Short Sale Constraints and the Likelihood of Crashes and Bubbles*

Martin T. Bohl† and Arne C. Klein‡

March 1, 2012

*We are indebted to Christian A. Salm for helpful comments and suggestions.

†Department of Economics, Westphalian Wilhelminian University of Münster, Am Stadtgraben 9, D-48143 Münster, Germany, fax: +49 251 83 22846, phone: +49 251 83 25005, email: martin.bohl@wiwi.uni-muenster.de

‡Department of Economics, Westphalian Wilhelminian University of Münster, Am Stadtgraben 9, D-48143 Münster, Germany, fax: +49 251 83 22846, phone: +49 251 83 22989, email: arne.klein@wiwi.uni-muenster.de.

Abstract

In this paper, we investigate short sale constraints' impact on the incidence of extreme stock market movements. The latter can be used to proxy for the likelihood of tail events like crashes and bubbles in a market and, thus, is a crucial measure of stock market stability. Since crashes and bubbles are, almost by definition, unpredictable, we, unlike scarce prior research which relies on simple descriptive statistics, address only the component of the return which hits investors unexpectedly. To this end, we rely on long lasting short selling regimes in 3 Asian markets which, unlike the short-lived bans analyzed in existing studies, provide us with a setting to consistently estimate sophisticated time series models for the market return. Our evidence suggests that, during some market phases, short sale restrictions lead to an increased kurtosis of pricing errors which, in turn, indicates a higher probability for tail events.

JEL Classification: G10, G12, G14, G15, G18

Keywords: Short Selling Ban, Crashes, Bubbles, Kurtosis, Markov Switching GARCH.

1 Introduction

The literature on short sale constraints focuses mainly on a ban's impact on market efficiency, liquidity and overpricing. Recently, the research on this topic has once again flared up as a consequence of the unprecedented number of short selling bans imposed during the recent global financial crisis and the ongoing European debt crisis. By contrast, in this study, we address short selling restrictions' effect on the incidence of extreme stock market movements, a topic almost completely neglected by prior research. Empirical research ought to be mindful of the latter as well since, in the literature, the occurrence of extreme returns is used to proxy for the frequency of crashes and bubbles, so-called tail events, in a market and, thus, provides crucial information to regulators and policy makers who aim at maintaining stable stock trading. Furthermore, as we shall see below, there are several theoretical grounds on which shorting restrictions can be expected to amplify both positive and negative tails in the distribution of stock returns.

Existing work on short sale constraints's impact on the kurtosis of returns, which measures the frequency of extreme returns irrespective of their sign, either deals with the case of restrictions on the individual firm level or is limited to the analysis of raw returns. To investigate market stability, it is superior to focus on the unpredictable shock component of the returns rather than on the raw returns as investors on mature stock markets can be expected to adapt themselves in advance to the foreseeable part of the return process whereas market turmoils, almost by definition, arise from unexpected events. Furthermore, we analyze long lasting short selling regimes in Hong Kong, Malaysia and South Korea which provide us with a sufficiently large number of observations to appropriately model the market return and to consistently estimate short sale constraints' effects. By contrast, existing papers mainly rely on transitory, short-lived bans expiring after a couple of months or even after a few days.[1]

As suggested by Blanchard and Watson (1982) and McQueen and Thorley (1994), the occurrence of bubbles and crashes may, in general, show up in the return distri-

[1] For instance, both short sale regimes imposed in the US in 2008 lasted for less than 20 trading days.

bution and, in particular, in abnormal positive and negative returns. While McQueen and Thorley (1994) focus on the durations of runs of the same sign, Blanchard and Watson (1982) directly employ the kurtosis to empirically asses the existence of such tail events.[2] Obviously, an increased kurtosis might not be enough to detect a specific bubble at a specific time but the other way around, tail events are more likely to arise in a market which is characterized by extraordinary strong movements. The latter is the scope of this paper.

The influence of short selling constraints on the incidence of price bubbles has been most explored in the literature. Since Miller (1977) it is well known that enabling investors to sell short can mitigate those bubbles as pessimists are able to express their negative beliefs on fundamental values without owning the stock. During rising markets, these investors are able to create additional supply, thereby, moderating strong price increases which may show up in less extreme positive returns. Accordingly, negative returns may be less extreme since there will be less or smaller bursting bubbles. Additional supply and selling pressure can be generated either via selling "imaginary" shares in the case of naked short sales or, in the case of covered shorts, by offering stocks that the lender otherwise would not have traded.[3]

Diamond and Verrecchia (1987) derive predictions about amplified negative price changes, i.e., a fat left tail in the return distribution, around earnings announcements. Their model shows that due to short sale constraints new information is impounded into prices with a delay where the effect is stronger for negative news. As a consequence, negative private information in the run-up to earnings announcements should have been priced to a lesser extent when the business report is released compared to positive one. This, in turn, entails a stronger reaction at the time negative news is released to the public which shows up in an increased likelihood of extreme negative returns.

[2] Following Blanchard and Watson (1982), an increase in the kurtosis may result from both large positive and negative returns during the peak and the burst of a bubble as well from a clustering of moderately positive returns when the bubble is arising.

[3] There is widespread evidence supporting Miller's (1977) overvaluation hypothesis (Seneca (1967), Figlewski (1981), Senchack and Starks (1993), Aitken et al. (1998), Danielsen and Sorescu (2001), Desai et al. (2002), Asquith et al. (2005), Boehme et al. (2006), Boulton and Braga-Alves (2010)) although there are dissenters (Hurtado-Sanchez (1978), Dickinson and Woolridge (1994), Huszár and Qian (2011)).

The theoretical model put forward by Hong and Stein (2003) is mostly cited as an explanation for the unconditional average negative skewness, an increased frequency of extreme negative realizations, in the returns of broad stock market indices. It is based on the divergence of opinion among investors combined with a prohibition of short sales. The latter deters the pessimists from impounding their beliefs into prices during rising markets. However, when, thereafter, the market declines, these investors fail to act as “marginal support buyers” thereby suddenly revealing their estimates for the true asset value. This leads to substantial price drops whereas the right-hand tail of the return distribution is unaffected. However, strictly speaking the model may also be used to derive implications for the kurtosis. Hong and Stein (2003) actually show that, given short sale constraints, skewness becomes negative when the divergence of opinion gets large whereas it turns positive during times when investors’ estimates for the stock value do not differ substantially. Assuming that the extent of investors’ disagreement in the market is changing over time, in some market phases, strong negative return realizations prevail, as do large positive returns during other periods. Thereby, an overall increase in the kurtosis may arises since the frequency of both positive and negative extreme returns is increased.

The work of Abreu and Brunnermeier (2003) deals with limits to arbitrage like short sale restrictions that prevent investors from coordinating their selling activities. As a result, persistent asset price bubbles may arise, finally ending up in a market crash. Scheinkman and Xiong’s (2003) model is similar in spirit although it highlights the role of overconfidence rather than a lack of coordination.

Investigating the bans in the US, the UK, Germany and France during the financial crisis, Lioui (2010) substantiates the claim that restricting short sellers leads to more extreme realizations in the returns of broad market indices as measured by the kurtosis. Unlike in the case of the skewness, he shows that this finding is not sensitive to outliers and, thus, is unlikely to be caused by a small number of trading days with strong market movements associated with the extraordinary financial turmoils during this period.

In a recent paper, Saffi and Sigurdsson (2011) use lending supply data for 26 countries to proxy for short sale restrictions on the individual firm level. They document that both a higher number of shares available for borrowing and lower lending fees result in significantly lower kurtosis of single stock raw returns as well as of market model residuals. The latter proxies for the idiosyncratic part of single stock returns while the number of stocks offered for borrowing and the associated fees constitute a fairly close approximation for short sale constraints on the individual firm level. Thus, higher barriers for short sellers make single stock trading more instable.

Unlike, the case of raw returns or single stocks, where for the latter residuals of capital asset pricing type models can be used, investigating the effects of short sale constraints on the unexpected part of the market return requires a setting that allows for the estimation of sophisticated time series models. This, in turn, requires markets facing long lasting short sale bans. 3 Asian markets, namely Hong Kong, Malaysia and South Korea provide us with such a setting. In Hong Kong and Malaysia, short sale bans affected all listed stocks, whereas in South Korea financial stocks have been exempted from shorting after the peak of the global financial crisis. The periods where short selling constraints where in place do not coincide for the 3 markets under consideration and, in addition, in Malaysia, shorting was even banned twice during the sample period. These facts help us to rule out exogenous factors affecting all three markets at a time.

To model short sale constraints' effect on the unforeseen part of the returns, we make use of a Markov Switching GARCH model to price the equity indices under consideration allowing for separate evaluation of different market phases. We apply a t-distribution since it enables us to explicitly model the kurtosis of error terms via time-varying degrees of freedom. Thereby, dummy variables serve to capture shifts in the degrees of freedom during short sale constraints. We perform robustness checks to ensure a sufficient control for spillover effects from world stock markets as well as a correct specification of the asset pricing model.

Our evidence for 3 Asian countries lends credence to the claim that short sale restrictions may destabilize stock markets by increasing the likelihood of extreme market movements. Since this finding indicates a rise in the likelihood of tail events, it further highlights a ban's substantial destabilizing impact on stock markets. These results calls into question regulators' view and high-profile media coverage blaming short sellers to destabilize stock markets.

The remainder of the paper proceeds as follows. Section 2 sets out the grounds on which the choice of the three markets under consideration is made, provides some institutional details on these markets and sketches the data used. Section 3 outlines the econometric methodology. Section 4 discusses the empirical results while section 5 briefly concludes.

2 Institutional Settings

Unlike the case of single stocks which can be priced by simple capital asset pricing type regressions, modeling the market return requires a more sophisticated time series approach. This, in turn, requires a sufficiently long duration of the ban period to consistently define a dummy variable designed to capture the ban's impact on kurtosis. Unfortunately, the majority of short selling bans, in particular most of those imposed during the global financial crisis, were in place for relatively short time spans. The following 3 Asian markets constitute exceptions to this pattern.

In Hong Kong, there was an outright ban on short sales until 1994 when a pilot scheme started allowing covered short sales in 17 stocks. Since March 1996, a quarterly revised list defines the stocks that are eligible for short selling.[4] To be included in this list, a stock has to meet certain criteria. Among requirements in terms of capitalization, trading volume and free float that are subject to revisions from time to time, membership of the well known Hang Seng Index has been a sufficient condition for short selling throughout. Therefore, in the case of Hong Kong, we analyze the Hang Seng Index. Our sample period starts in 1990 and ends at March 31, 2011.

In Malaysia, so called regulated short selling was first introduced on September 30, 1996. Similar to Hong Kong, there is a time-varying list of stocks eligible for shorting. Actually, the first draft of this list was published only on October 3, 1996,

[4]In what follows then, we define the introduction date as March 1, 1996. As a robustness check, we also run our analysis using the former date which produced qualitatively similar results.

we regard the latter as the point of introduction. As a consequence of the Asian crisis, regulators again made short selling off limits on August 28, 1997. Almost 10 years later, with effect from January 1, 2007 this ban was removed and short selling now is again feasible for stocks being member of a list. Prerequisites that qualify a stock to be added to that list are minimum values of market capitalization and trading volume. For Malaysia, we proxy for the market using the Kuala Lumpur Composite Index (KLCI), a capitalization-weighted index calculated from the 100 largest companies listed at the Bursa Malaysia.[5] Compared to Hong Kong, on the one hand, the situation here is not that clear-cut as index membership does not automatically result in short sale eligibility. One the other hand, since the approval for short selling depends on the market capitalization, the KLCI, as a value-weighted index, is strongly dominated by stocks that are eligible for short sales.[6] Again we make use of a sample beginning in 1990 and ending at March 31, 2011.

On September 30, 2008 the South Korean Financial Supervisory Commission imposed an outright prohibition of all short sales affecting all listed stocks, which was justified with 'malignant rumors' in the market. On May 20, 2009 this ban was announced to be lifted for non-financial stocks effective June 2009, whereas the constraints on financial stocks have not been removed yet. Accordingly, for South Korea our focus is on the financial sector. Therefore, we calculate the market as a value-weighted portfolio return of the 16 financials in the KOSPI 100 as it was on June 1, 2009 the date the ban on non-financial companies' stocks expired. All time series are obtained from Thomson Reuters Datastream. The historical constituents of the KOSPI 100 were provided by the Korea Exchange. Since for South Korea, we use a portfolio return as market and single stocks are listed and delisted, our sample begins in July 2002. We select this period to ensure that at least the returns of 13 out of 16 stocks are available at every point in time.[7]

[5]Until April 18, 1995, the number of constituents was 83.

[6]For instance, on February 18, 2009, 81% of the stocks but 92% of the capitalization of the KLCI were eligible for short selling.

[7]The Taiwanese stock market provides a setting similar in spirit to Malaysia with two ban periods since the 1990s. We do not include this case into our analysis since Bris et al. (2007) classify Taiwan as a market where short selling is actually not practiced although it is legally permissible.

3 Methodology

We aim at modeling the effects of short sale constraints on shocks affecting the stock markets as a whole. In the empirical literature, it is commonly accepted to model the market return in a GARCH framework where the conditional mean often is given by a first-order autoregressive process. In addition, to control for spillover effects from world stock markets, lagged values of foreign stock market returns can be included. For our baseline model, we use one period lagged US returns r_{t-1}^{US} to proxy for the global market. Our mean equation, then, reads

$$r_t = \alpha_{S_t} + \varphi_{1,S_t} r_{t-1} + \varphi_{2,S_t} r_{t-1}^{US} + \epsilon_t. \tag{1}$$

To account for different stock return dynamics in different market phases, we allow the parameters to switch between two distinct regimes where $S_t \in \{1, 2\}$ indicates in which one of these states the process is in at time t. In particular, this enables us to detect potential differences in the effects of short sale constraints in phases of high or low volatility. Additionally, Markov switching GARCH models often avoid estimating integrated or near-integrated variance processes.

The use of a normal distribution, which implies a constant kurtosis equal to 3, is not appropriate for our purpose since we explicitly want to model time-depending kurtosis in the error terms, ϵ_t. Instead, ϵ_t follows a mixture of 2 t-distributions with variances h_{S_t} and degrees of freedom parameters v_{S_t}, $\epsilon_t \sim t(0, h_{S_t}, v_{S_t})$. In general, the kurtosis of a t-distribution with v_{S_t} degrees of freedom is given by

$$\frac{3v_{S_t} - 6}{v_{S_t} - 4} = \frac{6}{v_{S_t} - 4} + 3. \tag{2}$$

From (2), it can be seen that lower degrees of freedom imply a higher kurtosis and, in turn, more extreme random draws. Conversely, as $v \to \infty$, the distribution converges to a normal distribution.

To identify changes in the kurtosis during periods with short sale constraints, we model the degrees of freedom according to the following regime depending process

$$v_{S_t} = \kappa_{1,S_t} + \kappa_{2,S_t} I_t^{SSC}. \tag{3}$$

I_t^{SSC} takes on the value 1 when short sale constraints are in place and 0 otherwise. The parameters κ_{2,S_t} are of main interest as they capture the impact that displacing short sellers has on the frequency of extreme pricing errors. (2) shows that a significantly positive value of κ_{2,S_t} is associated with an error distribution that is less heavier tailed as long as the constraints are in place. This, in turn, would support lower probabilities of extreme returns and, thereby, a reduced incidence of crashes and bubbles during periods of short sale restrictions as claimed by stock market regulators. In contrast, a significantly negative estimate would indicate an increased probability of extreme error realizations and could be interpreted as evidence against detaining investors from selling short.

To parsimoniously model ARCH effects and volatility clustering, we make use of a GARCH(1, 1) in our variance equation

$$h_t = \omega_{S_t} + \beta_{1,S_t}\epsilon_{t-1}^2 + \beta_{2,S_t}h_{t-1}^2, \tag{4}$$

where the parameter restrictions $\omega_{S_t}, \beta_{1,S_t}, \beta_{2,S_t} > 0$ and $\beta_{1,S_t} + \beta_{2,S_t} < 1$ apply. We solve the path dependence problem arising for h_t as proposed by Gray (1996b).

We assume that the state variable S_t is governed by a first-order Markov process with constant transition probabilities, $p_{ij} = Pr\,(S_t = j|S_{t-1} = i)$, $i, j \in \{1, 2\}$. All models are estimated using a one-step numerical optimization procedure. To overcome starting value dependence, we perform the optimization for a large number of randomly drawn initial values. To draw inference about the state the process is in at time t, the ex-ante probabilities, $p_{i,t-1} = Pr\,(S_t = i|\Gamma_{t-1})$, can be used. Γ_{t-1} indicates the information set available at $t - 1$. These probabilities are of particular interest for agents on financial markets because they can be used in forecasting. In addition, we calculate smoothed probabilities $p_{i,t|T} = Pr\,(S_t = i|\Gamma_T)$ using the forward looking algorithm provided in Gray (1996a). These probabilities exploit all information available up to the end of the sample period T, Γ_T.

We perform robustness checks with respect to spillover effects from world stock markets as well as with respect to the general specification of the asset pricing model. For the first purpose, we replace the US return by the return of the MSCI world stock index. The US are the world's dominating stock market, however, in recent years, other markets have gained more and more influence and may provide important information for asset pricing. For the latter purpose, we, firstly, replace the autoregressive component in the mean equation by a moving average term. The mean equation, then, changes as follows

$$r_t = \alpha_{S_t} + \varphi_{3,S_t}\epsilon_{t-1} + \varphi_{2,S_t} r^{US}_{t-1} + \epsilon_t. \tag{5}$$

Secondly, we allow for time-varying transition probabilities.[8] In line with Gray (1996b) and Bohl et al. (2011), we use the natural logarithm of the lagged value of the stock index level, L_{t-1}, as explanatory variable.[9] To map the transition probabilities into the region $[0, 1]$, we apply the cumulative normal distribution, ϕ,

$$p_{ii,t} = \phi\left(\rho_{1,S_t} + \rho_{2,S_t} log\left(L_{t-1}\right)\right). \tag{6}$$

For the parameters matching with those from the baseline model, we use the estimation results from this basic specification as starting values. For the parameters of the moving average terms and those in equation (6), we again try different random numbers.

4 Empirical Results

We first discuss the results for the baseline model defined in (1), (3) and (4). The parameter estimates are reported in Table 1. In all cases, both separated regimes are highly persistent with average durations, $\frac{1}{1-p_{ii}}$, of at least 188 trading days. We identify high and low volatility regimes by calculating the long run variance for each state, $\sqrt{\frac{\omega_{S_t}}{1-\beta_{1,S_t}-\beta_{2,S_t}}}$ and by plotting the estimates for the regime probabilities together with the conditional variance as provided in Figure 1.

[Insert Table 1 about here]

[Insert Figure 1 about here]

[8]The theory of time-varying transition probabilities can be found in Diebold et al. (1994) and Filardo (1994).

[9]Gray (1996b) models the first difference of interest rates and applies the lagged interest rate level as explanatory variable for the transition probabilities. Analogously, we model the first difference of logarithmic indices and use the lagged log index level.

The estimates for φ_{2,S_t}, the parameter of lagged US returns are always found highly significant with t-values ranging from 10.44 up to 22.95 which corroborates the control for spillover effects from world stock markets. To a lesser extent, this also holds for the parameters taking into account first-order autocorrelation as the estimates for φ_{1,S_t} show significant for 3 out of 6 cases, where the strongest evidence for autocorrelation is found for the Malaysian KLCI. This stock market is less developed than the other two markets under consideration and, thus, may be characterized by stronger informational efficiencies which may show up in disproportionately strong autocorrelation. When going through our results for the parameters governing the variance process, like in most daily financial time series, strong ARCH effects and volatility clustering, measured by $\hat{\beta}_{1,S_t}$ and $\hat{\beta}_{2,S_t}$, are present. For all markets, the stationarity condition for the variance is met in both states.

Turning to (3), the specification for the degree of freedom parameter of the t-distribution, in all cases, we find the constant, $\hat{\kappa}_{1,S_t}$ to be significant and to take on values where the kurtosis is defined.[10] Recall that we aim at revealing level shifts in the kurtosis of pricing errors by means of indicator variables for periods with short sale restrictions. Thus, the estimates for κ_{2,S_t}, the parameter designed for capturing changes in the degrees of freedom during short sale bans, are of main interest. For all countries, we find $\hat{\kappa}_{2,S_t}$ to be negative and significant in one state and indistinguishable from 0 in the other one. These findings suggests that short sale constraints have a strengthening effect on the frequency of extreme errors in some market phases whereas in others no influence is found. For Malaysia and South Korea the former is the case in the high volatility regime whereas, for Hong Kong, this holds in times of low volatility.

To sum up, for 3 Asian stock markets, namely Hong Kong, Malaysia and South Korea, we provide evidence that displacing short sellers can lead to an increased probability of extreme pricing errors during some market phases. In particular, this holds true in times of high volatility for the emerging markets Malaysia and South Korea and during tranquil times for the more advanced market Hong Kong. These results suggests that, aiming to stabilize stock markets, short sale constraints can in fact have

[10] This is the case for degrees of freedom greater than 4.

destabilizing effects by causing more extreme pricing errors. Please note that for South Korea the caveat applies that we provide evidence for the financial sector rather than for the equity market as a whole.

5 Conclusion

As a consequence of the short selling bans imposed during the recent global financial turmoils, the literature on short sale constraints' effects on stock markets has gathered momentum. Nonetheless, existing studies mainly focus on the restrictions' impact on market quality, liquidity and informational efficiency but are relatively silent about effects on the incidence of extreme market movements. This neglect is surprising as the frequency of extreme returns can be used to proxy for the likelihood of market crashes and bubbles and, thus, is a crucial in assessing stock market stability. Furthermore, the literature provides several grounds on which regulations preventing investors from selling short can be expected to have an amplifying effect on the incidence of both strong positive and negative returns.

Existing work dealing with this topic is mostly restricted to the analysis of raw returns or investigates limitations to short selling on the individual firm level while neglecting the effects on the systematic part of returns. The present paper makes a start towards closing this gap by investigating short sale restrictions' effect on the frequency of extreme market movements. Unlike prior research, we analyze the unforeseen part of the market return process in order to explicitly address the incidence of unexpected shocks the investors are subject to.

Long lasting short selling bans in 3 Asian markets, namely Hong Kong, Malaysia and South Korea, provide us with a setting to estimate time series models for the market return, thereby modeling the impact of short sale constraints on the kurtosis of pricing errors. The time schedule of the short sale restrictions differ between the markets analyzed in this paper making it less likely that the results are caused by exogenous factors affecting all 3 markets. We design our asset pricing approach to discriminate between different market conditions by making it subject to Markov regime switching.

In addition, we control for spill over effects from world markets where the results are not sensitive to the use of US returns versus world market returns. A second robustness check includes moving average effects and time varying transition probabilities as applied in Gray (1996b) and Bohl et al. (2011).

Our findings suggest an amplifying effect of short sale constraints on the kurtosis of market wide shocks. In addition, our results complement the work of Saffi and Sigurdsson (2011) reporting similar evidence for the idiosyncratic part of single stock returns. All things considered, we conclude that detering investors from expressing their negative beliefs on asset values can lead to an increased frequency of both positive and negative returns. This outcome calls into question regulators' hope of stabilizing equity markets by imposing short selling bans.

References

Abreu, D. and Brunnermeier, M. (2003). Bubbles and crashes. *Econometrica*, 71(1):173–204.

Aitken, M. J., Frino, A., McCorry, M. S., and Swan, P. L. (1998). Short Sales Are Almost Instantaneously Bad News: Evidence from the Australian Stock Exchange. *Journal of Finance*, 53(6):2205–2223.

Asquith, P., Pathak, P. A., and Ritter, J. R. (2005). Short Interest, Institutional Ownership, and Stock Returns. *Journal of Financial Economics*, 78(2):243–276.

Blanchard, O. and Watson, M. (1982). *Crisis in the Economic and Financial System*, chapter Bubbles, Rational Expectations and Financial Markets. Lexington, MA: Lexington Books.

Boehme, R. D., Danielsen, B. R., and Sorescu, S. M. (2006). Short-Sale Constraints, Differences of Opinion and Overvaluation. *Journal of Financial and Quantitative Analysis*, 41(2):455–87.

Bohl, M. T., Salm, C. A., and Wilfling, B. (2011). Do Individual Index Futures Investors Destabilize the Underlying Spot Market? *Journal of Futures Markets*, 31(1):81–101.

Boulton, T. J. and Braga-Alves, M. V. (2010). The skinny on the 2008 naked short-sale restrictions. *Journal of Financial Markets*, 13:397–421.

Bris, A., Goetzmann, W. N., and Zhu, N. (2007). Efficiency and the Bear: Short Sales and Markets Around the World. *Journal of Finance*, 62(3):1029–1079.

Danielsen, B. R. and Sorescu, S. M. (2001). Why Do Option Introductions Depress Stock Prices? a Study of Diminishing Short Sale Constraints. *Journal of Financial and Quantitative Analysis*, 36(4):451–484.

Desai, H., Ramesh, K., Thiagarajan, S. R., and Balachandran, B. V. (2002). An Investigation of the Informational Role of Short Interest in the Nasdaq Market. *Journal of Finance*, 57(5):241–269.

Diamond, D. W. and Verrecchia, R. E. (1987). Constraints on Short-Selling and Asset Price Adjustment To Private Information. *Journal of Financial Economics*, 18:277–311.

Dickinson, A. and Woolridge, J. R. (1994). Short Selling and Common Stock Prices. *Financial Analysts Journal*, 50(1):20–28.

Diebold, F. X. ., Lee, J. H., and Weinbach, G. C. (1994). *Nonstationary Time Series Analysis and Cointegration*, chapter Regime switching with time-varying transition probabilities, pages 283–302. Oxfort: Oxfort University Press.

Figlewski, S. (1981). The Informational Effects of Restrictions on Short Sales: Some Empirical Evidence. *Journal of Financial and Quantitative Analysis*, 16(4):463–476.

Filardo, A. J. (1994). Business-Cycle Phases and Their Transitional Dynamics. *Journal of Business & Economic Statistics*, 12(3):299–308.

Gray, S. F. (1996a). An analysis of conditional regime-switching models. *Working paper*.

Gray, S. F. (1996b). Modeling the conditional distribution of interest rates as a regime-switching process. *Journal of Financial Economics*, 42:27–62.

Hong, H. and Stein, J. C. (2003). Differences of Opinion, Short-Sales Constraints, and Market Crashes. *Review of Financial Studies*, 16(2):487–525.

Hurtado-Sanchez, L. (1978). Short Interest: Its Influence as a Stabilizer of Stock Returns. *Journal of Financial and Quantitative Analysis*, 13(5):965–985.

Huszár, Z. R. and Qian, W. (2011). Short Sale Return Predictability Revisited: Anomaly or Return Mis-measurement? *Working paper*.

Lioui, A. (2010). Spillover Effects of Counter-cyclical Market Regulation: Evidence from the 2008 Ban on Short Sales. *The Journal of Alternative Investments*, 13(3):53–66.

McQueen, G. and Thorley, S. (1994). Bubbles, Stock Returns, and Duration Dependence. *Journal of Financial and Quantitative Analysis*, 29(3):379–401.

Miller, E. M. (1977). Risk, Uncertainty, and Divergency of Opionion. *Journal of Finance*, 32(4):1151–1168.

Saffi, P. and Sigurdsson, K. (2011). Price Efficiency and Short Selling. *Review of Financial Studies*, 24(3):821–852.

Scheinkman, J. and Xiong, W. (2003). Overconfidence and speculative bubbles. *Journal of Political Economy*, 111(6):1183–1220.

Senchack, A. and Starks, L. T. (1993). Short-Sale Restrictions and Market Reaction to Short-Interest Announcements. *Journal of Fiancial and Quantitative Analysis*, 28(2):177–194.

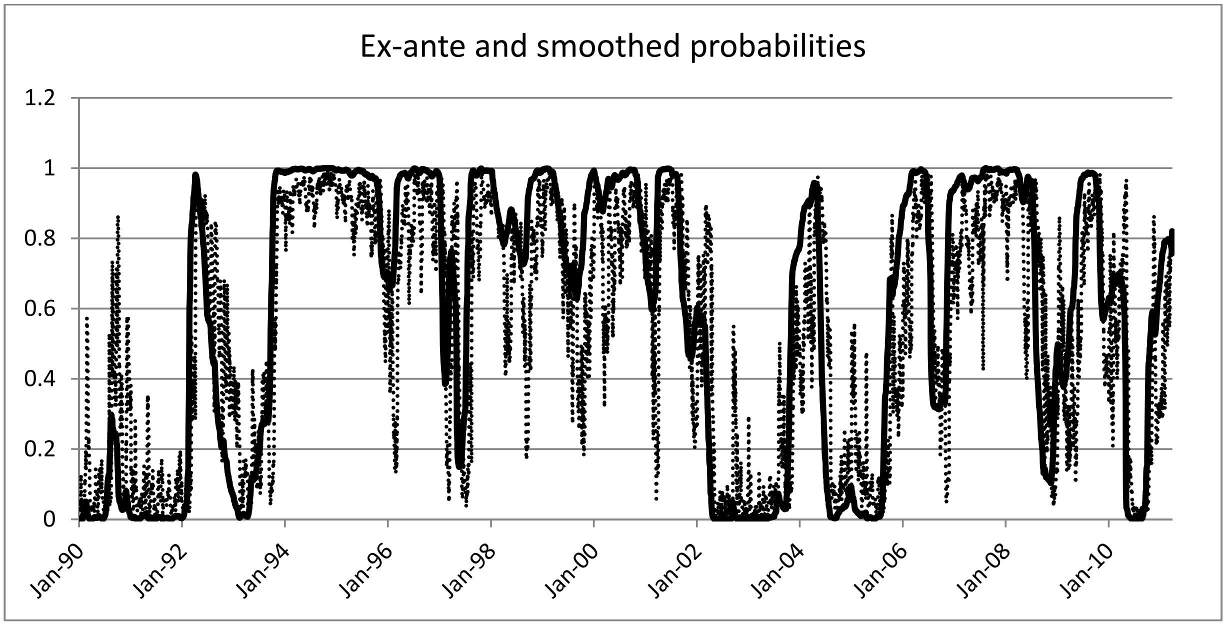
Seneca, J. J. (1967). Short Interest: Bearish or Bullish? *Journal of Finance*, 22(1):67–70.

Table 1: Estimation Results for the Markov-switching GARCH model

	Hong Kong		Malaysia		S. Korea	
	Coeff.	p-Value	Coeff.	p-Value	Coeff.	p-Value
$S_t = 1$						
$\hat{\alpha}_1$	0.028	(0.215)	0.031**	(0.026)	0.054	(0.218)
$\hat{\varphi}_{1,1}$	-0.015	(0.352)	0.194***	(0.000)	0.041	(0.134)
$\hat{\varphi}_{2,1}$	0.757***	(0.000)	0.328***	(0.000)	0.755***	(0.000)
$\hat{\omega}_1$	0.012	(0.143)	0.045***	(0.000)	0.060**	(0.038)
$\hat{\beta}_{1,1}$	0.083***	(0.000)	0.139***	(0.000)	0.060***	(0.000)
$\hat{\beta}_{2,1}$	0.894***	(0.000)	0.738***	(0.000)	0.908***	(0.000)
$\hat{\kappa}_{1,1}$	11.206***	(0.000)	5.971***	(0.000)	18.979**	(0.028)
$\hat{\kappa}_{2,1}$	1.871	(0.835)	-1.687**	(0.024)	-16.936*	(0.051)
$\hat{p}_{11}$	0.995***	(0.000)	0.998***	(0.000)	0.999***	(0.000)
$S_t = 2$						
$\hat{\alpha}_2$	0.084***	(0.000)	0.036***	(0.000)	0.026***	(0.701)
$\hat{\varphi}_{1,2}$	-0.011	(0.557)	0.090***	(0.000)	-0.061*	(0.079)
$\hat{\varphi}_{2,2}$	0.354***	(0.000)	0.173***	(0.000)	0.449***	(0.000)
$\hat{\omega}_2$	0.034***	(0.002)	0.001*	(0.056)	0.046	(0.106)
$\hat{\beta}_{1,2}$	0.037***	(0.001)	0.023***	(0.000)	0.053***	(0.002)
$\hat{\beta}_{2,2}$	0.880***	(0.000)	0.955***	(0.000)	0.915***	(0.000)
$\hat{\kappa}_{1,2}$	9.129***	(0.000)	4.337***	(0.000)	6.377**	(0.011)
$\hat{\kappa}_{2,2}$	-3.974*	(0.098)	-0.047	(0.912)	1.397	(0.667)
$\hat{p}_{22}$	0.995***	(0.000)	1.000***	(0.000)	0.997***	(0.000)

Notes: p-Values are provided in brackets. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Figure 1: Ex-ante and smoothed probabilities and conditional variance: Hong Kong



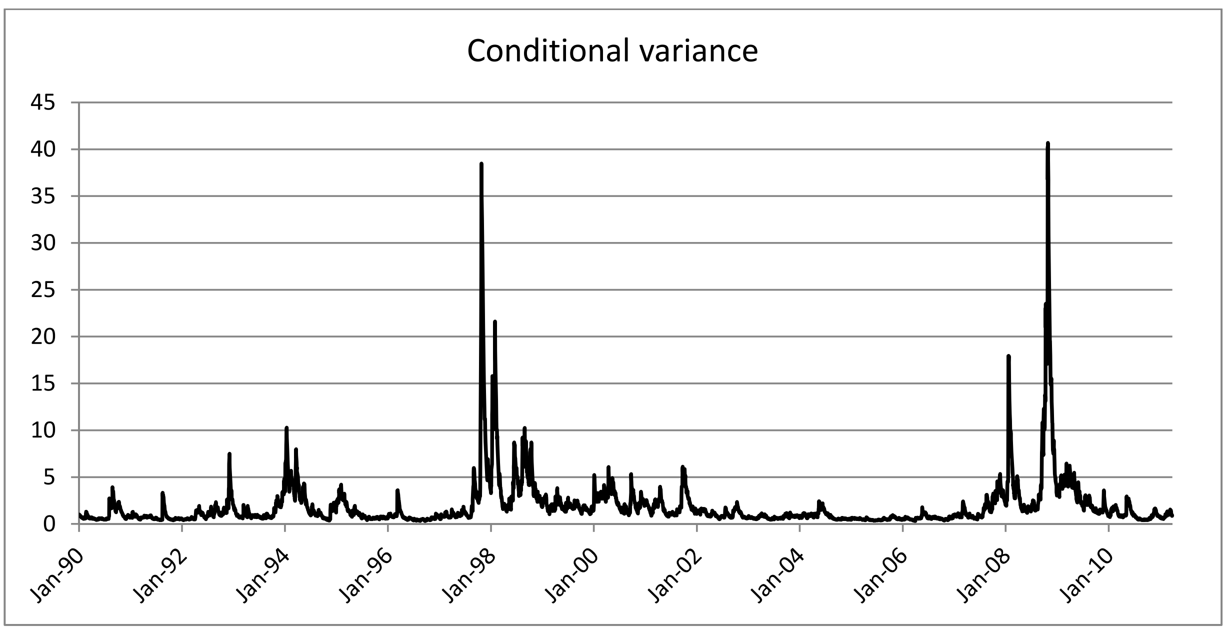
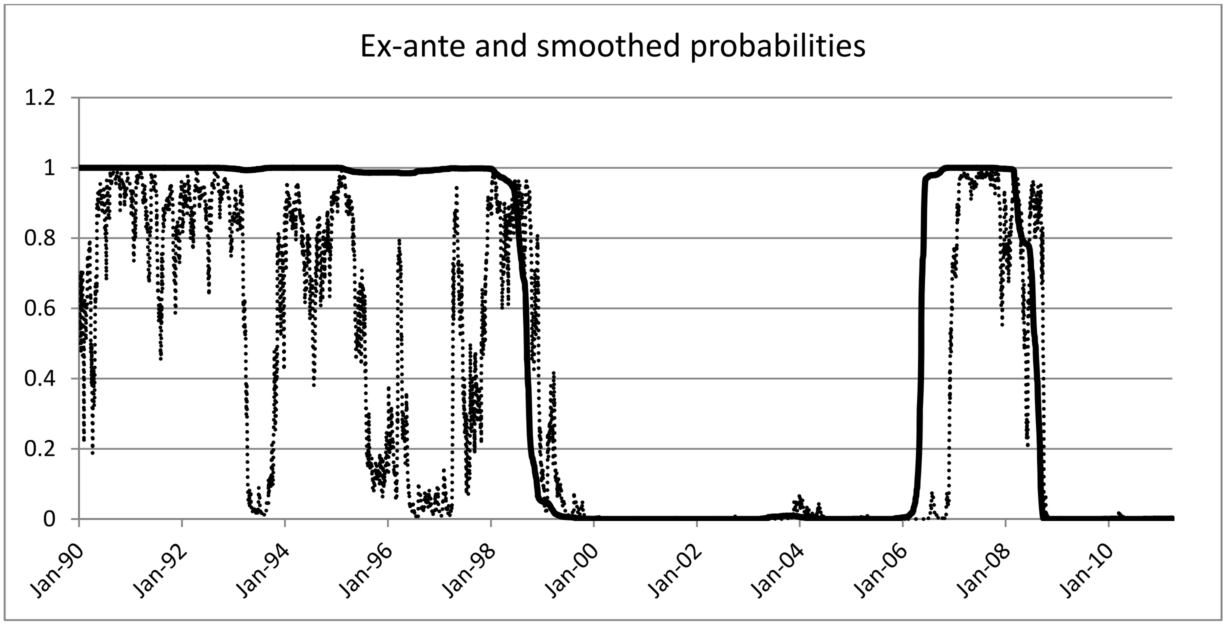


Figure 1: Ex-ante and smoothed probabilities and conditional variance (continued): Malaysia



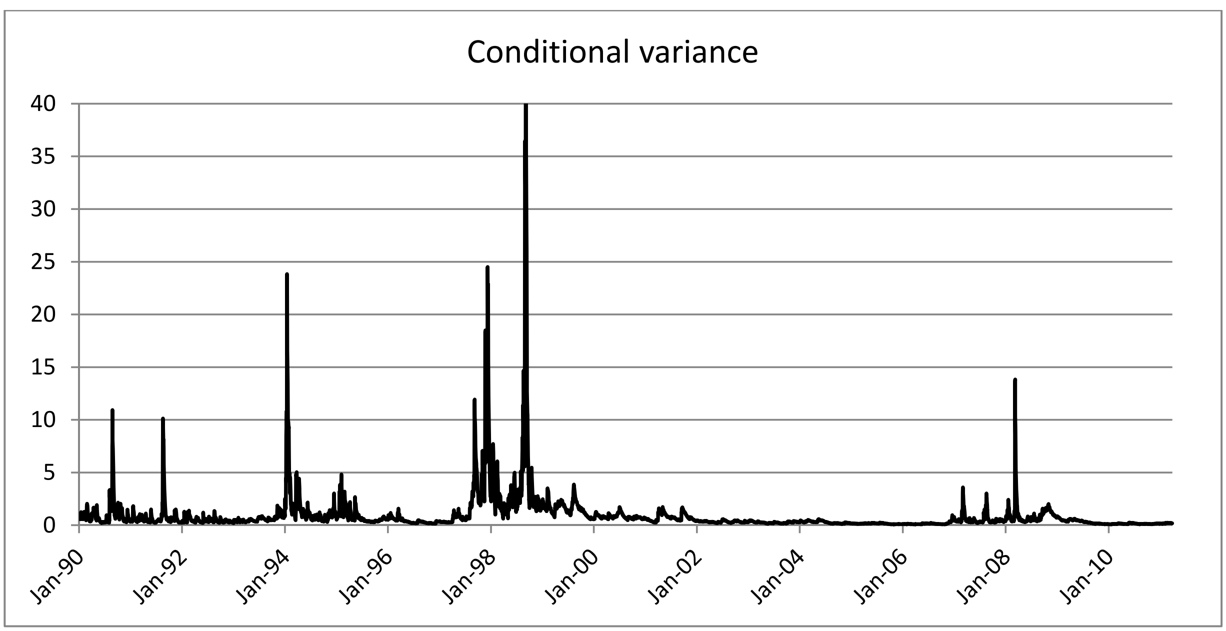
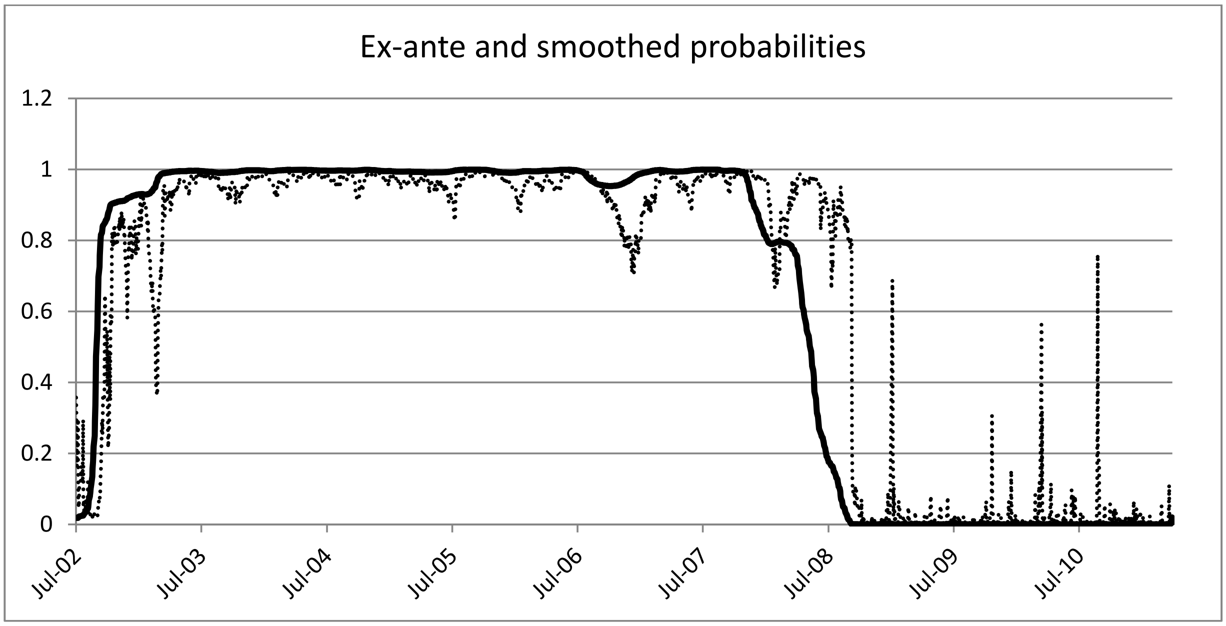
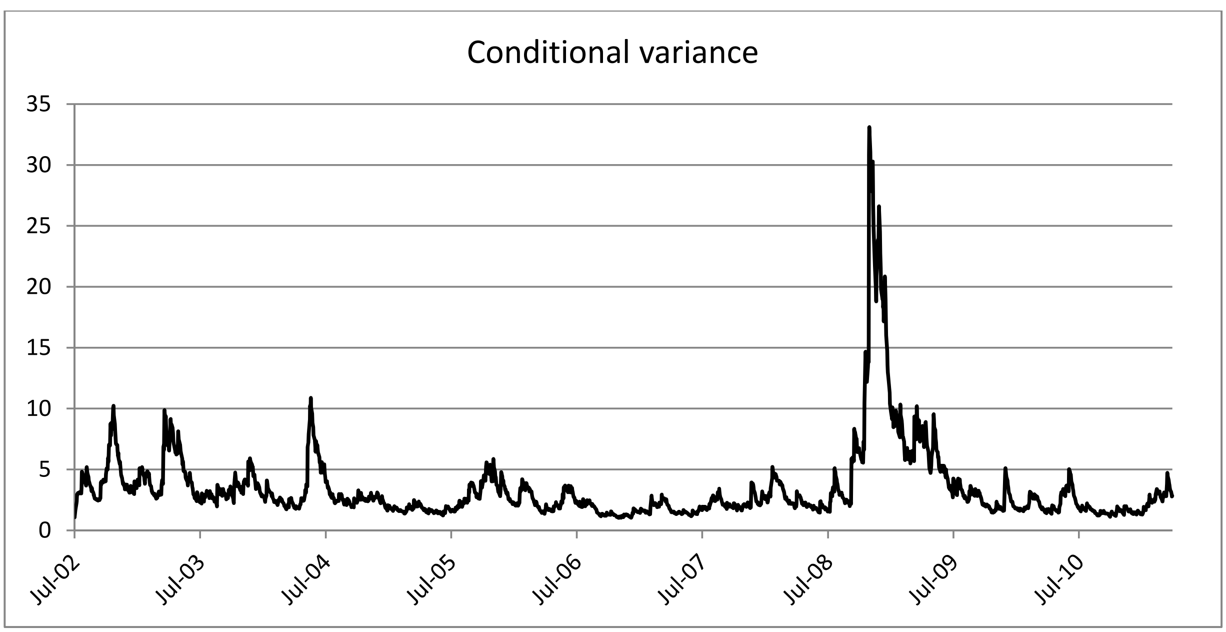


Figure 1: Ex-ante and smoothed probabilities and conditional variance (continued): Korea





Notes: In the upper part, ex-ante (dotted line) and smoothed probabilities for the first regime calculated as proposed by Gray (1996b). In the lower part, the conditional variance.