad (6)$$

where $L_t^{(k)}$ denotes one of the liability ratios, the interest rate $R_t^{(k)}$, the rate of output growth Y_t, and the equity index Q_t are included as control variables and the $\Psi_t^{\bullet}$ denote the various conditional volatility series identified by the associated superscripts. Note that the superscript '*(k)*' identifies which liability ratio and, hence, which interest rate level and volatility are employed, with '*A*' denoting total credit market liabilities, '*LM*' loans and mortgages and '*BP*' bonds and commercial paper. Finally, the lags of the dependent variable are included to account for serial correlation, where the lag length *h* is the smallest value required for white noise residuals[11]. The results are reported in Table 1.

Firstly, note that the volatility series are statistically significant in all cases except growth rate risk in the regression of L_t^A, which is nevertheless jointly significant with the other volatility series at the 1% level. Importantly, the estimated coefficients on these time-varying volatility series are negative in all cases, indicating that firms reduce their reliance on debt financing during periods of economic upheaval and exploit periods of tranquillity by increasing their credit market borrowing. The robustness of this result across

11 Note that, in practice, the lags included in the model are not necessarily sequential (see Table 1).

Table 1

OLS Estimation

Dependent variable: L^{A}_{t-1}			Dependent variable: L^{LM}_{t-1}			Dependent variable: L^{BP}_{t-1}		
Regressor	Coefficient	Std. Error	Regressor	Coefficient	Std. Error	Regressor	Coefficient	Std. Error
Constant	-18.617	15.863	Constant	-6.430	4.333	Constant	-4.522	6.499
R^{A}_{t}	6.329***	1.471	R^{LM}_{t}	2.003***	0.387	R^{BP}_{t}	2.547***	0.677
Y_t	-2.878***	0.909	Y_t	-0.438	0.296	Y_t	-1.166***	0.305
Q_t	0.231***	0.054	Q_t	0.054***	0.016	Q_t	0.110***	0.024
Ψ^{RA}_{t}	-0.013**	0.006	Ψ^{RLM}_{t}	-0.003**	0.001	Ψ^{RBP}_{t}	-0.017**	0.007
Ψ^{Y}_{t}	-0.023	0.016	Ψ^{Y}_{t}	-0.009*	0.005	Ψ^{Y}_{t}	-0.011*	0.006
Ψ^{I}_{t}	-0.067**	0.026	Ψ^{I}_{t}	-0.020**	0.008	Ψ^{I}_{t}	-0.035***	0.010
L^{A}_{t-1}	0.966***	0.087	L^{LM}_{t-1}	0.992***	0.041	L^{BP}_{t-1}	0.928***	0.020
L^{A}_{t-2}	-0.142	0.123	L^{LM}_{t-5}	-0.214**	0.093			
L^{A}_{t-3}	0.114	0.088	L^{LM}_{t-6}	0.158**	0.079			
R2	0.956		R2	0.967		R2	0.973	
Adj. R2	0.953		Adj. R2	0.965		Adj. R2	0.972	
BG s/correl.	3.374		BG s/correl.	2.048		BG s/correl.	2.665	
White het.	27.823		White het.	25.671		White het.	20.056	
F_{RISK}	4.871		F_{RISK}	4.679		F_{RISK}	9.029	

Note: '*' indicates significance at the 10% level, '**' the 5% level and '***' the 1% level. 'BG s/correl.' denotes the Breusch-Godfrey LM test for serial correlation while 'White het.' denotes the White LM test for heteroskedasticity. Neither indicates model misspecification at any standard significance level. 'F_{RISK}' denotes the F-test of the joint significance of $\Psi^{R(k)}_{t}$, and Ψ^{I}_{t}.

Source: Made by the author.

specifications provides strong support for the Minskyan position. Furthermore, comparing the coefficients associated with the risk measures in columns 2 and 3 of Table 1, it is interesting to note that the bond ratio exhibits greater sensitivity to economic and financial volatility than the loans ratio, lending some support to the notion that firms prefer bank-financing in times of economic upheaval.

Among the control variables, the positive effect of the stock market on the liability ratios reflects the impact of improved collateral on the access to credit. Moreover, the stock market provides a gauge of investor sentiment, with a buoyant stock market indicative of high expected profits. These expectations are then capitalised in the form of increased borrowing. The negative coefficients on economic growth can be rationalised in terms of the increased availability and use of internal funds during economic booms. However, as will be argued below, it may also reflect the inability of static regressions to distinguish between effects operating in different directions over different time scales. It is possible that the short-run effect of higher growth on borrowing may be negative due to the increased availability of internal funds, while the longer-term effect may be positive as firms increase their borrowing on the basis of optimistic expectations. Similarly, the positive coefficients on the level of the interest rate in each case conflict with the accepted wisdom that higher interest rates reduce borrowing. However, the existence of a positive relationship between the interest rate and the liability ratio may result from the close association between nominal interest rates, inflation, investment and leveraging over the longer-term. The expected negative relationship may be confined to the short-run, in which case a dynamic model may outperform the simple static specification in (6).

4. DYNAMIC MODELLING

One potential shortcoming of the static estimation above is that it fails to explicitly account for the possibility of cointegration between the nonstationary series[12]. This form of model misspecification amounts to omitted variable bias, where the omitted variable is the error correction term. While first differencing the data would solve this issue, it would also remove much of the informational content of the levels variables. This observation, in conjunction with the omission of dynamics from the OLS specification noted above, suggests that the development of an error correction model (ECM) may improve the modelling of the corporate leveraging decision.

A cointegrating relationship is often described as a long-run equilibrium, although this concept of equilibrium differs from that familiar to economic theorists as it can only exist between nonstationary series. More generally, long-run relationships may exist not just between nonstationary series but between any conceivable combination of stationary and nonstationary variates provided that the equation remains balanced. The ARDL approach to modelling long-run levels relationships (Pesaran and Shin, 1998; Pesaran, Shin and Smith, 2001; hereafter the PSS method) provides a

[12] Unit root testing (not reported) suggests that Y, Ψ^{I}, and Ψ^{RLM} are I(0) while all other variates follow I(1) processes. The finding that Ψ^{Y} and Ψ^{RBP} are I(1) indicates that the variance of these conditional variance series is asymptotically infinite. This is an interesting result which merits further study but is beyond the scope of the current paper.

simple means by which to model such processes. This property of the PSS method is particularly appealing in the current context due to the mixed integration orders of the variables considered.

The ARDL(*r-1,r*) model takes the form:

$$\Delta L_t^{(k)} = a_0 + \rho L_{t-1}^{(k)} + \underline{\theta}\, \underline{x}_{t-1}^{(k)} + \sum_{i=1}^{r-1} \varphi_i \Delta L_{t-i}^{(k)} + \\ + \sum_{i=0}^{r} \underline{\pi}_i \Delta \underline{x}_{t-i}^{(k)} + v_t \qquad (7)$$

where $|\rho| < 1$ is the speed of equilibrium-correction, $\underline{x}_t^{(k)}$ is a matrix of independent variables relating to the chosen leverage measure, $L_t^{(k)}$ (*i.e.* including the level and conditional variance of the relevant interest rate as well as the stock index, rate of output growth *etc*.), $\underline{\pi}_i$ is a matrix of unknown coefficients and v_t is a serially uncorrelated zero-mean Gaussian error process. The PSS bounds-based F-test for the existence of a stable long-run levels relationship tests the joint null hypothesis $\rho = \underline{\theta} = 0$, with simulated critical values provided by PSS subject to the specification of the deterministic model components. Under the null, (7) reduces to the standard regression model in first differences and no long-run relationship exists between the levels of the variables. Under the alternative, the long-run coefficients are computed as $\underline{\hat{\lambda}} = -\underline{\hat{\theta}} / \hat{\rho}$. The lag structure is determined using the general-to-specific approach starting with $r = 4$ and then sequentially dropping those differenced regressors not significant at the 10% level until an acceptable pattern of significance is achieved.

The results of ARDL analysis are presented in Table 2. In all cases, the PSS F-test is able to reject the null hypothesis at the 5% level. Moreover, the diagnostic tests reveal no evidence of model misspecification, validating the use of an error-correcting specification. The hypothesised negative relationship between economic volatility and the various liability ratios is again observed in all cases. While the pattern of significance of the conditional variance series is somewhat more mixed than in the static case, there remains strong evidence that firms take the volatility of the interest rate, the economic growth rate and their income stream into account when making financing decisions. Growth rate uncertainty is the most significant of the volatility series across the three models, perhaps reflecting the fact that professional output growth forecasts are widely available from a variety of credible sources while such information is less widely available in the case of interest rates and pre-tax income (*i.e.* firms may place less faith in the more tentative forecasts that are available for these variables).

It is interesting to note that all three risk series are significant at the 1% level in the long-run in the bond ratio equation, indicating that the issuance of bonds and corporate paper may be particularly sensitive to perceived economic volatility. Moreover, the magnitude of the long-run coefficients $\lambda^{\Psi RBP}$ and $\lambda^{\Psi I}$ is considerably larger in the bond ratio equation than the other equations. These observations once again reflect the increased flexibility of bank-financing relative to bond-financing. It follows that the ability to renegotiate the terms of bank loans *ex-post* in times of financial hardship leads firms to select in favour of bank-financing during periods of elevated uncertainty, rendering the loan/income ratio relatively less sensitive to interest rate and cash-flow risk.

Among the control variables, the long-run effect of the stock market on leveraging

Table 2

ARDL Estimation

Dependent variable: ΔL_t^A			Dependent variable: ΔL_t^{LM}			Dependent variable: ΔL_t^{BP}		
Regressor	Coefficient	Std. Err.	Regressor	Coefficient	Std. Err.	Regressor	Coefficient	Std. Err.
Constant	-27.929**	12.460	Constant	-8.046**	3.321	Constant	-12.642**	5.363
L_{t-1}^A	-0.125***	0.022	L_{t-1}^{LM}	-0.101***	0.018	L_{t-1}^{BP}	-0.124***	0.020
R_{t-1}^A	8.885***	1.473	R_{t-1}^{LM}	2.370***	0.417	R_{t-1}^{BP}	4.029***	0.629
Y_{t-1}	3.026***	0.990	Y_{t-1}	0.928***	0.278	Y_{t-1}	-0.157	0.303
Q_{t-1}	0.317***	0.048	Q_{t-1}	0.060***	0.013	Q_{t-1}	0.190***	0.024
Ψ_{t-1}^{RA}	-0.005	0.005	Ψ_{t-1}^{RLM}	0.000	0.001	Ψ_{t-1}^{RBP}	-0.019***	0.006
Ψ_{t-1}^{Y}	-0.065***	0.016	Ψ_{t-1}^{Y}	-0.016***	0.005	Ψ_{t-1}^{Y}	-0.020***	0.005
Ψ_{t-1}^{I}	-0.042*	0.023	Ψ_{t-1}^{I}	-0.011	0.007	Ψ_{t-1}^{I}	-0.047***	0.011
ΔR_{t-2}^A	-7.613**	3.019	ΔR_{t-3}^{LM}	-2.240***	0.741	ΔL_{t-3}^{BP}	-0.137*	0.074
ΔR_{t-3}^A	-9.187***	2.538	ΔR_{t-4}^{LM}	-2.304***	0.873	ΔR_{t-1}^{BP}	-3.034***	1.153
ΔR_{t-4}^A	-4.985*	2.814	ΔY_t	-2.291***	0.469	ΔR_{t-3}^{BP}	-4.131***	1.254
ΔY_t	-6.909***	1.619	ΔY_{t-1}	-1.259***	0.439	ΔY_t	-2.489***	0.512
ΔY_{t-1}	-3.689***	1.378	ΔY_{t-4}	-2.232***	0.448	ΔY_{t-4}	-2.005***	0.499
ΔY_{t-4}	-6.890***	1.475	ΔQ_{t-1}	-0.193**	0.095	ΔQ_{t-1}	-0.198*	0.117
ΔQ_{t-1}	-0.602**	0.298	ΔQ_{t-4}	-0.188*	0.111	ΔQ_{t-3}	-0.269**	0.127
ΔQ_{t-2}	-0.583*	0.318	$\Delta \Psi_{t-2}^{RLM}$	-0.004***	0.002	ΔQ_{t-4}	-0.379***	0.133
ΔQ_{t-3}	-0.588*	0.331	$\Delta \Psi_{t-1}^{Y}$	0.023***	0.008	$\Delta \Psi_t^I$	-0.048***	0.009
ΔQ_{t-4}	-0.995***	0.350	$\Delta \Psi_t^I$	-0.021***	0.007	$\Delta \Psi_{t-1}^I$	0.030***	0.009

(...)

Table 2 (continued from previous page)

ARDL Estimation

Dependent variable: ΔL_t^A			Dependent variable: ΔL_t^{LM}			Dependent variable: ΔL_t^{BP}		
Regressor	Coefficient	Std. Err.	Regressor	Coefficient	Std. Err.	Regressor	Coefficient	Std. Err.
$\Delta\Psi_{t-1}^{Y}$	0.064**	0.026				$\Delta\Psi_{t-4}^{I}$	0.016**	0.008
$\Delta\Psi_{t-3}^{Y}$	0.067**	0.027						
$\Delta\Psi_{t}^{I}$	-0.078***	0.022						
λ^{RA}	71.264***	11.970	λ^{RLM}	23.390***	3.731	λ^{RBP}	32.406***	6.271
λ^{Y}	24.273**	9.878	λ^{Y}	9.164***	3.506	λ^{Y}	-1.263	2.396
λ^{Q}	2.543***	0.436	λ^{Q}	0.591***	0.142	λ^{Q}	1.527***	0.191
$\lambda^{\Psi RA}$	-0.041	0.040	$\lambda^{\Psi RLM}$	-0.001	0.013	$\lambda^{\Psi RBP}$	-0.149***	0.053
$\lambda^{\Psi Y}$	-0.521***	0.112	$\lambda^{\Psi Y}$	-0.155***	0.041	$\lambda^{\Psi Y}$	-0.157***	0.037
$\lambda^{\Psi I}$	-0.333*	0.183	$\lambda^{\Psi I}$	-0.112	0.072	$\lambda^{\Psi I}$	-0.378***	0.091
R2	0.643		R2	0.638		R2	0.617	
Adj. R2	0.581		Adj. R2	0.587		Adj. R2	0.559	
BG s/correl.	3.960		BG s/correl.	1.436		BG s/correl.	0.986	
White het.	30.928		White het.	31.307		White het.	23.904	
F_{PSS}	12.063		F_{PSS}	14.187		F_{PSS}	11.637	

Note: Lag selection is achieved by the general-to-specific method starting with four lags of all differenced variables and using a 10% decision rule. 'F_{PSS}' denotes the PSS F-test for the existence of a long-run relationship where the relevant 5% critical value bounds are 3.15 and 4.43. The '$\lambda^{\bullet}$' denote the long-run coefficients.

Source: Made by the author.

is once again uniformly positive and highly significant, reflecting the association between the stock index and the firms' discounted expected cash-flows. A strong positive association between the interest rate and the liability ratios is again observed (in the long-run at least) despite the incorporation of sophisticated model dynamics. It is, however, noteworthy that the coefficients on the dynamic interest rate terms are, without exception, negative. This suggests that the long-run coefficient is picking up the positive association between the interest rate and the liability ratio arising from the close positive relationship between borrowing, investment, inflation and the interest rate in the long-run. By contrast, the dynamics are picking up the way that firms attempt to economise on debt in the short-run as its servicing becomes more costly.

Interestingly, the negative relationship between output growth and the various liability ratios observed in the OLS regressions is overturned in the ARDL models in the long-run. It was argued above that higher economic growth was associated with the increasing use of own funds, resulting in the observed negative effect. However, increased economic growth is generally associated with higher profit expectations, elevated asset values and increased collateralisable net worth and may, therefore, result in increased leveraging. These two effects are both present in the ARDL model, the former dominating in the short-run (note the negative coefficients on the ΔY_t's) and the latter in the long-run.

In conjunction with these opposite short- and long-run responses, the relatively modest estimated speed of equilibrium correction (between 40 and 50% per annum) suggests that firms are constrained in their ability to change their liability ratios in the short-run, taking more than two years to achieve complete adjustment. This result is intuitively reasonable given the long-term nature of credit contracts and the constraints imposed by the cash inflows generated by the business activities of firms. Moreover, it suggests that the financial conventions central to the FIH may change relatively slowly and that the expectations of economic agents may display a degree of inertia.

5. **CONCLUDING REMARKS**

The Minskyan proposition that economic stability is associated with increasing financial fragility has profound implications for the conduct of monetary policy. In the limiting case, it implies that the inflation targeting policies of many modern central banks are inconsistent with their more fundamental responsibility to ensure the soundness of the financial system. This leaves policymakers in a quandary, faced with an apparent choice between the pursuit of macroeconomic stability and the maintenance of a robust financial system[13].

Despite the resonance of this proposition, attempts at direct empirical analysis are notably absent from the literature. This paper has pursued an uncontroversial two step estimation procedure in which the conditional volatility of various key indicators was estimated using GARCH models, and the explanatory power of the resulting time-varying risk proxies was assessed in

[13] In practice, framing the issue in this black-and-white fashion may obscure the shades of grey in between these limiting cases but it nevertheless illustrates the concept adequately.

secondary regressions. Two distinct specifications of the secondary models have been tested: (i.) simple OLS-in-levels, as has become common practice in the empirical finance literature; and (ii.) an ARDL-ECM which explicitly accounts for the nonstationarity of a subset of the regressors and introduces sophisticated dynamics. The results provide substantial support to the hypothesised inverse relationship between the various risk measures and the aggregate corporate leveraging ratios. Moreover, the results are remarkably robust to the disaggregation of the corporate credit market liabilities by type, into those provided by banks and those emitted directly by firms. Hence, the results strongly support the Minskyan view that economic stability has led to increased debt exposure and financial fragility in the US since the 1970s.

These results raise an issue of paramount importance: how can the monetary and fiscal authorities reconcile the apparently conflicting goals of economic stability and financial robustness? Is the pursuit of stability ultimately self-defeating? The 'solution' to this dilemma, to the extent that it is soluble, remains unclear and is surely among the most important research topics in macroeconomics at the present time.

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DATA APPENDIX

The sample period used in estimation is 1971q2-2008q4. Monthly interest rate data was gathered from Federal Reserve Bank of St. Louis Economic Data Service and converted to quarterly frequency by averaging the observations in the appropriate three month period. Time-varying weights for the average interest rate series were calculated as the fraction of outstanding credit market liabilities for which each class of liability accounts in any given quarter. Similarly, the adjusted closing price of the S&P 500 index was downloaded at monthly frequency from Yahoo! Finance, converted to quarterly frequency and indexed (2002Y=100).

Quarterly real GDP data was downloaded from the IMF's International Financial Statistics and the growth rate computed in the usual manner. Figures for pre-tax income, total outstanding credit market liabilities, corporate paper, corporate bonds, municipal bonds, bank loans, mortgages and loans not elsewhere classified were retrieved from the Flow of Funds Accounts of the United States (Release Z1). All data are in billions of US Dollars in nominal terms. The dataset and computer code used in estimation are available from the author on request.