

APPLIED FINANCE LETTERS

Volume 01, Issue 01, 2012

Editors

Bart Frijns & Alireza Tourani-Rad

Investing in an Uncertain Environment

Trading and Fat Tails

Robert I. Webb

The Destruction of a Safe Haven Asset?

Dirk G. Baur and Kristoffer J. Glover

Pricing Currency Risk in Two Interlinked Stock Markets

Jan Antell and Mika Vaihekoski

The Effect of Credit Derivatives on Financial Stability

Richard van Ofwegen,
Willem F.C. Verschoor and
Remco Zwinkels



Editors:

Professor Bart Frijns

Director of the Auckland Centre for Financial Research

Auckland University of Technology, Auckland
New Zealand

Professor Alireza Tourani-Rad

Head of the Department of Finance

Auckland University of Technology, Auckland
New Zealand

ISSN 2253-5799 (Print)

ISSN 2253-5802 (Online)

Applied Finance Letters is available on the website of the
Auckland Centre for Financial Research

www.acfr.aut.ac.nz

Alternatively, copies can be ordered from the Auckland
Centre for Financial Research at a cost. If you would like to
receive a copy, please contact:

Auckland Centre for Financial Research

Faculty of Business and Law

Auckland University of Technology

Private Bag 92006

Auckland 1142, New Zealand

acfr@aut.ac.nz

Publishing in Applied Finance Letters

Applied Finance Letters publishes short empirical research
with clear implications and relevance for the finance
industry. The aim is to encourage discussions among
academics, policy makers and financial practitioners.

Submitted articles go through a blind review process and
may be returned to the authors for subsequent revision.

Please visit www.acfr.aut.ac.nz for author's guidelines and
style requirements.

Copyright

Authors submitting articles for publication warrant that the
work is not an infringement of any existing copyright and
will indemnify the publisher against any breach of such
warranty. By publishing in Applied Finance Letters, the
author(s) agree to the dissemination of their work through
Applied Finance Letters. However, authors are free to
use their published work in any way or form in future
publications.

Submissions should be sent to:

Bart Frijns

Auckland Centre for Financial Research

Auckland University of Technology

Private Bag 92006

Auckland 1142, New Zealand

or electronically to acfr@aut.ac.nz



AUCKLAND CENTRE FOR
FINANCIAL RESEARCH
AUT BUSINESS SCHOOL



APPLIED FINANCE LETTERS

Volume 01, Issue 01, 2012



Investing in an Uncertain Environment

Trading and Fat Tails

By Robert I. Webb

02

The Destruction of a Safe Haven Asset?

By Dirk G. Baur & Kristoffer J. Glover

08

Pricing Currency Risk in Two Interlinked Stock Markets

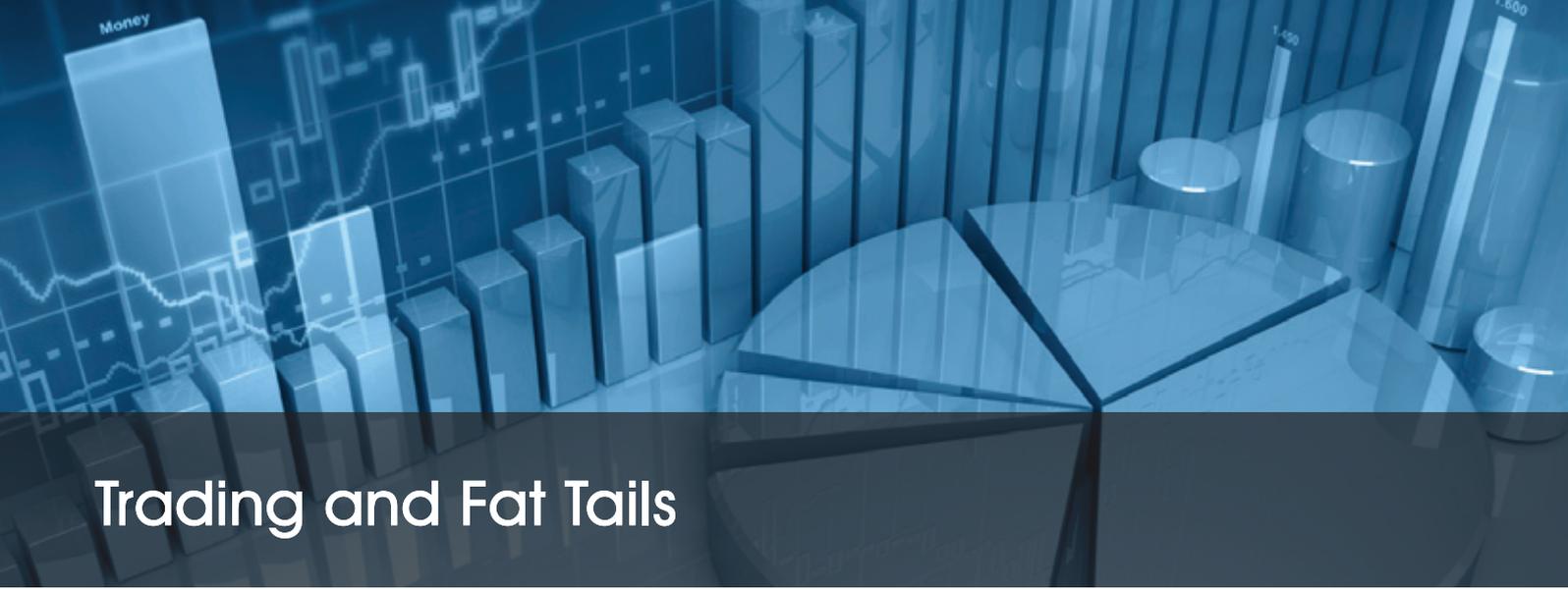
By Jan Antell & Mika Vaihekoski

16

The Effect of Credit Derivatives on Financial Stability

*By Richard van Ofwegen,
Willem F.C. Verschoor &
Remco C.J. Zwinkels*

22



Trading and Fat Tails

By Robert I. Webb

Robert I. Webb is the Paul Tudor Jones II Research Professor at the McIntire School of Commerce at the University of Virginia in Charlottesville, Virginia, USA.

Sudden, large price changes periodically occur in speculative markets. Many of these large price moves simply reflect the market's reaction to new fundamental economic information-- as financial theory would predict. However, some of the most extreme price moves—often characterized (albeit incorrectly) as “Black Swans” in popular parlance--reflect more the predictable behavior of traders in certain situations or poorly designed market microstructures than the arrival of new fundamental information. These trading-induced price moves have important implications for practitioners, policymakers and academics alike.

Keywords: fat tails; extreme events; stock price behaviour

1. The Behavior of Speculative Prices

Most changes in speculative prices follow simple time series processes. Indeed, empirical observations by Working (1934); Kendall (1953); and Roberts (1959) that changes in various speculative prices appeared to fluctuate randomly preceded the development of a theory to explain why they should (Samuelson, 1965). The notion that changes in speculative prices respond only to the arrival of new information in an efficient capital market as Fama (1965) and Ross (1989) have argued remains a central tenet of modern financial theory.

The observation by Mandelbrot (1963) that the distributions of changes in many speculative price series were characterized by leptokurtosis (i.e., both peakedness and fat tails) meant that the probability of extreme events was greater than what would exist if security returns were lognormally distributed. Put differently, even extreme price moves should be the result of the market's response to the arrival of new fundamental information in an efficient capital market.

To be sure, there is a considerable literature in financial economics that argues that changes in speculative prices are the result of factors other than the arrival of new fundamental economic information. These factors range from noise (Black, 1986) to the bid/ask bounce (Marsh and Rosenfeld, 1986) to positive feedback and noise trading (DeLong et al., 1989, 1990a, 1990a) to large orders or order flow (e.g., Evans and Lyons, 2002) among others. Not surprisingly, apparent bubbles and crashes in speculative prices have spawned a large literature that seeks to explain them or deny their existence. Implicit in much of this literature is the belief by many observers of the central role played by “excessive speculation.” Of course, as Miller (1988) has pointed out, the term requires a benchmark level of speculation against which to compare it. There is also a nascent literature on predatory trading that illustrates how the actions of some traders can exploit the problems of large distressed traders, thereby exacerbating a price move (Brunnermeier and Pedersen, 2005, Chamley, 2003 and Corsetti et al., 2004 among others).

2. Trading-Induced Price Changes—Predatory Trading

Speculative prices react to news. News can consist of perceived fundamental information or noise—non-fundamental information that affects prices. Prices may also react to the actions of traders without news per se such as from large orders or positive feedback trading. The nature and size of trading-induced price moves are perhaps best illustrated through various examples. For the convenience of exposition, trading-induced price moves will be dichotomized into those arising from *predatory trading* and those arising from *flawed market microstructures*.

The U.S. stock market crash of October 19, 1987 is well known even if the cause is still unclear. Jackwerth and Rubinstein (1996) point out that the 29% decline in the S&P 500 stock index futures price (the cash market declined less) was equivalent to a 27 standard deviation move assuming that changes in stock prices are lognormally distributed and annualized volatility averages 20%. The probability of a 27 standard deviation move is a 10^{-160} event or virtually impossible. Regardless of whether one regards the crash as trading-induced or the reaction to the arrival of fundamental information the question arises as to whether it could happen again. Or, rather, did it happen again in the USA in 1987? The answer is yes.

2.1 Extreme Events: October 22, 1987

On Wednesday, October 21, 1987, the December 1987 delivery Standard & Poor's 500 stock index futures contract closed at 258.25 on the Chicago Mercantile Exchange. A large (5,000 contract) sell order attributed to George Soros whose fund was rumored to be in trouble precipitated a sharp selloff in S&P 500 stock index futures prices at the opening the next day. Suppose that you were a trader on the floor of the Chicago Mercantile Exchange. How would you react to the large sell order given the rumors of a large trader in trouble? Would you buy or sell?

The November 2, 1987 issue of Barron's recounts the natural reaction of other traders:

"...The other pit traders, picking up the sound of a whale in trouble, hung back, but circled the prey. The offer went from 230 down to 220 to 215 to 205 to 200. Then, the pit traders attacked. The Soros block sold from 195 to 210. The spiral was ghastly. It was Soros's block and not program trading that drove the futures to a cash discount some 50 points, or 20%, below the cash value of the S&P contract. ..."

Keep in mind that each full point was worth \$500 per contract at the time and that prior to the crash on Monday the contract usually traded in \$25 increments. The opening offer at 230 was \$14,125 per contract below the previous close. Trades at 195 (the opening and lowest price of the day) were \$31,625 per contract lower than Wednesday's closing price. And, with interest rates exceeding dividend rates stock index futures prices should exceed corresponding cash market prices if the cost of carry model of futures prices is correct.

The market had an exceptionally wide opening range of 195 to 202 or \$3500. Soros suffered a loss in excess of \$200 million. *Barron's* (1987) reported: "...The discount on the 5,000 contracts represented some \$250 million. [Soros] covered there, as did a number of local traders who made millions off the immediate snapback in price. The contract that day closed at 244.50, or some \$222 million higher, based on Soros's position..."

Note that the magnitude of the decline in the value of the S&P 500 stock index futures contract from Wednesday's close to Thursday's opening was 21.8% to 23.8%—roughly the same size as the decline in the *cash* S&P 500 stock index on Monday, October 19, 1987. Note also that the effect of the large sell order was largely limited to the S&P 500 stock index futures market. Unlike Monday, October 19th, prices in the stock market did not fall very much so that, at one point, the December '87 S&P 500 stock index futures contract was trading at a 50 point discount to the cash index. The huge discount was a result, in part, of the inability to easily do index arbitrage in the wake of the crash.

2.2 Extreme Events: October 7, 1998

On Wednesday, October 7, 1998, the dollar fell sharply against the yen. At one point, the dollar was down almost 12 yen or over 9.15% intraday. This is an incredible move for the exchange rate between the currencies of two developed economies. The catalyst for this huge move was simply the unwinding of massive short yen and yen-carry positions by hedge funds and other market participants—and the belief that some major hedge funds were in trouble.

Once again, the rumor of some key traders attempting to unwind a large position sparked a change in the actions and strategies of other traders. Tiger Management—at the time the largest hedge fund in the world—was rumored to have lost over \$1 billion on that day from its short yen positions.

2.3 Extreme Events: October 26, 2008

The Sunday, October 26, 2008 announcement by Porsche that it controlled almost three-quarters of VW shares directly or indirectly through stock holdings and call options sparked panic buying by short sellers.³ This resulted in a 146% rise in VW's stock price on Monday, October 27, 2011 and, as Xydias (2008) notes, another 93% rise intraday on Tuesday, October 28, 2008 to a high of €1005 per share or over 5 times the closing price the previous Friday. For one brief shining moment, in the midst of a global financial crisis and widespread recession, VW was the largest company in the world in terms of market capitalization. Here was a large price move that was entirely related to one market participant gaming the system rather than the arrival of fundamental new information.

2.4 Extreme Events: Speculative Attacks

The above events were examples of traders behaving in a very opportunistic fashion—(i.e., taking advantage of traders in distress). There are numerous similar instances. But do cases exist where traders attempt to make things happen (i.e., create distress for market participants by pushing prices in a certain direction)? The answer is yes and such situations arise during speculative attacks. Webb (2007) reports that in 1997, some hedge funds tried to break the link of the HK dollar to the US dollar. This induced considerable volatility in interest rates and HK equity prices. The volatility spilled over to the USA on October 27, 1997 when US equity prices fell over 7%. Notwithstanding the volatility in equity and fixed income prices the link of the Hong Kong dollar to the U.S. dollar held as the hedge funds ran out of Hong Kong dollars to short. The hedge funds would have made a fortune had they sold Hong Kong stocks before the speculative attack. The hedge funds learned from their errors, borrowed HK\$30 billion via a currency swap and tried again in 1998. This time the hedge funds sold Hong Kong stock index futures in advance of the speculative attack on the Hong Kong dollar. Joseph Yam (1998), head of the Hong Kong Monetary Authority (Hong Kong's de facto central bank) at the time states: "We estimate that the hedge funds involved had amassed in excess of HK\$30 billion in currency borrowings at an interest cost of around HK\$4 million a day. They also held an estimated 80,000 short [Hang Seng stock index futures] contracts, which translated into the following calculation: for every fall of 1,000 points in the Hang Seng [stock] index they stood to make a profit of HK\$4 billion. ... If they could have achieved it within 100 days they would have netted HK\$3.6billion...."

The preceding examples demonstrate that you do not need electronic trading platforms and high frequency

traders to have substantial trading-induced price changes. Predatory trading can precipitate large price moves.

3. Trading-Induced Price Changes—Flawed Market Microstructures

Another source of sudden large price changes arises from the actions of high frequency and algorithmic traders in continuously open electronic markets without designated market makers. Consider the following examples.

3.1 May 6, 2010 "Flash Crash."

On May 6, 2010, the Dow Jones Industrial Average suddenly fell over 600 points in less than five minutes only to recover most of the 600-point loss within minutes.⁴ An interagency task force assigned to investigate the cause of the flash crash (Securities Exchange Commission (2010)) concluded it was caused by a fundamental trader who submitted an order to sell 75,000 e-mini S&P 500 stock index futures contracts without price or time limits. About 6 percent of the total value of the U.S. stock market was wiped out in moments without any apparent reason only to recover shortly thereafter.

While the flash crash in equity prices is well known fewer people are aware of even larger flash crashes in commodity markets. Moreover, it is doubtful that any lessons learned from the May 6, 2010 Flash Crash were implemented as these lesser-known flash crashes occurred in 2011.

3.2 March 1, 2011 "Flash Crash" in Cocoa Futures

On March 1, 2011, May delivery cocoa futures fell 12.5% in less than a minute on the Intercontinental Commodity Exchange only to quickly rebound and close down 2.5% for the day. Once again, the presumed culprit was a large sell order.

3.3 February 3, 2011 "Flash Crash" in Sugar Futures

On February 3, 2011, March delivery sugar futures prices suddenly plunged. The decline in cocoa futures prices mentioned earlier was slow compared with the nearly 6% plunge in March sugar futures prices in a single second. The presumed source in this case was algorithmic trading.

3.4 June 8, 2011 Natural Gas Futures Flash Crash

On June 8, 2011, July delivery New York Mercantile Exchange natural gas futures suddenly fell over 8% in after regular trading hours trading only to recover in a few seconds. Algorithmic trading was blamed.

3.5 November 25, 2011 Automated Trading Gone Wild

Reuters News (Spicer, 2011) reported on November 25, 2011 that a high frequency trading firm was fined by the CME for losing control over their trading algorithms on three occasions. The firm's "buying on February 3, [2010] sparked a frenzied \$1 surge in oil prices late that day as the computer program sent thousands of orders per second, racking up a million-dollar loss for the firm." Although this does not constitute an extreme price move it does illustrate the potential of uncontrolled trading algorithms to increase volatility in speculative prices.

3.6 Policy Responses to Automated Trading Induced Volatility

Bloomberg News (McCormick, 2011) reported on March 17, 2011: "The yen soared 4.5 percent in 26 minutes as markets closed in New York and re-opened in Asia amid speculation automated trades to limit losses were taking place. The yen reached 76.36 per dollar before erasing its gains." The sharp rise in the yen was one factor that precipitated an intervention in the currency markets by G-7 central banks.

4. Implications

Trading induced price changes may arise from: predatory trading; positive feedback trading; flawed market microstructure or trading strategies; erroneous orders; large orders in illiquid markets. These changes may spill over to other markets. They may affect the actions of other traders and policymakers.

4.1 Implications for Policymakers

Policymakers should make a concerted effort to harness the power of positive feedback trading when possible. Coordinated action by various central banks on November 30, 2011 sparked a rally in equity prices around the world in part due to triggering short covering. Policymakers need to be careful to avoid drawing incorrect inferences from speculative price moves. For instance, the Federal

Reserve's surprise 75 basis point rate cut on January 22, 2008 was precipitated, in part, by falling equity prices in Europe. As it turned out, European equity prices were falling due to the unwinding of Jerome Kerviel's rogue trading positions by Societe Generale.⁵

Policymakers must address the issue of whether additional safeguards are needed to protect the integrity of speculative markets from sharp price moves unrelated to the arrival of fundamental information. One dimension of market microstructure that should be considered is the frequency of trading. It is worth pointing out that the fragility of speculative markets to automated trading is partly a result of continuous markets.

4.2 Implications for Practitioners

Trading induced price changes or market microstructures that enhance volatility increase the risks for all market participants and change how they should trade and price securities. The regular occurrence of "extreme events" means that option prices should take the possibility of their occurrence into account. For instance, put options prior to the 1987 stock market crash were "underpriced."

4.3 Implications for Academics

Most prices reflect the interplay of supply and demand. It is worth repeating. Most prices reflect the interplay of supply and demand. For good or for ill, most market prices reflect the consensus view of market participants given current and prospective economic conditions and sentiment. However, mixed in with price changes driven by the arrival of new fundamental information or noise are price changes that are entirely trading induced.⁶

The fact that some of the largest extreme price moves are trading induced highlights the fact that *trading is a game*. Not all large price changes reflect new fundamental information (outside of game specific issues such as holdings by various market participants.) More research needs to be conducted on both predatory trading and positive feedback trading.

References

- Barron's, A Bad Two Weeks—A Wall Street Star Loses \$840 Million, November 2, 1987.
- Bachelier, L. (1964). Theory of speculation, in P. Cootner (ed.), *The Random Character of Stock Market Prices* (Cambridge, Mass., MIT Press).
- Black, F. (1986). Noise. *Journal of Finance* **41**, 529-543.
- Brunnermeier, M. K. and Pedersen, L. H. (2005). Predatory Trading. *Journal of Finance* **60**, 1825-1863.
- Camerer, C. F. (1989). Bubbles and Fads in Asset Markets: A Review of Theory and Evidence. *Journal of Economic Surveys* **3**, 3-38.
- Chamley, C. (2003). Dynamic Speculative Attacks. *American Economic Review* **93**, 603-621.
- Corsetti, G., Dasgupta, A., Morris, S., and Song, S. H. (2004). Does one Soros make a Difference? A Theory of Currency Crises with Large and Small Traders. *Review of Economic Studies* **71**, 87-113.
- DeLong, B. F., Shleifer, A., Summers, L. and Waldman, R. (1989). The Size and Incidence of Losses from Noise Trading. *Journal of Finance* **44**, 683-696.
- DeLong, B. F., Shleifer, A., Summers, L., and Waldman, R. (1990a). Positive Feedback Investment Strategies and Destabilizing Rational Speculation. *Journal of Finance* **45**, 379-396.
- DeLong, B. F., Shleifer, A., Summers, L. and Waldman, R. (1990b). Noise Trader Risk in Financial Markets. *Journal of Political Economy* **98**, 703-738.
- Evans, M., and R. Lyons (2002). Order Flow and Exchange Rate Dynamics. *Journal of Political Economy* **110**, 170-180.
- Fama, E. F. (1965). The Behavior of Stock Market Prices. *Journal of Business* **38**, 34-105.
- Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance* **25**, 383-417.
- Flood, R. P. and Hodrick, R. J. (1994). On Testing for Speculative Bubbles. In "Speculative Bubbles, Speculative Attacks, and Policy Switching," edited by R.P. Flood and P.M. Garber (MIT Press, Cambridge, MA).
- Jackwerth, J.C., and Rubinstein, M. (1996). Recovering Probability Distributions from Option Prices. *Journal of Finance* **51**, 1611-1632.
- Gürkaynak, R. S. (2008). Econometric Tests of Asset Price Bubbles: Taking Stock. *Journal of Economic Surveys* **22**, 166-186.
- Kendall, M. G. (1953). The Analysis of Economic Time Series, Part I: Prices. *Journal of the Royal Statistical Society* **96**, 11-35.
- LeRoy, S.F. (2004). Rational Exuberance. *Journal of Economic Literature* **42**, 783-804.
- Mandelbrot, B. (1963). The Variation in Certain Speculative Prices. *Journal of Business* **36**, 394-419.
- Marsh, T. and Rosenfeld, E. (1986). Nontrading, Market Making and Estimates of Stock Price Volatility. *Journal of Financial Economics* **15**, 359-372.
- McCormick, L. C. *Yen Risk Reversals Climb to a Nine-Month High Amid Options Hedging Demand*. Bloomberg News, March 17, 2011. <http://www.bloomberg.com/news/2011-03-17/yen-risk-reversals-climb-to-a-nine-month-high-amid-options-hedging-demand.html>.
- Miller, M. H. (1989). Who Should Set Futures Margins? *Review of Futures Markets* **7**, 398-404.
- Osler, Carol L. (2002). Stop-Loss Orders and Price Cascades in Currency Markets. *FRB of New York Staff Report No. 150*. Available at SSRN: <http://ssrn.com/abstract=920687> or <http://dx.doi.org/10.2139/ssrn.920687>
- Roberts, H. V. (1959). Stock Market Patterns and Financial Analysis: Methodological Suggestions. *Journal of Finance* **14**, 1-10.
- Ross, S. (1989). Information and Volatility: The No-Arbitrage Martingale Approach to Timing and Resolution Irrelevancy. *Journal of Finance* **44**, 1-17.
- Samuelson, P. A. (1965). Proof that Properly Anticipated Prices Fluctuate Randomly. *Industrial Management Review* **6**, 41-49.
- Securities and Exchange Commission and Commodity Futures Trading Commission, 2010, Findings regarding the Market Events of May 6, 2010, September 30, <http://www.sec.gov/news/studies/2010/marketevents-report.pdf>.
- Shiller, R. J. (2003). From Efficient Markets Theory to Behavioral Finance. *Journal of Economic Perspectives* **17**, 83-104.
- Spicer, J. *High-Frequency Firm fined for Trading Malfuctions*. Reuters News, November 25, 2011. <http://www.reuters.com/article/2011/11/25/us-cme-infinity-fine-idUSTRE7AO1Q820111125>

Webb, R. I. (2007) *Trading Catalysts: How Events Move Markets and Create Trading Opportunities*, (FT Press, New York).

Working, H. (1934). A Random Difference Series for use in the Analysis of Time Series. *Journal of the American Statistical Association* 29, 11–24.

Xydias, A. *Volkswagen Overtakes Exxon as Most Valuable Company (Update1)*, Bloomberg News, October 28, 2008. <http://www.bloomberg.com/apps/news?pid=newsarchive&sid=ahQ8kYJVCpWQ>.

Yam, J. (1998). *Coping with Financial Turmoil*, Inside Asia Lecture, Sydney Australia, Hong Kong Monetary Authority, November 23, http://www.info.gov.hk/hkma/eng/speeches/speechs/joseph/speech_231198b.htm.

-
- ¹ Bachelier (1964) both observed that certain speculative prices appeared to fluctuate randomly and advanced an explanation for it in the early part of the 20th century. However, his contribution to the literature was largely unknown until the second half of the 20th century.
 - ² For reviews of some of the literature see Camerer (1989) (bubbles and fads); Flood and Hodrick (1994) (tests of speculative bubbles); LeRoy (2004) (rational and irrational speculative bubbles); Gurkaynak (2008) (econometric tests of asset price bubbles); and Shiller (2003) (market inefficiencies and behavioral finance).
 - ³ This situation was made worse by the fact that the State of Lower Saxony held 20% of VW and was unlikely to sell any of its holdings.
 - ⁴ The market was already down several hundred points when the Flash Crash occurred. The decline in the market before the Flash Crash is sometimes mistakenly added to the decline that occurred during the Flash Crash.
 - ⁵ Mr Kerviel lost €1.4 billion for Societe Generale. However, SocGen lost another €3.5 billion unwinding Mr. Kerviel's rogue trading positions.
 - ⁶ In an analysis of large changes in the FX market, Osler [2002] argues that "Stop-loss [orders] propagated price cascades may help explain the well-known fat tails of the distribution of exchange rate returns, or equivalently the high frequency of large exchange rate moves." She also argues that the resulting "path dependence of exchange rates may also help explain why technical analysis has a track record of forecasting success while standard exchange rate models do not."
-

Corresponding Author

Robert I. Webb, McIntire School of Commerce, University of Virginia in Charlottesville, Virginia, USA.
Email: riw4j@comm.virginia.edu



The Destruction of a Safe Haven Asset?

By Dirk G. Baur & Kristoffer J. Glover

Dirk G. Baur is Associate Professor in Finance at the University of Technology Sydney, Australia.

Kristoffer J. Glover is a Postdoctoral Research Fellow in Finance at the University of Technology Sydney, Australia.

Gold has been a store of value for centuries and a safe haven for investors in the past decades. However, the increased investment in gold for speculative or hedging purposes has changed the safe haven property. We demonstrate theoretically and empirically that investor behaviour has the potential to destroy the safe haven property of gold. The results suggest that an asset cannot be both an investment asset and an effective safe haven asset. This finding has important implications for financial stability since assets are more likely to exhibit excess comovement and volatility in the absence of a safe haven.

Keywords: safe haven; gold; investor behaviour; funding constraints; contagion

1. Introduction

Gold has various roles in the global economy. It is said to be an inflation hedge, a “store of value”, and a safe haven. The safe haven means that the asset provides shelter in times of financial turmoil. For example, if negative news hit stocks in a specific country, leading to extreme losses and contagion to other stock markets, a safe haven is supposed to be immune to such an event and not lose its value. More recently, it appears that gold has been subject to increased investment demands evidenced by the extreme price increase from around US\$300 to above US\$1,900 within a period of 10 years. This price increase is comparable to the bubble in Japanese stocks in the 1980s and the “dotcom” bubble in Nasdaq in the 1990s.

At first blush, it seems that gold has many appealing properties, but can one asset really be all things to all men? We illustrate that it cannot. Firstly, we show empirically that gold has often not displayed the properties of a store of value or an inflation hedge in the past 40 years. Secondly, using financial theory and a simple thought experiment, we demonstrate that the use of a safe haven asset as an

investment or speculative asset weakens the safe haven property or, in extreme cases, destroys it. An empirical analysis fully supports the predictions of the thought experiment.¹

There is a growing literature on gold and safe haven assets (e.g. see Baur and Lucey, 2010; Baur and McDermott, 2010; and Rinaldo and Söderlind, 2010). To the best of our knowledge this is the first paper that analyzes the dynamic role of gold as a safe haven asset and the possibility that specific actions of investors undermine the safe haven property. This paper also forms part of a broader research question “Does the belief in gold as a safe haven asset reinforce or weaken its safe haven properties?”

The remainder of this paper contains three sections, a theoretical section, an empirical section and a policy section which addresses the implications for financial stability. The final part consists of a summary of the main results and concluding remarks.

2. How investors can destroy the safe haven property of gold

The equity market downturn in 2000 and the low historical correlation of commodities with stocks prompted many investors to view commodities as a desirable alternative asset class. Since this time, commodities markets (including gold) have seen the investment of billions of dollars from institutional investors such as pension funds, insurance companies, and hedge funds. Consequently, commodities now constitute a considerable proportion of many investors' portfolios (see Tang and Xiong, 2010). As a result of this, the price of a commodity such as gold is no longer determined simply by its supply and demand. The trading of investors who hold both stocks and gold in their portfolios can act as a channel to induce linkages between stock and gold prices. The exact nature of these links depends on investors' trading strategies.

The main thesis of this paper is that the increased holdings of gold by many investors in recent years have the potential to undermine and possibly destroy the safe haven property of gold. To illustrate our point we describe the following simple thought experiment. Consider two scenarios labelled A and B. In scenario A investors hold stocks and bonds but do not hold significant amounts of gold in their portfolios. In scenario B investors hold stocks, bonds and gold. Scenario A can also be characterized as a period in which gold appears to be segmented from other asset classes and in which gold has not been discovered by the average investor ("the crowd"), i.e. investors have not realized the gains from diversification if commodities in general, or gold in particular, are added to a portfolio. Consequently, scenario B can be described as a period in which gold is more integrated and the potential gains from diversification are exploited.²

In a next step, we assume that there is a shock that negatively affects the prospects and thus the valuations of firms leading to large losses in the (global) stock market. We further assume that investors face borrowing or funding constraints (e.g. see Boyer, Kumagei and Yuan; Brunnermeier and Pedersen, 2009). However, the main findings also hold without this assumption.

In scenario A, investors react to the negative news by selling some of their holdings in stocks. The first movers manage to minimise their losses by moving out of stocks early (pushing stock prices down) and are left with excess capital to invest elsewhere. The "second" movers will incur a potentially large loss on their stock positions. Furthermore, they may even be forced to liquidate some of their positions due to margin constraints. Since investors in scenario A do

not hold gold in their portfolios prior to the shock they cannot sell gold to meet margin calls or to reduce the risk of their portfolio after the shock. In this scenario gold is not affected by the shock and will act as a safe haven and not decrease in value. Baur and McDermott (2010) distinguish between a weak safe haven effect in which the price of gold does not decrease and a strong safe haven effect in which the price of gold increases. Scenario A is consistent with a weak safe haven effect. If we further assume that some investors use some of the capital freed by the sale of stocks to invest in gold—since it is perceived as a safe haven—scenario A would display a strong safe haven effect. In this scenario we hence observe that investors' perceptions about gold as a safe haven, and their subsequent actions, have the effect of reinforcing the safe haven property of gold. Hence their beliefs are self-fulfilling.

In scenario B, however, the story can be quite different. Investors may show a similar initial reaction to the negative news as in scenario A, i.e. they sell some of their holdings in stocks and possibly buy gold. However, in contrast to scenario A, investors do hold gold in their portfolios, allowing for additional mechanisms through which the shock in the stock market can subsequently influence the market for gold. These mechanisms are related to investors' portfolio optimization demands, liquidity constraints, and possible behavioural biases.

We identify four possible mechanisms through which an increase in the number of investors holding both gold and stocks in their portfolios in scenario B could undermine the safe haven property of gold. The ideas presented here are closely linked to the literature on financial contagion, where contagion can also be transmitted through many different channels. However, we mention here only those mechanisms that could have the potential to destroy the safe haven property of gold.

Firstly, and perhaps most importantly, the cross-market re-balancing effect (see Kodres and Pritsker, 2002) asserts that investors respond to shocks in the stock market by readjusting their portfolios and re-evaluating their demand for other assets, including gold.³ Assuming that an investor's optimal asset allocation is to maintain a constant proportion of their wealth invested in each asset, they will attempt to readjust their portfolios to regain their optimal portfolio weight.⁴ In the process of portfolio re-balancing, over-weighted assets are sold and under-weighted assets are purchased, predicting a reduced demand for gold, and downward pressure on gold prices.⁵ We note that there will exist a natural time lag between the shock in the stock market and the resulting effect on the gold market since the time until investors' portfolios moved sufficiently

out of line to warrant (costly) re-balancing would be strictly positive. However, as more investors hold gold, this time could be expected to shorten.

A second, related, mechanism is the wealth effect (see Kyle and Xiong, 2001), which states that when investors lose money in one asset, their capacity to bear risk is reduced, resulting in the liquidation of positions in all risky assets, hence reducing pricing in all markets.

Thirdly, the liquidity shock effect (cf. Brunnermeier and Pedersen, 2009) could also be at work, in which market participants who need to liquidate a portion of their assets to obtain cash, perhaps due to a call for additional collateral, would choose to liquidate assets in a number of different markets, effectively transmitting the liquidity shock between markets.

Finally, a more behavioural effect, the disposition effect (see Tversky and Kahneman, 1974), suggests that investors are reluctant to sell assets which incur losses (they do not want to realize losses), instead choosing to sell assets that have not decreased in value. Since, in scenario B, gold is not under immediate selling pressure (and is expected to be so due to the safe haven property) investors may choose to liquidate gold instead. This option is not available to investors in scenario A.

All the mechanisms described above would place downward pressure on gold prices in response to a

negative shock in the stock market. The implication being that the more people holding gold in their portfolios prior to a shock in the stock market, the more likely mechanisms such as those described above would negatively influence the price of gold and weaken the effectiveness of the safe haven, i.e. shorten the period in which it does not lose its value.

This thought experiment provides testable implications: (i) gold is an effective safe haven in periods following no significant investment demand for gold and (ii) gold is not an effective safe haven in periods following significant investment demand for gold. We use consistent price changes over a certain period as indication of significant changes in investment demand.

3. Empirical Evidence

Figure 1 shows the evolution of the price of gold and the MSCI stock index both measured at a daily frequency and denominated in US dollars from January 1970 to August 2012.⁶

The figure illustrates that the price of gold increased significantly from around US\$ 300 to above US\$ 1,900 between 2000 and 2011. This price increase is consistent with significant investment demand for gold and shows typical features of a bubble.⁷

Figure 1: Performance of stock market and safe haven asset.

The graph shows the evolution of the MSCI World stock market index in US dollars (dashed black line) and the price of gold in US dollars (solid line) from 1970 to 2012.

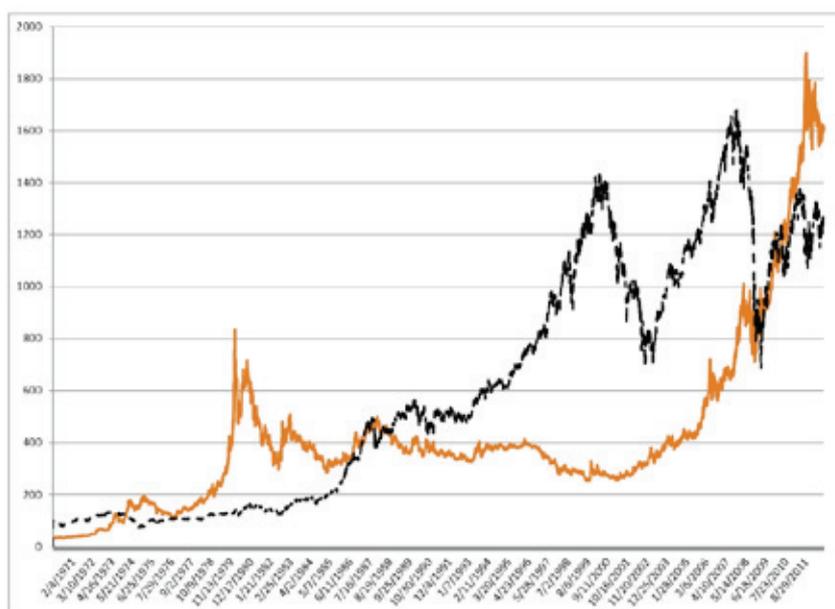
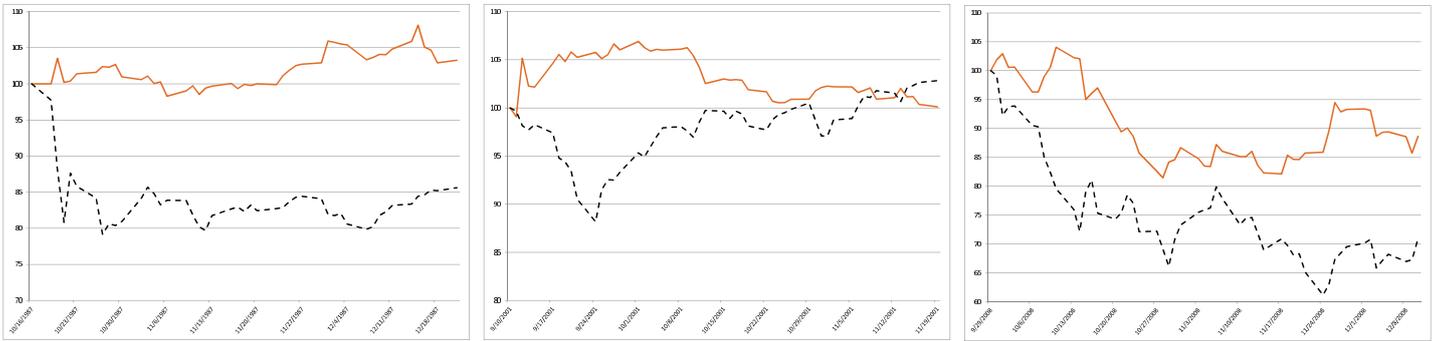


Figure 2: Graphical analysis of crash / financial crises.

The graph shows the crashes of October 1987 (left), September 11, 2001 (centre), and the subprime crisis and Lehman bankruptcy 2008 (right).



The graph also shows that gold was in a 20-year bear market between the late 1970s and 2000. This excludes gold from being a “store of value” in a strict sense since the price fell for a relatively long period. Because the price of gold did not hold its value for a significant period with positive inflation rates, gold was also not an effective inflation hedge.⁸

Figure 2 illustrates the price effects of stocks and gold during specific crises periods and stock market crashes. The plots display the 1987 stock market crash, the September 11, 2001 terrorist attacks and subsequent fall in stock prices, and the subprime crisis and Lehman bankruptcy in 2008.⁹

The graphs show the evolution of the price of gold and a global stock market index around the crisis outbreak and demonstrate that gold acted as a safe haven in all periods. However, the crisis in 2008 is significantly different, a positive increase in the price of gold consistent with a strong safe haven effect is followed by a drop in the price of gold to a level below 100 within 4 days compared to around 15 trading days in the other periods.¹⁰ This price drop is consistent with scenario B. The price drop followed a sustained period of increased investment demand.¹¹ The fact that the price did not fall jointly with the stock market is also consistent with our theory outlined in scenario B, since most of the mechanisms described predict a lagged response of gold price movements to the drop in stock prices. For example, margin calls or portfolio rebalancing, both requiring a sale of gold, would only arise after some time into the crisis.

There is another important difference in the 1987 and 2001 crashes compared to the crisis in 2008. Gold showed an inverse relationship with global stocks in the first two

episodes but a rather synchronized behaviour shortly after the start of the stock market downturn in 2008. This is further evidence that the effectiveness of the safe haven asset has weakened.

It must also be mentioned that the safe haven effect was generally short-lived, i.e. the price of gold does not fall for a relatively short period of time (around 15 trading days) but tends to fall after that (see Baur and Lucey, 2010). If investors buy gold in response to a negative news shock in the stock market the price of gold increases (strong safe haven effect). If stock prices continue to fall several days after the initial news arrival investors may find themselves in a situation similar to scenario B as described above, since investors would now be holding a significant proportion of gold. In this regard, it could be argued that this effect was always present and that the destruction of the safe haven effect is nothing new. What is new is that the period of 15 trading days is reduced significantly and in some conditions fully eliminated, i.e. reduced to zero trading days.

The finding of a short-lived safe haven effect is also directly linked to the empirical rejection of the store of value hypothesis. If the safe haven effect of gold was a persistent, long-lived, effect, gold would never exhibit a price drop and thus be a store of value.

Finally, an analogy based on the definition of a haven as a “port” and “shelter from the storm” may provide a simpler and perhaps more intuitive illustration of the mechanisms described in this paper. In such an analogy, the increased holding of gold in many investors’ portfolios has resulted in most investors now having two boats in operation; one out at sea and susceptible to a financial storm and a second in the port. During times of financial turmoil, the investors

(boats) who arrive at the port first are able to seek shelter from the storm and the continued arrival of investors to the port enhance their security further, due to the safety in numbers. However, as the storm begins to ease, those investors with boats still remaining at sea, and now damaged from the storm, must send out their second boat from the port to the aid of the first.

4. Financial Stability Implications

The existence or non-existence of a safe haven effect has strong implications for financial stability. In scenario A investors do not hold significant fractions of gold in their portfolios and thus cannot sell gold in response to their losses in the stock market. As a consequence gold will not lose its value at a time when global stock markets are in turmoil thereby positively influencing investor sentiment and indirectly stabilizing markets.

In scenario B, investors have incentives (due to portfolio re-balancing or wealth effects) or requirements (due to liquidity constraints) to sell gold following a negative shock in the stock market. This may lead to reduced selling pressure in the stock market. However, this is rather a short-term effect. When investors realize that the value of the safe haven asset falls (due to the sale of gold) it is likely that this will lead to increased uncertainty and instability. For example, they may overreact to the falling price in the gold market by selling more stocks or gold potentially increasing volatility in both markets.

The scenarios described in this paper also suggest that there is an impossibility of an effective use of a safe haven asset.¹² If investors do not hold the safe haven asset before the occurrence of a crash or a crisis (scenario A), the price will be stable but investors do not have the ability to reduce holdings in the safe haven asset to offset their losses in the stock market. In other words, they cannot fully exploit the safe haven property. If, on the other hand, investors do hold the safe haven asset before the occurrence of a crash or a crisis (scenario B), its price is more likely to fall following a downturn in the stock market. Hence, investors destroy the safe haven property precisely because they want to use it. Furthermore, if investors realize that the safe haven property is significantly influenced by their portfolio compositions, and thus their behaviour, this may change their belief in the effectiveness of the safe haven property and therefore fully eliminate it.

5. Conclusions

We used a simple thought experiment to demonstrate theoretically that significant investment in gold – due to its perceived safe haven and hedging properties – can reduce the effectiveness and thus duration of the safe haven effect. The empirical analysis further showed that the duration of the safe haven effect during the subprime crisis in 2008 was indeed reduced significantly. If investors become aware of the mechanisms working against the safe haven and change their beliefs about its effectiveness the safe haven property could be destroyed all together. Finally, we argued that the destruction of a safe haven asset has strong implications for financial stability. It is likely that crashes and crises are more extreme in the absence of a safe haven asset.

Appendix: Optimal Portfolio Weights

Consider an investor faced with the problem of finding the trading strategy π_t that maximizes their expected utility of terminal wealth

$$\max_{\pi} E_w[U(W_T^{\pi})]$$

where W denotes their wealth process (started at w), and T their time horizon. Merton (1969, 1971) provided a simple and elegant solution to this problem (in continuous time) in a world where assets follow log-normal distributions (the Black-Scholes-Merton world) and for investors that have a power utility functions (of the CRRA class) given by $U(x) = x^{1-\gamma}/(1-\gamma)$, where $\gamma > 0$ is the risk aversion coefficient. The optimal portfolio weights in this case are found to be

$$\pi_t = \frac{1}{\gamma} \Sigma_t^{-1} (\mu_t - r_f \mathbf{1})$$

where Σ_t denotes the covariance matrix, μ_t denotes the vector of expected returns, r_f the risk-free rate, and $\mathbf{1}$ the vector of ones. In the case of constant expectations for Σ and μ , this solution indicates that investors should strive to maintain a constant fraction of their wealth invested in each risky asset.

For illustrative purposes, we consider the two risky asset case in which we have

$$dS_t / S_t = \mu_S dt + \sigma_S dB_t^S$$

$$dG_t / G_t = \mu_G dt + \sigma_G dB_t^G$$

with $Cov(dB_t^S, dB_t^G) = \rho dt$ where S_t and G_t denote the prices of stocks and gold, respectively, and ρ the correlation between stocks and gold. Given this, we see from (1), that the portfolio fractions for stock and gold are constant in time and given by

$$\pi^S = \frac{\mu_S - r_f - \rho \frac{\sigma_S}{\sigma_G} (\mu_G - r_f)}{\gamma \sigma_S^2 (1 - \rho^2)}$$

$$\pi^G = \frac{\mu_G - r_f - \rho \frac{\sigma_G}{\sigma_S} (\mu_S - r_f)}{\gamma \sigma_G^2 (1 - \rho^2)}$$

What is neglected from the above is the existence of transaction costs. In the presence of such costs the optimal strategy is modified such that there is a no-trade region around the Merton proportions (given above) where a trade is made to rebalance the portfolio when the portfolio weights get too far out of line (see Davis and Norman, 1990). Such a strategy is consistent with the way in which many institutional investors operate and supports the existence of a lagged response between a shock in the stock market and (optimal) portfolio re-balancing.

Acknowledgements

We thank Thomas McDermott and Niels Schulze for detailed comments and suggestions based on an earlier version of this paper.

References

- Baur, D. G. and Lucey, B. M. (2010). Is Gold a Hedge or a Safe Haven? An Analysis of Stocks, Bonds and Gold. *Financial Review* **45**, 217–229.
- Baur, D. G. and McDermott, T. K. (2010). Is Gold a Safe Haven? International Evidence. *Journal of Banking & Finance* **34**, 1886–1898.
- Boyer, B. H., Kumagai, T. and Yuan, K. (2006). How Do Crises Spread? Evidence from Accessible and Inaccessible Stock Indices. *Journal of Finance* **61**, 957–1003.
- Brunnermeier, M. K., and Pedersen, L. H. (2009). Market Liquidity and Funding Liquidity. *Review of Financial Studies* **22**, 2201–2238.
- Davis, M. H. A. and Norman, A. R. (1990). Portfolio Selection with Transaction Costs. *Mathematics of Operations Research* **15**, 676–713.
- Grossman, S. J. and Stiglitz, J. E. (1980). On the Impossibility of Informationally Efficient Markets. *American Economic Review* **70**, 393–408.
- Kodres, L. E. and Pritsker, M. (2002). A Rational Expectations Model of Financial Contagion. *Journal of Finance* **57**, 769–799.
- Kyle, A. S. and Xiong, W. (2001). Contagion as a Wealth Effect. *Journal of Finance* **56**, 1401–1440.
- Merton, R. (1969). Lifetime Portfolio Selection under Uncertainty: The Continuous-time Case. *Review of Economics and Statistics* **51**, 247–257.
- Merton, R. (1971). Optimum Consumption and Portfolio Rules in a Continuous-time Model. *Journal of Economic Theory* **3**, 373–413.
- Phillips, P. C. B. and Yu., J. (2011). Dating the Timeline of Financial Bubbles During the Subprime Crisis. *Quantitative Economics* **2**, 455–491.
- Ranaldo, A. and Söderlind, P. (2010). Safe Haven Currencies. *Review of Finance* **14**, 385–407.
- Tversky, A. and Kahneman, D. (1974). Judgment under Uncertainty: Heuristics and Biases. *Science* **185**, 1124–1131.
- Tang, K. and Xiong, W. (2010). Index Investment and Financialization of Commodities. NBER Working Paper Series, WP16385.
- World Gold Council (2011). Gold Demand Trends - Second Quarter 2011. www.gold.org, August 20.

- ¹ In this paper we focus on gold, however our theoretical arguments would work for any safe haven asset subject to increased investment or speculative demand.
- ² Note that the safe haven property is not equal to a hedge or (mean-variance) diversification property (see Baur and Lucey, 2010).
- ³ Note that for non-US investors the role of the US dollar would have an additional effect on the portfolio re-balancing demands since gold is denominated in US dollars. When the US dollar appreciates, gold becomes more expensive to international investors and their demand would decrease, causing gold prices to co-move with the US dollar exchange rate. We do not explore this effect further as the ideas in this paper can be expressed without this additional effect.
- ⁴ Appendix A provides details of the assumptions required to ensure that the optimal portfolio allocation for an investor is to maintain a constant proportion of his/her wealth in each asset. These assumptions may not apply to all investors but the idea that one should maintain a constant proportion of wealth in each asset class has permeated modern portfolio theory and is the aim of many institutional money managers.
- ⁵ For example, if the value of stocks and gold in US dollars is given by $W_S = \$400$ and $W_G = \$400$ with the remaining capital in the risk-free asset, $W_R = \$200$; corresponding to a portfolio composition of (40%, 40%, 20%). A significant loss in the value of stocks to $W_S = \$300$ would result in the portfolio composition moving out of line with its initial optimum, motivating a re-balancing of the portfolio by transferring \$40 from gold and \$20 from the risk-free asset to obtain $W_S = \$360$, $W_G = \$360$, and $W_R = \$180$.
- ⁶ On August 15, 1971 President Nixon decreed that the US would no longer exchange dollars for gold, effectively ending the gold standard. Figure 1 shows the stability of the price from January 1970 until August 1971 and the increased fluctuation of the price of gold following the announcement in August 1971.
- ⁷ The World Gold Council provides investment demand figures. For example, in 2001 the investment demand (excluding jewellery and industrial demand) was 350 tonnes of gold with a value of 3.1bn US dollar. In 2008, investment demand was 1,200 tonnes of gold valued at 33.5bn US dollars (World Gold Council, 2011). This extreme trend can be explained with the financialization of commodities in general, the invention and popularity of exchange-traded funds, and the repercussions of the subprime crisis in 2008.
- ⁸ One may argue that gold is not meant to be a hedge against actual inflation but a hedge against (future) expected inflation. This argument could be used in light of the sovereign debt crisis and investors' expectations that paper currency may depreciate significantly boosting the price of gold. However, this argument does not work for the pre-2008 period.
- ⁹ Since a definition of the subprime crisis and the Lehman bankruptcy period is not straightforward and arbitrary to some degree we tried alternative start dates to analyse the robustness of the results, observing similar findings for all dates. The use of the MSCI World index complicates the optimal choice of the crisis date since some country-specific effects are less evident in a global context. Crisis time-lines, as published by central banks for example, can identify key dates of crisis origination and thus help to define and justify the crisis window. A focus on the US stock market would lead to stronger results.
- ¹⁰ See Baur and Lucey (2010) on the duration of the safe haven effect.
- ¹¹ We tested whether gold displayed bubble-like features using a bubble test proposed by Phillips and Yu (2011). The results show that gold indeed followed a price path consistent with a bubble.
- ¹² This idea is related to the impossibility of informationally efficient markets proposed by Grossman & Stiglitz (1980).

Corresponding Author

Dirk G. Baur, UTS, Business School, Finance Discipline Group, PO Box 123 Broadway, Sydney, NSW 2007, Australia,
Email: dirk.baur@uts.edu.au.



Pricing Currency Risk in Two Interlinked Stock Markets

By Jan Antell & Mika Vaihekoski

Jan Antell is Associate Professor in Finance at the Hanken School of Economics, Finland.

Mika Vaihekoski is Professor of Corporate Finance at the University of Turku, Finland.

We investigate the role of currency risk on stock markets in two interlinked Nordic countries exhibiting a gradual move from fixed to floating exchange rate regime. Tests are conducted for a conditional asset pricing model using the Ding and Engle (2001) specification which allows estimation of multivariate GARCH-in mean models. Using a sample period from 1970 to 2009, we find that the currency risk is priced in both stock markets, and that the price and the risk premium are lower after the flotation of the currencies. We also find some evidence of cross-country exchange rate effects. Our model has many practical applications and can easily be applied to study other countries, different asset classes, or industries that are closely connected.

Keywords: international asset pricing model, currency risk, devaluation, multivariate GARCH-M

1. Introduction

Nowadays it is considered commonplace to invest abroad. The general liberalization of the financial markets as well as lower costs and improved technology have all provided investors access to more investable assets than ever before. As part of this development, many developed countries have abolished foreign-exchange controls and adopted market-determined floating exchange rates. However, there are still many emerging countries with currencies that are still fixed, managed, or tied to certain target zones.

In Antell and Vaihekoski (2012) we study the pricing of stocks in two Nordic countries, Finland and Sweden, from the 1970s to 2009. Here we review the results and implications from a more practical point of view. Both Finland and Sweden are small export oriented countries whose currencies were first pegged against a currency index within a pre-specified band but were both forced to let their currencies float almost at the same time in 1992. They were also known to use competitive devaluations of their currencies to improve their international competitiveness. This gives us a unique opportunity to study cross-country

effects in currency risk. In addition, we test for the effect of fixed and floating currency regimes on the pricing of currency risk.

We combine a number of important features in our model. First, our model is based on the mildly segmented asset pricing model which allows for both global and local market risk to affect the pricing of both equity and currency risk. Furthermore, we estimate a conditional version of the pricing model which allows the parameters of the model to be time-varying (in practice market risk premium or beta are unlikely to stay constant over time). In particular, we allow the price of currency risk to differ for the periods before and after the flotation decision. We also utilize a GARCH-M approach to model the time-variation in the conditional (co)variances. In order to estimate the model for six assets jointly, we utilize the multivariate GARCH where the number of parameters is reduced using the Ding and Engle (2001) approach. Finally, we allow for the two countries' expected returns to depend on each other not only through their covariances but also through the prices of risks.

Including two rather similar, yet in many ways different countries allows also for interesting comparison between the countries. Our primary goal is to explore how the currency risk is priced in these stock markets. In particular, we study the role of the exchange rate mechanism. Second, we also study the differences in the pricing of local sources of risk in Finland and Sweden. The results can shed light on the role of currency risk and local risk on the pricing of stocks in countries that are currently emerging from segmentation and also restricting the free valuation of their currencies.

2. Research Methodology

2.1 Theoretical background

If capital markets are economically fully integrated, the expected return is driven by the same pricing model with a common set of risk factors with common risk premium in all countries. Return differences are exclusively explained by differences in the exposure to the risk factors. Suppose the correct model is given by the one-factor market model or the CAPM. Then the expected return is driven by the exposure to the value-weighted global equity benchmark portfolio (often measured using e.g. the MSCI world equity index).

However, if some assets deviate from pricing under full integration, their risk-adjusted return will differ from the world CAPM. Errunza and Losq (1985) suggested including the local market portfolio as an additional source of risk in the pricing equation. This leads to a mildly segmented version of the CAPM where both the global and local market portfolios appear as separate risk factors. Further, keeping in mind that an international investment is a combination of the direct investment into the asset itself and an indirect investment into the foreign currency, the conditional expected return for asset i can be stated under the assumption of non-stochastic inflation as

$$\begin{aligned}
 E_i[r_{i,t+1}] &= \lambda_{m,t+1}^w \text{Cov}_t(r_{i,t+1}, r_{m,t+1}^w) \\
 &+ \\
 &\sum_{c=1}^C \lambda_{c,t+1} \text{Cov}_t(r_{i,t+1}, f_{c,t+1}) \cdot \\
 &+ \\
 &\lambda_{m,t+1}^l \text{Cov}_t(r_{i,t+1}, r_{m,t+1}^l)
 \end{aligned}$$

where $\lambda_{m,t+1}^w$, $\lambda_{m,t+1}^l$, $\lambda_{c,t+1}$ and are the conditional prices of global and local market risk, and exchange rate risk for currency c . However, including a larger set of currencies in the model might become infeasible. In this case one can focus on a subset of currencies, as we have done here, or one could use an aggregate currency risk factor (e.g., trade-weighted currency index), in which case the model would boil down to a three-factor model.

Note that the price of risk in this model may look different from the standard beta-models. It is still the same model; we have only first broken down the definition of beta to separate the numerator term (covariance). Then we have divided the equity premium with the denominator of the beta. This ratio, $E[r_{m,t+1}]/\text{Var}(r_{m,t+1})^{-1}$, is defined to be the conditional price of global market risk $\lambda_{m,t+1}^w$. The same is done for all risk factors.

2.2 Empirical formulation

Even though the theoretical background of asset pricing models is quite old, the estimation of conditional asset pricing models in practice has been a rather recent development as there are a number of issues that have required further theoretical development as well as computational power. The first hurdle has been the formulation of the conditional expectations. Typical alternatives have been either using conditioning variables or GARCH-type of models. Here, we combine both approaches.

For the coefficients of price of risk we use the conditioning variables approach, i.e., each parameter is a (linear) function of selected variables. Different prices of risk can have their own set of variables. For example, to study the effect of the floating decision in 1992 on the price of currency risk, we use an indicator variable for the post-floating period when modeling the price of currency risk. In theory, we should pick variables that reflect the changes in the market prices of risk. However, from the analysts' point of view, one cannot obviously observe all variables, and empirically one has to settle for a fairly limited number of variables which one considers relevant for future forecasting. In practice, one has more freedom setting up the model, as the model can be estimated in a rolling fashion, which allows one to change the variables from time to time as their importance in the market might change.

For the conditional (co)variances, we employ a multivariate GARCH-in-mean specification similar to De Santis and Gérard (1998). GARCH models have been commonly used in practice since the 1980s, but when one estimates multivariate models with more than two or three assets, one runs into problems, e.g. with the convergence, despite having an abundance of time series observations

as the number of parameters to be estimated grows exponentially. In our case, we estimate the model using six assets: world, USA, Finland, Sweden, and two currencies. There are a number of alternative ways to limit the number of parameters. We use the covariance stationary specification of Ding and Engle (2001) which is convenient and reduces the number of GARCH parameters considerably.

3. Results

3.1 Case: Sweden and Finland

Historically, both Finland and Sweden have deployed a fixed exchange rate policy until the 1990s, tying their currencies to gold, the USD, or some exchange rate index. From 1970 to 1990 both currencies experienced several devaluations and a few occasional revaluations. In many cases, a devaluation decision in one country sparked a similar devaluation in the other. In fact, Sweden and Finland at times accused each other for using devaluations as tools to improve their export industries' (especially metal and forestry) competitive position.

From the beginning of 1991, both FIM and SEK were linked to the European Currency Unit (ECU) with fixed rate. However, after several speculative attacks in September 1992, Finland was forced to let its currency float. Sweden had to follow two months later in November 1992. Soon afterwards, both started to strengthen against the USD. In October 1996 FIM became part of the European Exchange Rate Mechanism (ERM). Finally, as a result of the economic and political integration within the EU, Finland joined the Economic and Monetary Union (EMU) in 1999 and Euro replaced the FIM. Sweden, on the other hand, opted out from the EMU, keeping Swedish Krona floating against the Euro.

In addition, both countries are interesting for their economic structures that have changed markedly over the sample period. Originally, both countries had relatively closed financial markets which started to open up to foreign investors in the 1980s. Historically, Sweden was economically more developed and had closer ties to the global financial markets. These developments began earlier than in Finland. In Sweden, the regulation took mostly place in the 1980s. Final steps were taken in the beginning of 1990, when restrictions on foreign ownership were abolished. In Finland, the regulation started in the 1980s and ended in the beginning of the 1990s. At the beginning of 1993, all restrictions on foreign ownership were abolished.

3.2 Data

It is typical for GARCH studies that a lot of data are needed, typically hundreds of time series observations. In our paper, the estimation is conducted using 474 months of data from March 1970 to August 2009. We take the view of a US investor. Thus, all returns are measured in US dollars in excess of U.S. investors' risk-free return. We use continuously compounded returns.

Global market portfolio returns are proxied by returns on the MSCI global equity market index with reinvested gross dividends. Local market portfolios' returns are calculated from local market indices (USA using the MSCI US index). As a proxy for the exchange rate risk, we use local bilateral currency exchange rates against the dollar, i.e., USD/FIM or USD/SEK exchange rates for Finnish and Swedish stocks, respectively.

Table 1 shows basic descriptive statistics for the assets. The annualized mean returns for the world equity market and the US market are 9.1% and 9.0%, respectively. Similarly, the corresponding returns for Finland and Sweden are 13.6% and 12.9% per annum. Hence, Finland has offered the highest returns for US investors during the sample period, but in general both Sweden and Finland have offered more than two-times the excess return of the US market. On the other hand, the world and the US market portfolios show clearly lower volatility.

Table 1. Mean asset return and volatility per annum.

	Mean (%)	Std. dev. (%)
World market portfolio	9.081	15.081
Risk-free rate	4.433	0.563
U.S.	9.024	15.675
Finland	13.614	24.067
Sweden	12.911	22.657
USDFIM	0.031	10.192
USDSEK	-0.805	10.664

To track predictable time-variation in asset returns, risk exposures, and the required rewards to risks, we use global and local predetermined forecasting variables. When modeling the price of currency risk, we select two currency specific information variables for both currencies on top of the floating indicator variable. The first variable is the difference between the Finnish (Swedish) and the US one month interest rates. It is aimed at detecting devaluation risk in the short run as central banks typically increase the local interest rates to fight against the pressure of devaluation.

Further, it is expected to capture longer-term pressure on the value of the Finnish (Swedish) currency. The second variable is the absolute value of lagged cross-currency return, i.e., the lagged Swedish absolute currency return for Finnish currency risk, and vice versa. It is expected to capture devaluation risk and currency shocks in the short run and potential uncertainty in the long run in the other currency.

Finally, we use two variables to model changes in the price of local risk in the case of Sweden and Finland. The first is the same variables as before. The second is a liberalization indicator that gets a value of one beginning in 1990 for Sweden and 1993 for Finland when all restrictions on foreign ownership in the Swedish (Finnish) stock market were removed.

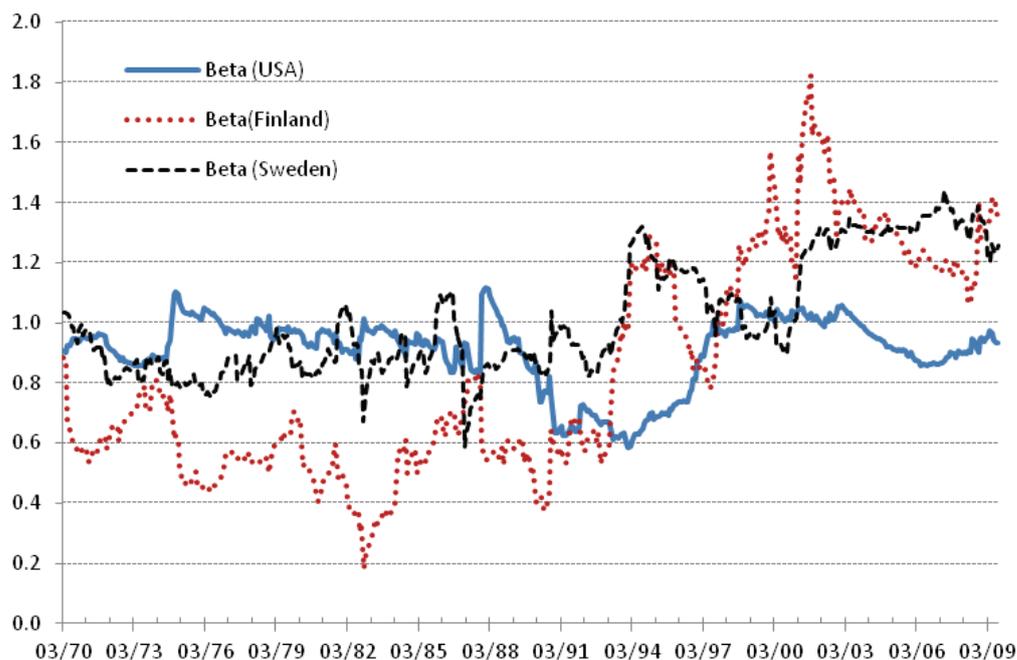
3.3 Empirical Results

Our initial empirical tests concentrate on constant price of risk specifications of the asset pricing model with currency risk. The results show that all three risk factors are relevant for the pricing of stocks in Finland and Sweden. Next we allow for prices of global, currency, and local risk to be time-varying, with the exception of the price of US local market risk, which is kept constant. Our model also allows the price of currency risk to differ before and after the floating decision in 1992.

The results for the global and local market risk remain basically unchanged. Global and local market risk are priced in both countries. Using the estimated (co) variances, we can also calculate time series values for the beta coefficients. Figure 1 shows the development of the global market betas for all three stock markets. We can see especially in the case of Finland that the sensitivity to global market risk has increased after 1980s.

We find the prices of local risk to be time-varying in Finland but not for Sweden. Somewhat surprisingly, the liberalization indicator is not found to have an impact on the price of the local market risk. This might be related to the fact that the floating decision almost coincides with the liberalization especially for Finland. The currency risk is also clearly priced in both countries, and the price is found to be time-varying. After the floating decision, the price of the currency risk has remained relatively stable (especially for Finland) but notable smaller than before.

Figure 1. Time-varying (conditional) global market beta.





4. Conclusions

The model presented in this paper is suitable for modeling the pricing of currency risk as well as global and local market risk in mildly segmented stock markets. Empirical results from Finland and Sweden support the pricing of the currency risk on their respective stock markets, as well as global and local market risk, and evidence is found on the importance of cross-currency linkages.

Although the model is quite tedious to estimate in practice, it offers wide flexibility in its setup. For example, instead of analyzing currency risk, one can study other sources of risk. The model is especially useful if one is interested to study countries (say, e.g., New Zealand and Australia) or different asset classes or industries that are closely linked. In practice, the benefits of conditional (multifactor) models

for the portfolio management industry compared to, e.g., the CAPM, comes from their ability to incorporate the time-varying nature of the parameter values instead of using long-term averages. Furthermore, it allows the breakdown of the market risk into its components. The outputs from the model (expected returns, covariances, and variances) can be in turn used as inputs into the portfolio optimizer. As circumstances change, the practical applicability of the model can be even further improved by using alternative sets of forecasting variables and/or time series models.

Acknowledgements

We are grateful for comments from Bart Frijns and Alireza Tourani-Rad.

References

Antell, J. and Vaihekoski, M. (2012). Pricing Currency Risk in the Stock Market: Empirical Evidence from Finland and Sweden 1970-2009. *Journal of International Financial Markets, Institutions & Money* 22, 120-136.

De Santis, G. and Gérard, B. (1998). How Big is the Premium for Currency Risk? *Journal of Financial Economics* 49, 375-412.

Ding, Z. and Engle, R. F. (2001). Large Scale Conditional Covariance Matrix Modeling, Estimation and Testing. *Academia Economic Papers* 29, 157-184.

Errunza, V. and Losq, E. (1985). Internal Asset Pricing under Mild Segmentation: Theory and Tests. *Journal of Finance* 40, 105-124.

Corresponding Author

Mika Vaihekoski: Turku School of Economics (TSE) and Lappeenranta University of Technology (LUT). Address: TSE, Department of Accounting and Finance, 20014 University of Turku, Finland. E-mail: mika.vaihekoski@utu.fi.



The Effect of Credit Derivatives on Financial Stability

By Richard van Ofwegen, Willem F.C. Verschoor & Remco C.J. Zwinkels

Richard van Ofwegen is at the Faculty of Social and Behavioural Sciences, University of Leiden, the Netherlands

Willem F.C. Verschoor is Professor of Finance at the Erasmus University Rotterdam, the Netherlands.

Remco Zwinkels is Assistant Professor of Finance at the Erasmus University Rotterdam, the Netherlands.

Due to the recent financial turmoil, questions have been raised about the impact of complex financial products, like credit derivatives, on financial stability. The academic literature however does not provide a clear answer to this question. This paper empirically links the stability of the financial sector to the use of credit derivatives for the main constituents of the European financial sector. We find that the use of credit derivatives increases the probability of default and thus reduces the overall financial sector stability. In addition, we find evidence that this relationship is progressive and economically meaningful.

Keywords: Credit derivatives, credit risk transfer, financial sector stability, probability of default.

1. Introduction

The debate regarding the impact of financial derivatives on financial sector stability is a long-standing one, but became more relevant as a result of the global financial crisis. There is no unambiguous answer to this question in the literature. The IMF Global Financial Stability Report explains that the increase in credit transfers has helped to make the banking and overall financial system more resilient and increases financial stability. With a broader and more diverse investor base, credit markets may deepen and liquidity should improve. At the same time, the transition from bank-dominated to a more market-based financial system presents new challenges and vulnerabilities.

Rule (2001) explains that the development of the credit derivative market has clear potential benefits for financial stability. Credit derivatives allow the origination and funding of credit to be separated from the allocation of the resulting credit risk. A more efficient allocation of credit risk allows banks to expand granting loans and taking deposits, which enhances portfolio diversification even more and reinforces risk reducing effects of credit risk transfer.

Rule (2001) also acknowledges, however, that credit risk transfer markets present some challenges and may carry potential costs. Separating the exposure to credit risk

from the direct relationship with the borrower might lessen capacity to monitor creditworthiness. Sellers of protection in a CDS contract have no contractual rights, thus reducing their ability to influence the decision making of the reference company. It might also make it more difficult for creditors, regulators and the monetary authorities to assess the actual credit exposures of banks and of the banking system as a whole. Although credit derivatives are in Rules' (2001) view more likely to disperse credit risk, there is also the possibility that they could deliberately or inadvertently concentrate it.

In the recent years regulators have been largely welcoming the development of credit derivatives, not only because of the more efficient allocation of credit risk or diversification effects but also because credit derivatives increase the relative liquidity of loans. In the past, illiquidity of bank loans has been a main source of banking fragility. An improved ability to sell assets will make banks less vulnerable to liquidity shocks. Instefjord (2003) states, however, that this ignores that banks may change their behaviour as a result of the increased liquidity of their assets. They may take on new risks following a reduction in the risks on their balance sheet through credit risk transfer.

Instefjod (2003) notes that banks that have access to a richer set of derivatives to manage risk, will also play the risk acquisition game more aggressively. Risk exposures become more attractive, knowing that they can be offloaded through a more active derivatives trading policy. These views are consistent with the empirical work of Cebenoyan and Strahan (2004), who provide evidence that banks who manage their risks in a loan sale market hold a larger share of their portfolio in risky assets than banks inactive in loan sale.

The question that naturally arises is how much of the extra risk will be transferred to outside parties and how much remains within the bank. Instefjod (2001) claims this is conditional on the price of credit and the price elasticity of the underlying credit markets. If too elastic, banks operate too aggressively in the underlying credit markets following a derivatives innovation which threaten bank stability. If too inelastic there is an opposite effect and the banking sector is stabilized by the development of the credit derivatives market.

Clearly, the literature shows no conclusive answer to the question whether credit derivatives raise or lower financial stability. Some authors believe that the introduction of credit derivatives increases the stability, while others claim that banks will change their behaviour now that they have access to credit derivatives. In the current study, we empirically investigate the relation between credit derivatives and financial stability, measured by the probability of default of the 20 largest European financial institutions. We find a negative relationship between the financial stability and the increased use of credit derivatives. Also, credit rating agency Standard & Poor's is found to incorporate CDS positively, but insignificant. In addition, we find evidence that this relationship is progressive and economically meaningful.

2. Methodology and data characteristics

We will use three different methods of calculating the probability of default: bond spread, CDS spread, and Merton (1974) distance to default model. In addition, we will use the credit rating of Standard and Poor (S&P) to see to what extent they incorporate the use of CDS. In the model, we use the probabilities of default as dependent variable and the amounts outstanding on credit derivatives as independent variables. We use Altman's (1968) bankruptcy prediction model as a source for control variables: working capital to total asset, the retained earnings to total asset, pre-tax income (earnings before tax) to total assets, the

market value of equity to book value of total debt, and the sales to total asset. Greatrex (2008) finds that market data, like implied volatility, can explain deviations in credit spreads. We therefore add the implied volatility of the stock prices into the model as a sixth control variable. The seventh explanatory variable is the variable of interest, the amount outstanding on credit derivative contracts to total assets.

Our sample consists of 20 main players in the European financial sector. We obtain the 20 largest banks in Europe, measured by total assets, using Bureau van Dijk's Bankscope. In this sample, we include only publicly traded banks. Even though the sample consists of only 20 banks, because of the relative size it provides a fair coverage of the European banking sector. Moreover, the largest banks are obviously of particular interest due to their relatively large impact in the stability, and the fact that they make up the majority of the credit derivative market. Table 1 lists the sample of financial institutions.

Table 1: Sample banks

Royal Bank of Scotland Group Plc	UniCredit SpA
Barclays Plc	Banco Santander SA
Deutsche Bank AG	Fortis
BNP Paribas	Credit Suisse
HSBC Holdings Plc	HBOS Plc
Crédit Agricole SA	Dexia
UBS AG	Commerzbank AG
ING Groep NV	Lloyds Banking Group Plc
Société Générale	Danske Bank Group
ABN Amro Holding NV	Nordea Bank AB

The outstanding amount of credit derivatives will be obtained by examining the annual reports of each of these financial institutions. We use data from 2001-2008. Since the market for credit derivatives before 2001 was small, only a limited number of financial institutions released information about their holdings. After the implementation of IFRS in 2004, almost all banks provide sufficient information on their derivative positions. The market based information that is used in this study is gathered using Thomson One Banker, Reuters, and Datastream. We use the CDS premium on senior secured debt; for bonds we use the variable rate over the swap curve.¹

The probability of default as calculated with bond spreads shows a pattern that is comparable with that of the overall economy. The probability of default increases during economic downturns (2001 – 2002 and 2007 – 2008), and decreases in prosperous times. Especially during the recent financial crisis the probabilities of default increased drastically. At the end of 2008 several banks had a probability of default of over 12% (HBOS and Nordea) while others remained around 2% (Santander).

There is no CDS spread data available for 2001; for 2002 this data is only available for two companies (ING and Nordea). Especially during the years 2003 – 2006 the CDS

spread is extremely low and so is the default probability. Only in 2007 and 2008 the probability of default increases. In 2008 however the average probability of default using CDS spreads is 2.7%, which is remarkably lower than that of the bond spread. The highest default probability is that of Dexia with 6.7%. Both methods use market data so that one would expect the results to be more or less comparable.

The probability of default from the Merton model shows the most extreme results. During the economic downturn of 2001 the probabilities of default are considerably higher than those during the next years. However, starting in 2007 and maturing in 2008, the Merton DD model provides its extreme results when comparing with the previous two methods. In 2008 the average probability of default was 10.6% while Fortis had a 36.3% probability to default on its obligations.

The probability of default using S&P's credit rating shows the smoothest pattern. Only small adjustments in the credit rating are made by S&P. A few companies have the same rating throughout the entire sample and most other companies have only one adjustment during these eight years. Even in 2008 the average probability of default is 0.055% and the maximum 0.08% which is rather low considering the problems in the financial sector.

Figure 1a: Average probability of default using bond spreads

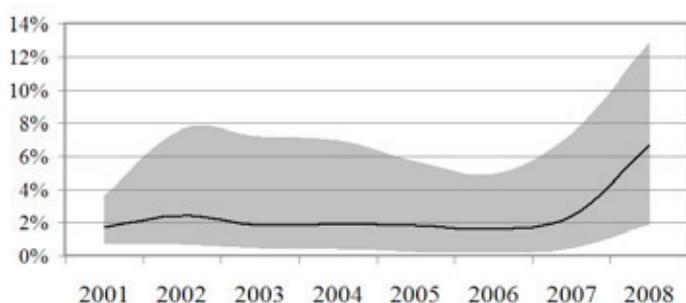


Figure 1b: Average probability of default using CDS spreads

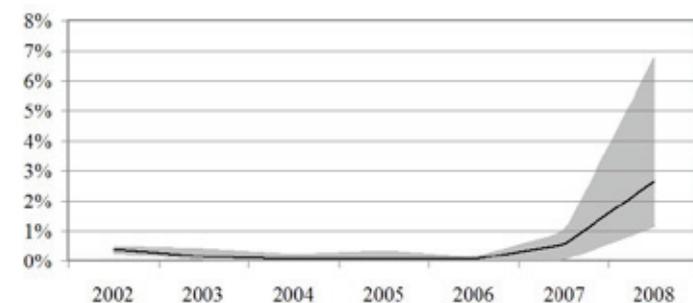


Figure 1c: Average probability of default using Merton DD model

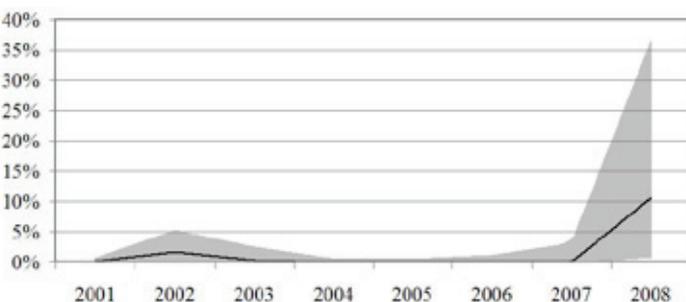


Figure 1d: Average probability of default using Standard and Poor's credit rating

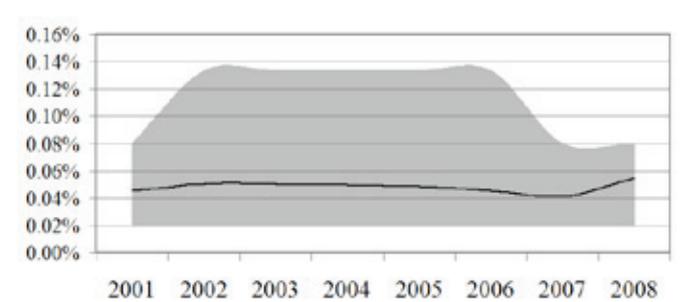


Table 2 presents the descriptive statistics of both the probabilities of default (a) and the control variables (b). A noticeable thing is the relatively high standard deviation of X7, which is the credit derivative variable. The mean is much higher than the median, indicating that a small number of banks uses a large amount of credit derivatives.

Table 2a: Descriptive statistics of the probabilities of default

	Bond spread	CDS spread	Merton DD	S&P
Mean	0.02537	0.00600	0.05861	0.00048
Median	0.01755	0.00121	0.00192	0.00047
Maximum	0.12811	0.06735	0.48875	0.00133
Minimum	0.00262	0.00013	0.00000	0.00020
Std. Dev.	0.02433	0.01071	0.10972	0.00022
Skewness	1.82	2.91	2.23	1.92
Kurtosis	6.75	13.10	7.55	8.12
Observations	160	115	156	156

Notes: Table displays the descriptive statistics of our three measures of default, plus the credit rating.

Table 2a: Descriptive statistics of the probabilities of default

	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇
Mean	0.03690	0.01763	0.00607	0.05982	0.06145	0.31301	0.45446
Median	0.03138	0.01699	0.00696	0.05551	0.05483	0.22236	0.18153
Maximum	0.16162	0.04395	0.01725	0.18487	0.17425	1.00193	2.81736
Minimum	0.00648	-0.01126	-0.02321	0.00629	0.00189	0.11205	0.00000
Std. Dev.	0.01841	0.00997	0.00574	0.03084	0.02779	0.20255	0.67281
Skewness	2.90	-0.22	-2.14	0.75	1.34	1.42	2.02
Kurtosis	18.20	3.73	9.94	4.05	5.19	4.20	6.36
Observations	126	155	158	157	157	132	130

Notes: X₁ = working capital to total assets; X₂ = retained earnings to total asset; X₃ = pre-tax income to total asset; X₄ = market value of equity to book value of total debt; X₅ = sales to total asset; X₆ = implied volatility using at-the-money options; X₇ = notional amount of credit derivative contracts to total assets.

Table 3 shows the correlations between the probabilities of default and the explanatory variables. Between the probabilities, the correlation is the highest between the CDS spreads and Merton DD with 78%. The correlation between the bond spreads and CDS spreads is 67%. The correlation of the default probabilities with X7, the notional amount of credit derivatives to total assets, provides a first answer to

our research question. For the bond spread, CDS spread, and Merton DD model, the correlation is highly comparable and positive. This indicates that the probability of default increases with an increased use of credit derivatives. The credit rating, on the other hand, depicts a negative correlation. As such, S&P views the use of credit derivatives as increasing the creditworthiness of a financial institution.

Table 3: Correlation matrix of the probabilities of default and the variables

	Bond spread	CDS spread	Merton DD	S&P	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇
Bond spread											
CDS spread	0.67302										
Merton DD	0.70205	0.77675									
S&P	0.09530	0.21300	0.06511								
X ₁	-0.21041	-0.20864	-0.19280	0.01052							
X ₂	-0.33039	-0.26846	-0.22941	-0.14501	0.29261						
X ₃	-0.69611	-0.69254	-0.61629	-0.33067	0.49749	0.41794					
X ₄	-0.52361	-0.55462	-0.60109	-0.25363	0.63972	0.31786	0.72644				
X ₅	-0.01837	0.10420	-0.14118	-0.11069	-0.02780	-0.38205	0.10512	0.02730			
X ₆	0.79103	0.87358	0.86052	0.14154	-0.21524	-0.22834	-0.73496	-0.64466	-0.05313		
X ₇	0.26390	0.25212	0.28177	-0.10191	-0.38802	0.13979	-0.33986	-0.37703	-0.27246	0.27602	

Notes: X₁ = working capital to total assets; X₂ = retained earnings to total asset; X₃ = pre-tax income to total asset; X₄ = market value of equity to book value of total debt; X₅ = sales to total asset; X₆ = implied volatility using at-the-money options; X₇ = notional amount of credit derivative contracts to total assets.

Table 4: Regression using Bond spreads, CDS spreads, Merton DD and Standard & Poor

Variable	Bond Spread	CDS Spread	Merton DD	S&P
C	22.583*** (0.211)	3.456*** (0.218)	5.477*** (0.712)	3.295*** (0.060)
X ₁	0.690 (26.085)	-2.420 (3.984)	-13.054 (25.813)	-0.281 (1.224)
X ₂	-33.413 (49.584)	-2.693 (6.929)	-6.718 (26.722)	2.459 (2.499)
X ₃	125.341 (111.507)	-9.631 (12.222)	11.421 (48.464)	8.907** (3.806)
X ₄	10.484 (12.438)	6.448*** (2.234)	-0.112 (14.369)	-0.688 (0.644)
X ₅	25.044* (14.539)	-2.978*** (0.955)	5.492* (3.108)	-0.272 (0.448)
X ₆	-0.937*** (0.145)	-1.835*** (0.299)	-6.429*** (1.461)	0.002 (0.059)
X ₇	-0.061* (0.038)	-0.104*** (0.036)	-0.145 (0.142)	0.011 (0.521)

Adjusted R ²	0.6633	0.831	0.613	0.781
AIC	0.0696	-0.0330	3.1218	-2.4891
Observations	93	79	89	93

Notes: X₁ = working capital to total assets; X₂ = retained earnings to total asset; X₃ = pre-tax income to total asset; X₄ = market value of equity to book value of total debt; X₅ = sales to total asset; X₆ = implied volatility using at-the-money options; X₇ = notional amount of credit derivative contracts to total assets. The numbers in parenthesis are standard errors; *, **, and *** denotes significance at the 1, 5, and 10% level, respectively.

3. Empirical results

The estimation results are presented in Table 4. In this regression the Z-score of the probability of default is the dependent variable².

Overall, we observe in Table 4 that the use of credit derivatives is detrimental to the stability of the financial institutions. This relation is significant in two cases. The probability of default given by the credit rating agency S&P actually decreases with the use of CDS, although not significantly.

Using the bond spreads, sales to total assets, implied volatility, and our variable of interest credit derivatives to total sales, are significant. In increase in sales to total assets decreases the probability of default. An increase in implied volatility increases the probability of default. The coefficient for X₇ is negative, so that an increase in credit derivative positions increases default risk and thus decrease stability.

When focusing on the CDS spreads, there are four significant variables: market value to total debt, sales to total assets, implied volatility, and credit derivatives

to total assets. The sign of the coefficient for the sales to total assets is minus, though, which implies that a rise in this ratio increases risk, which is in contradiction with the result from the model using bond spreads. The credit derivative coefficient is again negative.

For the Merton model, only two variables are significant: sales to total assets and the implied volatility. The signs of these variables are consistent with those from the model using bond spreads. The coefficient of the implied volatility, however, is much higher than with the other models. In this model using the S&P rating, only pre-tax income to total assets is significant; all other variables have high p-values. The credit derivative variable has a positive sign, in contrast to the previous models³.

To determine the economic impact of the credit derivative variable on the probability of default, we use our estimated models and calculate the probability of default when the companies would have held one standard deviation more credit derivative contracts and compare them to the probabilities from the original model. An increase in the holdings of credit derivatives with one standard deviation

would increase the probability of default of a company with 9.5, 18.2, and 8.5 percent for the bond spread, CDS spread, and Merton model, respectively. These numbers can be considered economically meaningful. S&P reduces the probability of default by 2.5%.

So far we have introduced the credit derivative variable as a linear variable in our model. However, it could be possible that the relationship between the outstanding amount of credit derivatives and the probability of default is non-linear. The probability of default could increase more than proportional due to the leverage embedded in the credit derivatives.

The squared value becomes negative and significant for all three measures. For CDS and Merton, the AIC value decreases, indicating a better fit. This progressive effect of CDS on the probability of default could indicate the initial stabilizing effect, and the subsequent destabilizing effect. In addition, a possible explanation is the counter party risk. For S&P the coefficient remains positive, and insignificant; the fit of the model also deteriorates.

4. Conclusion

Our results indicate that an increase in the use of credit derivatives increases the probability of default. Therefore, we conclude that an increase in the credit derivatives held by financial institutions reduces the stability of the financial sector. This is even more pressing considering the fact that credit risk instruments are typically only used by large, systemic financial institutions. The magnitude of the impact of credit derivatives on the probability of default of the financial institutions is economically relevant. Results further suggest that the relation between credit derivatives held by financial institutions and the probability of default is not linear, but quadratic.

Table 5: Substituting the credit derivative variable with its squared value

	Coefficient	Std. Error	Prob.	AIC	+ / -
Bond spread	-0.0178	0.0106	0.0974	0.0756	(+)
CDS spread	-0.0363	0.0138	0.0112	-0.0364	(-)
Merton DD	-0.0752	0.0424	0.0797	3.1150	(-)

Credit rating (S&P)	0.0036	0.0051	0.4884	-2.4881	(+)
---------------------	--------	--------	--------	---------	-----

Notes: Table displays the effect of introducing a progressive measure for CDS usage.

Acknowledgements

We gratefully acknowledge helpful comments from participants at the October 2010 Financial Management Association meetings in New York. The usual disclaimer applies.

References

- Altman, E.I. (1968). Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy. *Journal of Finance* 23, 589-609.
- Cebenoyan, S. and P.E. Strahan (2004). Risk Management, Capital Structure and Lending at Banks. *Journal of Banking and Finance* 28, 19-43.
- Greatrex, C.A. (2008). The Credit Default Swap Market's Determinants. *Journal of Fixed Income* 18, 18-32.
- Instefjord, N. (2003). Risk and Hedging: Do Credit Derivatives increase Bank Risk? *Journal of Banking and Finance* 29, 333-345.
- International Monetary Fund (IMF) (2006). Global Financial Stability Report: Market Developments and Issues.
- Merton, R.C. (1974). On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. *Journal of Finance* 29, 449-470.
- Rule, D. (2001). The Credit Derivatives Market: Its Developments and Possible Implications for Financial Stability. *Financial Stability Review*, 117-140.
- Standard and Poor (2008). Default, Transition, and Recovery: 2008 Annual Global Corporate Default Study and Rating Transitions.

¹ For calculating the probability of default, we apply a recovery rate of 51.9%.

² The sign of the coefficient indicates whether the variable increases or decreases default risk. A minus sign implies that it increases risk.

³ Since Standard & Poor's credit rating is ordinal data, an OLS-regression can lead to biased results. We also used the Ordered Probit methodology to estimate the model. This method provides qualitatively similar results.

Corresponding Author

Remco Zwinkels. Erasmus School of Economics, Erasmus University Rotterdam, P.O. Box 1738, 3000 DR Rotterdam, The Netherlands. E: zwinkels@ese.eur.nl T: +31 10 4081428 F: +31 10 4089165



New Zealand Capital Market Symposium

*To be held in Auckland on 31 May 2013
Call for Papers*

The Auckland Centre for Financial Research at the AUT Business School is hosting a one-day symposium on the New Zealand capital market. The purpose of the symposium is to bring leading practitioners, policy makers and academics together to discuss issues related to the New Zealand capital market.

Discussions may cover (but are not limited to):

- The structure and efficiency of the New Zealand Stock Exchange (NZX)
- The historical development of the NZ capital market
- The impact of regulatory and accounting changes on NZ companies and the NZX
- The role of the mutual fund industry (e.g. KiwiSaver)
- The role of the financial services industry
- The effects of privatizations on the NZX
- Corporate governance and financial practices of NZ companies

We invite high quality submissions of research on these and related topics on the New Zealand capital market and the companies listed therein.

Submission procedure

Interested authors are encouraged to submit papers by 15 April 2013 for presentation at the New Zealand Capital Market symposium. Papers accepted for the symposium may be considered for publication in a special issue of Pacific Accounting Review. Shorter papers may also be considered for publication in a special issue of Applied Finance Letters.

Submission

All inquiries and submissions should be sent to the Auckland Centre for Financial Research: acfr@aut.ac.nz

Symposium Organisers

Dr. Aaron Gilbert and Ms Annie Zhang



AUCKLAND CENTRE FOR
FINANCIAL RESEARCH
AUT BUSINESS SCHOOL

