Three Essays on Financial Markets

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ABSTRACT

Three Essays on Financial Markets

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This dissertation consists of three essays that address recent topics in financial markets that concern for scholars, policymakers, and investors. The first essay examines the benefits of international diversification for US investors, while accounting for market development, corporate governance, market cap effects, and structural change across countries over period August 1996 – July 2013. Improved risk adjusted returns are obtained from a diversified portfolio consisting of a mix of developed and emerging countries. Additionally, we find that diversification benefits are not significant for most of the small-cap foreign assets when an investor already holds position in corresponding countries large-cap assets. Diversification benefits based on the governance effectiveness of a country's companies are not ubiquitous. We find that economically significant improvements in risk-return performance can be attained by adding large caps of developed countries with high and low overall Governance Metrics International (GMI) ratings and large and small caps of emerging countries with low overall GMI ratings to the investment universe containing the assets of common law developed countries. However, diversification benefits are economically significant only for large and small caps of low GMI emerging countries when short selling is not allowed.

The second essay looks at the market impact of recent regulatory changes in Canada that provide for trading halts on individual stocks that experience large upside or downside movements. The focus is on all stocks traded on the Toronto Stock Exchange since the inception of the single

stock circuit breaker rule (SSCB) in February 2012, to replace the short-sale uptick rule. The results support pricing efficiency: material information that caused the circuit breaker is incorporated in stock prices on the day of the halt (neither overreaction nor underreaction), with no decline in market liquidity. Using trade-by-trade data constructed on 5-minute trading intervals, we refine the daily results, and show that shocks in realized volatility are focused in the ten-minute trading interval surrounding the halts. While circuit breakers provide a limited “safety net” for investors when their stocks are subject to severe volatility, they do not provide for a quick turnaround for stocks experiencing severe price decline events.

The last essay re-examines the historical vs implied volatility spread anomaly, reported by Goyal and Saretto (2009) using a second-order stochastic dominance (SSD) criterion. The approach incorporates transaction frictions, and is robust to model specification problems, return distributions, as well as preferences. It is found that option trading frictions such as cash collateral requirements and option trading costs significantly reduce but do not eliminate returns to a long-short straddle trading strategy pre-2006 period. However, the anomaly disappears after 2006, consistent with market efficiency. The SSD test results confirm the findings.

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Contribution of Authors

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Cagdas Tahaoglu: Data curation, Investigation, Conceptualization, Methodology, Formal analysis, Writing

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Table of Contents

List of Figures

List of Tables

Chapter 1: Introduction

My dissertation consists of three essays studying current issues on financial markets, covering diverse topics. The first essay investigates the benefits of international diversification for US investors, while accounting for market development, corporate governance, market cap effects, and structural change across countries over period August 1996 –July 2013. The second essay examines the market impact of recent regulatory changes, i.e. introduction of Single Stock Circuit Breakers, in Canada that provide for trading halts on individual stocks that experience large upside or downside movements. This last essay re-examines the historical vs implied volatility spread anomaly, reported by Goyal and Saretto (2009) using a second-order stochastic dominance (SSD) criterion. The approach incorporates transaction frictions, and is robust to model specification problems, return distributions, as well as preferences. Each of these three essays is self-contained and presented in chapters 2 to 4. In this chapter, I highlight their motivations, primary results, and main contributions to literature.

Earlier research has been looked at effects of market development, corporate governance, and market cap effects on international diversification separately. The first paper looks to synthesize these effects from a strategic asset allocation perspective. First, we look to assess the benefits of international diversification for a larger group of developed as well as emerging markets using more recent data, that include both the financial crisis as well as recovery periods. Next, size effects have been investigated. In addition, the effects of corporate governance differentials, as a factor affecting performance and the benefits of diversification, is considered. This study is the first, to my knowledge, to use widely followed Governance Metric International (GMI) country rankings to measure governance, in spanning tests that account for risk and return assess the effects of governance in enhancing the returns of international portfolios, incorporating clustering effects that may differ across developed and emerging markets. Finally, I look at the impact of structural change on the analysis, by performing the tests for pre-crisis among the international return series.

Mean variance spanning tests with and without and step-down spanning tests are conducted using the S&P 500 market index (SP500, representing large-cap stocks), the Russell 2000 index (R2000, small-cap stocks) and Ibbotson Associates SBBI US Long-Term Government Bonds index (an index based on the returns of long-term U.S. government bonds with maturities greater than 10 years) as initial benchmark assets. Test assets (overall, large and small cap country indices) are represented by US dollar denominated Russell total return indices from August 1996 until July 2013. Russell indices are relevant to the typical investor because they are either easily replicable using exchange-traded funds (ETFs) or can be replicated by investing in a manageable number of securities.

The empirical findings of our study suggest that for the entire period, US investors will derive benefits from diversification with a mix of firms from developed and emerging economies. Furthermore, I find evidence that additional diversification benefits of investing in emerging economies is significant when the investment universe benchmark consists of US and developed country indices. I also find that small-cap indices of few countries can be regarded as a separate asset class when the corresponding large-cap indices are included in the benchmark assets. These results are consistent with Switzer and Fan (2007) and contradict Eun, Huang and Lai (2008). I also investigated whether there is a relationship between the corporate governance level of sample countries and diversification benefits provided by them. In addition, some evidence for corporate governance effects across countries is shown. In particular, large caps of developed countries with high and low overall Governance Metrics International (GMI) ratings and large and small caps of emerging countries with low overall GMI ratings are not spanned by the benchmark assets.

However, diversification benefits are economically significant only for large and small caps of low GMI emerging countries when short selling is not allowed. The impact of structural change is significant for most of the analyses. In only a few cases do I find the same governance/style-based countries appearing in the optimal portfolios when the analyses separating regimes between pre-crisis and post-crisis periods is performed.

The second essay looks at the market impact of recent regulatory changes in Canada that provide for trading halts on individual stocks that experience large upside or downside movements. These halts are not based on violations of securities law, including market manipulation or illegal insider trading per se, but rather on the abrupt price movement between trades within the five-minute trading interval. The study covers all stocks traded on the Toronto Stock Exchange since the inception of the single stock circuit breaker rule (SSCB) in February 2012, to replace the short-sale uptick rule. Our findings are consistent with pricing efficiency, since material information is incorporated into stock prices on the day of the halt. In general, daily volatility measures decline for stocks affected by the circuit breaker. Using high frequency trading data to construct five-minute trading intervals, I also show that the largest volatility shock effect is centered on the five-minute trading interval surrounding the halt. There also exists significant volatility increases in the ten-minute window surrounding the halt. The magnitude of the volatility shock is asymmetric: for stocks experiencing price decreases, the volatility increase is considerably higher than for stocks experiencing price increases. In addition, market liquidity is not reduced after the introduction of SSCBs. This suggests that circuit breakers per-se do not induce "disorderly" markets either on the circuit breaker day itself or on subsequent trading days. However, the circuit breakers do not provide for a quick turnaround in the fortunes for stocks experiencing severe price declines. Nor do they induce reversals of gains for stocks that experience significant ascensions. Apart from the relevance of these findings to investors in an environment of severe volatility, our findings should also be of interest to policy makers and regulators as they monitor and refine trading protocols to improve market efficiency and fairness.

Third last essay focuses on importance of using a robust methodology that accurately incorporates transaction frictions, and is robust to model specification problems, return distributions, as well as preferences. The volatility spread anomaly, reported by Goyal and Saretto (2009), has been investigated by taking into account trading frictions such as cash collateral requirements for written options and option trading costs. I find that trading frictions significantly reduces returns to long-short spread straddle trading strategy based on the difference between HV and IV. Empirical evidence presented suggest that abnormal returns disappeared after 2006.

It is a well-known fact that option trading strategies have non-linear payoffs, and therefore linear factor models cannot provide a robust risk measure for option trading profits. Hence, we employ Second order stochastic dominance test which are distribution assumption free, to assess whether the existing returns to this strategy are abnormal (i.e. whether they are profitable for risk averse investors). Second order stochastic dominance test results suggest that spread straddle trading strategy based on the difference between HV and IV can provide abnormal return to investors. However, our findings suggest that these abnormal returns are available to traders who can benefit from lower transaction costs.

Chapter 2 to 4 correspond to my three essays and I conclude in Chapter 5.

Chapter 2: The Benefits of International Diversification: Market Development, Corporate Governance, Market Cap, and Structural Change Effects

2.1. Literature Review:

Over the past decade, the expansion of the global economy has been linked to the significant growth and liberalization of both emerging and developed capital markets, as well as technological advances which have made investing easier and have opened access to equity assets. An investor now has more options in constructing portfolios to achieve the benefits of a greater degree of international diversification as a consequence of nonsynchronous co-movements of national economies and stock exchanges. The earliest proponents of international diversification are the papers of Grubel (1968) and Levy and Sarnat (1970), who employ standard mean-variance analysis. Errunza, Hogan and Hung (1999) examine the benefits of constructing a domestic securities portfolio that mimics foreign indices to achieve a higher return without direct foreign exposure. They find that investments in the foreign markets provide significant diversification benefits, even though mimicking portfolios that are highly correlated with foreign markets could be created from US traded securities. However, they also show the benefits of international diversification have diminished during the time period of study from 1976 to 1993.

Li, Sarkar, and Wang (2003) find significant benefits to international diversification for a US-based investor despite portfolio constraints, in particular on short selling. Kearney and Lucey (2004) however highlight the reduced benefits of diversification into emerging markets as correlations increase over time (see also Gupta and Donleavy (2009), and Gupta and Guidy (2012).[1] More recently, Berger, Pukthuanthong, and Yang (2013) use mean-variance analysis to

[1] Pukthuanghong and Roll (2009), however, show that correlations across markets may not measure accurately the degree of integration between markets.

show international diversification benefits for adding frontier markets in recent years. Apart from looking at the benefits of international investment per se, more recent work has looked at more nuanced style based international diversification. Estrada (2008) examines the benefits of international diversification in the application of fundamental indexation, and finds significant benefits to diversifying fundamentals-based indices using low-cost country index funds and ETFs. Eun, Huang and Lai (2008) look at international portfolio diversification between 1980 and 1999 using mean-variance tests. Their sample countries include 10 countries, i.e., Australia, Canada, France, Germany, Hong Kong, Italy, Japan, the Netherlands, the U.K. and the U.S. They find that investing in small-cap stocks provides significant diversification benefits for US investors and investors holding large-cap stocks of sample countries. However, since they form market cap portfolios using data on all exchange traded companies, their strategies would be intractable to implement in practice. To deal with this issue, Switzer and Fan (2007) investigate international diversification benefits by using the sample of G7 countries large and small cap indices. The main advantage of their approach over Eun, Huang and Lai (2008) is the fact that their size-based indices are easily replicable either by investing exchange traded funds (ETFs) or in manageable number of securities.

Another relevant strand of literature examines relationships between corporate governance and performance. In a seminal study, La Porta, Lopez-de-Silanes, Sheifer, and Vishny (LLSV, 2002) introduce evidence suggesting that better corporate governance, as reflected in country macro proxies of governance (a) civil law vs. common law domicile; and b) country protection of minority shareholders)) enhances corporate valuation based on Tobin's q across countries. Gompers, Ishii, and Metrick (GIM, 2003) devise a trading strategy that involves buying a portfolio of strong stockholder rights firms and selling a portfolio of weak stockholder right firms generates an abnormal return of 8.5% per year during the 1990's. Bebchuk, Cohen, and Ferrell (BCF, 2009) show abnormal returns based on their entrenchment index. On the other hand, Johnson, Moorman, and Sorescu (2009) suggest that industry clustering is the main driver of the abnormal returns generated by the GIM trading strategy and those found by BCF(2009).

2.2 Description of the Data

This study uses monthly U.S. dollar-adjusted stock market total return data for indices from 44 different countries, including the United States. The data are obtained from Morningstar EnCorr. The sample data were collected monthly for the period from August 1996 until July 2013 giving a 204 individual monthly data points for each index. The S&P 500 index, the Russell 2000 index and the Ibbotson Associates SBBI US Long-Term Government Bonds index are used as representative of US large-cap, small-cap and bond investment returns. Each of the 43 foreign countries is represented by three Russell indices; overall return index, large-cap (Lc) return index, and small-cap (Sc) index. These foreign country indices are denominated in US dollars and hence include the effects of foreign exchange fluctuations over the period. Throughout the paper, countries are sorted according to their national gross domestic product (GDP), market development and overall corporate governance level. GDP data is obtained from the International Monetary Fund (IMF) as of 2012. The list of emerging countries is obtained from IMF, FTSE, MSCI, The Economist, S&P and Columbia University emerging country lists. Countries that are on either one of the lists are labelled as emerging economies. In order to rank countries based on corporate governance, average overall Governance Metrics International (GMI) ratings as of 2010 are used.[2] Countries are removed from the study if GMI ratings are not available or numbers of missing data

[2] GMI ratings are determined using a scoring approach that captures variation in Board Accountability; Financial Disclosure and Internal Controls; Shareholder Rights; Executive Compensation; Market for Control and Ownership Base, Corporate Behavior; and Corporate Social Responsibility Issues.

are greater than 5% of sample period for any of the three national indices. The final sample consists of indices of 35 countries.

[Please insert Table 2.1 about here]

Panel A of Table 2.1 tabulates sample countries' GDP, population and measures of corporate governance effectiveness. Although the total population of developed countries is less than one-third of the total population of emerging countries, the total GDP and average GDP per capita of developed countries are more than double of those of emerging countries. In addition, developed countries, on average, have higher overall GMI ratings and corruption perception indices. These results suggest developed countries are perceived to be less corrupt and more effective in terms of corporate governance practices. Panel B of Table 2.1 presents descriptive statistics for stock markets of sample countries. As of 2012, the total market capitalization of developed sample countries are two times more than emerging countries, although total market capitalization of emerging countries increased more than twice between 2005 -2012. These results are partially due to the increase in the total number of listed domestic companies in emerging markets as opposed to the decrease in the total number of the listed domestic companies in developed markets. Based on average turnover ratios, we can argue that developed (emerging) markets have become less (more) liquid from 2005 to 2012. Also, emerging markets, on average, seem to be almost as liquid as developed markets as of 2012.

[Please insert Table 2.2 about here]

Table 2.2 presents the sample indices, their summary descriptive statistics, and their risk return characteristics. 1-month T-bill return is used as the risk-free rate for the sample period. The countries are ordered in descending order, based on the GDP. We assume that investment universe of an US investors can be proxied by the large-cap (small-cap) U.S. index has a 0.738 (0.880) % mean, and 4.634 (5.985) % standard deviation and the long-term government bond index with 0.671% (3.124%) mean (standard deviation). The large and cap U.S. indices are highly correlated (ρ=0.816). However, negative correlations between US bond index and US stock indices suggest probable diversification benefits. The foreign country indices, on average, have a higher mean and standard deviation compared to US indices. However, the Sharpe and Sortino ratios for the U.S. indices are slightly higher than the average Sharpe and Sortino ratios of the foreign indices. The range of the correlation of foreign assets with US indices are between 0.389 – 0.812 for the S&P500 index, 0.395 – 0.783 for the R2000 index and -0.299 – -0.058 for the USLtGvt index. Empirical evidence provided in Panel B suggests that large-cap country indices have similar risk-return characteristics with the overall country indices. On the other hand, small-cap indices seem to provide, on average, higher Sharpe (Sortino) ratios and lower correlations with US assets compared to overall and large cap country indices. Furthermore, sample distribution of the most of the return series exhibit negative skewness, excess kurtosis and autocorrelation. Jarque-Bera test results provide evidence against normally distributed returns except for Italy large cap, Japan and India overall and large cap return indices.

Table 2.3 below provides evidence of an increased interdependency between country market returns and US market returns, from the first half of the sample (1996-2006) to the second half (2006-2013) using the variance decompositions based on Chen and Ho (2009)

[Please insert Table 2.3 about here]

These results suggest that the benefits of international diversification may be less apparent in more recent years, and would justify conducting the analyses for the two periods separately.

To further motivate the analyses, we also test for cointegrating relationships between country returns and U.S. returns, whose presence would detract from diversification benefits. As in Gupta and Guidi (2012) we first perform the analyses using the Gregory and Hansen (1996) allowing for an uninformative (with respect to timing) regime shift. The results are shown in Table 2.4.

[Please insert Table 2.4 about here]

As is shown therein, for most countries, few significant ADF statistics across models for the countries and "style" portfolios vis a vis US market returns. Hence, the results are not consistent with cointegration with an uninformative regime shift which could support the case for diversification.

I also conduct recursive cointegration tests developed by Hansen and Johansen (1999) to further examine the dynamics and stability of cointegration (or no cointegration) between local indexes and the US market return benchmark, see e.g. Yang, Khan and Pointer (2003) and Mylonidis and Kollias (2010), and Yunis (2013). More specifically, constancy of cointegration rank is tested by first estimating the model over a base period. Residuals from each recursive subsample are subsequently used to form the standard sample moments associated with Johansen's reduced rank. The eigenvalue problem is then solved directly from these subsample moment matrices. The sequence of trace test statistics of the recursive estimation is scaled by the corresponding 5% critical values.[3] The null hypothesis that the chosen cointegration rank is maintained can be rejected if it takes values greater than one (regardless of the subperiod for which it has been estimated). Results from the R1 representation (Hansen and Johansen,1993) of the

[3] The analysis was performed using CATS in RATS version 2.0.

bivariate recursive cointegration analysis between the US index (S&P 500) and each of the other thirty-five country indices are shown Figure 2.1 below.

[Please insert Figure 2.1 about here]

Aside from JPN, SGP, TAI, and THA, little evidence of bivariate cointegration is observed between the United States and most of these markets over much of the sample period. However, consistent with Yunis (2013) we find that over periods of financial crisis, such as the 1998 global emerging market crisis and the 2008 global financial crisis, many of the markets do show episodal evidence of cointegration, which would of course negate the benefits of diversification over these periods.

2.3. Methodology

Mean-variance spanning tests are the methods most often used by researchers to investigate international diversification.[4] The goal of the spanning test is to determine whether the addition of one set of risky assets can improve the portfolio performance of another set of risky assets. The assumption is that a typical investor measures the performance of his portfolio on the basis of the mean and the variance of the portfolio return. Hence it must be demonstrated that the addition of a new set of risky assets improves the mean-variance frontier from the original set of risky assets already in his portfolio. Huberman and Kandel (1987) formulated a multivariate test of hypothesis where a set of K risky assets spans a larger set of the original K risky assets and a set of N additional assets if the minimum-variance of the two sets is the same. The first set of K risky assets is called

[4]See e,g, Huberman and Kandel (1987),Harvey(1995), Bekaert and Urias (1996), Errunza et al. (1999), DeRoon, Nijman, and Werker (2001), Petrella (2005), Switzer and Fan (2007), and Eun, Huang and Lai (2008).

the benchmark assets and the second set is called the test assets. The test is a regression of the test assets N on the benchmark assets K:

$$r = A + RB + E \tag{2.1}$$

where r is a T x N vector of the returns of the test assets; R is a T x K matrix of the returns of the K benchmark assets; A and B represents the coefficient vectors; and E is a T x N vector of the error terms ε_t. The necessary and sufficient conditions for spanning are equal to the joint hypothesis:

$$H_0: \; A_j = 0 \text{ and } \Sigma_j B_j = 1 \tag{2.2}$$

The assumptions of the model are: A and B are constant over time, and $T \geq N + K + 1$. Kan and Zhou (2012) provide a GMM Wald test given in eq. (2.3) which is valid for all distributions of asset returns under conditional heteroskedasticity of error terms.

$$W_a = T \times vec(\widehat{\Theta}')'[(A_T \otimes I_N)\, S_T (A_T' \otimes I_N)]^{-1} vec(\widehat{\Theta}') \sim \chi^2_{2N} \tag{2.3}$$

$$E(g_t) = (R \otimes E) = 0'_{N(1+K)}, S_T = E(g_t' g_t), \text{and } A_T = \begin{bmatrix} 1 + \hat{\mu}_1{}' \hat{V}_{11}^{-1} \hat{\mu}_1 & -\hat{\mu}_1{}' \hat{V}_{11}^{-1} \\ \hat{\mu}_1{}' \hat{V}_{11}^{-1} 1_K & -1_K' \hat{V}_{11}^{-1} \end{bmatrix}$$

where, the moment condition is $E(g_t)$ and the $\hat{\mu}_1$ and $\hat{V}_{11}$ are the expected return and the variance-covariance matrix of K benchmark assets, respectively.

The joint hypothesis for the mean-variance spanning test of Equation (3) can also be broken down into two separate components and examined individually and jointly by the step-down mean variance spanning test. The step-down spanning test analyzes each component in terms of its effect on 1) the tangency portfolio, and 2) the global minimum-variance portfolio on the efficient frontier when a new portfolio is added to the benchmark portfolio (Kan and Zhou, 2012). Kan and Zhou

(2012) caution that the statistical significance does not always correspond to economic significance so care must be taken in interpreting the p-values of the individual tests. The spanning test puts a disproportionate heavier weight on the second constraint of Equation (2.2) corresponding to the global minimum-variance (GMV) portfolio than on the first constraint for the tangency portfolio. As a result, the joint test for spanning has strong power for cases with changes in the global-minimum variance but little power in cases that only have differences in the tangency portfolio but not in the global minimum-variance portfolio. To capture these cases, the step-down spanning tests analyze both measures separately. The GMM Wald test (W_1) for tangency portfolio effect is expressed as a test of the $\alpha = 0$ constraint by ignoring second constraint in Equation (2.2). The GMM Wald test (W_2) for the global-minimum variance portfolio effect is a test of the $\Sigma_j (\beta_j)= 1$ constraint, conditional on $\alpha = 0$. Both test statistics follows χ^2 distribution with N degrees of freedom under the null hypothesis.

The step-down spanning approach is conducted to assess the source of possible diversification benefits and avoid failure to reject a false null hypothesis of spanning. Furthermore, following the lead of Switzer and Fan (2007) and Petrella (2005), we also investigate the impact of investment policy constraints on the Sharpe ratio and standard deviation of global minimum variance portfolio.

2.4. Results from Mean-Variance Spanning Tests

2.4.1. Mean-variance spanning tests of country indices

The starting domestic benchmark portfolio is built with three initial risky assets: the Ibbotson Associates SBBI S&P 500 TR index (representing large-cap firms), the Russell 2000 TR index (small-cap firms), and the Ibbotson Associates SBBI US Long-Term Government Bonds TR index. This benchmark portfolio is designated as USall.

The first test tries to determine which countries' stocks are beneficial in building a superior portfolio to the benchmark portfolio. The indices of the stocks of 35 nations are tested one at a time to determine whether the addition of each individual nation's stocks to a new portfolio will be spanned by the benchmark portfolio. The countries are tested in descending order, based on the GDP.

When the index of a foreign country is not spanned by the benchmark portfolio (i.e. the test statistic is significant for the Wald-test), this index is included in the benchmark to form a new benchmark that will be used to test the next risky asset. On the other hand, if the test statistic is not significant, the benchmark assets will remain unchanged. Table 2.3 presents the spanning test results for overall national indices.

The analysis begins with a spanning test for the Chinese index (CHN) against USall, since China has the next largest GDP after the United States. As shown in Case 1 of Table 2.3, CHN is spanned by benchmark indices and not added to benchmark assets. Since the Japanese (JPN) index has a lower p-value than 0.10, we add JPN to benchmark assets to form a new benchmark with now 4 risky assets. This revised benchmark is used in Case 3 to test the next index, Germany (DEU), the country with the fourth-highest GDP. The Wald test results for DEU are not significant. This procedure is repeated until all 35 national indices have been tested.

Table 2.5 provides the results for the entire period, while Tables 2.6 and 2.7 are based on the two subperiods 1996-2006 and 2006-2013, respectively.

[Please insert Tables 2.5 to 2.7 about here]

After the completion of the spanning tests, we find that a well-diversified US investor can attain diversification benefits by investing in the national indices of 9 countries: JPN, GBR, BRA, ITA, AUS, TWN, CHL, HKG and ISR. The results of the step-down spanning tests for all 35 cases are also presented in Table 2.5. The results from Table 2.5 show that when the spanning tests are significant, there is a matching significant result for the W_2 test. However, there is no corresponding relation for W_1 significance when the joint Wald tests are significant. In Table 2.5, none of the 35 cases generate a significant W_1 test result. These findings indicate that the mean variance spanning test results are driven by changes in the global minimum-variance portfolios. This interpretation is supported by the reported performance measures. Large decreases in the standard deviation of global minimum-variance portfolios (ΔGMV) correspond to significant W_2 test results. However, there appears to be no relation between significant Wald test results and increases in the Sharpe ratio (ΔSR) of the tangency portfolio. Furthermore, increases in the Sortino ratios of the tangency portfolios (ΔSortR) are qualitatively similar to the increases in the Sharpe ratio. We also investigate whether diversification benefits exist after short sale constraints are introduced. Results given in Table 2.5 suggest that the introduction of short sale constraints reduce ΔSortR, ΔSR and ΔGMV significantly.

As noted by Switzer and Fan (2007), there is no relation between indices that are not spanned (are spanned) by the benchmark and low (high) correlation with the risky assets included to the benchmark. The correlation with the SP500 index and country indices that are not spanned by the benchmark ranges from 0.519 to 0.812. Similarly, the correlation between the R2000 index and the indices that are not spanned by the benchmark ranges from 0.476 to 0.707. The correlation between the country indices that are not spanned and the USLtGvt index ranges from -0.233 to -0.078.

Spanning test results for the first subperiod (August 1996-April 2006) provided in Table 2.6 is qualitatively similar to the overall period. Consistent with the test results for the entire period, JPN, GBR, BRA, TWN, CHL, and HKG are not spanned by benchmark assets. On the other hand, ITA, AUS and ISR (CAN and IRL) are (not) spanned by US assets during the first subperiod. As opposed to the spanning test results given in Table 2.5 and 2.6, indices that are not spanned by benchmark assets during the second subperiod (May 2006-July 2013) differ significantly. DEU, ITA, AUS, MYS, GRC and ISR are the indices that are not spanned for US assets. Furthermore, W_1 test results suggest that the inclusion of GRC to the investment universe provides statistically significant improvement in the tangency portfolio.

Empirical tests provided in Tables 2.5-2.7 suggest that diversification benefits of investing internationally mainly stem from investing in the stock markets of developed countries. In order to check the robustness of these results, we perform spanning tests for developed and emerging markets separately.

Panel A of Table 2.8 provides the spanning test results using developed countries as test assets. The exclusion of emerging countries from the investment environment causes several changes in the list of potential assets for diversification. CAN and FIN are spanned when an investor is allowed to invest in emerging markets but they are not spanned when emerging markets are excluded from the investment universe. According to the joint Wald test for developed countries in the last row of Panel A, there exists statistically significant evidence suggesting US investors can attain diversification benefits by adding developed countries to their investment universe.

[Please insert Table 2.8 about here]

Spanning test results for emerging countries are provided in Panel B of Table 2.8. Spanning test results suggest that MEX and TWN are the only two indices that are not spanned by the well diversified US portfolio of S&P500, R2000 and USLtGvt. As opposed to previous results, we fail to reject that the BRA, CHL, HKG and ISR indices are separate asset classes. These results provide additional evidence on the effect of the composition of the benchmark to the spanning test. According to the joint Wald test for emerging countries in the last row of Panel B, investing in emerging countries provides statistically significant diversification benefits for a US investor.

We also perform provide spanning test results for the first and second subperiods.[5] Spanning test results for the first subperiod are consistent with the results for the entire period with several exceptions. AUS and MEX are spanned whereas IRL is not spanned by US assets during the first period as opposed to tests based on an entire period. The international indices that are not spanned by US assets differ across sub-sample periods. We find DEU, ITA, AUS, and GRC (MEX, MYS and ISR) are the developed (emerging) countries that could provide diversification benefits to US investors based on the more recent subperiod.

2.4.2. Spanning tests of large and small-cap country indices

The spanning tests are repeated for the 35 countries using separate large-cap (Lc) and small-cap (Sc) indices. This is done to determine which component of national stock indices provides diversification benefits. The results are shown in Table 2.9. After the completion of the step by step mean variance spanning tests, we find that 10 large-cap national indices and 3 small-cap national indices are not spanned by the USall benchmark. Israel is the only country whose large-cap and small-cap indices are not spanned. Also, there exists statistically significant evidence

[5] Detailed results are available on request, and are omitted for brevity.

suggesting that DNKSc and CHLSc are a separate asset class. There is a strong relation between this series of tests and the spanning tests for the overall national indices given in Table 2.5. For all countries, except Chile, whose overall indices are not spanned, there exists statistically significant evidence suggesting that adding large cap stocks of those countries provides statistically significant diversification benefits. However, insignificant Wald test results for small caps of those countries suggest that small caps stocks do not provide additional diversification benefits.

[Please insert Table 2.9 about here]

The step-down spanning tests results are similar to those of Table 2.5. There is a strong relation between the large-cap and small-cap asset indices that are not spanned by the benchmark and the indices that are significant for the W_{2a} test. DNKSc is the only one index that is significant for the W_{1a} test. These results indicate that the significant findings for the spanning Wald test in Table 2.11 are mostly due to changes in the variance of the global minimum variance portfolio and not the Sharpe ratio of the tangency portfolio.

2.4.3. The effect of corporate governance on international diversification

In this section, we investigate whether international diversification benefits differ among countries with different corporate governance effectiveness. Sample countries are ranked based on average overall GMI ratings as of 2010. The large cap indices of common law countries and USLtGvt are used as benchmark assets. These common law countries, i.e., US, GBR, CAN, AUS, IRL and NZL, are also the ones with the highest average overall GMI ratings. Developed and emerging civil law countries are investigated separately. For each grouping, countries are ranked into three equal groups based on their average overall GMI ratings. Countries in the top 1/3 are considered as high GMI countries, whereas companies in the bottom 1/3 are considered as low-

GMI countries, and the remaining companies are categorized as medium-GMI countries. For each category, mean variance spanning tests are performed for large and small cap indices separately.

Panel A of Table 2.10 presents spanning test results for small cap common law indices. Wald test results suggest that all indices, except IRLSc, are spanned by the benchmark assets. However, Joint Wald test results given in the last row of Panel A suggest that small cap indices of common law countries are not spanned by large cap indices of common law countries. According to performance measures, adding common law small-caps increases (decreases) the Sharpe ratio (GMV) about 29.65 (4.10) %. These improvements are reduced to 16.27% for the Sharpe ratio and 0.38% for GMV when short selling is not allowed.

[Please insert Table 2.10 about here]

The spanning test results of large and small cap developed civil law countries ranked based on the GMI ratings are presented in Panel B and C of Table 2.10, respectively. In these panels, USLtGvt, large and small cap common law country indices are used as benchmark assets. According to joint Wald test results high and low GMI large caps and high GMI small caps are not spanned by the benchmark assets. Although these assets provide significant improvements in the portfolio performance when short selling is allowed, these improvements are negligible when short selling is not allowed. Among high GMI large caps, the CHELc index is the only index that is spanned by benchmark assets individually. There exists some evidence suggesting that some medium GMI large caps (i.e., FRALc and ITALc) could provide diversification benefits. However, these benefits vanish when short selling is not allowed. From Low GMI large cap indices, JPNLc and ESPLc can provide statistically significant diversification benefits individually. However, joint test results suggest that low GMI large cap indices are spanned by the benchmark assets.

According to Panel C of Table 2.10, JPNSc is the only small cap developed country index that is not spanned by benchmark assets.

For the subperiod analyses, we find that small cap indices of common law countries are spanned by large cap indices of common law countries for the first subperiod (August 1996 - April 2006). Furthermore, High GMI large caps and all small caps groups regardless their GMI rankings provide statistically significant diversification benefits between August 1996 - April 2006. Introduction of short-selling constraints decrease but does not eliminate these diversification benefits. During the second subperiod all of the international asset groups, except for the High GMI large caps, ranked based on GMI ratings are not spanned by the benchmark assets. However, change in performance measures (ΔSR, ΔSortR and ΔGMV) are close to 0.00% except for the common law small caps.

Table 2.11 provides the mean variance spanning test results for emerging countries sorted based on the average overall GMI index values of emerging countries. Spanning tests are conducted for each group and each index. USLtGvt, large and small cap common law country indices are used as benchmark assets.

[Please insert Table 2.11 about here]

The joint Wald test results given in Table 2.11 suggest that high and medium GMI emerging countries are spanned by the benchmark assets. In fact, MYSLc and TWNSc are the only two indices that could provide statistically significant diversification benefits among high and medium GMI emerging country indices. As opposed to high (medium) GMI emerging countries, there exists statistically significant evidence suggesting that both large and small caps of low GMI emerging countries are not spanned by the assets of common law countries. Also, these diversification benefits are economically significant. For example, an investor can increase his Sharpe ratio by 9.56% and decrease GMV by 0.79% by investing in the large caps of emerging countries with low GMI ratings, when there exist short-selling constraints. The Wald test conducted individually for test assets suggests that Mexican large cap, Chilean small caps and Turkish large and small caps and are not spanned by test assets.

The subperiod spanning test results for emerging country indices ranked by GMI ratings show that there exists evidence suggesting large and small caps of emerging countries with low GMI ratings provide diversification benefits for the first subperiod (August 1996 - April 2006) as opposed to High (Medium) GMI emerging countries. On the other hand, small caps of emerging Low GMI countries are the only group that is spanned by the well-diversified portfolio of common law countries during the second subperiod.

2.5. Robustness Tests: Incorporating Transaction Costs with and without Short Sale Constraints

In this section, we conduct an out-of-sample test to examine whether our empirical results in the earlier sections are robust when transaction costs are introduced. We assume a relative transaction cost of 0.1% and execute the out-of-sample test using the rolling portfolio approach. We compare monthly returns to the benchmark portfolio consisting of US assets and monthly returns to an augmented portfolio that contains the US assets and foreign assets. For each portfolio, starting from July 2001, we estimate tangency portfolio weights based on the previous 60-month returns and update these weights at each month considering transaction costs. As an initial portfolio, we use the equally weighed portfolio of S&P 500, R2000 and US long term government bond indices.

[Please insert Table 2.12 about here]

Table 2.12 provides the results of the out-of-sample test for various augmented portfolios. When short-selling is allowed, we find that including test assets to the investment universe increases the mean monthly return except for large cap common law indices. However, there exists evidence suggesting a US investor can attain statistically significantly higher mean returns by investing only in large, small or overall indices of developed countries. Furthermore, augmenting indices of developed countries provide more than 100% (160%) increase in Sharpe (Sortino) ratios. On the other hand, there are not any evidence suggesting that the mean monthly return of any augmented portfolio is statistically significantly different from the mean monthly return of benchmark portfolio when short selling is not allowed.

Chapter 3: Do Single Stock Circuit Breakers Provide a Safety Net for Canadian Investors?

3.1. Introduction

In recent years, securities regulators have focused on setting price limits associated with downward moves in stock market prices as a means of stabilizing markets in decline. In Canada, the tick test under Rule 3.1 of UMIR (Universal Market Integrity Rules) of the Investment Industry Regulatory Organization of Canada (IIROC))[6] went through several modifications from 2004 to 2010 before being revoked in 2012. IIROC's stance for revoking the uptick rule was that the extant empirical evidence showed that it had no appreciable impact on pricing, and that other mechanisms need be found to identify egregious cases of abusive long and short trading. The new mechanism ultimately adopted in Canada in February 2012 is the single-stock circuit breaker (SSCB),[7] which serves as the focal point of the research in this study. The single-stock circuit breaker is triggered when the price of a security swings 10% or more within 5 minutes, that is, it restricts both upside and downside movements. Once triggered, the trading of the security is halted for five minutes, although some trades that are initiated before the invocation of the halt may be permitted by IIROC, subject to being within 5% of the trigger price.[8] The main question that is addressed in this study is: Do these new single stock circuit breakers provide a safety net for Canadian investors?

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[6] The uptick rule is a trading restriction that states that short selling a stock is only allowed on an uptick, whether the current price is higher than the previous trade price.

[7] See IIRIC Notice 12-0040 "Guidance Respecting the Implementation of Single-Stock Circuit Breakers, Feb 2, 2012." https://www.iiroc.ca/Documents/2014/08873044-8215-4128-9d8e-c0074ee786ac_en.pdf

[8] Trades that occur during the halt period are subject to the discretion of IIROC. As noted in IIROC Notice 12-0040, "IIROC expects, given the volume and speed of trading in the current market, that some trades will occur after the triggering of the circuit breaker but prior to the invocation of the trading halt across all Canadian marketplaces. A Market Integrity Official would use their authority granted under Rule 10.9 (d) of UMIR to cancel any trade that is more than 5% beyond the calculated trigger price, as these trades are clearly in a zone where a person would not have had a reasonable expectation of execution at that time."

Early theoretical studies on circuit breakers provide competing predictions on the effectiveness of circuit breakers on market quality. Based on the Efficient Markets approach, Fama (1989) suggests that price limits and trading halts can cause inefficiencies by delaying incorporation of information into market prices. Critics argue that circuit breakers can lead to excess volatility and magnet effects. For the latter, prices are pulled downward towards lower bound limits due to a) investors' fear of illiquidity when new material information arrives to the market (Cho et al. ,2003; Goldstein and Kavajecz, 2004; Subrahmanyam ,1994); b) volatility spillovers to subsequent trading days (Lehmann,1989); and c) higher trading costs for uninformed investors (Subrahmanyam,1997). Proponents of circuit breakers, on the other hand, argue that circuit breakers and associated trading halts can improve market quality by providing a cooling off period for information dissemination. This cooling period can reduce information asymmetry (Spiegel and Subrahmanyam, 2000) and impede market manipulation, as the costs monitoring market manipulation are reduced (Kim and Park, 2010 and Deb et al, 2010). The cooling off can also inhibit noise trader driven excess volatility (Westerhoff ,2003).

Recent empirical studies provide mixed evidence regarding the effects of circuit breakers on market quality. Kim et al. (2008), Abad and Pascual (2010), and Gomber et al. (2013) provide evidence that circuit breakers can improve price discovery by reducing extreme volatility and abnormal trading activity. In contrast, a number of studies suggest that circuit breakers lead to increased volatility for both halted stocks as well as related non-halted stocks (see e.g. Corwin and Lipson, 2000; Christie et al. ,2002; Cui and Gozluklu ,2016; Brugler, et al. ,2020).

This chapter examines the overall effect of SSCBs on Toronto Stock Exchange listed stocks using daily as well as intraday trades and quotes.[9] We examine whether SSCBs provide improvement in market quality in terms of reduction in intraday price declines (ascensions) and volatility. Furthermore, we test the overreaction and delayed price-discovery hypotheses using standard event study methodology. Our analyses are conducted for all the firms that are included in the Toronto Stock Exchange during the sample period of February 2012 through December 2016.

In the next section, we discuss the data used in the analyses. In section 3.3, we present the results pertaining to pricing efficiency associated with the circuit breakers. Section 3.4 provides the empirical results relating to daily volatility effects. Section 3.5 examines price ascensions/declines induced by the circuit breakers. Section 3.6 looks at the effects on several market quality measures of targeted stocks. Section 3.7 presents the effect of SSCB on intraday realized volatility.

3.2. Data and Sample Description

This essay uses daily security price data from the Toronto Stock Exchange – Canadian Financial Markets Research Center (TMX – CFMRC**)** database**.** The dataset includes the daily closing (opening) prices, trading volume, number of transactions, number of quotes and closing (opening) bid and ask quotes on stocks. We obtained the implied volatilities based on 100% at the money options with 30-days to expiration for our sample stocks from Bloomberg.[10] Intraday

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[9] Several papers rely on intraday data in analyzing circuit breaker effects on stock market like Autore, Billingsley, and Kovacs (2011) and Battalio and Schultz (2011).

[10] To calculate the implied volatility at a fixed level of moneyness and time to maturity, Bloomberg uses Hermite cubic spline interpolation in variance space across strikes and time to maturity of call and put options.

quotes and trades data for the intraday volatility estimation is obtained from the TSX Trades and Quotes database. SSCB trading halts were obtained from the IIROC website.[11]

Our universe comprises all common stocks for companies headquartered in Canada (share code 1 and foreign code 0). The sample covers the period from January 1, 2007 to December 31, 2016. In order to minimize the impact of recording errors and microstructure related biases several filters are employed. Observations with missing daily closing prices, opening prices, returns, and low or high prices are deleted. Observations are also deleted if the daily lowest price is greater than or equal to the highest price, the opening (closing) price is not in between the opening (closing) bid and ask or daily low and high. We also delete stocks with a trading price less than $5 per share as well as investment and real estate funds. Based on these filters, there are 1,640 companies and 1,249,726 stock- day observations from the TMX-CFMRC database, which include both SSCB trigger event stocks as well as non-SSCB stocks. The daily single stock circuit breaker records are from the Investment Industry Regulatory Organization of Canada (IIROC). Effective February 2, 2012, SSCBs apply to "each security that is a constituent of the S&P/TSX Composite Index and each Exempt Exchange-traded Fund ("ETF") the assets of which is comprised principally of listed securities."[12] Since February 2, 2015 IIROC has included each security that is considered "actively traded" to the SSCB eligible list.[13] After the first compliance date (Feb. 2, 2012), there are 203,450 stock-day observations from 306 S&P/TSX Composite constituent firms subject to Single Stock Circuit Breaker. After Feb. 2, 2015, there are additional 20,727 stock-day

[11] https://iiroc.mediaroom.com/index.php?searchform=1&start=2007-01-01&end=2020-03-03&keywords=circuit+breaker&o=225&s=2429

[12] Guidance Respecting the Implementation of Single-Stock Circuit Breakers, Feb 2, 2012

[13] As per the "Guidance Respecting the Expansion of Single-Stock Circuit Breakers, Jul 10, 2014" an actively traded stock is: "For the purposes of this Notice, a listed security is considered actively-traded if the particular listed security traded, in total, on one or more marketplaces as reported on a consolidated market display during the three calendar months ending immediately preceding the determination: -an average of at least 500 times per trading day, and- with an average trading value of at least $1,200,000 per trading day."

observations from 155 “actively traded” firms that are subject to the SSCB regime. Table 3.1 reports the summary statistics of single stock circuit breaker records data from IIROC. We exclude TSX Venture market halts and halts associated with ETF funds. Some SSCB firms experience halts on multiple calendar dates. Final SSCB “event” sample comprises 59 firms and 76 events. The “flash crash” day of August 24, 2015 is the most active day with five Single Stock Circuit Breaker incidents.

[Please insert Table 3.1 around here]

A list of the SSCB stocks is provided in Appendix A. Appendix A shows that the halts occur for companies in a wide range of industries. Market capitalizations for the sample range from $78.5 Million to $52.6 Billion. Appendix B shows all company specific news that could be found on the halt days, from a Factiva search. As shown therein, for only 11 of the halt firms, no news could be found that could have given rise to the large stock price moves that triggered the halts.

In Figure 3.1, we plot the calendar date and trading time distributions of the SSCB halts. As we can see in Panel A, the majority of SSCB events occur after February 2, 2015. Panel B shows the distribution of the halts over the course of the trading day. SSCB halts are most frequent in the first two hours of the trading day.

[Please insert Figure 3.1 about here]

For the intraday analyses, for every IIROC Single Stock Circuit Breaker halt day, we divide the trading day into 5 minutes intervals starting at the open (9:30 am) and ending at the close (4 pm). The price associated with every interval is the reported price for the last trade within this five-minute interval. If a trading interval had no trades in it, we assign the previous interval price to this trading interval. We delete from our sample the daily observations where we had either no trading before the halt or after the halt. We have also deleted trading days having 10 consecutive 5-minutes intervals with no trading as well as stocks with fewer than thirty 5-minutes trading intervals. The intraday analyses are conducted with a sample of 51 firms. Aside from the few firms that experience halts on multiple calendar dates, a small sub-group experienced multiple halts on the same trading day. In total, there are 70 SSCB events represented in the intraday analyses.

3.3. Pricing Efficiency Effects: Event study Analyses

In this section, we conduct an event study to investigate the daily Average Abnormal Returns (AARs) and Cumulative Average Abnormal Returns (CAARs) around SSCB trading halts. The abnormal returns are based on the standard market model. We use the value-weighted CFMRC index return as the proxy for the market returns. Returns are estimated based on a GARCH (1.1) market model with an estimation window of (-280, -31) and a minimum length of 150 days:

$$R_{it} = \alpha_i + \beta_i \cdot R_{mt} + \varepsilon_{it}. \tag{3.1}$$

where $R_{i,\tau}$ is the return on the common stock of company i at time t, R_{mt} is the return on the market at time t and the error term ε_{it} is distributed as GARCH(1, 1) as per Bollerslev (1986) , $\varepsilon_{it} \sim N(0, \sigma_{it}^2)$, where

$$\sigma_{it}^2 = \omega + \gamma_1 \varepsilon_{it}^2 + \delta_1 \sigma_{it-1}^2 \tag{3.2}$$

Abnormal Returns (*AR*) and Cumulative Abnormal Returns (*CAR*) of each event are calculated by:

$$AR_{i,\tau} = (R_{i,\tau} - E(R_{i,\tau})) \quad (3.3)$$

$$CAR_{\tau} = \sum_{\tau=\tau_1}^{\tau=\tau_2} AR_{i,\tau} \quad (3.4)$$

where i is the event, τ is a day in the event window (τ = 0 is the event date), $R_{i,\tau}$ is the return on the event day τ and $E(R_{i,\tau})$ is the expected return.

Average Abnormal Returns (*AAR*) and Cumulative Average Abnormal Returns (*CAAR*) are calculated by taking the average ARs and *CAR*s for the N events: The null hypothesis is that the *AAR (CAAR)* is equal to zero.

In order to enhance the reliability of the results and to account for various event study complications such as serial correlation, event clustering and event-induced variances, various parametric and non-parametric event study test statistics are implemented as per Schimmer, Levchenko, and Müller (2015).[14]

In Table 3.2, the *AAR*s surrounding the SSCB events are reported. The event day is denoted as day 0. The *CAAR*s are calculated for the 5 trading days prior to as well as subsequent to day 0. Expected returns for equation (3) are estimated using the GARCH (1,1) market model in a window spanning from 280 days before the event to 31 days before the event.

[Please insert Table 3.2 around here]

Panel A of Table 3.2 shows the *AAR*s for the SSCB events that are triggered by sharp intraday declines in stock prices. The mean abnormal return on the event day (day 0) for these firms, is -14.88% which is significantly negative at the 1% significance level regardless of the test

[14] For details of test statistics please see: https://www.eventstudytools.com/significance-tests

statistic used. Only 3 of the 39 event stocks recover from this price decline on the event date. While the, mean abnormal returns from day -3 to day -1 are all negative, only those of day -1 are statistically significant according to the non-parametric significance test. Thus, there is extremely weak evidence to support an information leakage effect. The mean abnormal returns for days 1 to 5 are generally positive, but they are not statistically significant. These results reject the delayed price discovery hypothesis since the information that caused the trading halt is incorporated in stock prices at the day of the halt.

The *AAR*s for SSCB events triggered by intraday price ascensions are reported in Panel B of Table 3.2. The mean abnormal return, on the event day (day 0) is 7.55% and is significantly different from zero at 1% significance level regardless of the test statistic used. We also note that pre-event average abnormal returns from day -5 to day -1 are negative, although they are not statistically significant. This result is not consistent with the hypothesis that insiders privately leak good news and withhold bad news (Kothari et al., 2009). Similar to the price decline SSCB group, we find no evidence to support the delayed price discovery hypothesis: the post-event abnormal returns (day 1 to day 5) are not significantly different from zero. The *CAAR*s reported in Panel A (B) of Figure 3.2, confirm our findings that information associated with the trading halt is incorporated in the stock prices at the event day. We also find that the *CAAR*s are not statistically significantly different from zero for the post-event window (1,10) days for the stocks experiencing severe declines (Panel A) or large ascensions (Panel B).

[Please insert Figure 3.2 around here]

In the next section we will implement difference in difference test to assess effect of the circuit breaker on daily volatility in overall market.

3.4. SSCB Effects on Daily Volatility

This section examines the effects of SSCBs on daily volatility. We conduct Difference-in-difference tests using several volatility measures: Parkinson volatility – calculated as $\ln(\text{HIGH/LOW})^2/\ln(16)$ (Parkinson, 1980); Close-close (close-open) volatility – calculated as the square of daily returns based on closing prices (opening to previous day closing price); Intraday (price range) – calculated as the difference between daily high and low prices standardized by closing price (high price); Positive semi variance – calculated as max $[0, \log(\text{close}_t/\text{close}_{t-1})]^2$; negative semi variance – calculated as min $[0, \log(\text{close}_t/\text{close}_{t-1})]^2$ based on Markowitz (1959); the Rogers and Satchell (1991) drift independent estimator; and the 30-day implied volatility from Bloomberg.

For each volatility measure, sample stocks are ranked into quintiles based on their time-series average of that volatility measure throughout the sample period. Stocks ranked in the lowest (highest) quintile forms the *low (high)* quintile portfolio. In addition, stocks ranked in the remaining, i.e. the second, third, and fourth quintiles, are pooled together to form the *mid* portfolio. Table 3.3 reports the empirical results for the general effect of the circuit breaker on daily volatility of stocks.

[Please insert Table 3.3 around here]

The *pre (post)* rows report the time series average of cross-section average of the volatility measure in the pre-circuit breaker period (January 1, 2007 to February 1, 2012) and post-circuit breaker period (February 2, 2012 to December 31, 2016). The *diff* column reports the coefficient estimate of circuit breaker dummy from a time series regression of the variable on an intercept (not reported) and the circuit breaker dummy. The *diff-diff* column represents the coefficient estimate of circuit breaker dummy from a time series regression of the difference of the variable between *high* and *low* portfolio on an intercept (not reported) and the circuit breaker dummy. The circuit breaker dummy equals to one if the date is in the post-circuit breaker period and zero otherwise.

After the implementation of the SSCB rules, all intraday volatility measures decrease significantly for the low volatility portfolio. This result suggests that the most stable quintile portfolio became even less volatile. Results from the *mid* portfolio are qualitatively the same as the *low* portfolio indicating that market volatility is reduced. The empirical results of *high* portfolio, on the other hand, provide weak evidence on decreasing intraday volatility of the most volatile stocks after implementation of SSCB. The difference between pre and post implementation volatility are negative for all volatility measures except implied volatility. However, the difference is statistically significant only for the P_var, Intraday price range, semi-down and VRS volatility measures. The results in the *diff-diff* column, which compare the changes in the *low* and *high* portfolio provide only weak evidence for a volatility reduction after the introduction of single stock circuit breakers. As a robustness check, difference in difference tests are also performed using a truncated pre-circuit breaker sample, based on the period spanning February 2, 2011 to February 1, 2012, and a truncated post-circuit breaker period from February 2, 2012 to February 1, 2013.

3.5. Effects on Intraday Price Declines / Ascensions

In this section, we focus on the intraday price declines and ascensions associated with the SSCBs. In Table 3.4, stocks are sorted into intraday decline and ascension decile portfolios. In addition, 10, 7.5, and 5 percentile portfolios are constructed to investigate the most volatile stocks. The 10, 7.5, and 5 percentile portfolios include stock that declines (ascensions) intraday by at least

10, 7.5 and 5 percent respectively. The portfolios are equally weighted and rebalanced daily. The *pre (post)* columns of Table 3.4 represents the time-series average of the intraday decline/ascension of the portfolio in the pre-breaker (post-breaker) period. The *diff* column reports the coefficient estimate of circuit breaker dummy from a time-series regression of the variable on an intercept (not reported) and the circuit breaker dummy. The circuit breaker dummy equals to one if the date is in the post-circuit breaker period and zero otherwise.

[Please insert Table 3.4 around here]

As one can see in Panel A and B of Table 3.4, the *diff* column suggests statistically significant improvement in daily decline (ascension) in almost every portfolio. The improvement is observed for every daily decline decile portfolio (except decile 9) during the post circuit breaker period. Since this effect is found in every decile portfolio, the results might be reflective of a market-wide volatility shift rather than due to the effect of the SSCB. Note that for the decile that experiences the largest intraday decrease (increase), rank 1 (10), the average intraday decrease is around 5.6%. (6.5%) which is well below the 10% threshold. To test the circuit breaker's effect on highly volatile stocks, we construct three percentile portfolios based on return thresholds. Panel C of Table 3.4 shows the results for equal weighted portfolios based on 10, 7.5, and 5 percentile increases/decreases of component stock. Our results show that the diff test for extreme portfolios are only significant for the 5 % ascension portfolio. Our results do not support the hypothesis that the SSCB reduces the levels of intraday price range of the highly volatile stocks. In the next section, we separate the market shift effects vs. the effects of the SSCB by contrasting the differential behavior for several performance measures between SSCB stocks vs. non-SSCB stocks

3.6. Effects on alternative market quality measures for SSCB target stocks

In this section, pooled regressions of several market quality measure (treated variables) are conducted, using difference in differences regressions, as in equation (3.5) below:

$$Perf_{i,t} = a + b_1\ Treatment_{i,t} + b_2\ SSCB_{i,t} + b_3\ (Treatment_{i,t}\ x\ SSCB_{i,t}) + u_{i,t} \qquad (3.5)$$

where $Perf_{i,t}$ *is the* Return, Daily decline, Daily ascension and Turnover of stock i on day t respectively. $Treatment_{i,t}$ is a dummy that is equal to one if the stock is in the target group (subject to the single stock circuit breaker) and zero otherwise. SSCB is a dummy indicating when the observation date is in the post-breaker period (February 02, 2012 to December 31, 2016) and zero in the pre-breaker period (January 1, 2007 to February 01, 2012). SSCB*Treatment is an interaction term that equals one if both SSCB and Treatment equals to 1. All regressions include firm fixed effect and intercepts are dropped to avoid perfect collinearity. Standard errors are estimated using Heteroscedasticity and autocorrelation-consistent asymptotic variance (HAC) to account for error autocorrelation.

The difference-in-differences model compares the difference between pre- and post-circuit breaker periods in the control group to the difference in the target group. The interaction dummy coefficient is of primary interest here, since it represents the effect of the single stock circuit breaker on target group. Table 3.5 shows the results of the Difference in Differences analyses.

[Please insert Table 3.5 around here]

From the estimated coefficient of b_3, *we can infer that there* is a statistically significant reduction in returns for SSCB target stocks of 0.05%. Clearly this estimate is not economically significant, and hence is consistent with pricing efficiency. In other words, there does not seem to be any incremental economic impact on; stocks with the SSCB rule in effect vs. what would prevail in an unfettered market (based on the performance of our control stocks). Table 3.5 also shows that the SSCB significantly improves performance based on intraday volatility measured by intraday decline or ascension. Finally, we find that Market liquidity, as measured by share turnover is not adversely affected by the SSCB. In sum, these results suggest that SSCBs provide significant reduction in daily volatility without compromising market liquidity.

3.7. Intraday Volatility Analysis

In this section, we investigate the circuit breaker effects on higher frequency intraday volatility around the official IIROC trading halts. We subdivide the trading day into seventy-eight 5-minutes trading intervals from 9:30 am (the market open) to 4:00 pm, (the market close). The variable Interval (t=0) is defined as the 5 minute trading period encompassed by the SSCB trigger. Intervals (t=±j) corresponds to the j^{th} five minute trading interval after (before) the halt. For example, j=+1 corresponds to the first 5-min interval that succeeds the halt interval and j = -1 corresponds to the first 5-min interval that precedes the halt interval.

Figure 3.3 depicts graphically the average realized volatility around the five minute halt intervals (t=0) for sample firms.

[Please insert Figure 3.3 about here]

Panel A of Figure 3.3 shows the results for all firms in the sample. As can be seen therein, there is a sharp spike in volatility that is centered on the halt event (t=0), the volatility dissipates abruptly in the next interval. Panel B shows the plot constructed using all stocks in the sample that experienced a large price decreases leading into the halt. This figure is quite similar to that of Panel A, shows, a large spike centered on the halt interval, and a rapid decrease in the next trading interval. In Panel C, we focus on stocks which experienced a large price increase to trigger the halt. For this case, we note that the magnitude of the volatility jump is considerably smaller than in Panels A and B consistent with asymmetric volatility effects. In other words, the volatility shocks are considerably higher for price decreases as opposed to price increases. Furthermore, we note that for stocks with SSCB triggers that are caused by large price increases, some perceptible increased volatility is observed in the ten minute interval leading into the halt.

Figure 3.4 shows the volatility plots across halt intervals for a sample that excludes companies that experienced multiple halts over the trading day. Panel A shows the volatility graph for all companies in this group. Panels B and C show the corresponding graphs for stocks experiencing sharp prices decreases and increases, respectively.

[Please insert Figure 3.4 about here]

As is evident, these plots are quite similar to those of Figure 3.3. The asymmetric volatility effects are still observed, as well as the short-lived spike that is centered around the immediate halt interval (t=0).

We next conduct an event study that looks at the effects of the circuit breaker on the intra-day volatility of firms. Our dependent variable is the realized intraday stock return volatility for the firms in our study in five-minute trading intervals across the trading day. Abnormal volatility effects are inferred from estimated coefficients of dummy variables D_{jt} that is equal to 1 in the five minute event trading interval t, and 0 otherwise. We perform the analyses looking at the halt trading interval t=0, as well as 5 trading intervals surrounding the halt interval. The basic regression is as follows:

$$Realized\_Volatility_{i,t} = a + \sum_{j=-5}^{j=+5} b_j D_j + Controls + u_{i.t} \tag{3.6}$$

where $Realized\_Volatility_{i,t}$ is the realized volatility for halt-stock i in trading interval t. The realized volatility is estimated as the square of the changes in the log prices between two successive intervals. For control variables, we try to capture possible ‘U’ shaped volatility patterns (with volatility higher at the open and at the close) using the dummy variables $OPEN_i$ which is equal to 1 for the first five minute trading interval (from 9:30 am to 9:35 am) and 0 otherwise; the variable $CLOSE_i$ is equal to 1 for the trades that occur in the last five minute trading interval (from 3:55 pm to 4:00 pm) and zero otherwise. In the early part of our sample, the single stock circuit breaker rule applied from 9:50 am until 3:30 pm. As of February 2, 2015, a modified rule applies for the trading interval from 9:30 am to 9:50 am, which widens the price limit from 10% to 20%. We account for this change in regulations with the dummy variable IIROCPRE, which is equal to 1 for the period before February 2, 2015 and 0 otherwise. The coefficient IIROCPRE will actually capture two effects: any volatility enhancing or reducing effects of the new regulation, as well as changes in overall market volatility. To the extent that sample firms exhibit a similar increase in overall volatility as market as a whole in the post February 2, 2015 period, the sign of coefficient of IIROCPRE should be negative.[15] We also test whether the new regulation on limits affect the behavior of volatility just in the first 20 minutes of the trading day. To this end, we first create a dummy variable EARLYTRADE which is equal to 1 if the trade occurs in the 15 minutes following the open interval of the trading day (9:35-9:50 am) and zero otherwise, the OPEN interval covers the first 5 minutes. The effect of the refinement of SSCB in February 2015 is captured with the interactive dummy variable EARLYTRADEPRE which is computed as EARLYTRADE *IIROCPRE. Given the fairly wide band of 20% for price changes for the first part of the trading day in the post 2015 refinement of the SSCB, the sign of the coefficient of

[15] The annualized standard deviation of returns for the TSX Composite Index for the sample period from February 1, 2012 to February 2, 2015 is 10.9% vs. 13.3% in the period after February 2, 2015.

EARLYTRADEPRE is an empirical matter. Since the price limit band is wider than that which governs halts for later in the trading day, the new rule could be volatility enhancing to the extent that traders take positions earlier in the day. If this is the case, the expected sign of the coefficient of EARLYTRADEPRE is negative. In order to capture any volatility spikes driven by trades occurring by the end of the trading day and outside the SSCB regulation time, we create a dummy variable LATETRADE which is equal to 1 if the trade occurs in the 25 minutes preceding the close interval of the trading day (3:30-3:55 pm) and zero otherwise. Finally, we also include the firm's market capitalization $MARKETCAP_i$ to account for possible higher volatility shocks for small cap stocks due to limited analyst coverage.

With these control variables, our estimated model is given by:

$$Realized_{Volatility}{}_{i,t} = a + \sum_{t=-5}^{t=+5} b_t D_{i,t} + c_1\, OPEN_{i,t} + c_2\, CLOSE_{i,t} + c_3\, MARKETCAP_i + c_4\, IIROCPRE_{i,t} + c_5\, \text{EARLYTRADE}_{i,t} + c_6\, \text{EARLYTRADEPRE}_{i,t} + c_7\, \text{LATETRADE}_{\,i,t} + v_{i.t} \qquad (3.7)$$

where $v_{i,t}$ is a random error term.

Table 3.6 shows the results of the OLS estimation of regression of (3.7).

[Please insert Table 3.6 about here]

This table shows the results of the estimation using the complete sample of SSCB firms (in the first three columns) as well as a subsample of firms that have only single halts in the trading day (the no multiple Halts on the same day group: columns four to six). We also distinguish between firms with halts caused by negative stock price moves (columns two and five) and price increases (columns three and six). We find that the largest shock in volatility occurs in the halt interval, suggesting efficient incorporation of information into prices associated with the halt. For stocks with single halts, a significant increase in volatility is observed for up to ten minutes before and after the halt. Beyond this ten-minute window interval, however, persistent volatility shocks are not apparent. We also note that the shocks in realized volatility are much higher in magnitude for stocks that experience price decreases than price increases. Regarding the control variables, we note that volatility is higher at the open for the complete sample as well as for firms with no multiple halts on the same day. However, this market open effect is significant for triggers based on stock price drops for stocks with single halts over the trading day (about 83% of the sample firms). We also note that across all samples that the IIROCPRE variable is negative and significant. This suggests that the IIROC rule modification that permits a 20% price change from 9:30 to 9:50 am in the period after February 2, 2015 (vs. no limits to price changes in this time interval in the earlier period), was not associated with a subsequent reduction in realized volatility levels for the affected stocks. Of course, this result may also be due to a general increase in volatility in the post February 2, 2015 period. The coefficients of the EARLYTRADE variables, which capture trades in the early morning after the open (from 9:35 am to 9:50 am) are generally positive and significant. The negative and generally significant coefficients of the EARLYTRADEPRE dummy variable, suggest that the post Feb. 2, 2015 expansion of the circuity breaker rule to trades from 9:35 to 9:50 am did not serve to reduce intraday volatility for firms. The coefficients of CLOSE (trades from 3:55 to 4 pm) and LATE TRADE (from 3:30 to 3:55) are in general not significant. These results do not support a U- shape volatility pattern over the trading day. This may be due to the volatility mitigating effects of the circuit breaker. Our results also suggest that the suspension of the circuit breaker rule for the last thirty minutes of the trading day does not have adverse effects on market volatility. For testing the company size hypothesis, we note from the coefficient of the MARKETCAP variable that volatility is significantly lower only for larger firms that experience single daily halts caused by large price increases.

As a robustness check, we also conduct the analyses, differentiating firms with material news from Factiva vs. firms with circuit breaker events that are not associated with material news. Figures 3.5 and 3.6 show the volatility plots across halt intervals for a sample that separates companies according to whether they have material news from Factiva (Figure 3.5) vs. companies with no material news (Figure 3.6) on the SSCB event days. In all cases, the volatility patterns are similar to those of Figures 3.3 and 3.4. In sum, the volatility effects observed around the halt interval (t=0) are robust to whether or not we include firms based on whether they experience single vs. multiple SSCB halts, or whether or not the SSCB halt could be associated with material news.

[Please insert Figures 3.5 and 3.6 about here]

Table 3.7 shows the results of estimation of equation 3.7 for samples that differentiate between SSCB firms according to whether or not their trigger events are associated with material news.

[Please insert Table 3.7 about here]

Based on the results of the estimations, our general findings are robust to the differentiation of firms according to whether or not their circuit breakers triggers occur on material news days. Significant volatility shock effects are observed that are centered on the halt interval. Large volatility spikes are also found in the ten-minute interval surrounding the halt interval. In addition, an asymmetric volatility effect is observed for stocks with material news: stocks with SSCB halts that are initiated by a drop in stock prices experience higher realized volatility shocks than stocks with SSCB halts triggered by large price increases. In addition, realized volatility is higher for early trades (OPEN and EARLYTRADES intervals). This result is more pronounced for stocks with SSCB halts that are triggered by a drop in stock prices. The IIROCPRE and EARLYTRADEPRE variables remain significantly negative (at the 5% level) for the larger sample of firms with material news. In addition, the realized volatility for the trades that occur at the end of the trading day (LATETRADE and CLOSE) is in general either lower than for the rest of the day or insignificant.

In sum, our results for the intraday analyses using trades at five-minute intervals complement well our findings that are based on daily data. Consistent with the daily results, we find that markets react quickly to the SSCB halts, which serve to damper volatility. With the high-frequency data, we can hone in more precisely on the volatility shocks associated with the trading halts. In the previous section, we demonstrated that the impact of the SSCB halt is focused on to the SSCB halt day. Here we add precision to show that the SSCB halt effect is actually manifest in the five-minute halt interval as well as the ten-minute interval surrounding the halt.

Chapter 4: Investigating Returns to Stock Option Portfolios Using Second-Order Stochastic Dominance

4.1. Introduction

The behavior of the cross-section of stock option returns is one of the more complex and relatively unexplored topics in finance literature. Option prices are dependent on numerous factors, but volatility, volatility changes through time, and the volatility risk premium are paramount. Previous theoretical research (Galai and Masulis, 1976, Johnson, 2004, Broadie, Chernov, and Johannes, 2009) suggests an inverse (direct) relationship between expected call (put) option return and asset volatility. Earlier empirical option research has focused primarily on index options. Coval and Shumway (2001) examine whether the classic capital asset pricing theory can explain the expected option returns. They find that zero-beta at-the-money straddle positions on the Standard & Poor's (S&P) 500 produce average losses of approximately 3% per week. Based on their findings, they argue that some additional factor, such as systematic stochastic volatility, is priced in option returns. This large negative volatility risk premium is also confirmed by Bates (2000), Chernov and Ghysels (2000), Pan (2002) and Jones (2003). Broadie, Chernov, and Johannes (2009), on the other hand, find evidence suggesting a risk premium on volatility jumps rather than risk premium on volatility risk. Goyal and Saretto (2009) uncover an intriguing volatility risk premium anomaly relative to the traditional models that value options under perfect markets and no-arbitrage. They show that the volatility risk premium, measured as the difference between implied and historical volatility has predictive power for the cross-section of option returns. They also find that a zero-cost trading strategy that is long (short) in the portfolio with a large positive (negative) difference between these two volatility measures produces an economically and statistically significant average monthly return.

Goyal and Saretto (2009) is motivated by the well documented empirical result that the volatility of stock returns is highly mean reverting. They argue that large deviations of implied volatility (IV) from historical volatility (HV) of underlying stock are indicative of the misestimation of volatility dynamics. This strategy is characterized by buying straddles of stock options with the highest log (HV) –log (IV) and shorting straddles of stock options with the lowest log (HV) –log (IV). According to their findings, such portfolio strategy leads to economically and statistically significant returns after controlling for well-known equity-risk, option-risk factors and transaction costs. In addition, they provide evidence suggesting that their results are not explained by different market conditions, underlying firm characteristics and option liquidity characteristics. In this study, re-examine this phenomenon using a second-order stochastic dominance (SSD) criterion for evaluating performance. This approach takes into account trading frictions and uses a methodology that is robust to model misspecifications, distributional assumptions and preference assumptions.

The remainder of this chapter is organized as follows. Section 4.2 provides a brief review of the literature. Section 4.3 describes the option data. Section 4.4 describes the option trading strategies and their returns. Section 4.5 describes the methodology used to test trading returns using SSD tests. Section 4.6 tabulates results for the SSD tests.

4.2. Literature Review

Early work looking at the behavior of the volatility risk premium is based on index options. The Coval and Shumway (2001) paper, which motivates Goyal and Saretto (2009) challenges the classic capital asset pricing theory for explaining expected option returns. However, the subsequent literature remains mixed on this issue. Bakshi and Kapadia (2003) provide some weak evidence supporting standard theory based on a small sample of 25 firms and over five years. Carr and Wu (2009) provide evidence for a volatility risk premium using a similarly limited, though slightly longer sample. They also find that the volatility risk premium is weaker for equity options than in index options. Finally, Driessen, Maenhout, and Vilkov (2006) find insignificant differences between average model-free implied variances and average realized variances suggesting that the individual equity volatility risk premium does not exist. Goyal and Saretto (2009) ‘s paper which documents abnormal returns from zero-cost straddle trading strategies, consistent with overreaction and non-standard preferences (Barberis and Huang , 2001).

Another strand of literature focuses on the relation between skewness and option returns using the cross section of option returns. Bali and Murray (2013) investigate the cross-sectional pricing of options accounting for skewness of the implied risk-neutral distribution. They find a significantly negative relation between risk-neutral skewness and delta and vega (volatility) hedged option returns. Boyer and Vorkink (2014), on the other hand, focus on the contract level lottery-like characteristics of options driven by their moneyness. They identify a strong (both economically and statistically) significant negative relationship between total ex-ante skewness and average option returns. In addition, they find that total skewness is more relevant to the pricing of options than coskewness. Byun and Kim (2016) argue that the ex-ante skewness measure of Boyer and Vorkink (2014) fails to capture the underlying stock’s skewness characteristics due to the lognormal distribution assumption for stock prices. They use extreme positive returns or a higher level of idiosyncratic skewness over the past quarter as proxies for the underlying stock’s lottery-like characteristics. They find that a zero-cost strategy of buying calls on the least lottery-like stocks and selling calls on the most lottery-like stocks yields statistically and economically significant returns of about 10% to 20% per month. Blau, Bowles, and Whitby (2016) examine the impact of preferences for lottery-like returns on option trading volume. They find that call options written on more lottery-like stocks have a significantly higher trading volume. These results are consistent both with an asset pricing model where skewness is priced, such as Harvey and Siddique (2000), and behavioral models, e,g., Barberis and Huang (2008), in which investors' optimistic beliefs about an asset's extreme positive payoff are priced.

To summarize, there remains a large body of empirical work that suggests that various stock option anomalies persist after controlling for standard equity and option risk factors, and can be exploited by market participants. However, there are two major shortcomings of the extant literature. First of all, most papers ignore (or underestimate) transaction frictions. For example, Berkovich and Shachmurove (2013) argue that abnormal profits reported in the literature (e.g., Jones, 2006) might be due to setting incorrect initial amounts of collateral. Secondly, the existing literature generally tests the predictive power of various option characteristics on future option returns or the profitability of trading strategies using standard linear factor models. However, embedded leverage and non-linearity of payoffs lead to highly volatile and skewed distributions of option returns, see e.g., Broadie, Chernov, and Johannes (2009). This fact underscores the limitations of linear factor models and the linear stochastic discount factor (SDF) approaches for analyzing option anomalies due to their inability of capturing such extremes. In addition, prior findings of significant returns to option trading strategies, which are not explained by well-known risk factors, cannot establish that these are true risk-adjusted returns since estimated significant alphas might be caused by the omission of the unknown aggregate risk factor in the model. Cao and Han (2013) examine the effect of market imperfections and constrained financial intermediaries on stock option returns. They argue that there should be a negative relationship between delta-hedged option returns and the idiosyncratic volatility of the underlying stock since idiosyncratic volatility is positively correlated with arbitrage costs in imperfect markets (e.g., Pontiff, 2006). Empirical results in Cao and Han (2013) are consistent with their hypothesis. Vasquez (2017) shows that future option returns are positively related to the slope of the implied volatility term structure. Furthermore, he finds that straddle portfolios with high slopes of the volatility term structure economically and statistically significantly earn higher returns than outperform straddle portfolios with low slopes.

In this study, we propose to examine the abnormal profitability of option trading strategies in a manner that addresses the two major shortcomings of the earlier empirical stock option literature alluded to above. First, we account explicitly for reasonable transactions costs that would be faced by traders. Secondly, we implement performance tests using a second-order stochastic dominance (SSD) criteria which is free from model misspecifications, distributional assumptions and preference assumptions (i.e. will suit any risk-averse investor). To our best of knowledge, this approach has only been employed by Constantinides, Czerwonko, Jackwerth, and Perrakis (CCJP, 2011). CCJP (2011) investigate whether the risk-averse investor can benefit from including index options that violate stochastic dominance bounds of Constantinides and Perrakis (2007) to their portfolio. We also implement the trading strategy developed by Goyal and Saretto (2009) reported to exploit extreme deviations of implied volatility from the historical volatility is examined. Our analysis has important implications for the empirical option literature because it emphasizes the importance of controlling for trading costs, model misspecifications, distributional and preference assumptions when studying cross-sectional stock option returns.

4.3. Description of the Data

The options data for this study are obtained from the Optionmetrics Ivy database. Optionmetrics Ivy provides a comprehensive database for historical price and volatility data for the US equity and index options markets. The equity option data span the period from January 1, 1997 to April 30, 2016 is selected as the analysis period of this study. The dataset includes the closing bid and ask quotes on American options, daily trading volume, open interest, implied volatilities and greeks. The calculation of implied volatilities and greeks are conducted via the binomial model developed by Cox, Ross and Rubenstein (1979).

Furthermore, data on stock prices, history of dividends and splits as well as risk free rates are retrieved from the Optionmetrics database. Risk free rates are estimated from Zero Coupon Yield Curve to match the maturity of the option by conducting linear interpolation on risk free rates. When the option maturity is lower than the first risk free rate maturity, instead of extrapolation, the foremost risk-free rate is employed.

In order to minimize the impact of recording errors, option data filters are employed following Goyal and Saretto (2009). First, prices violating arbitrage bounds : Call option prices that fall outside the interval of $(S - K\, e^{-\tau.r} - D\, e^{-\tau.r}\,;\, S)$ and put option prices outside of the interval of $(-S+K\, e^{-\tau.r}+D\, e^{-\tau.r}\,;\, S\,)$ are eliminated, where S is the price of the underlying stock, K is the strike of the option, r is the risk free rate, D is the dollar dividend and τ is the time to expiration. Secondly, observation is removed in the following cases; the ask is lower than the bid, the bid (ask) is equal to zero, the spread is lower than the minimum tick size. For the stock options that are in Penny Pilot Program, the minimum tick size is \$0.01 (\$0.05) when the option's price is under (above) \$3. For other stock options, minimum tick size is \$0.05 (\$0.10) when the option's price is under (above) $3. The last step is filtering options with zero open-interest. These filters help us to ascertain the validity of option prices.

In this study, option portfolios are built based on the information available on the first trading day following the expiration day. In order to achieve a nonstop time series that has constant maturity, only options which mature in the next month are taken into consideration. Next, contracts closest to ATM are chosen from options. Stock options are considered as ATM when the ratio of strike to stock price is between 0.975 to 1.025. As a result, an ATM option contract couple (call and put) expiring the following month is chosen for each stock every month. Once option contracts expire, a new option contracts carrying the identical features are chosen78,731 monthly pairs of call and put contracts make up the final sample. In this sample, the average moneyness for calls and puts is nearly one. The sample consists of 4,250 stocks.

Two different measures of volatility are computed for every stock each month. First, historical volatility (HV) is calculated using the standard deviation of realized daily stock returns over the latest twelve months. Implied volatility (IV) is calculated by taking the average of the ATM call and put implied-volatilities. The following table presents the summary statistics of these two measures. The reported means are calculated as follows. First, the time-series average of these volatilities for each stock are calculated. Then, the cross-sectional averages of these average volatilities are reported. The methods used in attaining the remaining statistics are similar: The numbers provided (Table 4.1) are the cross-sectional averages of the time-series statistics.

[Please insert Table 4.1 around here]

The mean of HV and IV are close to each other, with values of 50.27% and 47.96%, respectively. Similar to the finding of Goyal and Saretto (2009) and Driessen, Maenhout, and

Vilkov (2009), HV is slightly higher than IV. The overall distribution of IV are similar to HV based on the first four moments. The average monthly change in both measures of volatility is close to zero. Furthermore, the standard deviation of ΔIV is a lot higher than that of ΔHV. This result is expected since changes in IV can be quite drastic following to important announcements such as earning announcements and events of critical importance for the survival of a firm

4.4. Option Trading Strategies

It is well documented that the volatility of stock returns is highly mean reverting. Hence, large deviations of current volatility from its long-term average are not likely to persist. Goyal and Saretto (2009) argue that the forecast of future volatility should take into account the mean reverting nature of stock volatility. Thus, they argue that IV, as a forecast of future volatility from an option of a stock, should be, on average, closer to the stock's HV than its current volatility. They speculate that extreme deviations between IV and HV might indicate volatility mispricing[16] (over or underestimation of future volatility of underlying by the market). Hence, they argue that stocks for which IV is much lower than HV have cheap options, and stocks for which IV is much higher than HV have expensive options.

In order to backtest the volatility trading strategy proposed by Goyal and Saretto (2009), stocks are classified into deciles based on the log difference between HV and IV (ln HV – ln IV) on the first trading day following the expiration Saturday of each month). Decile 1 (10) consists of stocks with the lowest (highest) log difference between these two volatility measures. The decile portfolios are equally-weighted and, on average, contain 34 stocks. Table 4.2 presents the volatility

[16] Stocks with higher volatility risk (higher volatility of volatility) will also exhibit differences between IV and (future) realized volatility for the compensation of volatility risk.

measures and option greeks of the constructed decile portfolios. Statistics are calculated by first computing equal-weighted averages across stocks for each month and for each portfolio. Then, the time-series averages of these statistics are reported.

While HV and (HV-IV) increase from decile 1 to 10 and IV decrease from decile 1 to 10. Furthermore, greeks are of similar magnitude across all decile portfolios. The spread in HV between portfolio 1 and 10 is much larger than that in IV. This shows that our sort is able to capture richer dynamics of the difference between HV and IV.For instance, deltas of calls in all deciles are close to 0.54 while the deltas of puts in all deciles are close to 0:46. Hence, the sensitivities of option decile portfolios to changes in underlying stock's price and volatility are similar. The findings in Table 4.2 are consistent with Goyal and Saretto (2009).

[Please insert Table 4.2 around here]

4.4.1. Option Portfolio returns

In order to examine returns on options based only on their volatility characteristics, the impact of movements in the underlying stocks should be neutralized as much as possible. To achieve this goal, straddle portfolios are formed as a combination of one call and one put with the same underlying, strike price, and maturity. Stock prices are obtained from the Optionmetrics security price database.

For each stock and for each month in the sample, a call and put contract pair with same strike price that is closest to being ATM and has one month to maturity is selected. Then, the straddle returns are calculated using the sum of the average of the closing bid and ask quotes of the call and put as the beginning price, and, as the closing price, the terminal payoff of the options that expires in the money. The terminal payoff depends on the stock price at expiration and the strike price of the option.

Portfolios are built on the first trading day (which is generally a Monday) after the expiration Friday of the month based on the log difference between HV and IV. Option portfolio strategies are initiated on the second trading day (typically a Tuesday) after the expiration Friday of the month. In doing so, the aim is to reduce microstructure and look-ahead biases.

Table 4.3 reports the summary statistics of the returns of the 10 decile portfolios, as well as the spread portfolio: 10-1 portfolio formed by taking a long position in decile 10 covered by writing the options in decile 1. As opposed to Goyal and Saretto (2009), 10-1 portfolio returns are calculated by taking into account short option straddle cash collateral requirements. According to the Chicago Board Options Exchange (CBOE) Margin Manual, collateral requirement is typically calculated as the collateral requirement on the short put or call, whichever is greater, plus the option proceeds on the other side. Collateral requirement on the short put is calculated as the sum of put proceeds, 20% of underlying price and the moneyness of the put. Collateral requirement on the short call is calculated as the sum of call proceeds, and 20% of underlying price. We calculated the collateral requirement for shorted decile 1 portfolio for each month during the analysis period and found that for each dollar of written decile 1 option on average 3.2056 dollar should be spared as the collateral requirement. In the following table, it is assumed that an investor is required to invest satisfy the collateral requirements for the long decile 10 – short decile 1 portfolio. It is also assumed that the investor earns the risk-free rate for the cash collateral margin requirement.

According to Table 4.3, the average returns to straddle portfolios and their volatility increases from decile 1 to decile 10. These results are consistent with the findings of Goyal and

Saretto (2009). Decile 10 portfolio earns 6.60% average monthly return. In addition, three measures related to the risk-return trade-off: Sharpe ratio, Sortino ratio and certainty equivalent (CE) are calculated. Sharpe ratio estimates increases from decile 1 to decile 10. However, Sortino ratio can give a better idea of a portfolio's risk-adjusted performance since its focuses only on the negative (ignores positive) deviation of a portfolio's returns from the mean. Sortino ratio of decile 1 (10) portfolio indeed suggest that the implemented sorting is able to identify options with high downside risk (upside reward). However, certainty equivalent return estimates for all decile portfolio are negative when the power utility with coefficient of constant relative risk aversion (ϒ) of 1, 3 or 5 is assumed. The 10–1 straddle strategy has an average return of 4.6% with a 11.6% monthly standard deviation leading to a monthly Sharpe Ratio of 0.396. Sortino Ratio is 0.92 and a Certainty Equivalent (CE) of (ϒ =3) of 2.8 % per month. Descriptive statistics on the value-weighted CRSP are also given in the table for comparison purposes. During the sample period, the CRSP index has a monthly Sharpe Ratio of 0.19, Sortino Ratio of 0.277, and a monthly CE (ϒ =3) of 0.5% per month. These results suggest that the 10–1 straddle strategy outperforms CRSP index in all performance measures.

[Please insert Table 4.3 around here]

So far, the findings of this paper confirm Goyal and Saretto (2009). However, whether the large returns to 10-1 straddle are due to the compensation of some systematic risk factor or abnormal should also be investigated. Furthermore, analyses so far are done assuming investors are able to trade at the mid-price of the bid-ask spread for the options. Yet, there are numerous studies demonstrating that transaction costs in the options market are very large as well as to some extent accountable for certain pricing anomalies, such as violations of the put–call parity relation (see e.g., George and Longstaff, 1993).

Since the transaction data is not available through the Optionmetrics database, several ratios for effective to quoted spread would be considered to investigate the effect of transaction costs on the trading strategy. Earlier studies on transaction costs for equity options provide various effective to quoted spread estimates. De Fontnouvelle, Fisher, and Harris (2003) and Mayhew (2002) show that the ratio of effective to quoted spread is less than 0.5. Furthermore, Muravyev and Pearson (2020) provide evidence suggesting that effective spread is less than one seventh of the average quoted bid-ask spread for the traders who are able to time executions. On the other hand, Battalio, Hatch, and Jennings (2004) find that the ratio of effective spread to quoted spread fluctuates between 0.8 and 1 for a small sample of large stocks for the period of January 2000 to June 2002.

The transaction costs of trading the underlying stocks should also be included since the settlement of individual equity options requires the delivery of the underlying stock. The cost is incurred only at expiration and is relative to the shares that need to be bought or delivered as a consequence of the exercise of one of the two options. Since intra-day transactions and quotations (TAQ) data for stocks were not available to me, I assumed one way 0.5% transaction costs for the stock trades.

Table 4.4 presents regression results for the returns of spread (10–1) straddle on various specifications of a linear pricing models consisting of excess market return, the Fama and French (1993) factors, and the Carhart (1997) momentum factor under different effective to quoted spread ratio (ESPR/QSPR) assumptions. Insignificant factor loadings for all regressions in the tabulated table suggest that returns to straddle portfolio are not due to known sources of risk and characteristics. Furthermore, the mean spread straddle return and risk-adjusted return estimates from regressions are statistically and economically significant if the ESPR/QSPR $\leq$ 70%. Results provided in this section suggest that even though returns to the spread straddle portfolios are reduced significantly as a result of transaction frictions, there still exist significant returns.

[Please insert Table 4.4 around here]

The subperiod analyses has also been conducted in order to investigate whether anomaly is time variant. Table 4.5 provides the results for the January 1997-August 2006, while Tables 4.6 present the regression results for the August 2006-April 2016 period. The empirical evidence from the first subperiod analysis suggest incorporating realistic trading frictions reduces risk-adjusted returns significantly. However, anomaly is both economically and significantly persistent pre-August 2006. On the other hand, our second subsample results suggest that the anomaly has disappeared under the assumption of ESPR/QSPR higher than 20%.

[Please insert Table 4.5 and 4.6 around here]

However, the question of whether these pre- 2006 returns are due to some unknown risk factor or abnormal remains unsolved. In the following section, these returns will be investigated by using the second order stochastic dominance test.

4.5. Second Order Stochastic Dominance (SSD) Test Methodology

In this section, the second-order stochastic dominance (SSD) criterion is used to test whether returns to straddle strategy provided in the previous section can be regarded as abnormal. An SSD tests are selected since it is independent of distributional assumptions, such as normality, and preference assumptions. According to the SSD criteria, the portfolio of option trader (OT) is preferred by any risk-averse trader over the portfolio index trader (IT), i.e. OT stochastically dominates IT, if for every z in the joint support of their respective distributions, if the following holds:

$$D_{IT}^{2}(z) - D_{OT}^{2}(z) \geq 0 \tag{4.1}$$

With strict inequality for at least one value of z where

$$D_{J}^{2}(z) = \int_{\hat{z}}^{z} (z - x) dF_{J}(x) \tag{4.2}$$

J=IT, OT, and $F_j(x)$, is the cumulative distribution function of portfolio J's return and $\hat{z}$ is the lower bound of common support.

In order to apply the SSD criteria to test whether straddle returns can be regarded as abnormal returns, SSD relationship between two different investment strategies are investigated. The first strategy will be the naïve trading strategy implemented by the index trader (IT) who invests his whole wealth into stock market index (benchmark) and the option trader (OT) will be the one that invests a constant proportion of his wealth into spread straddle strategy in addition to stock index. If OT $\succ_2$ IT, which states that the option trader's portfolio return stochastically dominates the index trader's portfolio return, we can argue that the option trading strategy provides abnormal returns.

Since the portfolios that will be tested in this paper are highly correlated by construction, the selected SSD statistical test should be able to deal with correlated samples. As opposed to other SSD tests, Davidson and Duclos (DD,2000) and Davidson and Duclos (DD, 2013) are the only two test procedures that are known to deal with correlated samples. These tests require that returns should be serially uncorrelated. The first-order serial correlation for returns are calculated and found that they are statistically insignificant.

The Davidson and Duclos (2000)'s test provides the null hypothesis of SSD for the investigated distributions. Hence, the rejection of the null hypothesis does not imply SSD. Furthermore, it can only evaluate distributions at an unchanging number of randomly selected points. As a result of this limitation, the DD (2000) test may lead to inconsistent results (Davidson and Duclos, 2000; Barrett and Donald, 2003).

The DD (2013) test is more favorable compared to the DD (2000) test due to several reasons. Firstly, the DD (2013) test is designed to test the null hypothesis of non-dominance for one distribution over another. Therefore, rejecting the null of non-dominance would indicate SSD of one distribution over another unambiguously. Although the same manner of establishing the null hypothesis is employed by Kaur, Prakasa Rao, and Singh (1994), the correlated samples cannot be handled within the approach they adopt.

Even though the distribution of the DD (2013) test statistic under the null of non-dominance proves to be asymptotically normal, it is essential that the p-values are bootstrapped in small samples. Thus, more accurate finite sample properties are attained, leading to a stronger test. DD (2013) describes a bootstrap algorithm to obtain the p-values for small samples.

4.5.1. Test statistic of Davidson and Duclos (2013) and Davidson and Duclos (2000)

It is not possible to arrive at straightforward calculations and comparisons of the integrals from the Equation (4.1) since the actual distribution which produces the return is not known. Instead, the counterparts in the sample is known. The sample counterparts of the integrals from Equation (4.1) are labeled in the below manner, adopting DD (2013)'s method:

$$D_K^2(z) = \frac{1}{N_K} \sum_{i=1}^{N_K} \max(z - y_{i,k}, 0) \tag{4.3}$$

wherein the distribution sample K, N_K is the number of observations, $y_{i,k}$ is the i-th observation in this sample, and z is the threshold of interest. The set of thresholds {z} covers all unique observations from both samples $\{y_{i, OT}\}$ and $\{y_{i, IT}\}$ situated in the joint support of the samples ensuring that there is minimum one observation in each sample higher than max(z) and at least one lower than min(z). This procedure is implemented since the null cannot be rejected over the entire support of the sample distribution.

As noted by Constantinides, Czerwonko, Jackwerth, and Perrakis (CCJP, 2011), the power of the DD (2013) test is low, unless the tails of the paired outcomes are trimmed. The tails of two distributions are trimmed based on the methodology described by CCJP (2011). One needs to start trimming with two pairs of coupled samples to limit the interval in the right tail, as given by CCJP (2011). One of the pairs should have the maximum from distribution of W_{IT} and the corresponding from W_{OT}, while the other should hold the maximal of W_{OT} distribution and the corresponding W_{IT}. This procedure should be continued until the intended level of trimming is achieved, In the left tail, the procedure to be applied is similar.

Subsequently, for each level of z, the standardized difference between the two dominance functions is calculated to test the null hypothesis that OT does not SSD IT:

$$t(z) = \frac{D_{IT}^2(z) - D_{OT}^2(z)}{\left\{\widehat{Var}\left(D_{IT}^2(z)\right) + \widehat{Var}\left(D_{OT}^2(z)\right) - 2\widehat{Cov}\left(D_{OT}^2(z), D_{IT}^2(z)\right)\right\}^{0.5}} \tag{4.4}$$

Where:

$$\widehat{Var}\left(D_K^2(z)\right) = \frac{1}{N}\left\{\frac{1}{N}\sum_{i=1}^{N_K} \max\,(z - y_{i,k}, 0)^2 - D_K^2(z)^2\right\}, K = OT, IT$$

$$\widehat{Cov}\left(D_{OT}^2(z), D_{IT}^2(z)\right)$$

$$= \frac{1}{N}\left\{\frac{1}{N}\sum_{i=1}^{N_K} \max\left(z - y_{i,OT}, 0\right) \max\left(z - y_{i,IT}, 0\right) - D_{OT}^2(z) D_{IT}^2(z)\right\}$$

where Var (.)·and Cov(.)· are the estimated variance and covariance of the dominance functions, respectively. For each of the chosen levels of a threshold z, the values from the DD (2013) test statistic are calculated based on the above equations.

With the second-order stochastic dominance of distribution IT by distribution OT, the implication is that the amount in Equation (4.4) is non-negative at all times. Therefore, with the aim of testing the null hypothesis that OT does not SSD IT, solely one number needs to be taken into consideration: the smallest value of t(z). The same test statistic is implemented by DD (2013)

$$t^* = \min(t(z)) \tag{4.5}$$

The test statistic t* is asymptotically normally distributed. However, the p-values should be determined with the implementation of bootstrapping. If the sample size is large, the standard normal distribution is employed.

For the DD (2000) test, the following hypothesis should be jointly tested to interpret the dominance relationship. First, the null hypothesis H_0: IT $\succ_2$ OT should be tested against the alternative that either OT $\succ_2$ IT or neither one of the two distributions dominates the other. Hence, the rejection of the null hypothesis fails to rank the two distributions. The null hypothesis of DD (2000) should be tested with finite number of threshold values (set of z's). Under the null hypothesis, DD (2000) show that t(z) is asymptotically distributed as the studentized maximum modulus (SMM) distribution. H_0, is rejected if t(z) is significant at any grid point (z). Hence, the SSD relation between OT and IT depends on the maximum and minimum values of t(z).

4.6. Testing Whether an Investor can benefit from the Reported Returns by using Second Order Stochastic Dominance tests

Let's assume that the first trader (IT) follows a passive trading strategy that requires investing his wealth W_{IT} in benchmark portfolio (e.g. an index fund). On the other hand, the second investor (OT) follows a trading strategy that requires investing x% of his wealth in the 10-1 straddle portfolio and his remaining wealth in the same benchmark portfolio as trader IT. Furthermore, let's assume that OT rebalances his portfolio to make sure that x% of his wealth is invested in the 10-1 straddle portfolio at the beginning of each trading period. Moreover, it is also assumed that OT incurs a one-way proportional transaction cost of 0.5% when he trades stocks or index. Since investor OT also has to deposit cash collateral of y for 1$ of written options, his portfolio composition would be:

$$Portfolio\ of\ OT = \begin{cases} (100 - y\,.x)\%\ invested\ to\ Index \\ x\%\ to\ zero\ cost\ straddle \\ (yx)\%\ to\ margin\ account \end{cases} \tag{4.6}$$

This trading strategy for the investor OT is selected to achieve constant portfolio composition for trader OT in order to estimate the return distribution of portfolio OT.

If OT $\succ_2$ IT, it would indicate that implementing the trading spread straddle strategy based on deviations of IV from HV will be preferred by any risk averse investor over the passive trading strategy of IT.

[Please insert Table 4.7 around here]

Table 4.7 to 4.9 present second order stochastic dominance test results under the following assumptions: IT will invest his wealth in CRSP value weighted index. OT will invest in the 10-1 straddle portfolio whose notional amount equals to 10% of his wealth, deposit a cash collateral of 3$ for 1$ of written options (30% of his wealth) and put his remaining wealth in the same benchmark portfolio as trader IT.

Table 4.7 provides DD (2000) and DD (2013) test results for the overall sample. The second column reports the return difference between OT and IT under different transaction cost assumptions. Option trader earn statistically and significantly higher returns than Index trader when ESPR/QSPR is assumed to be less than or equal to 50%. Furthermore DD (2000) null hypothesis that returns to IT $\succ_2$ OT is rejected under all different transaction cost assumptions. As for DD (2013), H_0: OT $\nsucc$2 IT cannot be rejected unless threshold values (z) from the left tail are trimmed. When the trimming is implemented, we find that H_0: OT $\nsucc_2$ IT can be rejected if ESPR/QSPR is assumed to be less than or equal to 40%. Overall, the OT portfolio dominate the IT portfolio, with lower effective to quoted spread ratio assumptions.

[Please insert Table 4.8 and 4.9 around here]

Subperiod analyses are also conducted to investigate whether pre-2006 returns can be regarded as anomalous; Table 4.8 confirms the findings of the linear factor models in the previous section. Empirical evidence suggests that H0: OT $\nsucc$2 IT can be rejected if ESPR/QSPR is assumed to be less than or equal to 80%. Table 4.9: affirms that anomalous returns have indeed been disappeared after 2006 when transaction costs are taken into account.

Our findings suggest that high returns reported to the trading strategy based on deviations of HV from IV were concentrated on pre-2006 period. Furthermore, DD(213) test results suggest that volatility spread anomaly disappears completely when transaction costs are taken into account. Additional tests are conducted under different percent relative investment (e.g. 15%) to the spread straddle portfolio assumptions. The results of these robustness checks are qualitatively similar.

Chapter 5: Conclusions

In this thesis, I study three aspects of financial markets and explore their implications for policy making and investment decisions. These three aspects include a) international diversification benefits; b) effects of Single Stock Circuit Breakers on financial markets; and c) cross-sectional option returns. The first essay investigates the existence of diversification benefits for US investors when they invest internationally based on market development, market size and overall corporate governance level diversification. The results of our study show that US investors can attain important gains in portfolio efficiency by investing in a mix of developed and emerging economies. Furthermore, we find evidence that adding emerging countries into the investment opportunity set containing assets of developed countries can provide additional diversification benefits. When mean variance spanning tests are conducted for large-cap and small-cap national indices, we find that most of the small-cap indices of countries are spanned by a benchmark portfolio that includes the corresponding large-cap indices. However, there is still a role for small-cap indices that complement existing benchmark assets.

The diversification benefits of different countries differ based on the level of overall governance effectiveness of the country's companies is also investigated. GMI ratings are used as a proxy of corporate governance. We find that large caps of developed countries with high and low overall GMI ratings and large and small caps of emerging countries with low overall GMI ratings are not spanned by the investment universe containing the assets of common law developed countries. However, diversification benefits are economically significant only for large and small caps of emerging countries with low GMI ratings when short selling is not allowed.

This second essay looks at the effects of regulatory changes in which restrictions on short sales on stocks with declining prices (uptick rule) are replaced by circuit breakers that are triggered when individual stocks experience large upside or downside movements. We look at all stocks traded on the Toronto Stock Exchange since the inception of the single stock circuit breaker rule in February 2012. We find that circuit breakers do provide some safety net to investors in stocks that experience severe volatility events: the material information that causes the SSCB induced trading halt is incorporated in stock prices at the day of the halt (neither overreaction nor under reaction). In addition, stocks that experience severe declines or ascensions do not experience significant turnarounds in their fortunes. Furthermore, daily volatility measures decline for stocks affected by the circuit breaker, consistent with Westerhoff (2003). This volatility decline is not associated with reduced market liquidity. This suggests that circuit breakers per-se do not induce "disorderly" markets. This is consistent with the hypotheses that the cooling period provided by the SSCB can reduce information asymmetry and impedes market manipulation (e.g. Spiegel and Subrahmanyam, 2000; Kim and Park, 2010; and Deb et al, 2010). However, the SSCBs do not provide for a quick turnaround for stocks experiencing severe price decline events.

We also illustrate how realized volatility, based on 5-minute trading intervals over the trading day increase progressively on the halt day with a sharp spike occurring during the halt interval. After an interval of about ten-minutes subsequent to the halt, realized volatility dissipates markedly. An asymmetric pattern for volatility shocks is observed: the volatility jumps in the SSCB halt intervals are significantly higher for stocks whose halts are triggered by sudden price drops, as opposed to price increases. Finally, it is not clear the IIROC modification of the SSCB rule for trades before 9:50 am after February 2, 2015 serves to reduce volatility. This may be due to the wide price limits established for trades (20%) in the 20-minute opening interval from 9:30

am to 9:50 am, that could induce informed traders to implement trades earlier in the day, before the 10% price limit is in effect.

Apart from the relevance of these findings to investors in an environment of severe volatility, our findings should also be of interest to policy makers and regulators as they monitor and refine trading protocols to improve market efficiency and fairness.

The objective of the last essay has been to re-examine the reported anomalies in the option pricing literature using a robust methodology. The volatility spread anomaly, reported by Goyal and Saretto (2009), has been investigated by taking into account trading frictions such as cash collateral requirements for written options and option trading costs. We find that trading frictions reduce returns to long-short straddle trading strategy based on the difference between HV and IV. Returns only disappear when the ratio of effective spread to quoted spread is greater than 70%. Furthermore, these returns are not explained by well-known risk factors. Additional subperiod analysis has shown that anomalous returns are concentrated on pre-2006 period and reduce significantly after 2006.

It is a well-known fact that option trading strategies have non-linear payoffs, and therefore linear factor models cannot provide a robust risk measure for option trading profits. Hence, we employ Second order stochastic dominance test which are distribution assumption free, to assess whether the pre-2006 positive returns to this strategy are abnormal (i.e. whether they are profitable for risk averse investors). Second order stochastic dominance test results confirm that volatility spread anomaly persist pre-2006. However, empirical results suggest that the volatility spread anomaly has been completely vanished after 2006.

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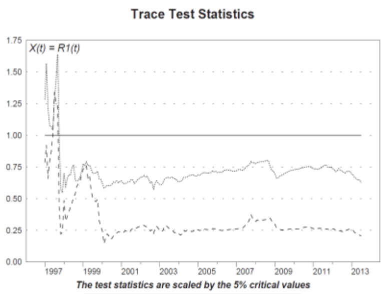
Figures

Figure 2.1: Bivariate Recursive Cointegration Trace Test Statistics R1(t), Benchmark Portfolio- S&P 500, July 1997-Aug. 2013

CHN



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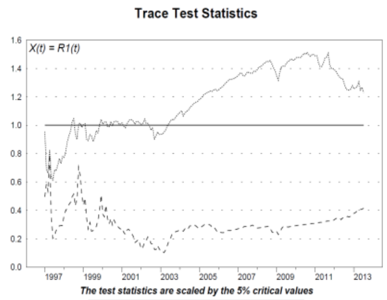

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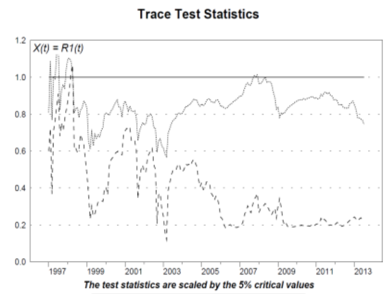

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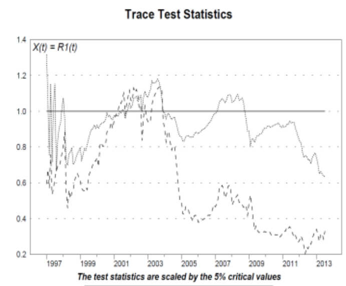
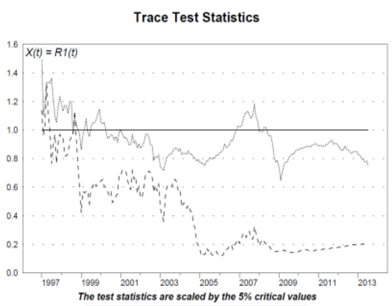


GBR



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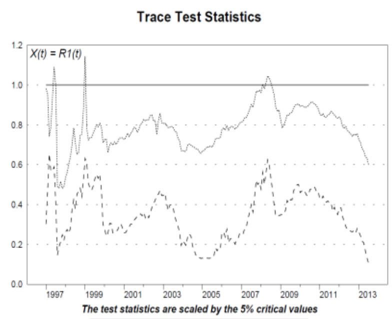

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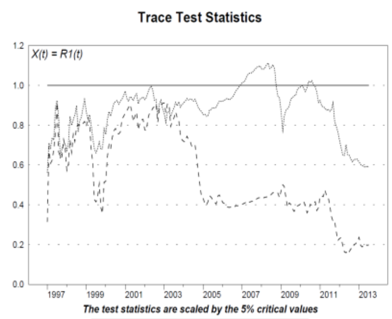

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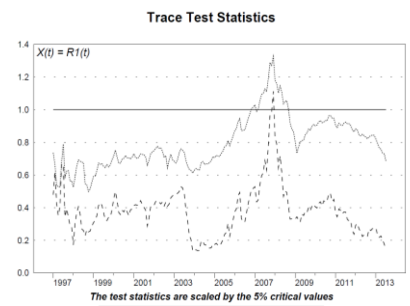
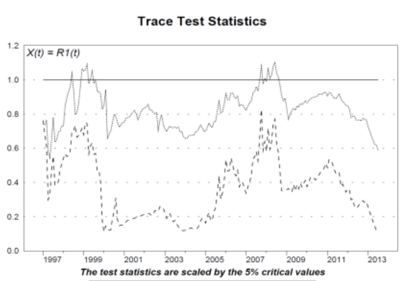
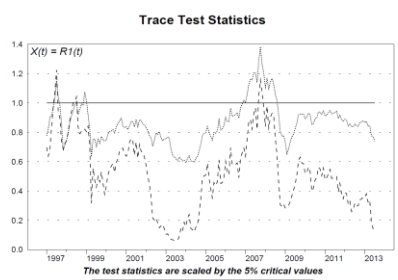


CAN



AUS



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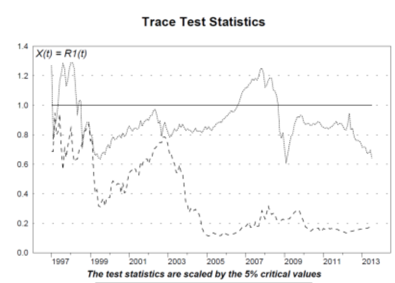

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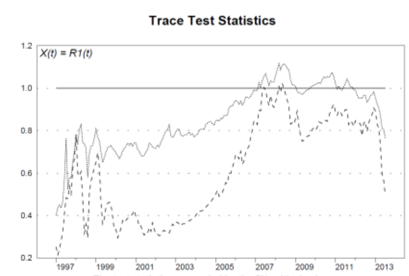
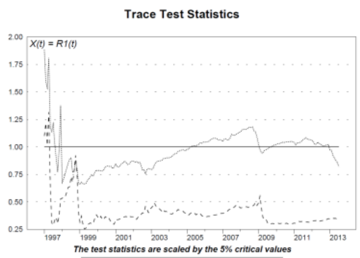


Figure 2.1 (cont'd)
Bivariate Recursive Cointegration Trace Test Statistics R1(t) : Benchmark Portfolio- S&P 500, July 1997-Aug. 2013

KOR



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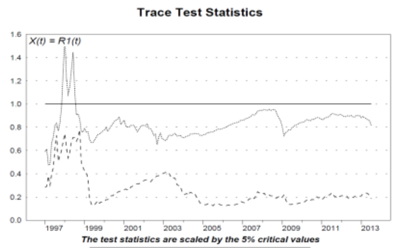
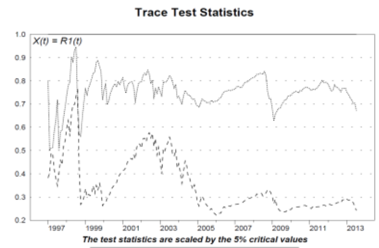
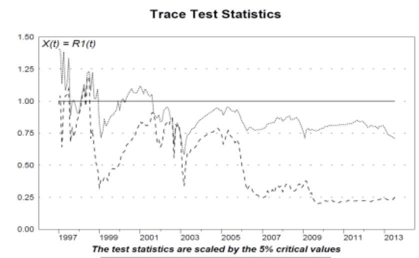


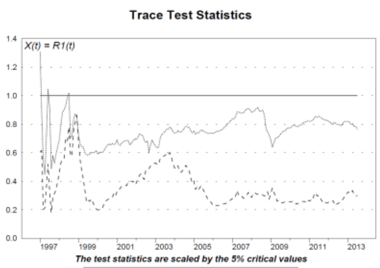
TUR



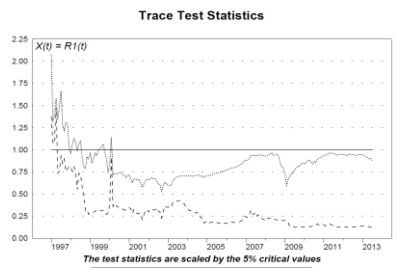
NLD



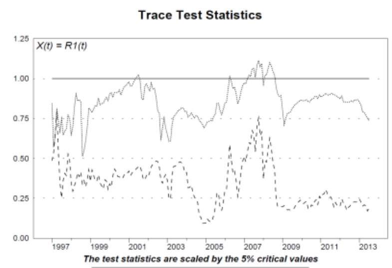
CHE



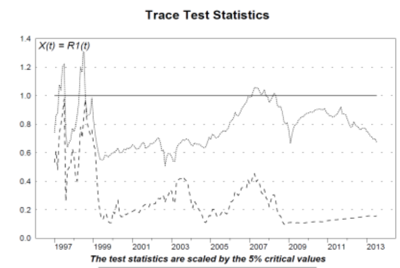
SWE



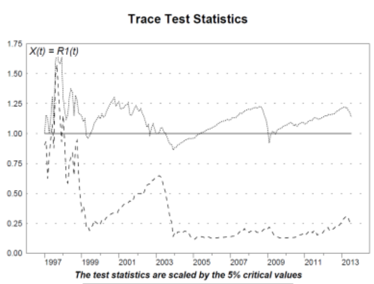
NOR



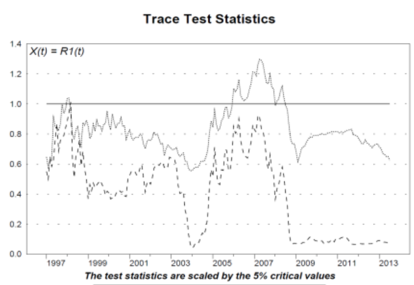
BEL



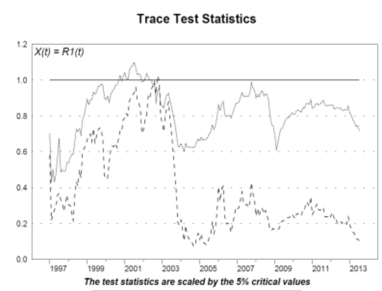
TAI



AUT



ZAF



THA

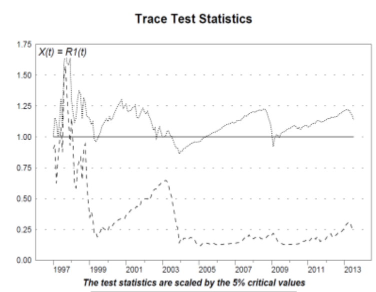
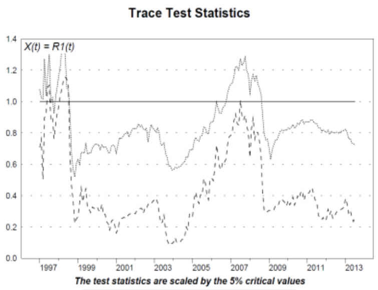
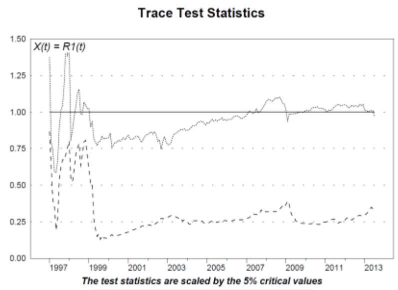


Figure 2.1 (cont'd)
Bivariate Recursive Cointegration Trace Test Statistics R1(t) : Benchmark Portfolio- S&P 500, July 1997-Aug. 2013

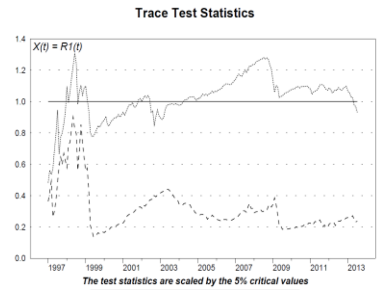
DNK



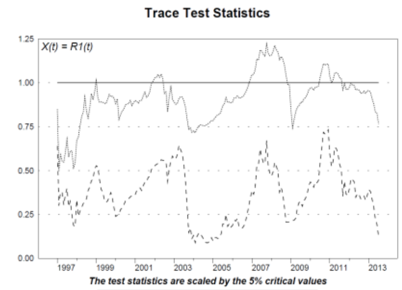
MYS



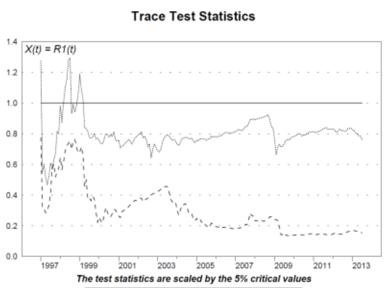
SGP



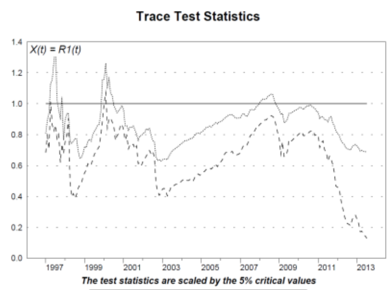
CHL



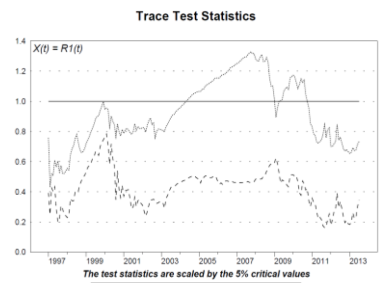
HKG



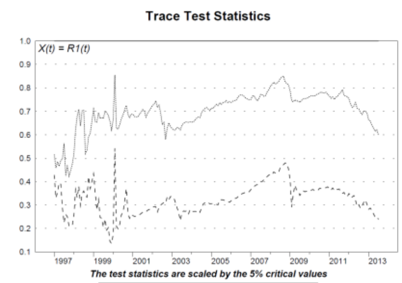
FIN



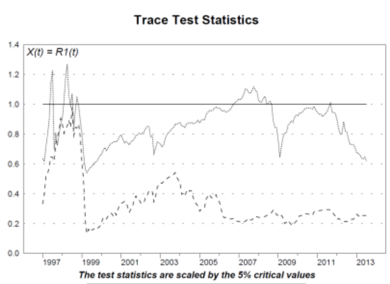
GRC



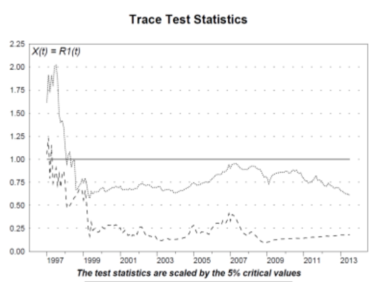
ISR



PRT



IRL



NZL

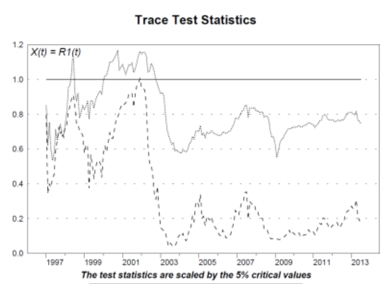
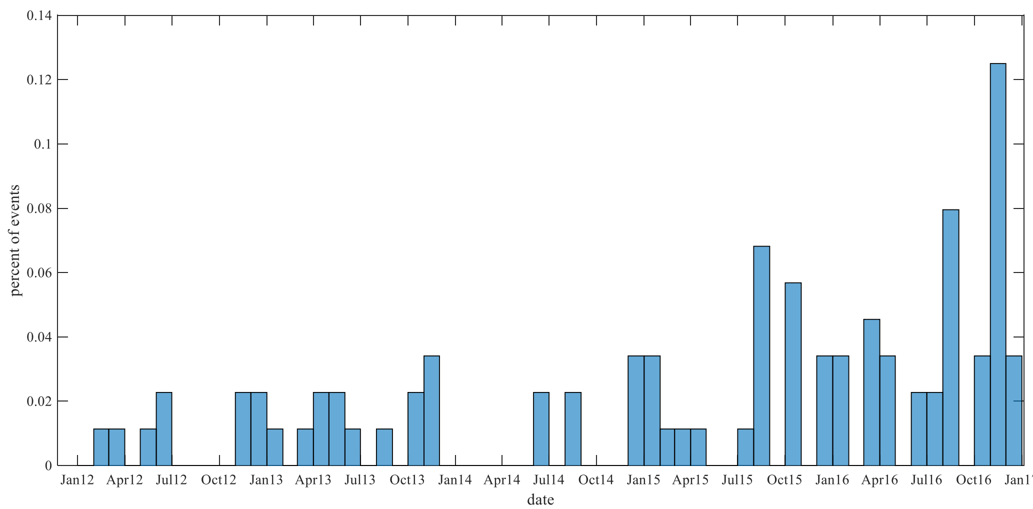


Figure 3.1: Distribution of single stock circuit breaker events

The following figures show the date and time distribution of single stock circuit breaker halts between Feb 2, 2012 and Dec 31, 2016. SSCB halts are collected from IIROC website. Events include common stocks from TSE during the regular trading hours from 9:30 to 16:00.

Panel A. Distribution of date of events



Panel B. Distribution of events by time of day

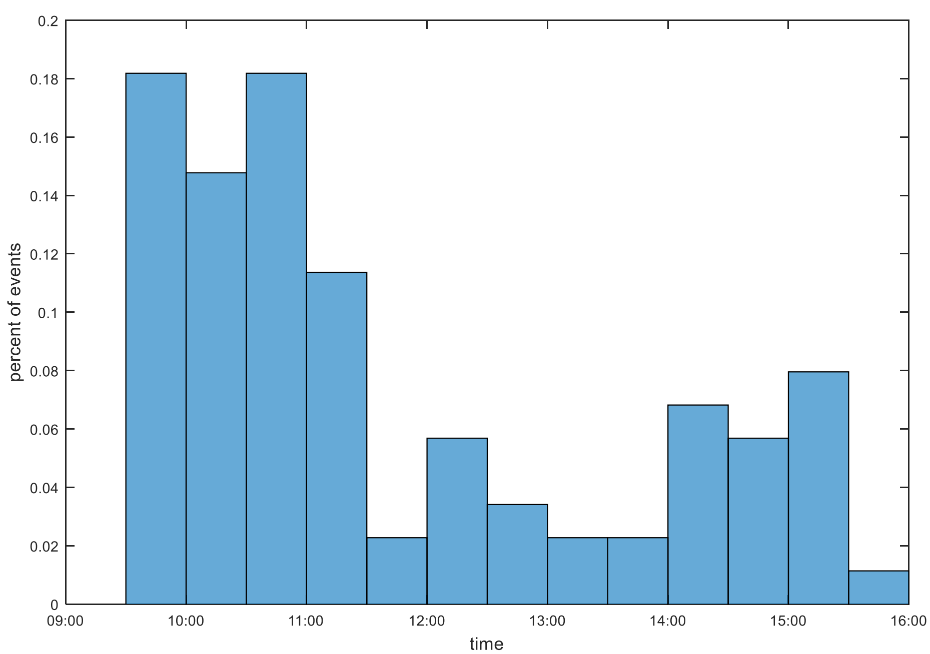
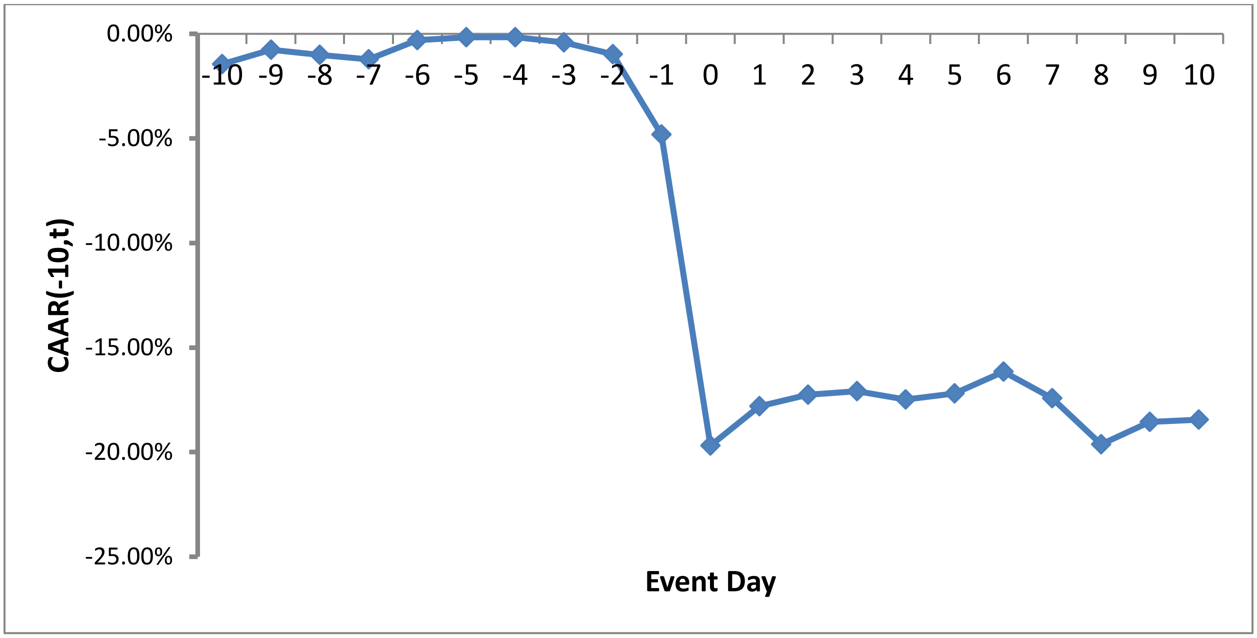


Figure 3.2: CAAR around the SSCB event day

This figure reports cumulative average abnormal (CAAR) returns for single stock circuit breaker halts. The event day is denoted as day 0. The CAARs are calculated for the (-10, 10) event window. Panel A (B) shows CAARs for SSCB events triggered by intraday decline (ascension).

Panel A: CAARs around SSCB events triggered by price decline



Panel B: CAARs around SSCB events triggered by price increase

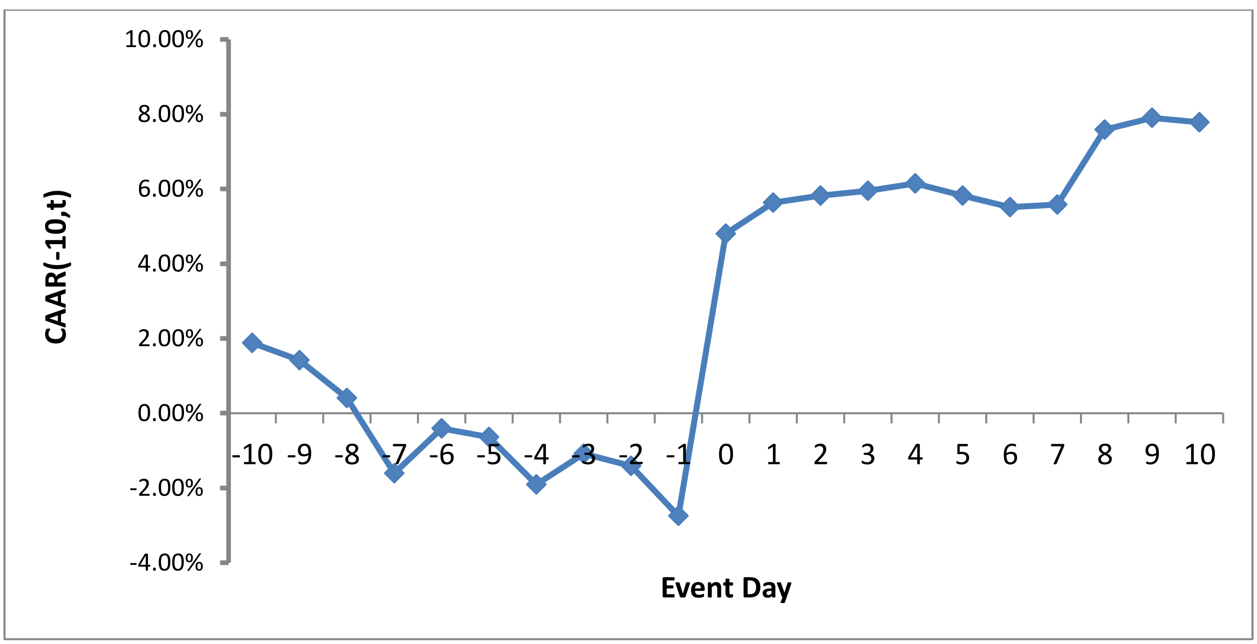
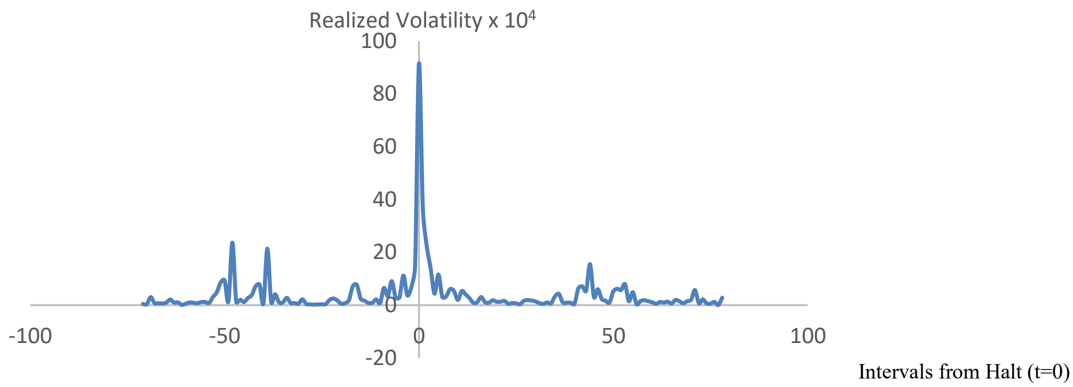


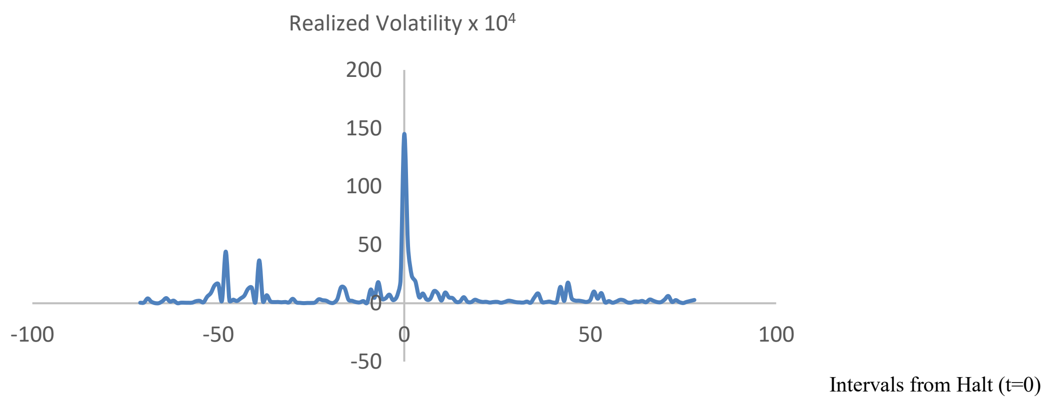
Figure 3.3: Plots of Realized Volatility around the Single Stock Circuit Breaker Halt Interval (t=0)

Realized Volatility for SSCB halted companies in the sample. Panel A contains all the SSCB halted stocks in the sample. Panel B is based on stocks that experience a drop in stock price that triggers the SSCB halt. Panel C is based on stocks that experience a positive price jump that triggers the SSCB halt

Panel A. Realized Volatility for all SSCB halt sample stocks



Panel B. Realized Volatility for stocks that experience SSCB halts triggered by a drop in price



Panel C. Realized Volatility of stocks that experience SSCB halts triggered by an increase in price

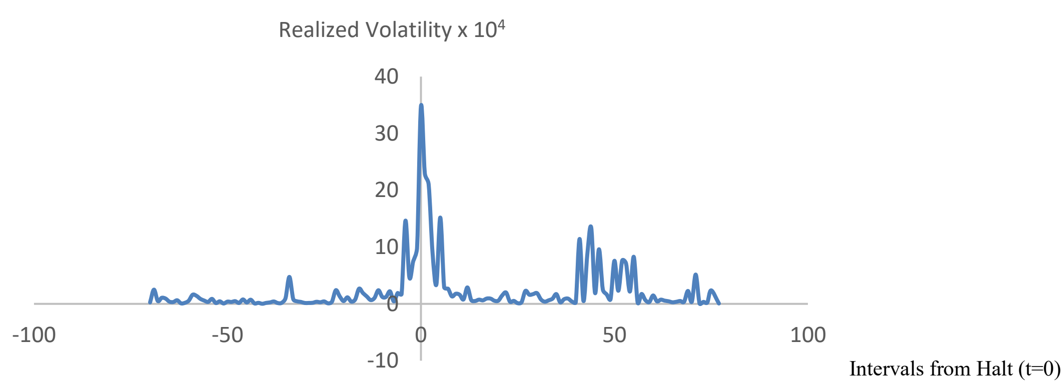
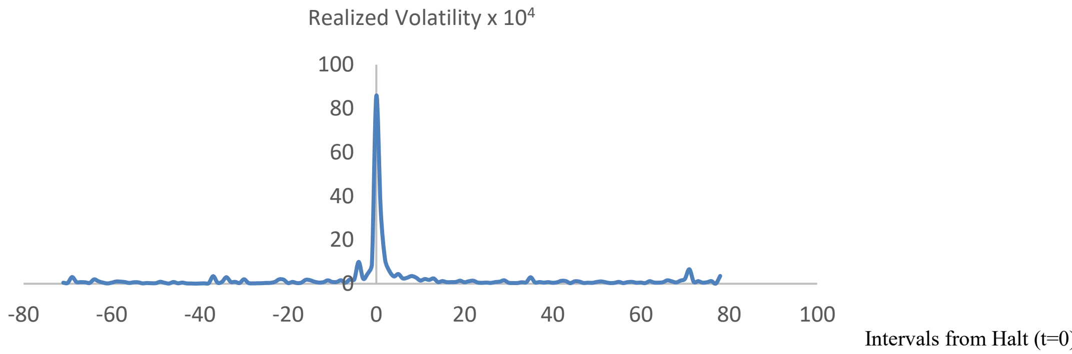


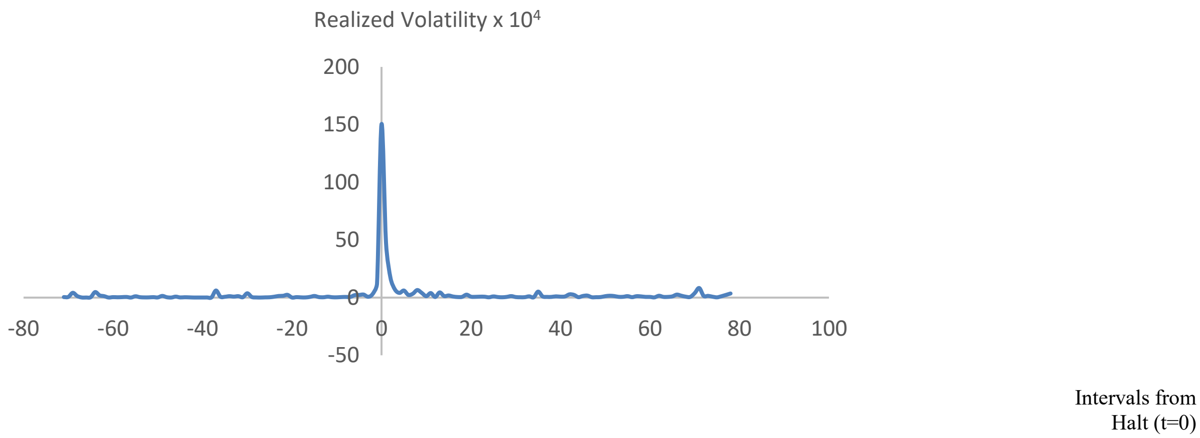
Figure 3.4: Plots of Realized Volatility around the Single Stock Circuit Breaker Halt Interval (t=0) – No Multiple Halt

Realized Volatility for the halted companies in the "No Multiple Halt on the Same Day" sample. This sample does not contain the stocks that are halted by IIROC multiple times on the same day. Panel A contains all the SSCB halted stocks in the sample. Panel B is based on stocks that experience a drop in stock price that triggers the SSCB halt. Panel C is based on stocks that experience a positive price jump that triggers the SSCB halt.

Panel A. Realized Volatility for all SSCB halt sample stocks



Panel B. Realized Volatility of stocks that experience SSCB halts triggered by a drop in price



Panel C. Realized Volatility of stocks that experience SSCB halts triggered by an increase in price

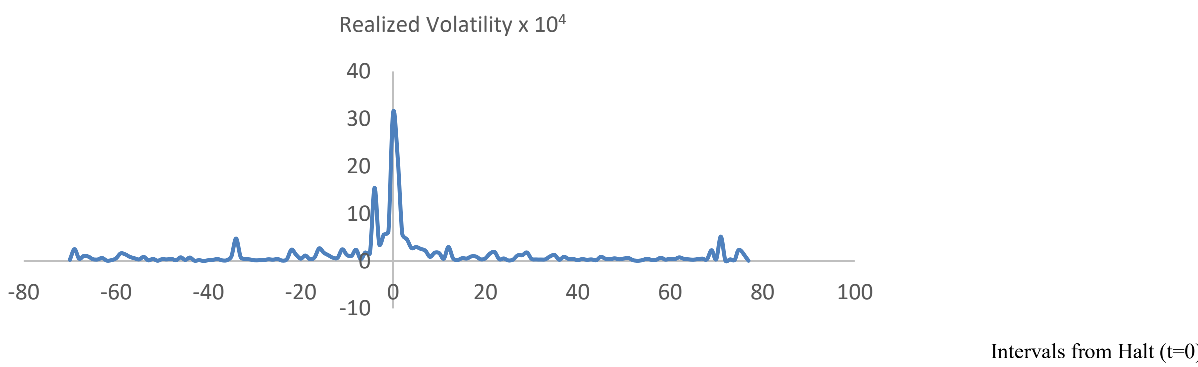
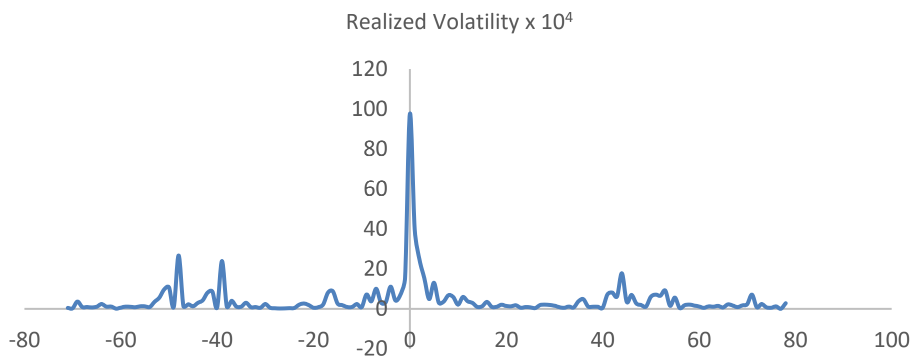


Figure 3.5: Plots of Realized Volatility around the Single Stock Circuit Breaker Halt Interval (t=0) – With Material News on Factiva

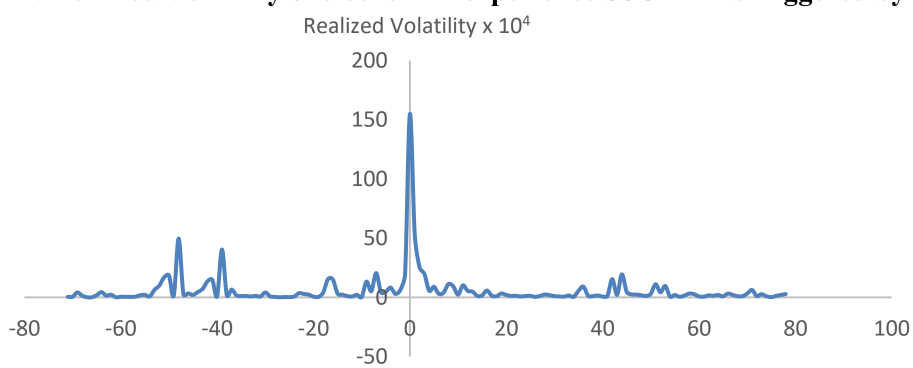
Realized Volatility for the halted companies in the "With Material News on Factiva" sample. This sample is limited to halts associated with material news on Factiva. Panel A contains all the SSCB halted stocks in the sample. Panel B is based on stocks that experience a drop in stock price that triggers the SSCB halt. Panel C is based on stocks that experience a positive price jump that triggers the SSCB halt

Panel A. Realized Volatility for all SSCB halt sample stocks



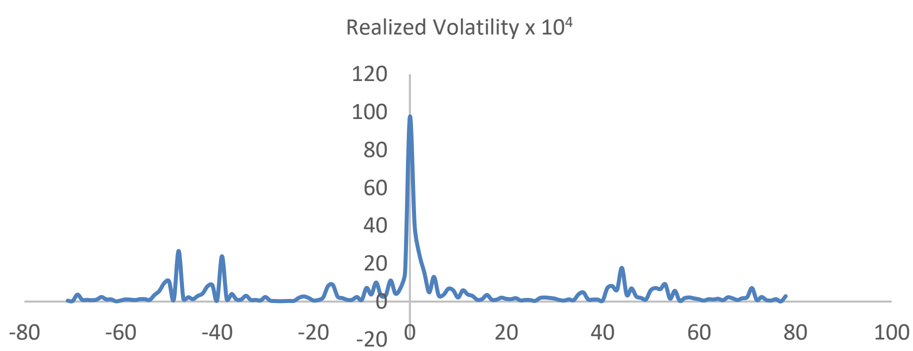
Intervals from Halt (t=0)

Panel B. Realized Volatility of stocks that experience SSCB halts triggered by a drop in price



Intervals from Halt (t=0)

Panel C. Realized Volatility of stocks that experience SSCB halts triggered by an increase in price

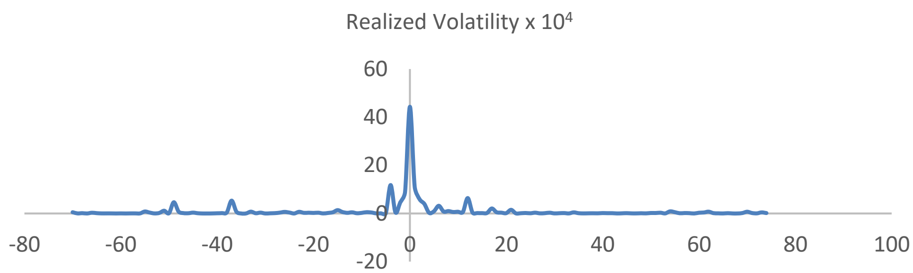


Intervals from Halt (t=0)

Figure 3.6: Plots of Realized Volatility around the Single Stock Circuit Breaker Halt Interval (t=0) – No Material News on Factiva

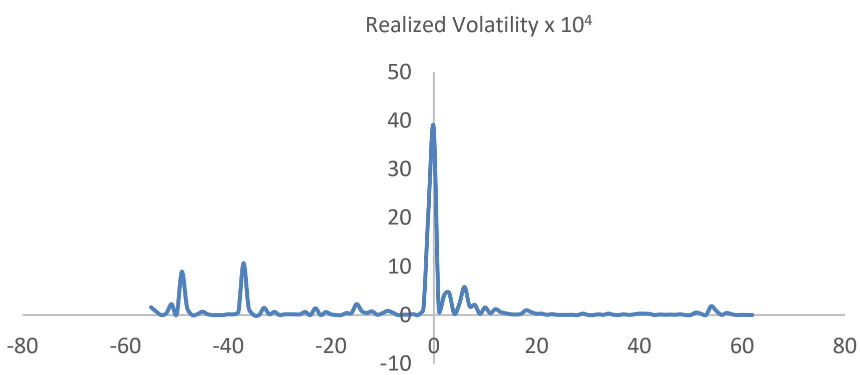
Realized Volatility for the halted companies in the "No Material News on Factiva" sample. This sample is limited to halts not associated with material news on Factiva. Panel A contains all the SSCB halted stocks in the sample. Panel B is based on stocks that experience a drop in stock price that triggers the SSCB halt. Panel C is based on stocks that experience a positive price jump that triggers the SSCB halt

Panel A. Realized Volatility for all SSCB halt sample stocks



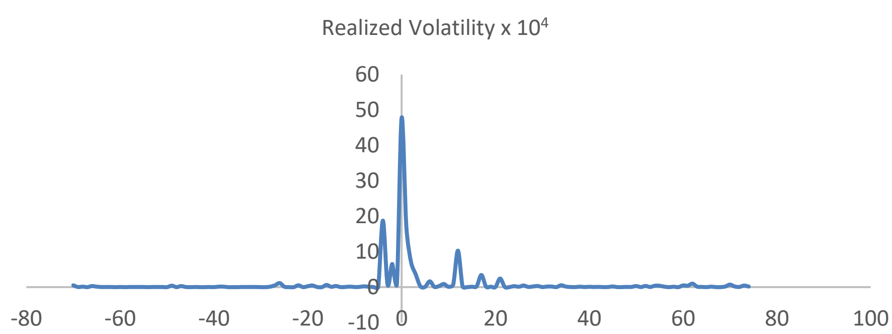
Intervals from Halt (t=0)

Panel B. Realized Volatility of stocks that experience SSCB halts triggered by a drop in price



Intervals from Halt (t=0)

Panel C. Realized Volatility of stocks that experience SSCB halts triggered by an increase in price



Intervals from Halt (t=0)

Tables

Table 2.1: Descriptive statistics of sample countries

This table tabulates descriptive statistics of sample countries. Panel A presents countries by GDP, population and corporate governance effectiveness. GDP and population data are obtained from the International Monetary Fund (IMF) as of 2012. The average overall Governance Metrics International (GMI) ratings are calculated as the mean overall GMI rating of companies covered by GMI as of 2010. Corruption Perceptions Index and rating are from Transparency International (TI) as of 2012. TI publishes the annually ranking countries by their perceived levels of corruption, as determined by expert assessments and opinion surveys. The CPI ranks countries on a scale from 100 (very clean) to 0 (highly corrupt). The last 9 rows of this table present the sum and mean of tabulated statistics for developed and emerging countries separately as well as together. Panel B of this table presents descriptive statistics for the stock markets of sample countries. The presented statistics are from World Development Indicators 2013 of the World Bank. The last 9 rows of this table present the sum and mean of tabulated statistics for developed and emerging countries separately as well as together.

GDP rank	Symbol	Country name	Emerging Dummy	GDP (Billions of $US)	Population (millions)	GDP Per Capita ($)	Average Overall GMI rating	Corruption Perception Ranking (2012)	Corruption Perception Index (2012)
Panel A: Countries by GDP, population and corporate governance effectiveness									
1	USA	United States	0	15,684.75	314.18	49,922.18	7.16	19	73
2	CHN	China	1	8,227.04	1,354.04	6,075.92	3.37	80	39
3	JPN	Japan	0	5,963.97	127.61	46,735.54	3.30	17	74
4	DEU	Germany	0	3,400.58	81.92	41,512.49	5.80	13	79
5	FRA	France	0	2,608.70	63.41	41,140.83	4.70	22	71
6	GBR	United Kingdom	0	2,440.51	63.24	38,588.72	7.60	17	74
7	BRA	Brazil	1	2,395.97	198.36	12,078.83	3.91	69	43
8	ITA	Italy	0	2,014.08	60.82	33,114.86	5.25	72	42
9	IND	India	1	1,824.83	1,223.17	1,491.89	4.54	94	36
10	CAN	Canada	0	1,819.08	34.83	52,231.92	7.36	9	84
11	AUS	Australia	0	1,541.80	22.77	67,723.67	6.65	7	85
12	ESP	Spain	0	1,352.06	46.16	29,288.76	3.97	30	65
13	MEX	Mexico	1	1,177.12	114.87	10,247.20	2.43	105	34
14	KOR	South Korea	1	1,155.87	50.01	23,112.82	3.93	45	56
15	IDN	Indonesia	1	878.20	244.47	3,592.28	3.14	118	32
16	TUR	Turkey	1	794.47	74.89	10,609.17	3.62	54	49
17	NLD	Netherlands	0	773.12	16.76	46,142.41	6.45	9	84
18	CHE	Switzerland	0	632.40	8.00	79,030.24	5.86	6	86
19	SWE	Sweden	0	526.19	9.54	55,156.39	5.88	4	88
20	NOR	Norway	0	501.10	5.04	99,464.27	4.90	7	85
21	BEL	Belgium	0	484.69	11.10	43,685.62	4.35	16	75
22	TAI	Taiwan	1	473.97	23.32	20,328.14	3.84	37	61
23	AUT	Austria	0	398.59	8.47	47,081.74	5.77	25	69
24	ZAF	South Africa	1	384.32	51.20	7,506.59	6.09	69	43
25	THA	Thailand	1	365.56	64.38	5,678.49	4.20	88	37
26	DNK	Denmark	0	313.64	5.58	56,197.28	4.79	1	90
27	MYS	Malaysia	1	303.53	29.46	10,304.07	4.21	54	49
28	SGP	Singapore	1	276.52	5.41	51,160.04	4.82	5	87
29	CHL	Chile	1	268.18	17.40	15,409.81	2.13	20	72
30	HKG	Hong Kong	1	263.02	7.17	36,668.20	4.06	14	77
31	FIN	Finland	0	250.13	5.43	46,097.68	6.38	1	90
32	GRC	Greece	0	249.20	11.30	22,055.14	4.25	94	36
33	ISR	Israel	1	240.89	7.70	31,297.13	3.79	39	60
34	PRT	Portugal	0	212.72	10.54	20,178.33	4.14	33	63
35	IRL	Ireland	0	210.42	4.59	45,892.26	7.21	25	69
36	NZL	New Zealand	0	169.68	4.44	38,224.83	6.70	1	90
All Countries:									
Total				60,576.87	4,381.54	-	-	-	-
Average				1,682.69	-	34,584.05	4.90	36.64	65.19
Developed Countries:									
Total				41,547.39	915.71	-	-	-	-
Average				1,978.45	-	47,593.58	5.64	20.38	74.86
Emerging Countries:									
Total				19,029.48	3,465.83	-	-	-	-
Average				1,268.63	-	16,370.71	3.87	59.40	51.67

Table 2.1 (continued): Descriptive statistics of sample countries

This table tabulates descriptive statistics of sample countries. Panel A presents countries by GDP, population and corporate governance effectiveness. GDP and population data are obtained from the International Monetary Fund (IMF) as of 2012. The average overall Governance Metrics International (GMI) ratings are calculated as the mean overall GMI rating of companies covered by GMI as of 2010. Corruption Perceptions Index and rating are from Transparency International (TI) as of 2012. TI publishes the annually ranking countries by their perceived levels of corruption, as determined by expert assessments and opinion surveys. The CPI ranks countries on a scale from 100 (very clean) to 0 (highly corrupt). The last 9 rows of this table present the sum and mean of tabulated statistics for developed and emerging countries seperately as well as together. Panel B of this table presents descriptive statistics for the stock markets of sample countries. The presented statistics are from World Development Indicators 2013 of the World Bank. The last 9 rows of this table present the sum and mean of tabulated statistics for developed and emerging countries seperately as well as together.

		Market capitalization				Market Value of		Turnover ratio Value of shares		Listed domestic number		S&P/Global	
		$ billions		% of GDP		% of GDP		% of market				% change	
GDP rank	Symbol	2005	2012	2005	2011	2005	2011	2005	2012	2005	2012	2011	2012
Panel B: Descriptive statistics of sample country stock markets													
1	USA	16,970.87	18,668.33	135.10	104.30	171.20	205.10	129.20	124.60	5,143.00	4,102.00	0.00	13.40
2	CHN	780.76	3,697.38	34.60	46.30	26.00	104.80	82.50	164.40	1,387.00	2,494.00	-21.70	17.20
3	JPN	4,736.51	3,680.98	103.60	60.00	109.30	70.60	118.80	99.80	3,279.00	3,470.00	-12.20	18.00
4	DEU	1,221.25	1,486.32	44.10	32.90	63.70	48.80	146.00	91.80	648.00	665.00	-16.60	27.00
5	FRA	1,758.72	1,823.34	82.30	56.40	71.40	53.00	92.00	66.40	885.00	862.00	-19.50	15.20
6	GBR	3,058.18	3,019.47	133.20	118.70	181.50	121.60	141.90	84.00	2,759.00	2,179.00	-6.10	5.80
7	BRA	474.65	1,229.85	53.80	49.60	17.50	38.80	38.30	67.90	381.00	353.00	-24.40	-0.30
8	ITA	798.17	480.45	44.70	19.70	62.40	40.50	140.50	166.60	275.00	279.00	-27.60	11.00
9	IND	553.07	1,263.34	66.30	54.20	52.00	39.50	92.20	54.60	4,763.00	5,191.00	-38.00	23.30
10	CAN	1,480.89	2,016.12	130.60	107.20	74.50	85.50	63.60	61.60	3,721.00	3,876.00	-14.70	6.00
11	AUS	804.07	1,286.44	116.10	86.60	89.00	90.00	78.00	84.70	1,643.00	1,959.00	-15.70	15.00
12	ESP	960.02	995.10	84.90	69.80	137.70	96.10	163.90	106.30	3,300.00	3,167.00	-16.80	1.50
13	MEX	239.13	525.06	28.20	35.30	6.20	9.70	25.70	25.30	151.00	131.00	-14.80	26.90
14	KOR	718.18	1,180.47	85.00	89.20	142.40	182.40	209.80	139.20	1,620.00	1,767.00	-10.90	18.90
15	IDN	81.43	396.77	28.50	46.10	14.70	16.50	54.20	23.30	335.00	459.00	1.10	2.80
16	TUR	161.54	308.78	33.40	26.00	41.70	53.40	154.90	136.50	302.00	405.00	-37.00	60.70
17	NLD	592.91	651.00	92.90	71.10	130.90	66.30	147.70	70.80	237.00	105.00	-16.40	17.50
18	CHE	938.62	1,079.02	244.00	141.40	229.60	140.80	100.10	63.70	263.00	238.00	-9.40	18.10
19	SWE	403.95	560.53	109.00	87.20	125.20	93.80	118.90	73.00	252.00	332.00	-18.50	19.70
20	NOR	190.95	252.95	62.80	44.60	64.10	42.40	117.20	56.30	191.00	184.00	-18.10	16.40
21	BEL	288.52	300.06	76.50	44.70	33.30	20.90	44.80	39.00	222.00	154.00	-15.10	33.30
22	TAI	-	-	-	-	-	-	-	-	-	-	-	-
23	AUT	124.39	106.04	40.80	19.70	15.10	9.30	43.60	50.10	92.00	70.00	-35.80	29.90
24	ZAF	565.41	612.31	228.90	130.20	81.20	92.60	39.30	54.90	388.00	348.00	-17.40	15.70
25	THA	124.86	383.00	70.80	77.70	50.60	67.20	73.90	70.40	504.00	502.00	-4.70	39.60
26	DNK	178.04	224.86	69.10	53.80	59.00	45.10	92.30	52.20	179.00	174.00	-17.30	29.40
27	MYS	181.24	476.34	126.30	137.20	34.80	44.80	26.90	28.60	1,020.00	921.00	-1.10	11.40
28	SGP	316.66	414.13	256.40	125.80	97.00	103.60	40.40	43.30	685.00	472.00	-21.20	28.90
29	CHL	136.45	313.33	109.70	107.60	15.20	22.70	14.90	16.00	245.00	225.00	-24.10	11.40
30	HKG	693.49	1,108.13	381.90	357.70	162.00	623.80	43.30	123.10	1,020.00	1,459.00	-20.20	22.60
31	FIN	209.50	158.69	107.00	54.40	139.70	66.20	139.10	83.50	134.00	119.00	-33.10	12.70
32	GRC	145.01	44.58	60.40	11.60	27.20	8.50	48.30	37.90	307.00	267.00	-58.30	24.70
33	ISR	120.11	148.44	89.70	59.70	44.70	43.40	55.50	45.90	572.00	532.00	-29.70	3.10
34	PRT	66.98	65.53	34.90	26.00	21.70	15.20	60.70	41.80	48.00	46.00	-31.00	3.00
35	IRL	114.13	109.01	56.30	48.90	31.90	7.10	56.70	11.20	53.00	42.00	-1.50	19.40
36	NZL	43.41	79.80	38.40	51.40	15.40	12.80	40.00	33.00	154.00	142.00	-3.80	26.50
All Countries:													
Total		40,232.07	49,145.91	-	-	-	-	-	-	37,158.00	37,691.00	-	-
Average		1,149.49	-	98.86	75.80	75.42	79.51	86.72	71.19	1,061.66	1,076.89	-18.62	18.45
Developed Countries:													
Total		35,085.10	37,088.61	-	-	-	-	-	-	23,785.00	22,432.00	-	-
Average		1,670.72	-	88.89	62.40	88.28	63.79	99.20	71.35	1,132.62	1,068.19	-18.45	17.31
Emerging Countries:													
Total		5,146.97	12,057.30	-	-	-	-	-	-	13,373.00	15,259.00	-	-
Average		367.64	-	113.82	95.90	56.14	103.09	67.99	70.96	955.21	1,089.93	-18.86	20.16

Table 2.2 : Descriptive Statistics and Risk-Return Characteristics of return indexes

This table presents descriptive statistics and risk-return Characteristics for sample countries return indices. The sample period is from August 1996 to July 2013. Panel A tabulates the statistics for US return Indices. The statistics for Total, Large-cap and Small-cap indices of other countries are presented in Panel B, Panel C and Panel D respectively. The countries are ordered in descending order, based on the national gross domestic product (GDP) for the year 2012.

Symbol	Country	Mean Return	Median Return	Std. Dev	Skew.	Kurt.	JB test (p value)	Sharpe Ratio	Sortino Ratio	Ljung-Box Q-test (5 leg)	Corr. with SP500	Corr. with R2000	Corr. with USLtGv
						Panel A: US Return Indices							
SP500	USA	0.738%	1.260%	4.634%	-0.632	3.769	0.003	0.113	0.160	0.394	1.000	0.816	-0.198
R2000	USA	0.880%	1.576%	5.985%	-0.503	3.845	0.006	0.111	0.159	0.492	0.816	1.000	-0.250
USLtGvt	USA	0.671%	0.851%	3.124%	-0.001	5.452	0.000	0.146	0.228	0.003	-0.198	-0.250	1.000
						Panel B: Country Total Return Indices							
CHN	China	1.491%	1.288%	11.365%	0.536	7.285	0.000	0.112	0.180	0.236	0.481	0.562	-0.145
JPN	Japan	0.177%	0.157%	5.354%	0.086	2.928	0.855	-0.007	-0.010	0.019	0.519	0.476	-0.078
DEU	Germany	0.860%	1.412%	7.028%	-0.562	4.281	0.001	0.092	0.129	0.720	0.804	0.776	-0.220
FRA	France	0.821%	1.383%	6.222%	-0.550	3.635	0.007	0.097	0.137	0.371	0.804	0.746	-0.211
GBR	UK	0.702%	0.997%	4.782%	-0.530	4.734	0.000	0.102	0.146	0.009	0.812	0.707	-0.232
BRA	Brazil	1.616%	2.125%	11.428%	-0.201	5.370	0.000	0.123	0.183	0.950	0.617	0.581	-0.210
ITA	Italy	0.694%	0.900%	7.343%	-0.195	3.352	0.256	0.065	0.094	0.201	0.682	0.661	-0.164
IND	India	1.147%	1.358%	9.050%	-0.055	4.165	0.010	0.103	0.155	0.539	0.475	0.505	-0.103
CAN	Canada	0.989%	1.660%	6.369%	-0.784	5.427	0.000	0.122	0.172	0.237	0.799	0.783	-0.171
AUS	Australia	1.123%	1.708%	6.432%	-0.645	4.803	0.000	0.141	0.204	0.429	0.724	0.683	-0.104
ESP	Spain	1.000%	1.451%	7.326%	-0.358	3.829	0.014	0.107	0.157	0.155	0.690	0.643	-0.148
MEX	Mexico	1.630%	2.299%	7.980%	-0.651	5.115	0.000	0.178	0.265	0.538	0.710	0.712	-0.152
KOR	South Korea	1.039%	0.255%	12.007%	0.871	7.272	0.000	0.069	0.112	0.739	0.541	0.493	-0.174
IDN	Indonesia	1.272%	2.172%	13.169%	0.299	6.414	0.000	0.080	0.122	0.010	0.437	0.409	-0.058
TUR	Turkey	1.979%	1.418%	15.319%	0.322	4.612	0.001	0.115	0.185	0.261	0.516	0.499	-0.159
NLD	Netherlands	0.784%	1.694%	6.161%	-0.843	4.904	0.000	0.092	0.126	0.418	0.801	0.743	-0.214
CHE	Switzerland	0.825%	1.345%	5.133%	-0.476	3.951	0.005	0.119	0.171	0.228	0.704	0.602	-0.163
SWE	Sweden	1.178%	1.743%	7.917%	-0.278	4.258	0.005	0.122	0.180	0.135	0.773	0.755	-0.251
NOR	Norway	1.068%	1.394%	8.163%	-0.884	5.700	0.000	0.105	0.146	0.191	0.710	0.701	-0.299
BEL	Belgium	0.791%	1.533%	6.389%	-1.292	8.524	0.000	0.090	0.121	0.001	0.703	0.623	-0.133
TWN	Taiwan	0.554%	0.755%	8.414%	0.145	3.692	0.071	0.040	0.060	0.191	0.538	0.505	-0.209
AUT	Austria	0.696%	1.264%	7.190%	-0.930	6.975	0.000	0.067	0.091	0.002	0.624	0.600	-0.154
ZAF	South Africa	1.078%	1.070%	8.036%	-0.626	4.487	0.001	0.108	0.155	0.612	0.593	0.640	-0.104
THA	Thailand	0.926%	1.503%	10.762%	0.072	4.712	0.001	0.066	0.098	0.423	0.484	0.420	-0.066
DNK	Denmark	1.087%	2.041%	6.133%	-0.776	5.588	0.000	0.142	0.204	0.035	0.718	0.666	-0.177
MYS	Malaysia	0.665%	0.977%	8.592%	0.695	10.693	0.000	0.052	0.079	0.004	0.389	0.395	-0.166
SGP	Singapore	0.896%	1.237%	8.207%	-0.068	5.424	0.000	0.083	0.121	0.683	0.688	0.648	-0.202
CHL	Chile	0.900%	1.064%	6.800%	-0.482	4.948	0.000	0.101	0.146	0.064	0.545	0.530	-0.233
HKG	Hong Kong	0.818%	1.312%	7.632%	-0.011	5.702	0.000	0.079	0.117	0.294	0.642	0.621	-0.148
FIN	Finland	1.269%	1.275%	9.404%	-0.032	3.954	0.026	0.112	0.171	0.084	0.705	0.623	-0.185
GRC	Greece	0.426%	0.483%	10.487%	-0.065	3.992	0.021	0.020	0.029	0.058	0.540	0.491	-0.244
ISR	Israel	0.951%	1.040%	7.221%	0.041	4.683	0.001	0.102	0.153	0.797	0.580	0.599	-0.190
PRT	Portugal	0.696%	1.124%	6.864%	-0.460	3.815	0.008	0.070	0.099	0.032	0.602	0.557	-0.125
IRL	Ireland	0.962%	1.924%	6.447%	-0.830	4.932	0.000	0.116	0.161	0.001	0.763	0.691	-0.206
NZL	New Zealand	0.937%	1.180%	6.310%	-0.392	3.9163	0.0091	0.114	0.166	0.030	0.619	0.548	-0.072
	mean:	**0.973%**	**1.330%**	**8.098%**	**-0.283**	**5.088**	**0.037**	**0.094**	**0.138**	**0.277**	**0.638**	**0.606**	**-0.168**
	median:	**0.937%**	**1.345%**	**7.343%**	**-0.358**	**4.734**	**0.000**	**0.102**	**0.146**	**0.201**	**0.642**	**0.621**	**-0.166**
	min.:	**0.177%**	**0.157%**	**4.782%**	**-1.292**	**2.928**	**0.000**	**-0.007**	**-0.010**	**0.001**	**0.389**	**0.395**	**-0.299**
	max:	**1.979%**	**2.299%**	**15.319%**	**0.871**	**10.693**	**0.855**	**0.178**	**0.265**	**0.950**	**0.812**	**0.783**	**-0.058**

Table 2.2 (cont.): Descriptive Statistics and Risk-Return Characteristics of return indexes

This table presents descriptive statistics and risk-return Characteristics for sample countries return indices. The sample period is from August 1996 to July 2013. Panel A tabulates the statistics for US return Indices. The statistics for Total, Large-cap and Small-cap indices of other countries are presented in Panel B, Panel C and Panel D respectively. The countries are ordered in descending order, based on the national gross domestic product (GDP) for the year 2012.

Symbol	Country	Mean Return	Median Return	Std. Dev	Skew.	Kurt.	JB test (p value)	Sharpe Ratio	Sortino Ratio	Ljung-Box Q-test (5 leg)	Corr. with SP500	Corr. with R2000	Corr. with USLtGvt
	Panel C: Large-cap return Indices												
CHNLc	China	1.552%	1.199%	11.988%	0.857	8.246	0.000	0.112	0.185	0.454	0.462	0.548	-0.135
JPNLc	Japan	0.173%	-0.038%	5.362%	0.055	2.864	0.873	-0.008	-0.011	0.022	0.542	0.496	-0.093
DEULc	Germany	0.872%	1.481%	7.081%	-0.550	4.270	0.002	0.093	0.130	0.768	0.804	0.772	-0.221
FRALc	France	0.828%	1.356%	6.252%	-0.536	3.573	0.008	0.098	0.138	0.402	0.806	0.742	-0.209
GBRLc	UK	0.692%	0.904%	4.762%	-0.476	4.511	0.001	0.100	0.144	0.018	0.815	0.694	-0.227
BRALc	Brazil	1.610%	2.040%	11.664%	-0.159	5.661	0.000	0.120	0.179	0.971	0.615	0.571	-0.210
ITALc	Italy	0.682%	1.035%	7.421%	-0.183	3.304	0.330	0.063	0.091	0.194	0.682	0.657	-0.162
INDLc	India	1.044%	0.929%	9.113%	-0.091	3.574	0.166	0.091	0.136	0.860	0.476	0.507	-0.084
CANLc	Canada	0.996%	1.520%	6.419%	-0.738	5.236	0.000	0.122	0.173	0.247	0.806	0.771	-0.161
AUSLc	Australia	1.119%	1.491%	6.350%	-0.593	4.486	0.001	0.143	0.208	0.580	0.729	0.683	-0.107
ESPLc	Spain	0.997%	1.379%	7.449%	-0.334	3.805	0.018	0.105	0.154	0.155	0.691	0.642	-0.148
MEXLc	Mexico	1.698%	2.276%	8.056%	-0.570	5.001	0.000	0.184	0.279	0.573	0.698	0.699	-0.143
KORLc	South Korea	1.213%	0.595%	12.128%	1.217	9.013	0.000	0.082	0.140	0.468	0.530	0.473	-0.183
IDNLc	Indonesia	1.265%	1.801%	13.613%	0.478	7.148	0.000	0.077	0.118	0.127	0.448	0.419	-0.039
TURLc	Turkey	1.816%	1.185%	16.199%	0.167	3.875	0.028	0.099	0.155	0.251	0.506	0.496	-0.146
NLDLc	Netherlands	0.783%	1.486%	6.183%	-0.840	4.853	0.000	0.092	0.126	0.483	0.801	0.737	-0.211
CHELc	Switzerland	0.822%	1.415%	5.157%	-0.457	3.973	0.005	0.118	0.170	0.246	0.699	0.588	-0.158
SWELc	Sweden	1.163%	1.574%	8.060%	-0.282	4.175	0.006	0.118	0.174	0.158	0.770	0.746	-0.245
NORLc	Norway	1.134%	1.174%	8.384%	-0.872	5.736	0.000	0.110	0.154	0.438	0.683	0.669	-0.283
BELLc	Belgium	0.779%	1.463%	6.585%	-1.335	8.680	0.000	0.086	0.114	0.001	0.698	0.614	-0.122
TWNLc	Taiwan	0.564%	0.735%	8.292%	0.171	3.631	0.085	0.042	0.063	0.178	0.573	0.533	-0.206
AUTLc	Austria	0.887%	1.637%	7.763%	-0.810	6.159	0.000	0.087	0.120	0.014	0.611	0.570	-0.159
ZAFLc	South Africa	1.007%	1.220%	8.211%	-0.577	4.535	0.001	0.097	0.139	0.506	0.592	0.630	-0.092
THALc	Thailand	0.585%	1.524%	10.619%	0.027	4.801	0.001	0.035	0.050	0.606	0.476	0.406	-0.096
DNKLc	Denmark	1.050%	2.002%	6.275%	-0.676	5.087	0.000	0.133	0.192	0.144	0.713	0.650	-0.157
MYSLc	Malaysia	0.773%	0.967%	8.327%	0.599	9.511	0.000	0.067	0.102	0.003	0.360	0.369	-0.150
SGPLc	Singapore	0.887%	1.284%	8.254%	-0.171	4.931	0.001	0.081	0.118	0.850	0.688	0.641	-0.206
CHLLc	Chile	0.862%	0.924%	7.049%	-0.538	5.255	0.000	0.092	0.132	0.165	0.566	0.527	-0.230
HKGLc	Hong Kong	0.851%	1.160%	7.595%	0.122	5.630	0.000	0.084	0.127	0.381	0.637	0.608	-0.140
FINLc	Finland	1.294%	1.352%	9.978%	-0.016	3.993	0.022	0.108	0.165	0.080	0.693	0.603	-0.171
GRCLc	Greece	0.435%	0.326%	10.532%	-0.029	4.273	0.007	0.021	0.030	0.244	0.545	0.520	-0.237
ISRLc	Israel	1.012%	1.419%	7.297%	-0.094	4.784	0.001	0.109	0.161	0.636	0.510	0.542	-0.174
PRTLc	Portugal	0.703%	1.066%	6.890%	-0.450	3.968	0.006	0.071	0.100	0.053	0.597	0.551	-0.117
IRLLc	Ireland	0.918%	1.962%	6.634%	-0.773	4.830	0.000	0.106	0.147	0.001	0.761	0.666	-0.195
NZLLc	New Zealand	0.684%	0.629%	7.660%	-0.28	3.9952	0.0117	0.061	0.087	0.176	0.567	0.493	-0.053
	mean:	**0.964%**	**1.271%**	**8.274%**	**-0.250**	**5.068**	**0.045**	**0.091**	**0.134**	**0.327**	**0.633**	**0.595**	**-0.162**
	median:	**0.887%**	**1.352%**	**7.660%**	**-0.282**	**4.784**	**0.001**	**0.093**	**0.138**	**0.246**	**0.637**	**0.603**	**-0.159**
	min.:	**0.173%**	**-0.038%**	**4.762%**	**-1.335**	**2.864**	**0.000**	**-0.008**	**-0.011**	**0.001**	**0.360**	**0.369**	**-0.283**
	max:	**1.816%**	**2.276%**	**16.199%**	**1.217**	**9.511**	**0.873**	**0.184**	**0.279**	**0.971**	**0.815**	**0.772**	**-0.039**

Table 2.2 (cont.): Descriptive Statistics and Risk-Return Characteristics of return indexes

This table presents descriptive statistics and risk-return Characteristics for sample countries return indices. The sample period is from August 1996 to July 2013. Panel A tabulates the statistics for US return Indices. The statistics for Total, Large-cap and Small-cap indices of other countries are presented in Panel B, Panel C and Panel D respectively. The countries are ordered in descending order, based on the national gross domestic product (GDP) for the year 2012.

Symbol	Country	Mean Return	Median Return	Std. Dev	Skew.	Kurt.	JB test (p value)	Sharpe Ratio	Sortino Ratio	Ljung-Box Q-test (5 leg)	Corr. with SP500	Corr. with R2000	Corr. with USLtGvt
		Panel D: Small-cap return Indices											
CHNSc	China	1.440%	1.412%	11.294%	0.270	5.576	0.000	0.109	0.169	0.029	0.456	0.496	-0.178
JPNSc	Japan	0.250%	0.281%	6.089%	0.291	3.988	0.011	0.006	0.008	0.042	0.330	0.307	0.009
DEUSc	Germany	0.730%	1.407%	6.809%	-0.589	4.314	0.001	0.076	0.105	0.016	0.699	0.743	-0.177
FRASc	France	0.821%	1.472%	6.637%	-0.795	5.277	0.000	0.091	0.126	0.023	0.668	0.721	-0.224
GBRSc	UK	0.904%	1.368%	5.957%	-0.795	6.306	0.000	0.116	0.163	0.000	0.669	0.734	-0.247
BRASc	Brazil	1.939%	2.074%	11.207%	-0.189	4.776	0.001	0.154	0.238	0.028	0.571	0.593	-0.196
ITASc	Italy	0.864%	1.152%	7.122%	-0.179	3.974	0.018	0.091	0.134	0.352	0.612	0.639	-0.168
INDSc	India	1.321%	2.165%	10.028%	0.328	6.894	0.000	0.110	0.170	0.107	0.448	0.472	-0.103
CANSc	Canada	1.030%	1.735%	6.878%	-0.952	6.355	0.000	0.119	0.166	0.180	0.695	0.760	-0.200
AUSSc	Australia	1.167%	1.588%	7.429%	-0.853	6.770	0.000	0.128	0.182	0.035	0.664	0.652	-0.085
ESPSc	Spain	1.051%	1.522%	6.481%	-0.721	4.123	0.001	0.129	0.184	0.001	0.580	0.572	-0.166
MEXSc	Mexico	1.014%	2.152%	8.170%	-1.049	6.162	0.000	0.098	0.132	0.057	0.726	0.714	-0.202
KORSc	South Korea	0.889%	0.060%	12.734%	0.498	5.758	0.000	0.053	0.082	0.778	0.509	0.474	-0.126
IDNSc	Indonesia	1.051%	1.802%	13.957%	0.023	6.224	0.000	0.060	0.087	0.004	0.399	0.377	-0.109
TURSc	Turkey	2.244%	2.653%	14.919%	0.541	6.904	0.000	0.136	0.221	0.351	0.513	0.486	-0.164
NLDSc	Netherlands	0.742%	1.571%	6.583%	-0.593	4.849	0.000	0.080	0.111	0.001	0.686	0.725	-0.231
CHESc	Switzerland	0.976%	1.228%	5.947%	-0.704	4.151	0.001	0.128	0.182	0.006	0.642	0.685	-0.207
SWESc	Sweden	1.276%	1.663%	7.479%	-0.036	5.646	0.000	0.142	0.220	0.025	0.728	0.749	-0.285
NORSc	Norway	0.962%	1.748%	8.314%	-0.781	5.225	0.000	0.090	0.125	0.011	0.696	0.698	-0.325
BELSc	Belgium	0.919%	1.453%	5.754%	-0.709	6.204	0.000	0.122	0.175	0.001	0.634	0.609	-0.199
TWNSc	Taiwan	0.614%	0.785%	9.315%	0.149	3.864	0.031	0.043	0.063	0.233	0.450	0.430	-0.202
AUTSc	Austria	0.690%	0.985%	6.456%	-0.759	6.503	0.000	0.074	0.102	0.001	0.579	0.587	-0.168
ZAFSc	South Africa	1.332%	1.895%	8.078%	-0.647	4.253	0.001	0.138	0.201	0.442	0.567	0.627	-0.133
THASc	Thailand	1.064%	1.136%	11.240%	0.198	4.960	0.001	0.076	0.115	0.172	0.454	0.402	-0.037
DNKSc	Denmark	1.341%	1.630%	7.076%	-0.520	5.517	0.000	0.159	0.237	0.000	0.635	0.629	-0.266
MYSSc	Malaysia	0.594%	0.917%	9.616%	0.903	11.839	0.000	0.039	0.059	0.035	0.410	0.412	-0.183
SGPSc	Singapore	1.035%	1.635%	8.618%	0.253	7.374	0.000	0.095	0.143	0.092	0.622	0.612	-0.173
CHLSc	Chile	0.956%	1.278%	6.964%	-0.268	4.294	0.004	0.106	0.159	0.018	0.474	0.493	-0.220
HKGSc	Hong Kong	0.760%	1.337%	8.868%	-0.405	6.737	0.000	0.062	0.086	0.111	0.586	0.606	-0.163
FINSc	Finland	1.203%	1.310%	6.968%	-0.457	4.638	0.001	0.142	0.210	0.004	0.612	0.657	-0.250
GRCSc	Greece	0.770%	0.989%	11.282%	0.162	3.991	0.018	0.049	0.073	0.028	0.481	0.406	-0.243
ISRSc	Israel	1.007%	0.873%	8.339%	0.418	6.019	0.000	0.095	0.148	0.358	0.650	0.660	-0.188
PRTSc	Portugal	0.696%	0.901%	7.794%	-0.147	3.632	0.095	0.062	0.090	0.003	0.524	0.485	-0.155
IRLSc	Ireland	1.400%	1.792%	6.755%	-0.603	5.191	0.000	0.176	0.259	0.016	0.617	0.706	-0.212
NZLSc	New Zealand	1.037%	1.319%	6.418%	-0.219	3.922	0.0195	0.128	0.191	0.012	0.574	0.508	-0.086
	mean:	**1.031%**	**1.408%**	**8.388%**	**-0.255**	**5.492**	**0.006**	**0.100**	**0.146**	**0.102**	**0.576**	**0.584**	**-0.179**
	median:	**1.007%**	**1.412%**	**7.479%**	**-0.268**	**5.277**	**0.000**	**0.098**	**0.148**	**0.028**	**0.586**	**0.609**	**-0.183**
	min.:	**0.250%**	**0.060%**	**5.754%**	**-1.049**	**3.632**	**0.000**	**0.006**	**0.008**	**0.000**	**0.330**	**0.307**	**-0.325**
	max:	**2.244%**	**2.653%**	**14.919%**	**0.903**	**11.839**	**0.095**	**0.176**	**0.259**	**0.778**	**0.728**	**0.760**	**0.009**

Table 2.3: Variance decomposition results

This table presents variance decomposition results. Following Chen and Ho (2009), we decompose variance of test indices in to three components. σ^2_{US} , σ^2_{W} and σ^2_{j} refers to the portion of the variance related to the US , the world and the idiosyncratic component of test index j. S&P 500 and the MSCI All Country World Index ex US are taken as the US and world benchmarks, respectively. Each entry in the table stands for the percent of variance which has been explained through the given component.The last three rows provide averages for all, developed and emerging country indices respectively.

	Overall Index									**Large Caps**									**Small Caps**								
	Aug. 96 -July 13			**Aug. 96 -Apr. 06**			**Apr. 06 -July 13**			**Aug. 96 -July 13**			**Aug. 96 -Apr. 06**			**Apr. 06 -July 13**			**Aug. 96 -July 13**			**Aug. 96 -Apr. 06**			**Apr. 06 -July 13**		
Country	σ^2_{US}	σ^2_{W}	σ^2_{j}	σ^2_{US}	σ^2_{W}	σ^2_{j}	σ^2_{US}	σ^2_{W}	σ^2_{j}	σ^2_{US}	σ^2_{W}	σ^2_{j}	σ^2_{US}	σ^2_{W}	σ^2_{j}	σ^2_{US}	σ^2_{W}	σ^2_{j}	σ^2_{US}	σ^2_{W}	σ^2_{j}	σ^2_{US}	σ^2_{W}	σ^2_{j}	σ^2_{US}	σ^2_{W}	σ^2_{j}
China (CHN)	0.23	0.11	0.65	0.16	0.08	0.76	0.44	0.26	0.30	0.21	0.12	0.67	0.16	0.10	0.75	0.42	0.26	0.32	0.21	0.07	0.73	0.10	0.01	0.89	0.52	0.24	0.24
Japan (JPN)	0.27	0.23	0.50	0.17	0.32	0.51	0.49	0.12	0.39	0.29	0.23	0.47	0.20	0.32	0.48	0.51	0.12	0.37	0.11	0.17	0.72	0.05	0.22	0.73	0.33	0.10	0.57
Germany (DEU)	0.65	0.17	0.19	0.54	0.19	0.27	0.78	0.11	0.10	0.65	0.16	0.19	0.54	0.19	0.28	0.78	0.11	0.11	0.49	0.21	0.30	0.31	0.21	0.48	0.73	0.15	0.13
France (FRA)	0.65	0.19	0.16	0.55	0.23	0.22	0.77	0.12	0.11	0.65	0.19	0.16	0.55	0.22	0.22	0.77	0.12	0.11	0.45	0.27	0.28	0.25	0.32	0.43	0.69	0.15	0.16
United Kingdom (GBR)	0.66	0.19	0.15	0.56	0.18	0.25	0.79	0.13	0.08	0.66	0.17	0.16	0.57	0.17	0.27	0.79	0.13	0.08	0.45	0.24	0.32	0.28	0.25	0.47	0.66	0.15	0.19
Brazil (BRA)	0.38	0.17	0.45	0.33	0.17	0.51	0.52	0.26	0.22	0.38	0.16	0.47	0.33	0.16	0.51	0.52	0.26	0.22	0.33	0.22	0.45	0.24	0.20	0.56	0.48	0.25	0.26
Italy (ITA)	0.46	0.20	0.34	0.31	0.19	0.50	0.66	0.14	0.20	0.47	0.19	0.34	0.32	0.18	0.50	0.65	0.14	0.21	0.37	0.25	0.38	0.21	0.23	0.56	0.60	0.18	0.21
India (IND)	0.23	0.20	0.58	0.09	0.13	0.78	0.45	0.20	0.35	0.23	0.17	0.60	0.09	0.11	0.80	0.46	0.19	0.35	0.20	0.22	0.58	0.08	0.14	0.78	0.37	0.23	0.40
Canada (CAN)	0.64	0.11	0.25	0.60	0.10	0.30	0.69	0.12	0.19	0.65	0.09	0.26	0.61	0.08	0.30	0.69	0.11	0.20	0.48	0.19	0.33	0.38	0.17	0.45	0.61	0.16	0.24
Australia (AUS)	0.52	0.23	0.24	0.38	0.23	0.39	0.70	0.17	0.13	0.53	0.22	0.25	0.40	0.22	0.38	0.70	0.16	0.14	0.44	0.26	0.30	0.23	0.24	0.54	0.71	0.17	0.12
Spain (ESP)	0.48	0.20	0.32	0.45	0.20	0.35	0.52	0.18	0.30	0.48	0.20	0.33	0.46	0.19	0.35	0.52	0.18	0.30	0.34	0.21	0.46	0.21	0.22	0.57	0.50	0.14	0.36
Mexico (MEX)	0.50	0.05	0.45	0.38	0.03	0.59	0.73	0.07	0.21	0.49	0.04	0.47	0.36	0.03	0.61	0.72	0.06	0.22	0.53	0.08	0.39	0.44	0.07	0.49	0.66	0.10	0.25
South Korea (KOR)	0.29	0.11	0.60	0.21	0.12	0.67	0.58	0.13	0.29	0.28	0.11	0.61	0.19	0.12	0.69	0.59	0.11	0.30	0.26	0.11	0.63	0.18	0.09	0.73	0.48	0.19	0.33
Indonesia (IDN)	0.19	0.12	0.69	0.12	0.11	0.77	0.46	0.18	0.37	0.20	0.11	0.68	0.14	0.11	0.75	0.44	0.17	0.39	0.16	0.12	0.72	0.09	0.11	0.79	0.40	0.17	0.42
Turkey (TUR)	0.27	0.05	0.68	0.24	0.04	0.72	0.39	0.16	0.45	0.26	0.04	0.71	0.24	0.03	0.73	0.35	0.15	0.50	0.26	0.06	0.67	0.20	0.05	0.75	0.48	0.15	0.37
Netherlands (NLD)	0.64	0.19	0.17	0.53	0.23	0.23	0.78	0.12	0.11	0.64	0.18	0.18	0.54	0.22	0.24	0.77	0.11	0.12	0.47	0.27	0.26	0.29	0.32	0.39	0.70	0.15	0.15
Switzerland (CHE)	0.50	0.20	0.30	0.35	0.24	0.41	0.70	0.12	0.17	0.49	0.19	0.32	0.34	0.22	0.44	0.70	0.12	0.18	0.41	0.31	0.28	0.25	0.35	0.40	0.62	0.19	0.19
Sweden (SWE)	0.60	0.16	0.24	0.50	0.19	0.32	0.73	0.11	0.16	0.59	0.15	0.26	0.49	0.18	0.33	0.72	0.11	0.17	0.53	0.20	0.27	0.41	0.25	0.34	0.68	0.10	0.21
Norway (NOR)	0.50	0.22	0.28	0.38	0.19	0.42	0.65	0.19	0.16	0.47	0.22	0.31	0.33	0.18	0.50	0.64	0.20	0.16	0.48	0.16	0.35	0.37	0.16	0.47	0.64	0.13	0.24
Belgium (BEL)	0.49	0.18	0.33	0.32	0.17	0.51	0.71	0.11	0.18	0.49	0.17	0.35	0.31	0.16	0.52	0.70	0.10	0.20	0.40	0.22	0.37	0.24	0.18	0.58	0.61	0.19	0.20
Taiwan (TAI)	0.29	0.08	0.63	0.20	0.04	0.77	0.48	0.19	0.33	0.33	0.07	0.60	0.25	0.04	0.71	0.50	0.17	0.32	0.20	0.10	0.70	0.10	0.03	0.87	0.42	0.21	0.38
Austria (AUT)	0.39	0.31	0.30	0.13	0.36	0.51	0.71	0.16	0.13	0.37	0.27	0.35	0.12	0.27	0.61	0.71	0.16	0.14	0.34	0.29	0.38	0.10	0.34	0.56	0.64	0.15	0.21
South Africa (ZAF)	0.35	0.22	0.42	0.22	0.24	0.54	0.58	0.18	0.24	0.35	0.21	0.43	0.23	0.22	0.55	0.57	0.18	0.25	0.32	0.21	0.47	0.19	0.23	0.58	0.56	0.16	0.28
Thailand (THA)	0.23	0.11	0.65	0.20	0.10	0.70	0.37	0.24	0.39	0.23	0.12	0.65	0.18	0.11	0.71	0.39	0.23	0.37	0.21	0.10	0.69	0.19	0.09	0.71	0.27	0.22	0.51
Denmark (DNK)	0.52	0.17	0.31	0.39	0.14	0.47	0.67	0.15	0.18	0.51	0.15	0.34	0.38	0.11	0.50	0.66	0.15	0.19	0.40	0.19	0.41	0.22	0.21	0.58	0.63	0.09	0.27
Malaysia (MYS)	0.15	0.09	0.76	0.09	0.07	0.83	0.43	0.18	0.38	0.13	0.08	0.79	0.08	0.07	0.85	0.40	0.18	0.42	0.17	0.08	0.75	0.10	0.06	0.83	0.46	0.17	0.38
Singapore (SGP)	0.47	0.10	0.42	0.39	0.05	0.56	0.63	0.24	0.13	0.47	0.09	0.44	0.39	0.05	0.56	0.65	0.22	0.13	0.39	0.14	0.47	0.28	0.07	0.65	0.56	0.28	0.16
Chile (CHL)	0.30	0.13	0.58	0.28	0.11	0.61	0.32	0.17	0.51	0.32	0.10	0.58	0.33	0.08	0.58	0.31	0.16	0.53	0.22	0.16	0.62	0.16	0.14	0.70	0.32	0.17	0.51
Hong Kong (HKG)	0.41	0.15	0.44	0.34	0.10	0.56	0.54	0.25	0.20	0.41	0.13	0.46	0.34	0.10	0.57	0.54	0.24	0.22	0.34	0.17	0.48	0.24	0.11	0.65	0.49	0.27	0.24
Finland (FIN)	0.50	0.07	0.43	0.40	0.05	0.55	0.70	0.10	0.20	0.48	0.05	0.47	0.39	0.04	0.57	0.68	0.09	0.23	0.37	0.32	0.30	0.18	0.35	0.47	0.63	0.20	0.17
Greece (GRC)	0.29	0.16	0.54	0.15	0.10	0.75	0.50	0.19	0.31	0.30	0.16	0.54	0.16	0.12	0.72	0.49	0.15	0.36	0.23	0.14	0.63	0.11	0.05	0.84	0.46	0.25	0.29
Israel (ISR)	0.34	0.03	0.63	0.32	0.02	0.66	0.41	0.12	0.47	0.26	0.04	0.70	0.24	0.02	0.73	0.33	0.12	0.55	0.42	0.03	0.55	0.35	0.02	0.63	0.60	0.07	0.33
Portugal (PRT)	0.36	0.22	0.41	0.24	0.21	0.55	0.53	0.20	0.28	0.36	0.22	0.42	0.23	0.20	0.57	0.53	0.20	0.27	0.27	0.20	0.53	0.16	0.17	0.67	0.42	0.16	0.42
Ireland (IRL)	0.58	0.07	0.35	0.44	0.06	0.50	0.76	0.03	0.21	0.58	0.05	0.38	0.44	0.04	0.52	0.75	0.02	0.23	0.38	0.22	0.40	0.20	0.25	0.54	0.62	0.12	0.26
New Zealand (NZL)	0.38	0.17	0.44	0.23	0.19	0.58	0.62	0.10	0.28	0.32	0.11	0.57	0.20	0.11	0.69	0.54	0.08	0.38	0.33	0.17	0.50	0.17	0.18	0.65	0.61	0.10	0.29
Average:	**0.42**	**0.15**	**0.43**	**0.32**	**0.15**	**0.53**	**0.59**	**0.16**	**0.25**	**0.41**	**0.14**	**0.44**	**0.32**	**0.14**	**0.54**	**0.59**	**0.15**	**0.26**	**0.34**	**0.18**	**0.48**	**0.22**	**0.17**	**0.61**	**0.55**	**0.17**	**0.28**
Dev. Countries ex US	**0.50**	**0.18**	**0.31**	**0.38**	**0.19**	**0.43**	**0.67**	**0.13**	**0.19**	**0.50**	**0.17**	**0.33**	**0.38**	**0.17**	**0.45**	**0.67**	**0.13**	**0.21**	**0.39**	**0.22**	**0.39**	**0.23**	**0.23**	**0.54**	**0.60**	**0.15**	**0.24**
Emg. Countries	**0.31**	**0.11**	**0.58**	**0.24**	**0.09**	**0.67**	**0.49**	**0.19**	**0.32**	**0.30**	**0.11**	**0.59**	**0.24**	**0.09**	**0.67**	**0.48**	**0.18**	**0.34**	**0.28**	**0.13**	**0.59**	**0.20**	**0.10**	**0.71**	**0.47**	**0.19**	**0.34**

Table 2.4: Gregory and Hansen (1996) test for structural change in the cointegration relationship with the United States indices

This table presents Gregory and Hansen (1996) test for structural change in the cointegration relationship of the test assets with the United States indices. Null hypothesis of no cointegration is investigated using Level shift (C) Model, Level Shift with trend (C/T) Model and Regime Shift with trend (C/S) Model using natural logarithm of index prices. The number of lags that are included in the model are choosen based on Bayesian Information Criteria. (*) represents rejection of null hypothesis of cointegration with one structural break based on asymptotic critical values provided by Gregory and Hansen (1996) at 10% significance level. The sample period is from August 1996 to July 2013. The Gregory and Hansen (1996) test statistic results for Total, Large-cap and Small-cap indices of sample countries are presented in Panel B, Panel C and Panel D respectively. The countries are ordered in descending order, based on the national gross domestic product (GDP) for the year 2012.

Panel A: Total Return Indices

	Level shift (C) Model							Level Shift with trend (C/T) Model							Regime Shift with trend (C/S) Model						
Index	ADF	Tb	lag	Zt	Tb	Za	Tb	ADF	Tb	lag	Zt	Tb	Za	Tb	ADF	Tb	lag	Zt	Tb	Za	Tb
CHN	-3.308	Dec-06	0	-3.350	Jan-07	-22.514	Jan-07	-4.073	Dec-06	0	-4.283	1/1/2007	-37.189	Mar-07	-4.197	Jul-07	0	-4.110	Jul-07	-31.460	Jul-07
JPN	-4.514	Mar-04	0	-4.601	May-05	-34.536	May-05	-5.287	Mar-04	0	-5.300	3/1/2004	-44.699	Apr-04	-5.217	Nov-07	0	-5.289	Dec-07	-43.236	Dec-07
DEU	-4.077	Dec-06	0	-4.087	Dec-06	-31.687	Dec-06	-4.535	Mar-99	0	-4.572	3/1/1999	-43.249	Mar-99	-4.544	Apr-07	0	-4.630	Dec-06	-38.889	Dec-06
FRA	-3.485	Dec-10	0	-3.599	Dec-10	-23.372	Dec-10	-4.444	Aug-04	0	-4.597	3/1/2004	-41.344	Mar-04	-5.291	Dec-06	0	-5.519	Aug-06	-51.781	Aug-06
GBR	-3.977	Apr-05	0	-3.987	Apr-05	-30.391	May-05	-4.462	Jan-06	0	-4.429	1/1/2006	-36.494	Jan-06	-4.089	Apr-05	0	-4.065	Apr-05	-31.642	Apr-05
BRA	-3.456	Jul-07	0	-3.375	Jan-07	-26.624	Jul-07	-3.363	Feb-05	0	-3.372	2/1/2005	-27.234	Jul-07	-5.574	Jul-07	0	-5.603	Jul-07	-57.025	Jul-07
ITA	-3.966	Dec-10	0	-4.007	Dec-10	-31.406	Dec-10	-3.888	Dec-10	0	-3.929	12/1/2010	-30.574	Dec-10	-5.301	Apr-06	0	-5.314	Apr-06	-49.087	Apr-06
IND	-3.369	Jul-07	0	-3.302	Jan-07	-23.898	Jan-07	-3.531	Oct-04	0	-3.566	1/1/2005	-27.600	Feb-99	-4.959	Jul-07	0	-4.941	Jul-07	-43.504	Jul-07
CAN	-3.060	Jul-07	0	-2.819	Sep-05	-19.826	Jul-07	-3.138	Oct-04	0	-3.146	10/1/2004	-22.995	Oct-04	-4.485	Jul-07	0	-4.363	Jul-07	-37.718	Jul-07
AUS	-4.105	Apr-07	0	-4.202	Dec-06	-34.577	Dec-06	-3.953	Dec-06	0	-4.034	12/1/2006	-36.798	Sep-99	-4.149	Jul-07	0	-4.163	Apr-07	-34.060	Apr-07
ESP	-2.873	Jul-04	0	-2.894	Jul-04	-16.508	Dec-10	-3.699	Sep-03	0	-3.803	6/1/2003	-28.779	Jun-03	-4.224	Jul-06	0	-4.235	Jul-06	-33.146	Jul-06
MEX	-3.160	Dec-10	0	-3.167	Dec-10	-19.376	Dec-10	-4.295	Oct-08	0	-4.367	10/1/2008	-42.914	Oct-08	-3.902	Jan-07	0	-3.964	Jan-07	-29.425	Aug-06
KOR	-3.855	Jan-99	0	-3.768	Jan-99	-22.955	Jan-99	-4.761	Jan-99	0	-4.772	1/1/1999	-40.634	Jan-99	-4.757	Nov-00	0	-4.628	Jun-00	-38.756	Jan-00
IDN	-4.612	Jun-00	4	-3.729	Jul-07	-25.163	Jul-07	-4.507	Oct-00	0	-4.556	10/1/2000	-38.853	Oct-00	-4.171	Nov-00	0	-4.206	Jun-00	-34.903	Jun-00
TUR	-3.917	Oct-04	0	-3.885	Feb-05	-29.712	Feb-05	-4.586	Oct-04	0	-4.609	10/1/2004	-42.031	Sep-04	-5.308	Jul-07	0	-5.321	Jul-07	-50.906	Jul-07
NLD	-4.359	Dec-06	0	-4.443	Sep-06	-37.359	Apr-07	-4.747	Jan-99	0	-4.965	2/1/1999	-50.779	Feb-99	-4.431	Sep-06	0	-4.572	Sep-06	-39.244	Sep-06
CHE	-4.048	Jan-06	0	-4.154	Jan-06	-31.968	Jan-06	-4.406	Mar-99	0	-4.536	3/1/1999	-41.179	Mar-99	-4.045	Jan-06	0	-4.157	Jan-06	-32.164	Jan-06
SWE	-4.077	Jul-05	3	-3.764	Apr-07	-28.005	Aug-07	-4.574	Mar-01	0	-4.585	3/1/2001	-43.602	Mar-01	-5.009	Jul-05	3	-4.557	Nov-08	-37.064	Nov-08
NOR	-3.997	Jul-07	0	-3.962	Apr-07	-30.246	Apr-07	-4.082	Apr-07	0	-4.092	4/1/2007	-33.300	Feb-99	-4.443	Apr-05	0	-4.467	Apr-05	-37.809	Mar-05
BEL	-4.056	Mar-04	1	-3.849	Apr-04	-28.632	Apr-04	-4.017	Mar-04	1	-3.868	4/1/2004	-28.771	Apr-04	-4.678	Mar-04	1	-4.455	Mar-04	-38.729	Mar-04
TWN	-5.249*	Dec-00	0	-5.247*	Dec-00	-49.043*	Dec-00	-5.84*	Dec-00	0	-5.855*	12/1/2000	-59.902*	Dec-00	-5.141	Jul-07	0	-5.093	Jul-07	-47.034	Jul-07
AUT	-3.604	Aug-04	0	-3.643	Aug-04	-25.637	Aug-04	-3.605	Aug-04	0	-3.638	8/1/2004	-25.617	Aug-04	-3.698	Sep-99	0	-3.618	Apr-04	-26.634	Apr-04
ZAF	-3.646	Mar-01	0	-3.537	Apr-07	-25.071	Mar-01	-3.962	Mar-01	0	-3.824	10/1/2000	-32.152	Nov-00	-3.953	Jul-07	0	-3.923	Apr-05	-29.837	Apr-05
THA	-4.539	Feb-00	0	-4.454	Mar-00	-30.059	Sep-00	-4.601	Feb-00	0	-4.466	3/1/2000	-30.440	Mar-00	-5.589	Dec-99	0	-5.765*	Nov-99	-58.641	Nov-99
DNK	-4.321	Sep-06	0	-4.254	Sep-06	-34.292	Sep-06	-4.406	Apr-06	0	-4.300	4/1/2006	-34.515	Apr-06	-4.705	Jul-07	0	-4.707	Sep-06	-40.331	Sep-06
MYS	-3.442	Jul-07	0	-3.391	Jul-07	-20.428	Jul-07	-4.083	Jun-10	0	-4.141	12/1/2010	-32.238	Dec-10	-4.985	Jan-99	0	-5.275	Jan-00	-49.203	Jan-00
SGP	-3.949	Jul-07	0	-3.959	Jul-07	-27.353	Jul-07	-4.426	Apr-10	0	-4.453	5/1/2001	-37.011	May-10	-3.879	Jul-07	0	-3.888	Jul-07	-26.956	Jul-07
CHL	-4.400	Jul-07	0	-4.370	Jul-07	-37.014	Jul-07	-4.248	Jul-07	0	-4.210	7/1/2007	-35.767	Mar-01	-5.023	Apr-07	0	-4.953	Jan-07	-46.201	Jan-07
HKG	-4.445	Jul-07	0	-4.456	Jul-07	-37.113	Jul-07	-4.661	May-01	0	-4.873	5/1/2001	-45.525	May-01	-4.443	Jul-07	0	-4.454	Jul-07	-36.875	Jul-07
FIN	-3.390	Feb-99	1	-3.226	Dec-10	-21.440	Mar-99	-4.281	Jun-08	0	-4.461	6/1/2008	-40.875	Jun-08	-3.942	Jul-06	1	-3.767	Nov-09	-25.663	Nov-09
GRC	-3.700	Dec-10	0	-3.804	Dec-10	-29.313	Dec-10	-4.426	Jun-03	0	-4.437	6/1/2003	-38.700	Jun-03	-4.876	Jul-07	0	-5.072	Jul-07	-46.512	Aug-07
ISR	-2.457	Dec-10	0	-2.602	Dec-10	-14.077	Dec-10	-3.364	Jun-03	0	-3.372	6/1/2003	-24.035	Jun-03	-3.621	Jan-06	1	-3.805	Jul-08	-28.179	Jul-08
PRT	-2.992	Dec-10	0	-3.022	Dec-10	-18.413	Dec-10	-3.440	Sep-03	0	-3.478	6/1/2003	-24.156	Jun-03	-3.969	Feb-07	0	-4.041	Jul-07	-30.748	Jul-07
IRL	-4.447	Feb-09	2	-3.968	Sep-08	-29.191	Sep-08	-4.511	Feb-09	2	-4.588	5/1/2010	-38.480	May-10	-4.703	Apr-04	0	-4.823	May-04	-43.439	May-04
NZL	-4.592	Feb-00	0	-4.313	Feb-00	-33.882	Mar-00	-4.527	Feb-00	0	-4.241	2/1/2000	-32.829	Mar-00	-6.241*	Oct-02	0	-6.098*	Jun-02	-63.528*	Jun-02

(continued)

Table 2.4 (cont.): Gregory and Hansen (1996) test for structural change in the cointegration relationship with the United States indices

This table presents Gregory and Hansen (1996) test for structural change in the cointegration relationship of the test assets with the United States indices. Null hypothesis of no cointegration is investigated using Level shift (C) Model, Level Shift with trend (C/T) Model and Regime Shift with trend (C/S) Model using natural logarithm of index prices. The number of lags that are included in the model are choosen based on Bayesian Information Criteria. (*) represents rejection of null hypothesis of no cointegration with one structural break based on asymptotic critical values provided by Gregory and Hansen (1996) at 10% significance level. The sample period is from August 1996 to July 2013. The Gregory and Hansen (1996) test statistic results for Total, Large-cap and Small-cap indices of sample countries are presented in Panel B, Panel C and Panel D respectively. The countries are ordered in descending order, based on the national gross domestic product (GDP) for the year 2012.

Panel B: Large Cap Return Indices

	Level shift (C) Model							Level Shift with trend (C/T) Model							Regime Shift with trend (C/S) Model						
Index	ADF	Tb	lag	Zt	Tb	Za	Tb	ADF	Tb	lag	Zt	Tb	Za	Tb	ADF	Tb	lag	Zt	Tb	Za	Tb
CHNLc	-2.513	Dec-06	0	-2.519	Dec-06	-13.714	Dec-06	-4.034	Nov-99	0	-4.145	12/1/1999	-35.394	Dec-99	-3.311	Jul-07	0	-3.228	Nov-07	-20.036	Nov-07
JPNLc	-4.555	Jun-05	0	-4.621	May-05	-35.213	May-05	-5.331*	Mar-04	0	-5.345*	3/1/2004	-45.993	Mar-04	-5.320	Nov-07	0	-5.389	Dec-07	-45.135	Dec-07
DEULc	-4.186	Dec-06	0	-4.196	Dec-06	-33.406	Dec-06	-4.509	Mar-99	0	-4.537	3/1/1999	-42.779	Mar-99	-4.690	Apr-07	0	-4.764	Dec-06	-40.987	Dec-06
FRALc	-3.528	Dec-10	0	-3.634	Dec-10	-23.935	Dec-10	-4.475	Sep-03	0	-4.575	3/1/2004	-41.100	Mar-04	-5.396	Dec-06	0	-5.611	Aug-06	-53.351	Aug-06
GBRLc	-3.915	Apr-05	0	-3.924	Apr-05	-29.479	Apr-05	-4.348	Jan-06	0	-4.302	1/1/2006	-34.674	Jan-06	-4.012	Apr-05	0	-3.975	Apr-05	-30.326	Apr-05
BRALc	-3.372	Jul-07	0	-3.344	Oct-05	-25.567	Apr-07	-3.450	Feb-05	0	-3.459	2/1/2005	-26.676	Feb-05	-5.633	Jul-07	0	-5.668	Jul-07	-58.346	Jul-07
ITALc	-3.972	Dec-10	0	-4.014	Dec-10	-31.690	Dec-10	-3.897	Dec-10	0	-3.939	12/1/2010	-30.905	Dec-10	-5.361	May-06	0	-5.374	May-06	-50.354	May-06
INDLc	-3.789	Jul-07	0	-3.670	Jan-07	-28.369	Apr-07	-3.840	Jul-07	0	-3.762	5/1/2007	-32.324	Feb-99	-5.178	Jul-07	0	-5.147	Jul-07	-46.804	Jul-07
CANLc	-2.820	Jul-07	0	-2.714	Sep-05	-17.278	Jun-07	-3.168	Oct-04	0	-3.187	11/1/2004	-23.408	Nov-04	-4.410	Jul-07	0	-4.309	Jul-07	-36.227	Jul-07
AUSLc	-4.198	Apr-07	0	-4.268	Dec-06	-35.656	Apr-07	-4.049	Apr-07	0	-4.158	9/1/1999	-38.739	Sep-99	-4.235	Jul-07	0	-4.265	Apr-07	-35.313	Apr-07
ESPLc	-2.936	Jul-04	0	-2.952	Jul-04	-17.101	Jun-04	-3.796	Sep-03	0	-3.883	6/1/2003	-29.942	Jun-03	-4.278	Jul-06	0	-4.299	Jul-06	-34.201	Apr-07
MEXLc	-3.073	Dec-10	0	-3.081	Dec-10	-18.459	Oct-10	-4.265	Oct-08	0	-4.308	10/1/2008	-41.859	Oct-08	-3.614	Jan-07	0	-3.665	Jan-07	-25.280	Aug-06
KORLc	-4.326	Jan-99	0	-4.290	Jan-99	-30.873	Jan-99	-5.075	Jan-99	0	-5.088	1/1/1999	-46.173	Jan-99	-4.922	Nov-00	0	-4.841	Jul-00	-42.341	Jan-00
IDNLc	-4.551	Jun-00	4	-3.760	Aug-07	-25.800	Aug-07	-4.633	Oct-00	0	-4.644	10/1/2000	-40.099	Oct-00	-4.334	Nov-00	0	-4.250	Nov-00	-35.001	May-00
TURLc	-4.215	Jul-07	0	-4.082	Jul-07	-33.094	Jul-07	-5.035	Sep-00	0	-5.048	9/1/2000	-50.607	Sep-00	-5.205	Jul-07	0	-5.199	Jul-07	-48.613	Jul-07
NLDLc	-4.530	Dec-06	0	-4.589	Sep-06	-39.503	Apr-07	-4.902	Jan-99	0	-5.081	2/1/1999	-52.284	Feb-99	-4.597	Sep-06	0	-4.719	Sep-06	-41.409	Sep-06
CHELc	-4.000	Jan-06	0	-4.125	Jan-06	-31.690	Jan-06	-4.376	Mar-99	0	-4.518	3/1/1999	-40.627	Mar-99	-4.014	Sep-99	0	-4.127	Jan-06	-31.827	Jan-06
SWELc	-4.019	Jul-05	3	-3.780	Mar-01	-28.382	Mar-01	-4.705	Mar-01	0	-4.717	3/1/2001	-45.433	Mar-01	-5.095	Jul-05	3	-4.692	Nov-08	-39.131	Nov-08
NORLc	-4.318	Apr-07	0	-4.328	Apr-07	-35.650	Jul-07	-4.387	Apr-07	0	-4.398	4/1/2007	-36.544	Apr-07	-4.549	Jul-07	0	-4.569	Apr-05	-39.595	Mar-05
BELLc	-4.125	Mar-04	1	-3.913	Apr-04	-29.479	Apr-04	-4.083	Mar-04	1	-3.946	4/1/2004	-29.798	Apr-04	-4.892	Mar-04	1	-4.640	Apr-04	-41.440	Apr-04
TWNLc	-4.812	Dec-00	0	-4.805	Nov-07	-42.065	Nov-07	-5.832*	Dec-00	0	-5.846*	12/1/2000	-60.517*	Dec-00	-5.424	Jul-07	0	-5.360	Jul-07	-51.511	Jul-07
AUTLc	-3.782	Nov-10	0	-3.756	Dec-10	-26.986	Dec-10	-3.670	Nov-10	0	-3.640	12/1/2010	-25.653	Dec-10	-4.262	Sep-99	0	-4.193	May-04	-34.467	May-04
ZAFLc	-3.950	Apr-07	0	-3.900	Apr-07	-29.665	Apr-07	-4.499	Mar-01	0	-4.354	3/1/2001	-39.470	Mar-01	-4.280	Sep-05	0	-4.233	Apr-05	-34.373	Apr-05
THALc	-5.129*	Dec-00	0	-4.925	Mar-00	-37.934	Sep-00	-5.224	Feb-00	0	-4.996	2/1/2000	-38.702	Mar-00	-5.837*	Nov-00	0	-5.747	Nov-00	-56.462	Nov-00
DNKLc	-4.349	Apr-07	0	-4.300	Apr-07	-35.264	Apr-07	-4.534	Jan-07	0	-4.474	1/1/2007	-37.418	Jan-07	-4.610	Jul-07	0	-4.607	Apr-07	-39.027	Apr-07
MYSLc	-3.524	Nov-00	2	-3.454	Jul-07	-21.217	Jul-07	-4.019	Jun-10	0	-4.132	9/1/2010	-32.180	Sep-10	-5.042	Jan-99	0	-5.370	Feb-00	-51.812	Feb-00
SGPLc	-3.918	Jul-07	0	-3.897	Jul-07	-26.294	Jul-07	-4.584	Apr-10	0	-4.596	4/1/2010	-39.308	Jun-10	-3.877	Jul-07	0	-3.862	Jul-07	-26.342	Jul-07
CHLLc	-4.126	Jul-07	0	-4.102	Mar-01	-33.183	Mar-01	-4.216	Mar-01	0	-4.169	3/1/2001	-37.631	Mar-01	-4.808	Apr-07	0	-4.726	Jan-07	-42.729	Jan-07
HKGLc	-4.396	Jul-07	0	-4.407	Jul-07	-36.361	Apr-07	-4.670	May-01	0	-4.934	5/1/2001	-46.605	May-01	-4.405	Jul-07	0	-4.416	Jul-07	-36.109	Jul-07
FINLc	-3.680	Feb-99	1	-3.479	Mar-99	-24.768	Mar-99	-4.350	Dec-99	0	-4.492	6/1/2008	-40.467	Jun-08	-3.680	Jun-00	1	-3.597	May-08	-23.811	May-08
GRCLc	-3.928	Dec-10	0	-3.974	Dec-10	-30.194	Dec-10	-4.461	Jun-03	0	-4.472	6/1/2003	-37.699	Jun-03	-4.760	Jul-07	0	-4.917	Aug-07	-43.112	Aug-07
ISRLc	-2.517	Dec-10	0	-2.614	Dec-10	-14.165	Dec-10	-3.415	Feb-00	0	-3.306	2/1/2000	-23.786	Mar-00	-3.646	Feb-06	2	-3.400	Dec-01	-22.608	Dec-01
PRTLc	-2.890	Dec-10	0	-2.897	Dec-10	-17.386	Dec-10	-3.374	Sep-03	0	-3.487	6/1/2003	-24.717	Jun-03	-4.072	Feb-07	0	-4.119	Jul-07	-32.140	Jul-07
IRLLc	-4.582	Jul-08	0	-4.294	May-08	-33.731	May-08	-4.557	Jul-08	0	-4.603	5/1/2010	-38.736	May-10	-4.623	Apr-04	0	-4.751	May-04	-43.101	Jun-02
NZLLc	-4.988	Feb-00	0	-4.821	Mar-00	-41.261	Mar-00	-4.957	Feb-00	0	-4.767	3/1/2000	-40.671	Mar-00	-5.615	May-02	0	-5.319	Jun-02	-49.916	Feb-02

(continued)

Table 2.4 (cont.): Gregory and Hansen (1996) test for structural change in the cointegration relationship with the United States indices

This table presents Gregory and Hansen (1996) test for structural change in the cointegration relationship of the test assets with the United States indices. Null hypothesis of no cointegration is investigated using Level shift (C) Model, Level Shift with trend (C/T) Model and Regime Shift with trend (C/S) Model using natural logarithm of index prices. The number of lags that are included in the model are choosen based on Bayesian Information Criteria. (*) represents rejection of null hypothesis of no cointegration with one structural break based on asymptotic critical values provided by Gregory and Hansen (1996) at 10% significance level. The sample period is from August 1996 to July 2013. The Gregory and Hansen (1996) test statistic results for Total, Large-cap and Small-cap indices of sample countries are presented in Panel B, Panel C and Panel D respectively. The countries are ordered in descending order, based on the national gross domestic product (GDP) for the year 2012.

Panel C: Small Cap Return Indices

	Level shift (C) Model							Level Shift with trend (C/T) Model							Regime Shift with trend (C/S) Model						
Index	ADF	Tb	lag	Zt	Tb	Za	Tb	ADF	Tb	lag	Zt	Tb	Za	Tb	ADF	Tb	lag	Zt	Tb	Za	Tb
CHNSc	-4.461	Sep-06	0	-4.496	Sep-06	-32.357	Jan-07	-4.479	Sep-06	0	-4.545	12/1/2006	-33.469	Jan-07	-4.798	Feb-07	0	-4.871	Jan-07	-39.299	Jan-07
JPNSc	-4.788	Jan-99	0	-4.800	Jan-99	-36.041	Jan-99	-4.890	Oct-03	0	-4.921	10/1/2003	-37.691	Oct-03	-5.319	Jan-00	0	-5.300	Jan-00	-48.821	Jan-00
DEUSc	-3.420	Jul-07	0	-3.533	Apr-07	-23.168	Aug-07	-4.575	Mar-99	0	-4.700	3/1/1999	-42.768	Mar-99	-3.955	Sep-05	1	-3.921	Nov-07	-27.728	Nov-07
FRASc	-4.300	Feb-05	0	-4.523	Mar-05	-37.968	Mar-05	-4.590	Oct-04	0	-4.770	10/1/2004	-41.462	Oct-04	-4.244	Sep-06	0	-4.463	Mar-05	-37.054	Mar-05
GBRSc	-5.208*	Apr-06	0	-5.221*	Apr-06	-48.363	Apr-06	-5.374*	Apr-06	0	-5.388*	4/1/2006	-50.912	Apr-06	-5.242	Aug-06	0	-5.289	Aug-06	-49.855	Apr-05
BRASc	-4.562	Jul-07	0	-4.573	Jul-07	-41.348	Jul-07	-4.271	Jul-07	0	-4.281	7/1/2007	-38.392	May-01	-5.252	Jul-07	0	-5.265	Jul-07	-49.681	Jul-07
ITASc	-3.973	Dec-10	0	-4.031	Dec-10	-30.440	Dec-10	-3.881	Dec-10	0	-3.933	12/1/2010	-29.261	Dec-10	-4.807	Feb-05	0	-4.819	Feb-05	-40.496	Feb-05
INDSc	-2.855	Jul-07	0	-2.823	Apr-05	-19.166	Jan-07	-3.325	Sep-04	0	-3.524	4/1/2004	-27.623	Apr-04	-4.611	Jul-07	0	-4.622	Jul-07	-39.334	Jul-07
CANSc	-3.736	Jul-07	0	-3.673	Jul-07	-30.575	Jul-07	-3.552	Jul-07	0	-3.479	4/1/2007	-28.188	Apr-07	-4.360	May-09	0	-4.362	Jun-09	-36.327	Jun-09
AUSSc	-3.737	Dec-06	0	-3.889	Dec-06	-31.087	Dec-06	-3.607	Dec-06	0	-3.757	12/1/2006	-30.348	Mar-00	-3.721	Jul-07	0	-3.730	Jul-07	-29.403	Jun-07
ESPSc	-3.200	Dec-10	0	-3.303	Jun-10	-21.672	Jun-10	-3.035	Dec-10	0	-3.250	6/1/2010	-21.393	Jun-10	-3.987	Jul-06	0	-4.066	Apr-06	-30.952	Apr-06
MEXSc	-4.432	Dec-06	0	-4.338	Jan-07	-34.509	Jan-07	-5.036	Jul-99	0	-5.000	7/1/1999	-47.316	Jul-99	-4.577	Dec-06	0	-4.489	Sep-06	-36.639	Sep-06
KORSc	-3.845	Sep-05	0	-3.840	Jun-05	-24.838	Jan-06	-4.829	Feb-05	0	-4.880	2/1/2005	-40.750	Feb-05	-3.962	Jul-07	0	-3.864	Dec-06	-26.734	Jun-00
IDNSc	-3.975	Jul-07	0	-3.960	Jul-07	-27.916	Jul-07	-4.480	Oct-00	0	-4.559	10/1/2000	-38.262	Oct-00	-4.225	Oct-99	1	-4.142	Jul-07	-32.788	May-00
TURSc	-4.198	Dec-10	0	-4.183	Dec-10	-34.266	Dec-10	-4.273	Dec-10	0	-4.283	12/1/2010	-38.686	Dec-10	-5.275	Feb-09	0	-5.320	Feb-09	-50.754	Feb-09
NLDSc	-3.657	Apr-07	0	-3.666	Apr-07	-27.917	Apr-07	-3.671	Feb-99	0	-3.703	6/1/1999	-32.498	Feb-99	-4.355	Jul-07	0	-4.366	Jul-07	-35.729	Jul-07
CHESc	-3.609	Sep-06	0	-3.617	Sep-06	-26.078	Sep-06	-3.606	Sep-06	0	-3.615	9/1/2006	-28.147	Feb-99	-5.335	Apr-07	0	-5.348	Apr-07	-47.119	Jan-07
SWESc	-4.076	Apr-06	0	-4.086	Apr-06	-31.659	May-06	-4.028	Apr-06	0	-4.038	4/1/2006	-32.149	Jul-99	-4.069	Sep-06	0	-4.079	Sep-06	-31.544	Aug-06
NORSc	-3.621	Jul-07	0	-3.605	Sep-05	-24.726	Apr-07	-3.796	Feb-99	0	-3.828	3/1/1999	-33.165	Mar-99	-4.508	Apr-05	0	-4.519	Apr-05	-38.524	Apr-05
BELSc	-2.912	Mar-05	1	-3.090	Feb-04	-19.085	Feb-04	-2.857	Mar-05	1	-3.132	2/1/2004	-19.904	Feb-04	-3.699	Oct-00	0	-3.605	Jul-03	-26.091	Jul-03
TWNSc	-5.162*	Oct-00	0	-5.147*	Dec-00	-47.191	Nov-00	-5.367*	Nov-00	1	-5.293	6/1/2000	-50.447	Nov-00	-5.134	Nov-00	1	-4.944	Nov-00	-44.728	Nov-00
AUTSc	-3.436	Aug-04	0	-3.560	Sep-04	-24.184	Sep-04	-3.441	Feb-05	0	-3.554	9/1/2004	-24.175	Sep-04	-3.324	Dec-03	0	-3.433	Mar-04	-24.216	Mar-04
ZAFSc	-3.375	Oct-00	0	-3.200	Oct-00	-21.492	Oct-00	-3.350	Feb-00	0	-3.211	10/1/2000	-23.622	Oct-00	-3.518	Jul-07	0	-3.483	Dec-03	-24.589	Dec-03
THASc	-4.039	Mar-10	0	-4.084	Mar-10	-25.849	Mar-10	-4.327	Jun-10	0	-4.328	9/1/2010	-30.804	Sep-10	-5.253	Nov-99	1	-4.885	Nov-99	-43.680	Nov-99
DNKSc	-4.554	May-10	0	-4.551	May-10	-36.921	May-10	-4.427	Dec-09	0	-4.399	5/1/2010	-35.103	May-10	-5.222	Apr-05	0	-5.209	Oct-05	-48.049	Oct-05
MYSSc	-3.372	Jul-07	0	-3.268	Jul-07	-19.147	Jul-07	-4.158	Dec-10	0	-4.216	12/1/2010	-33.063	Dec-10	-5.005	Mar-00	0	-5.088	Feb-00	-45.939	Feb-00
SGPSc	-3.957	Apr-07	0	-4.021	Apr-07	-29.266	Apr-07	-4.293	Sep-99	0	-4.440	9/1/1999	-37.582	Sep-99	-3.841	Apr-07	0	-3.894	Apr-07	-30.049	Oct-99
CHLSc	-4.638	Jul-07	0	-4.624	Jul-07	-40.842	Jul-07	-4.336	Jul-07	0	-4.346	7/1/2007	-38.201	May-01	-5.083	Jul-07	0	-5.070	Jul-07	-46.688	Jul-07
HKGSc	-4.643	Jul-07	0	-4.654	Jul-07	-40.690	Jul-07	-4.800	Jul-07	0	-4.812	1/1/2001	-44.435	Feb-09	-4.650	Feb-09	0	-4.674	Feb-09	-40.256	Jul-07
FINSc	-2.868	Nov-04	0	-2.951	May-05	-17.717	May-05	-2.736	Apr-06	0	-2.857	4/1/2004	-16.750	Apr-04	-3.384	Oct-00	0	-3.325	Oct-00	-23.081	Oct-00
GRCSc	-3.669	Dec-10	0	-3.881	Dec-10	-30.856	Dec-10	-4.632	May-03	0	-4.629	5/1/2003	-43.000	May-03	-5.045	Jul-07	0	-5.218	Jul-07	-49.231	Jul-07
ISRSc	-3.806	Nov-07	0	-3.937	Feb-08	-31.042	Feb-08	-4.384	Mar-01	0	-4.418	3/1/2001	-37.988	Mar-01	-5.141	Nov-08	0	-5.198	Sep-08	-49.307	Aug-08
PRTSc	-3.486	Sep-10	0	-3.544	Dec-10	-23.874	Dec-10	-3.628	Nov-03	0	-3.610	11/1/2003	-24.039	Mar-04	-3.542	Jun-10	1	-3.600	Mar-04	-24.791	Mar-04
IRLSc	-3.813	May-10	0	-3.809	May-10	-27.034	May-10	-3.688	May-10	0	-3.697	5/1/2010	-25.637	May-10	-4.263	Apr-04	0	-4.338	Jan-04	-34.723	Jan-04
NZLSc	-4.579	Feb-00	0	-4.315	Feb-00	-33.757	Mar-00	-4.523	Feb-00	0	-4.252	2/1/2000	-32.827	Mar-00	-6.573*	Oct-02	0	-6.355*	Oct-02	-62.728	Jun-02

Table 2.5: Spanning tests and Performance Improvements (August 1996 - July 2013)

This table reports the results of the mean-variance spanning test, step-down spanning test on the returns of the country funds and associated performance measures. The countries are ordered in descending order, based on the national gross domestic product (GDP) for the year 2012. As an initial benchmark, the investor is assumed to hold a well diversified US portfolio of S&P 500, R2000 and USLtGvt. The spanning test is implemented on each country fund. If the test asset is not spanned by the US benchmark, then it is added into benchmark assets. The table reports the heteroskedasticity corrected Wald-statistics and p-values for the spanning test with the null hypothesis that the test asset is spanned by the benchmark assets. The last row of each panel presents joint Wald tests of all international equity indices using the initial benchmark. The step-down test provides information on the causes of the rejection of traditional spanning test. The first test (W_{1a}) investigates whether two tangent portfolios on the efficient frontier are statistically different; and the second test (W_{2a}) investigates whether the two global minimum-variance portfolios are different statistically. The last six columns provide information on the improvement of portfolio performance by adding the test asset to the portfolio under different investment policy and short-selling constraints. Unconstrained and No Short Sales correspond to unlimited and no short-selling respectively. ΔSR, ΔSortR and ΔGMV represent the percentage improvement in the Sharpe Ratio and Sortino Ratio of the tangency portfolio and standard deviation of the Global Minimum-Variance portfolio when the test asset is included in the benchmark portfolio.

								Percentage Change in Performance Measures					
	Add to							Unconstrained			No Short Sales		
Test Asset	Benchmark Assets	W_a	p-val.	W_{1a}	p-val.	W_{2a}	p-val.	ΔSR	ΔSortR	ΔGMV	ΔSR	ΔSortR	ΔGMV
CHN	No	0.919	0.631	0.701	0.403	0.463	0.496	3.81%	7.92%	0.04%	3.81%	7.92%	0.00%
JPN	Yes	9.358	0.009	1.111	0.292	8.797	0.003	8.39%	14.91%	1.37%	0.00%	0.00%	1.37%
DEU	No	0.861	0.650	0.002	0.963	0.855	0.355	0.01%	0.00%	0.30%	0.00%	0.00%	0.00%
FRA	No	0.169	0.919	0.089	0.765	0.088	0.766	0.48%	0.48%	0.02%	0.15%	-0.08%	0.00%
GBR	Yes	6.509	0.039	0.918	0.338	6.209	0.013	2.45%	2.67%	1.98%	1.14%	0.89%	1.98%
BRA	Yes	7.461	0.024	0.817	0.366	6.408	0.011	6.03%	8.06%	1.02%	5.46%	7.63%	0.00%
ITA	Yes	5.401	0.067	1.069	0.301	3.565	0.059	2.53%	3.28%	1.09%	0.00%	0.00%	0.00%
IND	No	0.665	0.717	0.442	0.506	0.266	0.606	2.06%	1.48%	0.02%	0.32%	0.25%	0.00%
CAN	No	4.441	0.109	0.001	0.976	4.337	0.037	0.13%	0.01%	1.20%	0.00%	-0.02%	0.00%
AUS	Yes	9.156	0.010	0.244	0.621	8.927	0.003	2.61%	3.73%	2.66%	1.03%	0.23%	0.00%
ESP	No	2.845	0.241	0.409	0.522	2.623	0.105	2.23%	2.58%	0.53%	0.01%	-0.04%	0.00%
MEX	No	2.982	0.225	1.439	0.230	1.468	0.226	6.34%	4.94%	0.20%	9.12%	9.19%	0.00%
KOR	No	0.393	0.821	0.382	0.537	0.085	0.770	1.62%	3.73%	0.00%	0.00%	0.00%	0.00%
IDN	No	1.858	0.395	0.017	0.896	1.854	0.173	0.23%	-0.12%	0.33%	0.00%	0.00%	0.00%
TUR	No	3.897	0.142	0.400	0.527	2.843	0.092	2.33%	1.43%	0.42%	2.34%	2.18%	0.00%
NLD	No	1.469	0.480	0.050	0.822	1.390	0.238	0.05%	-0.02%	0.33%	0.00%	0.00%	0.00%
CHE	No	2.127	0.345	1.174	0.279	1.070	0.301	3.64%	4.31%	0.54%	0.81%	0.64%	0.03%
SWE	No	2.997	0.223	0.612	0.434	2.498	0.114	3.00%	1.97%	0.39%	1.43%	1.11%	0.00%
NOR	No	0.200	0.905	0.200	0.655	0.011	0.918	0.89%	0.17%	0.01%	0.51%	0.30%	0.00%
BEL	No	1.208	0.547	0.059	0.809	1.148	0.284	0.06%	0.18%	0.61%	0.00%	0.00%	0.00%
TWN	Yes	6.446	0.040	0.124	0.724	6.338	0.012	1.21%	2.44%	1.24%	0.00%	0.00%	0.25%
AUT	No	1.002	0.606	0.312	0.577	0.852	0.356	0.78%	1.53%	0.34%	0.00%	0.00%	0.00%
ZAF	No	2.043	0.360	0.002	0.961	1.963	0.161	0.10%	-0.03%	0.37%	0.00%	0.00%	0.00%
THA	No	1.904	0.386	0.007	0.934	1.796	0.180	0.01%	-0.03%	0.46%	0.00%	0.00%	0.00%
DNK	No	3.527	0.171	1.244	0.265	1.502	0.220	6.11%	5.50%	0.25%	3.19%	1.72%	0.00%
MYS	No	2.040	0.361	0.182	0.670	1.383	0.240	0.31%	-0.02%	0.39%	0.00%	-0.05%	0.43%
SGP	No	0.871	0.647	0.056	0.812	0.664	0.415	0.10%	0.15%	0.19%	0.00%	0.00%	0.00%
CHL	Yes	5.831	0.054	0.467	0.494	5.682	0.017	0.70%	0.11%	2.26%	0.54%	0.95%	0.70%
HKG	Yes	5.659	0.059	0.331	0.565	4.201	0.040	0.54%	-0.11%	1.06%	0.00%	0.00%	0.00%
FIN	No	3.518	0.172	0.386	0.535	2.697	0.101	2.27%	3.09%	0.46%	1.12%	1.18%	0.00%
GRC	No	0.527	0.769	0.186	0.666	0.351	0.553	0.78%	0.91%	0.04%	0.00%	0.00%	0.00%
ISR	Yes	4.722	0.094	0.421	0.517	4.392	0.036	0.79%	0.07%	1.00%	0.74%	1.19%	0.23%
PRT	No	0.376	0.829	0.023	0.879	0.332	0.565	0.16%	0.25%	0.06%	0.00%	0.00%	0.00%
IRL	No	2.299	0.317	0.266	0.606	1.682	0.195	1.65%	3.07%	0.39%	1.12%	0.80%	0.00%
NZL	No	0.588	0.745	0.322	0.570	0.249	0.617	0.89%	1.05%	0.09%	0.01%	-0.07%	0.00%

Table 2.6: Spanning tests and Performance Improvements (August 1996 - April 2006)

This table reports the results of the mean-variance spanning test, step-down spanning test on the returns of the country funds and associated performance measures. The countries are ordered in descending order, based on the national gross domestic product (GDP) for the year 2012. As an initial benchmark, the investor is assumed to hold a well diversified US portfolio of S&P 500, R2000 and USLtGvt. The spanning test is implemented on each country fund. If the test asset is not spanned by the US benchmark, then it is added into benchmark assets. The table reports the heteroskedasticity corrected Wald-statistics and p-values for the spanning test with the null hypothesis that the test asset is spanned by the benchmark assets. The last row of each panel presents joint Wald tests of all international equity indices using the initial benchmark. The step-down test provides information on the causes of the rejection of traditional spanning test. The first test (W_{1a}) investigates whether two tangent portfolios on the efficient frontier are statistically different; and the second test (W_{2a}) investigates whether the two global minimum-variance portfolios are different statistically. The last six columns provide information on the improvement of portfolio performance by adding the test asset to the portfolio under different investment policy and short-selling constraints. Unconstrained and No Short Sales correspond to unlimited and no short-selling respectively. ΔSR, ΔSortR and ΔGMV represent the percentage improvement in the Sharpe Ratio and Sortino Ratio of the tangency portfolio and standard deviation of the Global Minimum-Variance portfolio when the test asset is included in the benchmark portfolio.

								Percentage Change in Performance Measures					
	Add to							Unconstrained			No Short Sales		
Test Asset	Benchmark Assets	W_a	p-val.	W_{1a}	p-val.	W_{2a}	p-val.	ΔSR	ΔSortR	ΔGMV	ΔSR	ΔSortR	ΔGMV
CHN	No	0.606	0.739	0.568	0.451	0.005	0.941	4.42%	8.85%	0.01%	4.42%	8.85%	0.01%
JPN	Yes	7.127	0.028	0.080	0.777	7.059	0.008	3.04%	5.80%	1.85%	0.00%	0.00%	1.85%
DEU	No	0.950	0.622	0.103	0.749	0.853	0.356	0.30%	0.44%	0.46%	0.41%	0.28%	0.46%
FRA	No	3.098	0.212	1.647	0.199	1.456	0.228	9.29%	11.87%	1.15%	9.17%	9.25%	1.15%
GBR	Yes	9.910	0.007	2.533	0.112	7.244	0.007	11.13%	17.73%	4.19%	9.97%	13.75%	4.19%
BRA	Yes	6.118	0.047	0.282	0.595	6.159	0.013	4.80%	3.82%	1.40%	3.83%	3.19%	0.00%
ITA	No	0.438	0.803	0.299	0.584	0.173	0.677	2.15%	3.69%	0.02%	2.91%	4.65%	0.00%
IND	No	1.621	0.445	1.248	0.264	0.469	0.493	7.91%	7.10%	0.46%	5.25%	4.41%	0.13%
CAN	Yes	9.533	0.009	0.081	0.777	9.363	0.002	3.02%	3.73%	2.66%	1.00%	-0.22%	0.00%
AUS	No	2.023	0.364	1.521	0.217	0.339	0.560	7.95%	5.75%	0.36%	5.16%	2.79%	0.00%
ESP	No	1.496	0.473	1.496	0.221	0.023	0.878	8.64%	8.99%	0.02%	9.37%	11.37%	0.00%
MEX	No	2.495	0.287	2.493	0.114	0.003	0.953	14.97%	15.74%	0.13%	14.24%	16.95%	0.00%
KOR	No	0.784	0.676	0.766	0.381	0.236	0.627	5.21%	5.97%	0.04%	0.47%	0.04%	0.00%
IDN	No	0.002	0.999	0.002	0.964	0.000	0.992	0.01%	-0.09%	0.00%	0.00%	0.00%	0.00%
TUR	No	0.901	0.637	0.232	0.630	0.435	0.509	2.28%	0.99%	0.10%	2.89%	2.43%	0.00%
NLD	No	0.283	0.868	0.156	0.693	0.116	0.733	1.34%	0.98%	0.01%	0.00%	0.00%	0.00%
CHE	No	1.865	0.394	0.408	0.523	1.463	0.226	1.64%	1.10%	0.72%	0.78%	0.15%	0.61%
SWE	No	0.350	0.840	0.277	0.599	0.047	0.828	1.50%	0.47%	0.06%	1.68%	0.73%	0.00%
NOR	No	1.707	0.426	0.227	0.634	1.536	0.215	0.75%	0.57%	0.72%	1.46%	1.71%	0.01%
BEL	No	0.903	0.637	0.340	0.560	0.504	0.478	3.03%	2.88%	0.10%	3.97%	2.14%	0.00%
TWN	Yes	7.423	0.024	0.001	0.981	7.410	0.006	1.11%	2.24%	2.87%	0.00%	0.00%	1.60%
AUT	No	3.353	0.187	1.179	0.278	1.909	0.167	5.14%	8.77%	0.93%	5.28%	8.15%	0.14%
ZAF	No	0.787	0.675	0.389	0.533	0.179	0.672	1.86%	0.12%	0.14%	0.62%	-0.70%	0.00%
THA	No	2.235	0.327	0.321	0.571	1.247	0.264	0.87%	0.32%	0.63%	0.00%	0.00%	0.00%
DNK	No	0.680	0.712	0.662	0.416	0.004	0.952	4.39%	4.12%	0.02%	5.90%	6.78%	0.00%
MYS	No	1.806	0.405	0.130	0.719	1.784	0.182	1.76%	2.67%	0.52%	0.00%	0.00%	0.18%
SGP	No	0.276	0.871	0.047	0.828	0.263	0.608	0.54%	-0.20%	0.08%	0.00%	0.00%	0.00%
CHL	Yes	6.838	0.033	0.077	0.782	6.021	0.014	0.10%	0.19%	2.74%	0.00%	0.00%	0.43%
HKG	Yes	7.308	0.026	0.516	0.473	3.997	0.046	1.18%	-1.32%	1.45%	0.00%	0.00%	0.00%
FIN	No	2.593	0.273	0.881	0.348	1.560	0.212	8.38%	6.71%	0.35%	7.94%	6.50%	0.00%
GRC	No	1.316	0.518	1.313	0.252	0.008	0.930	7.77%	13.21%	0.08%	9.44%	11.57%	0.58%
ISR	No	0.621	0.733	0.221	0.638	0.455	0.500	1.00%	1.76%	0.24%	1.48%	1.79%	0.04%
PRT	No	0.431	0.806	0.184	0.668	0.218	0.641	1.67%	2.74%	0.04%	2.33%	2.37%	0.00%
IRL	Yes	5.183	0.075	1.639	0.201	2.629	0.105	15.24%	14.62%	0.56%	13.63%	14.74%	0.00%
NZL	No	0.765	0.682	0.005	0.944	0.764	0.382	0.01%	0.07%	0.24%	0.00%	0.00%	0.00%

Table 2.7: Spanning tests and Performance Improvements (May 2006 - July 2013)

This table reports the results of the mean-variance spanning test, step-down spanning test on the returns of the country funds and associated performance measures. The countries are ordered in descending order, based on the national gross domestic product (GDP) for the year 2012. As an initial benchmark, the investor is assumed to hold a well diversified US portfolio of S&P 500, R2000 and USLtGvt. The spanning test is implemented on each country fund. If the test asset is not spanned by the US benchmark, then it is added into benchmark assets. The table reports the heteroskedasticity corrected Wald-statistics and p-values for the spanning test with the null hypothesis that the test asset is spanned by the benchmark assets. The last row of each panel presents joint Wald tests of all international equity indices using the initial benchmark. The step-down test provides information on the causes of the rejection of traditional spanning test. The first test (W_{1a}) investigates whether two tangent portfolios on the efficient frontier are statistically different; and the second test (W_{2a}) investigates whether the two global minimum-variance portfolios are different statistically. The last six columns provide information on the improvement of portfolio performance by adding the test asset to the portfolio under different investment policy and short-selling constraints. Unconstrained and No Short Sales correspond to unlimited and no short-selling respectively. ΔSR, ΔSortR and ΔGMV represent the percentage improvement in the Sharpe Ratio and Sortino Ratio of the tangency portfolio and standard deviation of the Global Minimum-Variance portfolio when the test asset is included in the benchmark portfolio.

								Percentage Change in Performance Measures					
	Add to							Unconstrained			No Short Sales		
Test Asset	Benchmark Assets	W_a	p-val.	W_{1a}	p-val.	W_{2a}	p-val.	ΔSR	ΔSortR	ΔGMV	ΔSR	ΔSortR	ΔGMV
CHN	No	2.827	0.243	0.207	0.650	2.636	0.104	3.42%	6.72%	0.91%	3.42%	6.72%	0.00%
JPN	No	3.851	0.146	2.584	0.108	1.722	0.189	28.73%	50.39%	0.61%	0.00%	0.00%	0.64%
DEU	Yes	8.609	0.014	0.152	0.696	7.787	0.005	0.70%	1.12%	4.93%	0.00%	0.00%	0.00%
FRA	No	1.357	0.507	1.310	0.252	0.094	0.759	13.45%	22.18%	0.00%	0.00%	0.00%	0.00%
GBR	No	3.186	0.203	0.057	0.811	2.991	0.084	1.49%	2.34%	2.38%	0.00%	0.00%	0.14%
BRA	No	0.339	0.844	0.297	0.586	0.213	0.644	4.90%	6.51%	0.33%	3.01%	3.92%	0.00%
ITA	Yes	4.938	0.085	4.938	0.026	0.685	0.408	47.22%	74.81%	0.03%	0.00%	0.00%	0.00%
IND	No	0.200	0.905	0.012	0.913	0.201	0.654	0.07%	0.38%	0.11%	0.00%	0.00%	0.00%
CAN	No	0.056	0.972	0.001	0.978	0.042	0.838	0.01%	-0.01%	0.04%	0.00%	0.00%	0.00%
AUS	Yes	6.921	0.031	0.000	0.985	6.236	0.013	0.07%	0.15%	4.16%	0.00%	0.00%	0.00%
ESP	No	3.709	0.157	2.263	0.133	2.817	0.093	12.37%	23.56%	0.49%	0.00%	0.00%	0.00%
MEX	No	1.690	0.429	0.177	0.674	1.521	0.218	1.67%	-0.81%	0.63%	5.03%	2.59%	0.00%
KOR	No	0.832	0.660	0.542	0.462	0.058	0.809	4.28%	-1.88%	0.02%	0.00%	0.00%	0.00%
IDN	No	0.987	0.611	0.196	0.658	0.397	0.529	1.95%	2.01%	0.27%	6.97%	10.59%	0.00%
TUR	No	1.281	0.527	0.208	0.648	1.052	0.305	1.17%	0.18%	0.48%	0.56%	0.01%	0.00%
NLD	No	1.185	0.553	0.699	0.403	0.203	0.652	4.65%	4.74%	0.09%	0.00%	0.00%	0.00%
CHE	No	3.898	0.142	0.572	0.449	3.219	0.073	2.47%	4.81%	2.60%	0.29%	0.50%	0.00%
SWE	No	0.580	0.748	0.401	0.527	0.067	0.796	2.62%	4.31%	0.01%	1.14%	2.08%	0.00%
NOR	No	2.237	0.327	0.612	0.434	2.123	0.145	4.63%	2.02%	2.84%	1.14%	2.05%	0.00%
BEL	No	0.380	0.827	0.303	0.582	0.324	0.569	2.58%	3.66%	0.73%	0.00%	0.00%	0.00%
TWN	No	3.933	0.140	0.052	0.820	3.813	0.051	0.12%	0.25%	2.41%	0.41%	1.16%	0.00%
AUT	No	1.522	0.467	1.494	0.222	0.331	0.565	9.83%	16.87%	0.56%	0.00%	0.00%	0.00%
ZAF	No	0.358	0.836	0.342	0.558	0.034	0.853	2.43%	7.38%	0.00%	0.00%	0.00%	0.00%
THA	No	1.135	0.567	1.126	0.289	0.116	0.734	7.64%	9.32%	0.27%	13.16%	16.14%	0.00%
DNK	No	1.140	0.565	0.899	0.343	0.728	0.394	6.22%	5.60%	1.18%	1.66%	0.80%	0.00%
MYS	Yes	15.239	0.000	4.632	0.031	9.584	0.002	23.28%	30.91%	7.81%	38.53%	57.25%	1.64%
SGP	No	0.232	0.890	0.063	0.802	0.213	0.645	0.27%	-0.10%	0.18%	0.00%	0.00%	0.00%
CHL	No	2.659	0.265	0.130	0.718	2.572	0.109	0.48%	0.16%	2.69%	0.03%	0.08%	0.54%
HKG	No	0.816	0.665	0.178	0.673	0.614	0.433	1.04%	-0.44%	0.22%	0.00%	0.00%	0.00%
FIN	No	0.718	0.699	0.524	0.469	0.143	0.705	2.48%	4.58%	0.02%	0.00%	0.00%	0.00%
GRC	Yes	5.249	0.072	4.380	0.036	1.284	0.257	15.91%	28.62%	0.16%	0.00%	0.00%	0.00%
ISR	Yes	18.110	0.000	0.481	0.488	16.451	0.000	2.80%	5.19%	8.52%	0.00%	0.00%	2.54%
PRT	No	0.717	0.699	0.030	0.863	0.604	0.437	0.19%	1.08%	0.35%	0.00%	0.00%	0.00%
IRL	No	1.835	0.399	1.284	0.257	0.279	0.597	4.46%	8.67%	0.04%	0.00%	0.00%	0.00%
NZL	No	0.359	0.836	0.356	0.550	0.004	0.952	1.16%	-0.55%	0.00%	0.00%	0.00%	0.00%

Table 2.8: Spanning tests and Performance Improvements based on Country Development (August 1996 - July 2013)

This table reports the results of the mean-variance spanning test, step-down spanning test on the returns of the country funds and associated performance measures based on market development. The sample consists of Russell indices from 35 countries. Panel A presents empirical results for developed countries. As an initial benchmark, the investor is assumed to hold a well diversified US portfolio of S&P 500, R2000 and USLtGvt. The spanning test is implemented on each country fund. Panel B presents empirical results for emerging countries. As an initial benchmark, the investor is assumed to hold a well diversified US portfolio of S&P 500, R2000 and USLtGvt. The countries are ordered in descending order, based on the national gross domestic product (GDP) for the year 2012. If the test asset is not spanned by the benchmark assets, then it is added into benchmark assets. The sample period is from August 1996 to July 2013. The table reports the heteroskedasticity corrected Wald-statistics and p-values for the spanning test with the null hypothesis that the test asset is spanned by the benchmark assets. The last row of each panel presents joint Wald tests of all international equity indices using the initial benchmark. The step-down test provides information on the causes of the rejection of traditional spanning test. The first test (W1a) investigates whether two tangent portfolios on the efficient frontier are statistically different; and the second test (W2a) investigates whether the two global minimum-variance portfolios are different statistically. The last six columns provide information on the improvement of portfolio performance by adding the test asset to the portfolio under different investment policy and short-selling constraints. Unconstrained and No Short Sales correspond to unlimited and no short-selling respectively. ΔSR, ΔSortR and ΔGMV represent the percentage improvement in the Sharpe Ratio and Sortino Ratio of the tangency portfolio and standard deviation of the Global Minimum-Variance portfolio when the test asset is included in the benchmark portfolio.

								Percentage Change in Performance Measures					
	Add to							Unconstrained			No Short Sales		
Test Asset	Benchmark Assets	W_a	p	W_{1a}	p	W2a	p	ΔSR	ΔSortR	ΔGMV	ΔSR	ΔSortR	ΔGMV
Panel A: Developed Countries													
JPN	Yes	9.358	0.009	1.111	0.292	8.797	0.003	8.39%	14.91%	1.37%	0.00%	0.00%	1.37%
DEU	No	0.861	0.65	0.002	0.96	0.855	0.35	0.01%	0.00%	0.30%	0.00%	0.00%	0.00%
FRA	No	0.169	0.91	0.089	0.76	0.088	0.76	0.48%	0.48%	0.02%	0.15%	-0.08%	0.00%
GBR	Yes	6.509	0.03	0.918	0.33	6.209	0.01	2.45%	2.67%	1.98%	1.14%	0.89%	1.98%
ITA	Yes	6.418	0.04	0.929	0.33	4.514	0.03	2.31%	3.54%	1.25%	0.00%	0.00%	0.00%
CAN	Yes	7.604	0.02	0.076	0.78	6.645	0.01	1.41%	1.22%	1.80%	0.71%	0.36%	0.00%
AUS	Yes	8.461	0.01	0.536	0.46	7.64	0.00	4.39%	6.43%	2.25%	2.50%	2.24%	0.00%
ESP	No	3.952	0.13	0.499	0.48	3.754	0.05	2.98%	2.83%	0.76%	0.13%	0.11%	0.00%
NLD	No	1.954	0.37	0.009	0.92	1.949	0.16	0.01%	0.02%	0.46%	0.00%	0.00%	0.00%
CHE	No	2.041	0.36	1.303	0.25	0.736	0.39	4.27%	4.63%	0.38%	1.24%	1.33%	0.03%
SWE	No	2.95	0.22	0.703	0.40	2.337	0.12	3.50%	2.74%	0.35%	2.12%	2.21%	0.00%
NOR	No	0.62	0.73	0.319	0.57	0.418	0.51	1.20%	1.32%	0.16%	1.05%	1.07%	0.00%
BEL	No	1.467	0.48	0.067	0.79	1.366	0.24	0.08%	0.31%	0.76%	0.00%	0.00%	0.00%
AUT	No	0.538	0.76	0.391	0.53	0.21	0.64	1.32%	2.64%	0.11%	0.00%	0.00%	0.00%
DNK	No	2.552	0.27	1.397	0.23	0.802	0.37	6.68%	6.07%	0.08%	4.44%	3.41%	0.00%
FIN	Yes	5.556	0.06	0.43	0.51	4.597	0.03	2.93%	4.16%	0.78%	1.47%	1.65%	0.00%
GRC	No	2.05	0.35	0.121	0.72	1.851	0.17	0.79%	0.21%	0.29%	0.00%	0.00%	0.00%
PRT	No	0.022	0.98	0.006	0.93	0.017	0.89	0.02%	0.06%	0.01%	0.00%	0.00%	0.00%
IRL	No	3.336	0.18	0.274	0.60	2.728	0.09	1.97%	3.32%	0.71%	0.83%	0.81%	0.00%
NZL	No	0.319	0.85	0.138	0.71	0.151	0.69	0.37%	0.59%	0.05%	0.00%	-0.03%	0.00%
All	**Yes**	**129.215**	**0**	**11.123**	**0.943**	**95.5**	**0**	**52.91%**	**73.35%**	**13.95%**	**9.88%**	**7.77%**	**3.36%**
Panel B: Emerging Countries													
CHN	No	0.919	0.631	0.701	0.403	0.463	0.496	3.81%	7.92%	0.04%	3.81%	7.92%	0.00%
BRA	No	2.447	0.29	0.949	0.33	1.223	0.26	6.61%	8.68%	0.14%	6.61%	8.68%	0.00%
IND	No	0.385	0.82	0.367	0.54	0.01	0.92	2.20%	1.56%	0.00%	2.20%	1.56%	0.00%
MEX	Yes	7.273	0.02	2.337	0.12	3.976	0.04	16.60%	18.98%	0.68%	16.57%	18.78%	0.00%
KOR	No	0.151	0.92	0.007	0.93	0.141	0.70	0.05%	0.11%	0.03%	0.03%	0.04%	0.00%
IDN	No	0.75	0.68	0.036	0.85	0.638	0.42	0.04%	0.45%	0.19%	0.00%	0.00%	0.00%
TUR	No	1.909	0.38	0.444	0.50	1.325	0.25	2.39%	1.40%	0.23%	2.23%	1.07%	0.00%
TWN	Yes	5.663	0.05	0.197	0.65	5.525	0.01	1.60%	2.29%	0.94%	0.00%	0.00%	0.54%
ZAF	No	0.609	0.73	0.037	0.84	0.504	0.47	0.07%	0.40%	0.11%	0.00%	0.00%	0.00%
THA	No	1.746	0.41	0.123	0.72	1.431	0.23	0.22%	0.47%	0.40%	0.00%	0.00%	0.00%
MYS	No	3.243	0.19	0.172	0.67	2.579	0.10	0.27%	-0.62%	0.82%	0.00%	0.00%	0.76%
SGP	No	0.279	0.87	0.179	0.67	0.055	0.81	0.62%	1.06%	0.03%	0.00%	0.00%	0.00%
CHL	No	4.283	0.11	0.568	0.45	4.083	0.04	1.31%	1.05%	2.25%	0.56%	0.11%	1.52%
HKG	No	0.364	0.83	0.259	0.61	0.108	0.74	0.95%	0.34%	0.06%	0.00%	0.00%	0.00%
ISR	No	2.462	0.29	0.384	0.53	2.198	0.13	0.95%	1.92%	0.55%	0.85%	1.49%	0.42%
All	**Yes**	**107.98**	**0**	**5.925**	**0.98**	**86.40**	**0**	**33.50**	**44.75**	**8.99%**	**20.07**	**21.86**	**2.54%**

Table 2.9: Spanning tests and Performance Improvements: Large and Small Cap Country Indices (August 1996 - July 2013)

This table reports the results of the mean-variance spanning test, step-down spanning test on the returns of the country funds and associated performance measures. The sample consists of Large and Small cap Russell indices from 35 countries. The countries are ordered in descending order, based on the national gross domestic product (GDP) for the year 2012. As an initial benchmark, the investor is assumed to a hold well diversified US portfolio of S&P 500, R2000 and USLtGvt. The spanning test is implemented on each country fund. If the test asset is not spanned by benchmark assets, then it is added in benchmark assets. The table reports the heteroskedasticity corrected Wald-statistics and p-values for the spanning test with the null hypothesis that the test asset is spanned by the benchmark assets.The last row of each panel presents joint Wald tests of all international equity indices using the initial benchmark. The step-down test provides information on the causes of the rejection of traditional spanning test. The first test (W_{1a}) investigates whether two tangent portfolios on the efficient frontier are statistically different; and the second test (W_{2a}) investigates whether the two global minimum-variance portfolios are different statistically. The last six columns provide information on the improvement of portfolio performance by adding the test asset to the portfolio under different investment policy and short-selling constraints. Unconstrained and No Short Sales correspond to unlimited and no short-selling respectively. ΔSR, ΔSortR and ΔGMV represent the percentage improvement in the Sharpe Ratio and Sortino Ratio of the tangency portfolio and standard deviation of the Global Minimum-Variance portfolio when the test asset is included in the benchmark portfolio

								Percentage Change in Performance Measures					
								Unconstrained			No Short Sales		
Test Asset	Add to Benchmark Assets	W_a	p-val.	W_{1a}	p-val.	W_{2a}	p-val.	ΔSR	ΔSortR	ΔGMV	ΔSR	ΔSortR	ΔGMV
CHNLc	No	1.075	0.584	0.677	0.411	0.719	0.397	3.74%	7.70%	0.06%	3.74%	7.70%	0.00%
CHNSc	No	1.198	0.549	1.083	0.298	0.071	0.790	5.20%	9.87%	0.08%	5.20%	9.87%	0.08%
JPNLc	Yes	9.741	0.008	1.201	0.273	9.058	0.003	9.00%	15.70%	1.37%	0.00%	0.00%	1.37%
JPNSc	No	0.636	0.728	0.576	0.448	0.002	0.962	2.43%	2.17%	0.01%	0.00%	0.00%	0.01%
DEULc	No	0.914	0.633	0.000	1.000	0.913	0.339	0.05%	0.03%	0.31%	0.01%	-0.03%	0.00%
DEUSc	No	0.134	0.935	0.029	0.864	0.112	0.738	0.09%	0.28%	0.04%	0.00%	0.00%	0.00%
FRALc	No	0.262	0.877	0.097	0.755	0.178	0.673	0.55%	0.57%	0.04%	0.17%	-0.06%	0.00%
FRASc	No	0.819	0.664	0.341	0.559	0.606	0.436	1.26%	1.70%	0.25%	0.49%	0.27%	0.25%
GBRLc	Yes	6.802	0.033	0.878	0.349	6.444	0.011	2.25%	2.57%	1.91%	0.98%	0.82%	1.91%
GBRSc	No	1.008	0.604	0.849	0.357	0.001	0.973	4.69%	4.39%	0.01%	3.14%	2.36%	0.01%
BRALc	Yes	7.213	0.027	0.812	0.368	6.145	0.013	5.99%	8.29%	0.99%	5.21%	7.36%	0.00%
BRASc	No	3.095	0.213	1.880	0.170	1.404	0.236	8.21%	9.05%	0.12%	7.01%	7.70%	0.00%
ITALc	Yes	5.674	0.059	1.114	0.291	3.715	0.054	2.61%	3.71%	1.12%	0.00%	0.00%	0.00%
ITASc	No	1.934	0.380	1.357	0.244	0.283	0.595	4.41%	6.11%	0.14%	0.00%	0.00%	0.00%
INDLc	No	0.457	0.796	0.181	0.671	0.291	0.590	0.90%	0.50%	0.03%	0.00%	0.00%	0.00%
INDSc	No	1.649	0.438	0.833	0.361	0.947	0.331	4.02%	3.39%	0.10%	1.40%	1.36%	0.00%
CANLc	Yes	5.020	0.081	0.000	0.995	4.923	0.026	0.20%	-0.02%	1.31%	0.01%	-0.08%	0.00%
CANSc	No	0.183	0.913	0.117	0.732	0.105	0.745	0.40%	1.05%	0.06%	0.38%	0.66%	0.00%
AUSLc	Yes	6.704	0.035	0.349	0.555	6.173	0.013	2.82%	3.94%	1.84%	1.30%	0.46%	0.00%
AUSSc	No	1.410	0.494	0.161	0.688	1.368	0.242	0.28%	0.31%	0.66%	0.00%	0.00%	0.00%
ESPLc	No	3.618	0.164	0.340	0.560	3.501	0.061	2.03%	2.06%	0.74%	0.00%	0.00%	0.00%
ESPSc	No	3.217	0.200	2.672	0.102	0.447	0.504	8.47%	11.36%	0.29%	3.28%	3.67%	0.00%
MEXLc	No	3.413	0.182	1.854	0.173	1.381	0.240	7.78%	7.13%	0.16%	10.94%	11.76%	0.00%
MEXSc	No	1.110	0.574	0.154	0.695	0.886	0.347	0.32%	2.19%	0.30%	0.00%	0.00%	0.00%
KORLc	No	0.994	0.608	0.989	0.320	0.070	0.791	4.06%	7.36%	0.00%	0.35%	0.68%	0.00%
KORSc	No	0.421	0.810	0.003	0.959	0.407	0.523	0.04%	0.34%	0.08%	0.00%	0.00%	0.00%
IDNLc	No	2.817	0.244	0.006	0.939	2.798	0.094	0.18%	0.10%	0.50%	0.00%	0.00%	0.00%
IDNSc	No	0.014	0.993	0.001	0.982	0.014	0.906	0.00%	-0.06%	0.00%	0.00%	0.00%	0.00%
TURLc	No	3.698	0.157	0.084	0.772	3.209	0.073	0.78%	0.28%	0.58%	0.87%	0.61%	0.00%
TURSc	No	3.498	0.174	1.420	0.233	1.360	0.243	6.14%	5.68%	0.12%	5.51%	6.12%	0.00%
NLDLc	No	1.858	0.395	0.039	0.843	1.822	0.177	0.02%	-0.03%	0.47%	0.00%	0.00%	0.00%
NLDSc	No	0.501	0.779	0.001	0.972	0.500	0.479	0.04%	0.31%	0.13%	0.00%	0.00%	0.00%
CHELc	No	1.744	0.418	1.117	0.291	0.637	0.425	3.54%	3.70%	0.33%	0.74%	0.57%	0.04%
CHESc	No	4.416	0.110	2.476	0.116	2.072	0.150	7.46%	6.68%	0.82%	2.02%	1.46%	0.02%
SWELc	No	2.158	0.340	0.513	0.474	1.728	0.189	2.41%	1.60%	0.27%	1.00%	0.57%	0.00%
SWESc	No	2.781	0.249	2.655	0.103	0.049	0.825	9.07%	9.92%	0.09%	6.66%	8.55%	0.00%

(continued)

Table 2.9 (cont'd): Spanning tests and Performance Improvements: Large and Small Cap Country Indices (August 1996 - July 2013)

This table reports the results of the mean-variance spanning test, step-down spanning test on the returns of the country funds and associated performance measures. The sample consists of Large and Small cap Russell indices from 35 countries. The countries are ordered in descending order, based on the national gross domestic product (GDP) for the year 2012. As an initial benchmark, the investor is assumed to a hold well diversified US portfolio of S&P 500, R2000 and USLtGvt. The spanning test is implemented on each country fund. If the test asset is not spanned by benchmark assets, then it is added in benchmark assets. The table reports the heteroskedasticity corrected Wald-statistics and p-values for the spanning test with the null hypothesis that the test asset is spanned by the benchmark assets.The last row of each panel presents joint Wald tests of all international equity indices using the initial benchmark. The step-down test provides information on the causes of the rejection of traditional spanning test. The first test (W_{1a}) investigates whether two tangent portfolios on the efficient frontier are statistically different; and the second test (W_{2a}) investigates whether the two global minimum-variance portfolios are different statistically. The last six columns provide information on the improvement of portfolio performance by adding the test asset to the portfolio under different investment policy and short-selling constraints. Unconstrained and No Short Sales correspond to unlimited and no short-selling respectively. ΔSR, ΔSortR and ΔGMV represent the percentage improvement in the Sharpe Ratio and Sortino Ratio of the tangency portfolio and standard deviation of the Global Minimum-Variance portfolio when the test asset is included in the benchmark portfolio.

								Percentage Change in Performance Measures					
								Unconstrained			No Short Sales		
Test Asset	Add to Benchmark Assets	W_a	p-val.	W_{1a}	p-val.	W_{2a}	p-val.	ΔSR	ΔSortR	ΔGMV	ΔSR	ΔSortR	ΔGMV
NORLc	No	0.667	0.716	0.303	0.582	0.459	0.498	1.05%	0.69%	0.17%	0.81%	0.56%	0.00%
NORSc	No	1.454	0.483	0.319	0.572	1.335	0.248	0.83%	0.46%	0.50%	0.37%	0.33%	0.00%
BELLc	No	1.931	0.381	0.121	0.728	1.799	0.180	0.17%	0.37%	1.09%	0.00%	0.00%	0.00%
BELSc	No	3.342	0.188	1.520	0.218	2.251	0.134	4.29%	1.69%	1.09%	2.21%	0.56%	0.16%
TWNLc	Yes	5.426	0.066	0.140	0.708	5.261	0.022	1.21%	2.16%	1.06%	0.00%	0.00%	0.15%
TWNSc	No	2.690	0.260	0.343	0.558	2.110	0.146	0.58%	0.29%	0.72%	0.00%	0.00%	0.28%
AUTLc	No	0.731	0.694	0.009	0.924	0.689	0.407	0.12%	-0.10%	0.19%	0.00%	0.00%	0.00%
AUTSc	No	0.427	0.808	0.008	0.929	0.366	0.545	0.10%	0.22%	0.12%	0.00%	0.00%	0.00%
ZAFLc	No	1.555	0.459	0.071	0.790	1.312	0.252	0.08%	0.16%	0.32%	0.00%	0.00%	0.00%
ZAFSc	No	1.309	0.520	1.250	0.264	0.164	0.685	4.44%	4.85%	0.00%	1.99%	1.44%	0.00%
THALc	No	0.799	0.671	0.217	0.641	0.435	0.509	0.55%	1.16%	0.13%	0.00%	0.00%	0.00%
THASc	No	2.324	0.313	0.003	0.955	2.293	0.130	0.16%	-0.04%	0.60%	0.00%	0.00%	0.00%
DNKLc	No	1.962	0.375	0.729	0.393	0.956	0.328	3.32%	3.67%	0.13%	1.62%	0.34%	0.00%
DNKSc	Yes	5.797	0.055	5.737	0.017	0.006	0.936	20.40%	21.59%	0.07%	13.06%	14.66%	0.01%
MYSLc	Yes	4.899	0.086	0.435	0.509	3.113	0.078	0.74%	0.60%	0.86%	0.10%	-0.01%	0.71%
MYSSc	No	2.326	0.313	0.940	0.332	0.375	0.540	1.73%	2.99%	0.18%	0.00%	0.00%	0.00%
SGPLc	No	1.310	0.519	0.166	0.683	1.102	0.294	0.33%	0.74%	0.29%	0.00%	0.00%	0.00%
SGPSc	No	2.995	0.224	0.059	0.808	2.562	0.109	0.04%	0.07%	0.54%	0.00%	0.00%	0.00%
CHLLc	No	4.009	0.135	0.033	0.856	3.989	0.046	0.00%	0.04%	1.44%	0.00%	0.00%	0.35%
CHLSc	Yes	6.039	0.049	0.098	0.755	5.980	0.014	0.00%	-0.01%	2.30%	0.11%	0.50%	0.64%
HKGLc	Yes	4.958	0.084	0.204	0.651	4.009	0.045	0.24%	-0.25%	0.89%	0.00%	0.00%	0.00%
HKGSc	No	2.166	0.339	0.973	0.324	1.286	0.257	2.42%	5.91%	0.66%	0.00%	0.00%	0.00%
FINLc	No	4.087	0.130	0.482	0.488	3.123	0.077	1.95%	2.25%	0.49%	0.25%	-0.23%	0.00%
FINSc	No	0.913	0.634	0.772	0.380	0.075	0.785	1.58%	2.69%	0.06%	0.07%	-0.03%	0.00%
GRCLc	No	1.426	0.490	1.105	0.293	0.454	0.500	2.71%	4.67%	0.03%	0.00%	0.00%	0.00%
GRCSc	No	0.633	0.729	0.024	0.876	0.590	0.443	0.02%	-0.02%	0.12%	0.00%	0.00%	0.00%
ISRLc	Yes	11.896	0.003	0.945	0.331	11.220	0.001	1.22%	-0.17%	2.30%	1.44%	1.65%	0.58%
ISRSc	Yes	5.481	0.065	0.248	0.618	5.530	0.019	0.15%	0.56%	1.26%	0.00%	0.00%	0.00%
PRTLc	No	0.147	0.929	0.000	0.995	0.146	0.702	0.00%	0.03%	0.03%	0.00%	0.00%	0.00%
PRTSc	No	0.034	0.983	0.029	0.864	0.011	0.918	0.07%	0.23%	0.00%	0.00%	0.00%	0.00%
IRLLc	No	1.261	0.532	0.111	0.739	1.220	0.269	0.12%	0.31%	0.35%	0.00%	0.00%	0.00%
IRLSc	No	2.201	0.333	1.151	0.283	1.201	0.273	3.61%	4.58%	0.15%	2.66%	2.75%	0.00%
NZLLc	No	0.178	0.915	0.164	0.685	0.017	0.898	0.40%	0.40%	0.00%	0.00%	0.00%	0.00%
NZLSc	No	1.443	0.486	0.324	0.569	1.181	0.277	0.58%	2.39%	0.29%	0.07%	0.07%	0.00%

Table 2.10: Developed Economies ranked by Corporate governance: Spanning tests and Performance Improvements (August 1996 - July 2013)

This table reports the results of the mean-variance spanning test, step-down spanning test on the returns of the country funds and associated performance measures. The sample consists of Russell indices from 21 developed countries. Panel A presents empirical results for common law small cap indices. USLtGvt.and large cap common law country indices are used as benchmark assets. Panel B and C display, respectively, emprical results for civil law countries large cap and small cap indices sorted based on the GMI country ratings as of 2010. USLtGvt,.large and small cap common law country indices are used as benchmark assets. The sample period is from August 1996 to July 2013. The table reports the heteroskedasticity corrected Wald-statistics and p-values for the spanning test with the null hypothesis that the test asset is spanned by the benchmark assets.The last row of each panel presents joint Wald tests of all international equity indices using the initial benchmark. The step-down test provides information on the causes of the rejection of traditional spanning test. The first test (W_{1a}) investigates whether two tangent portfolios on the efficient frontier are statistically different; and the second test (W_{2a}) investigates whether the two global minimum-variance portfolios are different statistically. The last six columns provide information on the improvement of portfolio performance by adding the test asset to the portfolio under different investment policy and short-selling constraints. Unconstrained and No Short Sales correspond to unlimited and no short-selling respectively. ΔSR, ΔSortR and ΔGMV represent the percentage improvement in the Sharpe Ratio and Sortino Ratio of the tangency portfolio and standard deviation of the Global Minimum-Variance portfolio when the test asset is included in the benchmark portfolio.

							Percentage Change in Performance Measures					
							Unconstrained			**No Short Sales**		
Test Asset	**W_a**	**p-val.**	**W_{1a}**	**p-val.**	**W_{2a}**	**p-val.**	**ΔSR**	**ΔSortR**	**ΔGMV**	**ΔSR**	**ΔSortR**	**ΔGMV**
Panel A: Common Law Small-Cap												
Russell 2000	3.217	0.200	0.404	0.525	3.015	0.083	0.88%	1.71%	1.41%	1.36%	2.08%	0.32%
GBRSc	3.716	0.156	1.072	0.301	2.925	0.087	3.34%	2.48%	1.39%	1.68%	1.07%	0.25%
CANSc	2.833	0.243	0.216	0.642	2.779	0.096	0.35%	0.93%	1.17%	0.51%	1.26%	0.00%
AUSSc	0.831	0.660	0.176	0.675	0.773	0.379	0.57%	1.19%	0.41%	0.00%	0.00%	0.00%
IRLSc	7.919	0.019	6.098	0.014	1.202	0.273	21.65%	26.15%	0.94%	16.17%	20.08%	0.02%
NZLSc	2.589	0.274	1.491	0.222	0.849	0.357	5.18%	7.45%	0.38%	0.91%	1.39%	0.00%
All	**24.402**	**0.018**	**8.534**	**0.202**	**13.536**	**0.035**	**29.65%**	**35.59%**	**4.10%**	**16.27%**	**20.04%**	**0.38%**
Panel B: Large Cap Developed Countries Ranked based on GMI index												
Panel B1: High GMI Large-Cap												
DEULc	6.270	0.044	1.216	0.270	5.065	0.024	1.92%	4.03%	2.44%	0.00%	0.00%	0.00%
NLDLc	7.086	0.029	0.961	0.327	5.909	0.015	1.61%	4.01%	1.64%	0.00%	0.00%	0.00%
CHELc	0.201	0.905	0.001	0.977	0.198	0.657	0.02%	0.13%	0.05%	0.00%	0.00%	0.11%
SWELc	4.670	0.097	0.036	0.850	4.660	0.031	0.54%	0.27%	1.36%	0.05%	0.09%	0.00%
FINLc	7.624	0.022	0.487	0.485	6.707	0.010	2.64%	5.33%	1.12%	1.12%	1.73%	0.00%
All	**21.580**	**0.017**	**2.804**	**0.730**	**16.233**	**0.006**	**7.48%**	**13.89%**	**4.08%**	**1.12%**	**1.73%**	**0.11%**
Panel B2: Medium GMI Large-Cap												
FRALc	4.686	0.096	0.711	0.399	3.996	0.046	1.16%	2.39%	1.57%	0.00%	0.00%	0.00%
ITALc	6.187	0.045	1.442	0.230	3.518	0.061	2.42%	5.13%	1.20%	0.00%	0.00%	0.00%
NORLc	0.353	0.838	0.010	0.922	0.327	0.567	0.06%	-0.17%	0.05%	0.00%	0.00%	0.00%
AUTLc	1.410	0.494	0.418	0.518	0.944	0.331	0.84%	2.27%	0.32%	0.00%	0.00%	0.00%
DNKLc	2.367	0.306	0.215	0.643	2.063	0.151	1.05%	-0.25%	0.31%	0.00%	0.00%	0.00%
All	**8.646**	**0.566**	**2.122**	**0.832**	**5.216**	**0.390**	**4.94%**	**6.70%**	**1.80%**	**0.00%**	**0.00%**	**0.00%**
Panel B3: Low GMI Large-Cap												
JPNLc	9.624	0.008	1.810	0.178	8.376	0.004	6.86%	9.46%	1.46%	0.00%	0.00%	0.67%
ESPLc	5.424	0.066	0.099	0.753	4.950	0.026	0.01%	0.06%	1.74%	0.00%	0.00%	0.00%
BELLc	4.038	0.133	1.059	0.303	3.797	0.051	2.29%	4.50%	1.81%	0.00%	0.00%	0.00%
GRCLc	0.730	0.694	0.700	0.403	0.004	0.951	1.86%	4.68%	0.02%	0.00%	0.00%	0.00%
PRTLc	1.217	0.544	0.712	0.399	0.477	0.490	1.61%	2.44%	0.24%	0.00%	0.00%	0.00%
All	**32.490**	**0.000**	**3.603**	**0.608**	**27.659**	**0.000**	**12.18%**	**18.46%**	**4.64%**	**0.00%**	**0.00%**	**0.67%**

(continued)

Table 2.10 (cont.): Developed Economies ranked by Corporate governance: Spanning tests and Performance Improvements (August 1996 - July 2013)

This table reports the results of the mean-variance spanning test, step-down spanning test on the returns of the country funds and associated performance measures. The sample consists of Russell indices from 21 developed countries. Panel A presents empirical results for common law small cap indices. USLtGvt.and large cap common law country indices are used as benchmark assets. Panel B and C display, respectively, emprical results for civil law countries large cap and small cap indices sorted based on the GMI country ratings as of 2010. USLtGvt,.large and small cap common law country indices are used as benchmark assets. The sample period is from August 1996 to July 2013. The table reports the heteroskedasticity corrected Wald-statistics and p-values for the spanning test with the null hypothesis that the test asset is spanned by the benchmark assets.The last row of each panel presents joint Wald tests of all international equity indices using the initial benchmark. The step-down test provides information on the causes of the rejection of traditional spanning test. The first test (W_{1a}) investigates whether two tangent portfolios on the efficient frontier are statistically different; and the second test (W_{2a}) investigates whether the two global minimum-variance portfolios are different statistically. The last six columns provide information on the improvement of portfolio performance by adding the test asset to the portfolio under different investment policy and short-selling constraints. Unconstrained and No Short Sales correspond to unlimited and no short-selling respectively. ΔSR, ΔSortR and ΔGMV represent the percentage improvement in the Sharpe Ratio and Sortino Ratio of the tangency portfolio and standard deviation of the Global Minimum-Variance portfolio when the test asset is included in the benchmark portfolio.

							Percentage Change in Performance Measures					
							Unconstrained			No Short Sales		
Test Asset	**W_a**	**p-val.**	**W_{1a}**	**p-val.**	**W_{2a}**	**p-val.**	**ΔSR**	**ΔSortR**	**ΔGMV**	**ΔSR**	**ΔSortR**	**ΔGMV**
Panel C: Small Cap Developed Countries Ranked based on GMI index												
Panel C1: High GMI Small-Cap												
DEUSc	2.589	0.274	2.031	0.154	0.865	0.352	4.98%	8.70%	0.63%	0.00%	0.00%	0.00%
NLDSc	2.673	0.263	2.185	0.139	0.297	0.586	5.33%	9.59%	0.22%	0.00%	0.00%	0.00%
CHESc	0.588	0.745	0.003	0.959	0.583	0.445	0.00%	0.07%	0.20%	0.00%	0.00%	0.06%
SWESc	2.609	0.271	0.775	0.379	2.018	0.155	2.70%	4.18%	0.20%	0.84%	1.60%	0.00%
FINSc	0.785	0.675	0.587	0.444	0.127	0.722	1.52%	2.33%	0.08%	0.27%	0.64%	0.00%
All	**18.307**	**0.050**	**7.646**	**0.177**	**7.975**	**0.158**	**19.11%**	**30.60%**	**1.88%**	**0.84%**	**1.60%**	**0.06%**
Panel C2: Medium GMI Small-Cap												
FRASc	1.692	0.429	1.156	0.282	0.456	0.500	2.85%	5.17%	0.21%	0.00%	0.00%	0.00%
ITASc	1.217	0.544	0.315	0.574	0.724	0.395	0.53%	2.20%	0.28%	0.00%	0.00%	0.00%
NORSc	0.022	0.989	0.018	0.895	0.002	0.963	0.06%	0.25%	0.00%	0.00%	0.00%	0.00%
AUTSc	1.979	0.372	1.332	0.249	0.864	0.353	4.05%	7.10%	0.06%	0.00%	0.00%	0.00%
DNKSc	2.230	0.328	2.224	0.136	0.000	0.990	6.35%	7.30%	0.05%	2.92%	3.88%	0.02%
All	**10.465**	**0.401**	**7.874**	**0.163**	**2.127**	**0.831**	**18.60%**	**29.31%**	**0.60%**	**2.92%**	**3.88%**	**0.02%**
Panel C3: Low GMI Small-Cap												
JPNSc	8.160	0.017	0.816	0.366	8.060	0.005	3.54%	5.66%	1.50%	0.00%	0.00%	0.66%
ESPSc	0.227	0.893	0.227	0.634	0.011	0.915	0.67%	-0.02%	0.00%	0.00%	-0.01%	0.00%
BELSc	1.134	0.567	0.048	0.826	1.042	0.307	0.03%	-0.33%	0.31%	0.00%	0.00%	0.10%
GRCSc	0.370	0.831	0.018	0.892	0.349	0.555	0.02%	-0.11%	0.09%	0.00%	0.00%	0.03%
PRTSc	0.369	0.831	0.338	0.561	0.007	0.936	0.89%	1.72%	0.01%	0.00%	0.00%	0.00%
All	**12.006**	**0.285**	**2.154**	**0.827**	**10.179**	**0.070**	**6.76%**	**10.52%**	**2.00%**	**0.00%**	**-0.01%**	**0.77%**

Table 2.11: Emerging Economies ranked by Corporate governance: Spanning tests and Performance Improvements (August 1996 - July 2013)

This table reports the results of the mean-variance spanning test, step-down spanning test on the returns of the country funds and associated performance measures. The sample consists of Russell indices from 15 emerging countries. As an initial benchmark, the investor is assumed to hold USLtGvt., large and small cap common law country indices. Panel A and B display, respectively, empirical results for emerging civil law countries large cap indices sorted based on the GMI country ratings as of 2010. The table reports the heteroskedasticity corrected Wald-statistics and p-values for the spanning test with the null hypothesis that the test asset is spanned by the benchmark assets.The last row of each panel presents joint Wald tests of all international equity indices using the initial benchmark. The step-down test provides information on the causes of the rejection of traditional spanning test. The first test (W_{1a}) investigates whether two tangent portfolios on the efficient frontier are statistically different; and the second test (W_{2a}) investigates whether the two global minimum-variance portfolios are different statistically. The last six columns provide information on the improvement of portfolio performance by adding the test asset to the portfolio under different investment policy and short-selling constraints. Unconstrained and No Short Sales correspond to unlimited and no short-selling respectively. ΔSR, ΔSortR and ΔGMV represent the percentage improvement in the Sharpe Ratio and Sortino Ratio of the tangency portfolio and standard deviation of the Global Minimum-Variance portfolio when the test asset is included in the benchmark portfolio.

							Percentage Change in Performance Measures					
							Unconstrained			No Short Sales		
Test Asset	W_a	**p-val.**	W_{1a}	**p-val.**	W_{2a}	**p-val.**	**ΔSR**	**ΔSortR**	**ΔGMV**	**ΔSR**	**ΔSortR**	**ΔGMV**
Panel A: Large Cap Emerging Countries Ranked based on GMI index												
Panel A1: High GMI Large-Cap												
INDLc	0.187	0.911	0.011	0.917	0.180	0.672	0.06%	0.11%	0.03%	0.00%	0.00%	0.00%
ZAFLc	0.723	0.696	0.448	0.503	0.210	0.647	1.14%	1.87%	0.10%	0.00%	0.00%	0.00%
THALc	1.488	0.475	1.204	0.272	0.459	0.498	3.50%	5.64%	0.02%	0.00%	0.00%	0.00%
MYSLc	6.399	0.041	0.044	0.833	5.838	0.016	0.00%	0.00%	1.21%	0.00%	0.00%	0.92%
SGPLc	0.005	0.998	0.000	0.990	0.004	0.947	0.00%	-0.01%	0.00%	0.00%	0.00%	0.00%
All	**12.549**	**0.250**	**2.219**	**0.818**	**8.716**	**0.121**	**4.75%**	**7.25%**	**1.48%**	**0.00%**	**0.00%**	**0.92%**
Panel A2: Medium GMI Large-Cap												
BRALc	1.517	0.468	0.231	0.631	1.327	0.249	0.99%	1.55%	0.15%	1.55%	2.01%	0.00%
KORLc	0.839	0.657	0.237	0.627	0.497	0.481	0.49%	1.67%	0.12%	0.41%	1.29%	0.00%
TWNLc	3.402	0.183	0.090	0.764	3.294	0.070	0.67%	0.25%	0.68%	0.00%	0.00%	0.19%
HKGLc	0.277	0.871	0.145	0.704	0.113	0.737	0.33%	0.05%	0.04%	0.00%	0.00%	0.00%
ISRLc	3.862	0.145	0.438	0.508	3.540	0.060	0.68%	0.97%	0.87%	2.02%	3.34%	0.69%
All	**12.735**	**0.239**	**1.402**	**0.924**	**9.942**	**0.077**	**3.67%**	**6.36%**	**2.35%**	**3.01%**	**4.35%**	**0.88%**
Panel A3: Low GMI Large-Cap												
CHNLc	0.842	0.656	0.770	0.380	0.001	0.977	1.94%	4.61%	0.02%	1.46%	3.43%	0.00%
MEXLc	6.722	0.035	4.414	0.036	1.715	0.190	14.21%	17.61%	0.08%	9.55%	7.76%	0.00%
IDNLc	3.933	0.140	0.210	0.647	3.707	0.054	0.24%	0.31%	0.79%	0.00%	0.00%	0.00%
TURLc	7.008	0.030	0.263	0.608	6.363	0.012	1.69%	2.49%	1.15%	0.81%	0.79%	0.00%
CHLLc	4.301	0.116	0.185	0.668	4.041	0.044	0.13%	0.17%	1.31%	0.26%	0.41%	0.79%
All	**42.011**	**0.000**	**5.734**	**0.333**	**29.185**	**0.000**	**16.88%**	**22.31%**	**4.65%**	**9.56%**	**7.81%**	**0.79%**

(continued)

Table 2.11 (cont.): Emerging Economies ranked by Corporate governance: Spanning tests and Performance Improvements (August 1996 - July 2013)

This table reports the results of the mean-variance spanning test, step-down spanning test on the returns of the country funds and associated performance measures. The sample consists of Russell indices from 15 emerging countries. As an initial benchmark, the investor is assumed to hold USLtGvt., large and small cap common law country indices. Panel A and B display, respectively, empirical results for emerging civil law countries large cap indices sorted based on the GMI country ratings as of 2010. The sample period is from August 1996 to July 2013. The table reports the heteroskedasticity corrected Wald-statistics and p-values for the spanning test with the null hypothesis that the test asset is spanned by the benchmark assets.The last row of each panel presents joint Wald tests of all international equity indices using the initial benchmark. The step-down test provides information on the causes of the rejection of traditional spanning test. The first test (W_{1a}) investigates whether two tangent portfolios on the efficient frontier are statistically different; and the second test (W_{2a}) investigates whether the two global minimum-variance portfolios are different statistically. The last six columns provide information on the improvement of portfolio performance by adding the test asset to the portfolio under different investment policy and short-selling constraints. Unconstrained and No Short Sales correspond to unlimited and no short-selling respectively. ΔSR, ΔSortR and ΔGMV represent the percentage improvement in the Sharpe Ratio and Sortino Ratio of the tangency portfolio and standard deviation of the Global Minimum-Variance portfolio when the test asset is included in the benchmark portfolio.

							Percentage Change in Performance Measures					
							Unconstrained			No Short Sales		
Test Asset	**W_a**	**p-val.**	**W_{1a}**	**p-val.**	**W_{2a}**	**p-val.**	**ΔSR**	**ΔSortR**	**ΔGMV**	**ΔSR**	**ΔSortR**	**ΔGMV**
Panel B: Small Cap Emerging Countries Ranked based on GMI index												
Panel B1: High GMI Small-Cap												
INDSc	0.221	0.895	0.140	0.708	0.099	0.754	0.44%	0.60%	0.01%	0.08%	0.00%	0.00%
ZAFSc	0.216	0.898	0.208	0.648	0.013	0.909	0.60%	0.80%	0.00%	0.54%	1.03%	0.00%
THASc	0.564	0.754	0.233	0.630	0.232	0.630	0.48%	0.90%	0.08%	0.00%	0.00%	0.00%
MYSSc	3.604	0.165	0.092	0.761	3.589	0.058	0.59%	1.50%	0.62%	0.00%	0.00%	0.46%
SGPSc	0.050	0.975	0.031	0.860	0.011	0.917	0.07%	0.22%	0.00%	0.00%	0.00%	0.00%
All	**6.273**	**0.792**	**0.678**	**0.984**	**6.048**	**0.302**	**2.01%**	**3.61%**	**1.14%**	**0.55%**	**0.97%**	**0.46%**
Panel B2: Medium GMI Small-Cap												
BRASc	3.353	0.187	1.530	0.216	2.080	0.149	5.10%	7.31%	0.19%	3.94%	5.34%	0.00%
KORSc	0.420	0.811	0.241	0.624	0.117	0.733	0.56%	0.77%	0.04%	0.00%	0.00%	0.00%
TWNSc	4.927	0.085	0.001	0.979	4.904	0.027	0.09%	0.05%	1.00%	0.00%	0.00%	0.42%
HKGSc	0.856	0.652	0.722	0.395	0.016	0.901	1.64%	1.36%	0.03%	0.00%	0.00%	0.00%
ISRSc	1.090	0.580	0.000	0.987	1.087	0.297	0.03%	0.10%	0.18%	0.10%	0.20%	0.00%
All	**11.426**	**0.325**	**3.206**	**0.668**	**8.363**	**0.137**	**9.05%**	**13.02%**	**1.78%**	**3.94%**	**5.34%**	**0.42%**
Panel B3: Low GMI Small-Cap												
CHNSc	1.526	0.466	0.925	0.336	0.376	0.540	2.34%	6.54%	0.19%	2.00%	4.26%	0.00%
MEXSc	2.505	0.286	0.029	0.864	2.452	0.117	0.00%	0.07%	0.65%	0.00%	0.00%	0.00%
IDNSc	0.344	0.842	0.146	0.702	0.170	0.680	0.35%	0.64%	0.05%	0.00%	0.00%	0.00%
TURSc	7.957	0.019	1.713	0.191	5.953	0.015	6.32%	11.16%	0.69%	4.37%	5.51%	0.00%
CHLSc	5.655	0.059	0.391	0.532	5.042	0.025	0.37%	1.14%	1.76%	0.64%	1.22%	1.18%
All	**22.250**	**0.014**	**3.681**	**0.596**	**18.062**	**0.003**	**10.91%**	**23.74%**	**4.31%**	**6.43%**	**8.22%**	**1.18%**

Table 2.12: Out-of-sample test results

In this table we show the results of an out-of-sample test to examine whether our empirical results in the earlier sections are robust when transaction costs are introduced. We assume a relative transaction cost of 0.1% and execute the out-of-sample test using a rolling portfolio approach. We compare monthly returns to the benchmark portfolio consisting of US assets and monthly returns to a augmented portfolio that contains the US assets and foreign assets. For each portfolio, starting from July 2001, we estimate the tangency portfolio weights based on the previous 60-month returns and update these weights at each month considering transaction costs. As an initial portfolio we use the equally weighed portfolio of S&P 500, R2000 and US long term government bond.

Percentage Change in Performance Measures

Augmented Portfolio	Unconstrained						No Short Sales					
	$M_{Aug}-M_b$	p-value	SR	ΔSR (%)	SortR	ΔSortR (%)	$M_{Aug}-M_b$	p-value	SR	ΔSR (%)	SortR	ΔSortR (%)
All Countries	1.32%	0.101	0.176	103.4%	0.286	143.4%	0.23%	0.528	0.174	41.0%	0.249	41.6%
Developed Countries	1.26%	0.068	0.202	133.8%	0.326	176.9%	0.16%	0.654	0.158	28.0%	0.222	26.3%
Emerging Countries	0.49%	0.550	0.083	-3.9%	0.120	2.1%	0.31%	0.388	0.201	62.4%	0.291	65.4%
LC and SC of All Countries	1.72%	0.098	0.167	92.7%	0.299	154.1%	0.33%	0.371	0.196	59.0%	0.280	59.2%
LC of All Countries	1.19%	0.121	0.171	97.4%	0.271	130.6%	0.31%	0.386	0.205	65.5%	0.300	70.4%
SC of All Countries	1.82%	0.074	0.179	106.8%	0.333	183.0%	0.43%	0.258	0.217	75.3%	0.311	76.6%
LC and SC of Developed Countries	1.94%	0.015	0.249	188.2%	0.441	274.9%	0.28%	0.438	0.188	52.4%	0.270	53.6%
LC of Developed Countries	1.09%	0.093	0.194	124.2%	0.310	163.4%	0.25%	0.484	0.188	51.8%	0.269	53.2%
SC of Developed Countries	1.85%	0.017	0.247	185.0%	0.454	285.7%	0.31%	0.399	0.195	58.2%	0.279	58.6%
LC and SC of Emerging Countries	0.33%	0.689	0.065	-25.0%	0.096	-18.2%	0.32%	0.385	0.197	59.1%	0.276	57.1%
LC of Emerging Countries	0.38%	0.668	0.065	-25.4%	0.093	-21.0%	0.31%	0.372	0.210	69.6%	0.306	73.8%
SC of Emerging Countries	1.48%	0.193	0.133	53.7%	0.245	108.2%	0.40%	0.289	0.208	68.2%	0.293	66.6%
LC and SC of Common Law Countries	0.28%	0.728	0.061	-29.6%	0.088	-24.9%	0.22%	0.532	0.176	42.8%	0.252	43.3%
LC of Common Law Countries	-0.02%	0.979	0.034	-60.5%	0.045	-61.3%	0.21%	0.537	0.181	46.7%	0.267	52.0%
SC of Common Law Countries	0.44%	0.419	0.127	46.8%	0.191	62.2%	0.23%	0.522	0.177	42.9%	0.250	42.3%
LC and SC of High GMI Dev. Countries	0.37%	0.453	0.130	49.7%	0.203	72.8%	0.20%	0.556	0.180	45.6%	0.260	47.7%
LC of High GMI Dev. Countries	0.11%	0.831	0.072	-16.9%	0.121	2.9%	0.05%	0.891	0.138	11.3%	0.195	10.8%
SC of High GMI Dev. Countries	0.52%	0.295	0.161	85.6%	0.257	118.7%	0.22%	0.526	0.185	50.1%	0.270	53.4%
LC and SC of Medium GMI Dev. Countries	0.84%	0.110	0.206	138.4%	0.321	173.2%	0.35%	0.332	0.211	70.5%	0.306	74.0%
LC of Medium GMI Dev. Countries	0.74%	0.109	0.226	160.9%	0.350	197.7%	0.26%	0.468	0.187	50.9%	0.265	50.8%
SC of Medium GMI Dev. Countries	0.69%	0.181	0.183	111.4%	0.291	147.7%	0.35%	0.331	0.213	72.1%	0.309	75.9%
LC and SC of Low GMI Dev. Countries	0.82%	0.230	0.147	69.3%	0.242	105.8%	0.23%	0.538	0.166	34.1%	0.242	37.6%
LC of Low GMI Dev. Countries	0.66%	0.382	0.111	28.0%	0.169	43.5%	0.02%	0.965	0.113	-8.3%	0.157	-10.9%
SC of Low GMI Emg. Countries	0.93%	0.363	0.102	18.3%	0.206	75.1%	0.28%	0.445	0.186	50.3%	0.274	55.6%
LC and SC of High GMI Emg. Countries	0.55%	0.318	0.143	65.2%	0.231	96.0%	0.35%	0.342	0.207	67.4%	0.302	71.8%
LC of High GMI Emg. Countries	0.52%	0.314	0.152	75.2%	0.269	128.7%	0.25%	0.469	0.191	54.6%	0.288	63.7%
SC of High GMI Emg. Countries	0.85%	0.168	0.170	96.1%	0.287	143.8%	0.36%	0.331	0.203	64.7%	0.293	66.7%
LC and SC of Medium GMI Emg. Countries	0.25%	0.719	0.069	-20.4%	0.106	-10.1%	0.27%	0.452	0.193	56.1%	0.285	61.8%
LC of Medium GMI Emg. Countries	0.09%	0.901	0.047	-45.5%	0.070	-40.2%	0.23%	0.496	0.195	58.0%	0.298	69.6%
SC of Medium GMI Emg. Countries	0.96%	0.242	0.134	54.6%	0.209	77.6%	0.39%	0.298	0.210	69.8%	0.309	75.6%
LC and SC of Low GMI Emg. Countries	0.22%	0.758	0.063	-27.5%	0.091	-22.6%	0.32%	0.383	0.197	59.1%	0.280	59.0%
LC of Low GMI Emg. Countries	0.72%	0.254	0.146	69.0%	0.238	102.5%	0.31%	0.394	0.194	57.1%	0.277	57.7%
SC of Low GMI Emg. Countries	0.72%	0.230	0.156	80.4%	0.276	134.7%	0.35%	0.345	0.205	66.1%	0.300	70.5%

Table 3.1: Summary statistics of the SSCBs.

Exchange records consist of single stock circuit breaker records obtained from IIROC website. Duplicates are single stock circuit breaker records with the same trading symbol on the same day. The sample period is February 1, 2012, to December 31, 2016.

Sample Distribution for the Daily Analysis		**Sample Distribution for the Daily Analysis**	
Item	**NOBS**	**Item**	**NOBS**
IIROC records	119	IIROC records	119
Less trading at TSX-Venture or CSE	17	Less trading at TSX-Venture or CSE	17
Less ETF	11	Less ETF)	11
Less duplicates	10	Less halt-firms with no intraday data	4
Triggered by Mistake	1	Less halt-firms with wrong halt time (under investigation by IIROC)	3
Missing data on CFMRC	4	Less halt-firms with fewer than 50 trading intervals during the halt day	8
Total with Daily Data	76	Less halt-firms with no trade before the halt	2
		Less halt-firms with no trade after the halt	2
		Less halt-firm missing data on CFMRC	2
		Total with Intra-Day Data	70

Table 3.2: Abnormal returns around SSCB halts

This table reports abnormal returns based on the GARCH(1,1) market model around single stock circuit breaker halts between Feb,2, 2012 and Dec, 31, 2016. SSCB halts are collected from IIROC website. The event day is denoted as day 0. The estimation window is (-280, -31) with a minimum length of 150 days. P-values for parametric and non-parametric significance tests are provided in parenthesis. Panel A (B) presents the results for the trading halts triggered by intraday price decline (increase).

Panel A: SSCB events triggered by intraday decline

Event date	-5	-4	-3	-2	-1	0	1	2	3	4	5
AAR	0.13%	0.01%	-0.25%	-0.57%	-3.83%	-14.88%	1.88%	0.55%	0.18%	-0.41%	0.29%
N	39	39	39	39	39	39	39	39	39	39	39
Pos:Neg AAR	23:16	19:20	19:20	20:19	11:28	3:36	22:17	17:22	18:21	19:20	21:18
Patell Z	(0.150)	(0.325)	(0.227)	(0.024)	(0.000)	(0.000)	(0.001)	(0.470)	(0.432)	(0.440)	(0.465)
Generalized Sign Z	(0.089)	(0.473)	(0.473)	(0.349)	(0.006)	(0.000)	(0.152)	(0.283)	(0.400)	(0.473)	(0.240)
Csect T	(0.437)	(0.494)	(0.319)	(0.242)	(0.110)	(0.000)	(0.086)	(0.293)	(0.430)	(0.324)	(0.348)
Std Csec t Z	(0.204)	(0.373)	(0.260)	(0.085)	(0.043)	(0.000)	(0.182)	(0.485)	(0.466)	(0.471)	(0.479)
Rank Z	(0.064)	(0.243)	(0.469)	(0.422)	(0.014)	(0.000)	(0.013)	(0.442)	(0.474)	(0.315)	(0.234)
Generalized Rank T	(0.061)	(0.214)	(0.423)	(0.436)	(0.409)	(0.001)	(0.020)	(0.337)	(0.361)	(0.264)	(0.255)
Adjusted Patell Z	(0.150)	(0.325)	(0.227)	(0.024)	(0.000)	(0.000)	(0.001)	(0.470)	(0.432)	(0.440)	(0.465)
Adjusted Std Csect Z	(0.204)	(0.373)	(0.260)	(0.085)	(0.043)	(0.000)	(0.182)	(0.485)	(0.466)	(0.471)	(0.479)
Generalized Rank Z	(0.044)	(0.193)	(0.416)	(0.430)	(0.401)	(0.000)	(0.011)	(0.323)	(0.349)	(0.245)	(0.236)
Skewness Corrected T	(0.453)	(0.496)	(0.316)	(0.257)	(0.072)	(0.000)	(0.094)	(0.273)	(0.419)	(0.334)	(0.331)

Table 3.2(continued)

Panel B: SSCB events triggered by intraday price increase

Event date	-5	-4	-3	-2	-1	0	1	2	3	4	5
AAR	-0.23%	-1.27%	0.83%	-0.33%	-1.34%	7.55%	0.83%	0.19%	0.13%	0.20%	-0.33%
N	37	37	37	37	37	37	37	37	37	37	37
Pos: Neg AAR	21:16	17:20	20:17	16:21	17:20	30:7	22:15	19:18	15:22	21:16	20:17
Patell Z	(0.296)	(0.147)	(0.392)	(0.042)	(0.097)	(0.000)	(0.000)	(0.438)	(0.108)	(0.324)	(0.227)
Generalized Sign Z	(0.264)	(0.247)	(0.382)	(0.155)	(0.247)	(0.000)	(0.169)	(0.489)	(0.090)	(0.264)	(0.382)
Csect T	(0.375)	(0.068)	(0.158)	(0.359)	(0.244)	(0.000)	(0.231)	(0.418)	(0.443)	(0.367)	(0.287)
Std Csec t Z	(0.323)	(0.172)	(0.392)	(0.079)	(0.199)	(0.000)	(0.057)	(0.467)	(0.155)	(0.319)	(0.221)
Rank Z	(0.475)	(0.220)	(0.442)	(0.052)	(0.161)	(0.000)	(0.051)	(0.477)	(0.143)	(0.383)	(0.246)
Generalized Rank T	(0.424)	(0.187)	(0.415)	(0.046)	(0.118)	(0.000)	(0.132)	(0.285)	(0.096)	(0.377)	(0.192)
Adjusted Patell Z	(0.295)	(0.146)	(0.391)	(0.042)	(0.096)	(0.000)	(0.000)	(0.437)	(0.107)	(0.324)	(0.226)
Adjusted Std Csect Z	(0.323)	(0.171)	(0.392)	(0.079)	(0.198)	(0.000)	(0.057)	(0.467)	(0.154)	(0.319)	(0.220)
Generalized Rank Z	(0.427)	(0.196)	(0.418)	(0.049)	(0.125)	(0.000)	(0.140)	(0.293)	(0.104)	(0.382)	(0.201)
Skewness Corrected T	(0.371)	(0.045)	(0.109)	(0.374)	(0.186)	(0.000)	(0.237)	(0.412)	(0.434)	(0.368)	(0.279)

Table 3.3: Difference-in-difference tests on intraday volatility before and after the compliance date. (February 2, 2012)

For each volatility measure, the sample stocks are ranked into quintiles based on their time-series average of that volatility measure throughout the sample period. Low (high) portfolio consists of stocks in the lowest (highest) quintile. Mid portfolio includes stocks in the second, third, and fourth quintiles. For each day, the equally weighted average of the volatility measure for three portfolios are calculated. The pre (post) rows report the time-series average of cross-section average of the variable in the pre-circuit breaker period (January 1, 2007 to February 2, 2012) and post-circuit breaker period (February 2, 2012 to December 31, 2016). The diff rows report the coefficient estimate of circuit breaker dummy from a time-series regression of the variable on an intercept (not reported) and the circuit breaker dummy. The diff-diff row represents the coefficient estimate of circuit breaker dummy from a time-series regression of the difference of the variable between high and low portfolio on an intercept (not reported) and the circuit breaker dummy. The circuit breaker dummy equals to one if the date is in the post circuit breaker period and zero otherwise. P_var is Parkinson volatility calculated as $\ln(HIGH/LOW)^2/\ln(16)$ (Parkinson, 1980). Close-close (close-open) volatility is calculated as the square of daily returns based on closing prices (opening to previous day closing price). Intraday (price range) is the difference between daily high and low prices standardized by closing price (high price). Positive semi variance is calculated as $\max[0, \log(close_t/close_{t-1})]^2$ and negative semi variance is calculated as $\min[0, \log(close_t/close_{t-1})]^2$ (Markowitz 1959). VRS is the Rogers–Satchell (RS) daily volatility measure. and ATMIV30d is the average implied volatility of at the money call and put options from Bloomberg.

		P_var	close_close	close_open	intraday	pricerange	semidown	semiup	VRS	ATMIV30d
LOW	Pre	0.00029	0.00030	0.00011	0.02091	0.02054	0.00013	0.00015	0.00028	0.00030
	Post	0.00015	0.00017	0.00005	0.01544	0.01518	0.00007	0.00008	0.00015	0.00015
	Diff	-0.00014	-0.00013	-0.00007	-0.00546	-0.00537	-0.00006	-0.00006	-0.00013	-0.00016
	pval.	0.00000	0.00000	0.00002	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
MID.	Pre	0.00071	0.00081	0.00031	0.03334	0.03236	0.00034	0.00042	0.00075	0.00090
	Post	0.00040	0.00055	0.00017	0.02643	0.02592	0.00022	0.00029	0.00041	0.00057
	Diff	-0.00031	-0.00025	-0.00015	-0.00692	-0.00644	-0.00012	-0.00013	-0.00034	-0.00032
	pval.	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
HIGH	Pre	0.00250	0.00222	0.00133	0.05178	0.04937	0.00080	0.00115	0.00424	0.00300
	Post	0.00087	0.00169	0.00120	0.04643	0.04526	0.00064	0.00093	0.00067	0.00372
	Diff	-0.00163	-0.00053	-0.00013	-0.00535	-0.00411	-0.00017	-0.00022	-0.00357	0.00073
	pval.	0.02082	0.09486	0.77416	0.00002	0.00000	0.00522	0.05039	0.04134	0.21188
HIGH-LOW	Diff-Diff	-0.00149	-0.00040	-0.00006	0.00010	0.00124	-0.00011	-0.00016	-0.00344	0.00088
	pval.	0.03228	0.20593	0.88895	0.91970	0.00762	0.05407	0.15947	0.04861	0.12814

Table 3.4:The impact of SSCB rule on intraday decline and ascension

This table presents the impact of SSCB rule on intraday decline and ascension. Sample stocks are sorted into decile portfolios based on percentage of intraday decline calculated as decline = ($low_t/close_{t-1}$)−1 and intraday ascension calculated as ascenscion = ($high_t/close_{t-1}$)−1), where low(high) is the daily low(high) price, and close is the closing price. The pre (post) rows reports the results in the pre-circuit breaker period (January 1, 2007 to February 2, 2012) and post-circuit breaker period (February 2, 2012 to December 31, 2016). The diff column reports the coefficient estimate of circuit breaker dummy from a time-series regression of the variable on an intercept (not reported) and the circuit breaker dummy. The portfolios are rebalanced daily. Intraday decline(ascension) results are reported in Panel A (Panel B). Percentile portfolios only consist of stocks with intraday decline (ascension) larger than or equal to 10%, 7.5%, or 5% are built in the same fashion and are presented in Panel C.

Panel A Equal-Weighted Decile Intraday Decline Portfolio

Decile Port.	Pre	Post	Diff	Pval	t-stat
1	-0.0564	-0.0454	0.0110	0.0000	11.2533
2	-0.0328	-0.0246	0.0081	0.0000	13.1526
3	-0.0245	-0.0177	0.0068	0.0000	13.6296
4	-0.0190	-0.0134	0.0056	0.0000	13.2864
5	-0.0147	-0.0102	0.0045	0.0000	12.3709
6	-0.0111	-0.0076	0.0034	0.0000	11.0023
7	-0.0077	-0.0053	0.0024	0.0000	8.8654
8	-0.0044	-0.0032	0.0013	0.0000	5.4901
9	-0.0007	-0.0007	0.0000	0.9405	-0.0747
10	0.0097	0.0069	-0.0028	0.0000	-8.5724

Panel B Equal-Weighted Decile Intraday Ascension Portfolio

	Pre	Post	Diff	Pval	t-stat
1	-0.0083	-0.0055	0.0028	0.0000	10.8153
2	0.0005	0.0010	0.0005	0.0096	2.5930
3	0.0040	0.0034	-0.0006	0.0016	-3.1614
4	0.0072	0.0056	-0.0016	0.0000	-6.9776
5	0.0103	0.0078	-0.0025	0.0000	-9.4255
6	0.0139	0.0104	-0.0036	0.0000	-11.2962
7	0.0183	0.0135	-0.0047	0.0000	-12.7797
8	0.0241	0.0180	-0.0061	0.0000	-13.5913
9	0.0334	0.0254	-0.0080	0.0000	-13.9799
10	0.0651	0.0499	-0.0152	0.0000	-6.2436

Panel C. Equal-Weighted Intraday Decline and Ascension Percentile Portfolios.

	Intercept	t-stat	p value	Diff	t-stat	p value
10 pct decline	-0.1419	-70.2390	0.0000	0.0022	0.6981	0.4852
7.5 pct decline	-0.1063	-89.5208	0.0000	0.0017	0.9780	0.3282
5 pct decline	-0.0728	-133.3241	0.0000	0.0007	0.8588	0.3905
10 pct ascension	0.1502	53.4551	0.0000	-0.0021	-0.4887	0.6251
7.5 pct ascension	0.1142	56.8122	0.0000	-0.0024	-0.8003	0.4236
5 pct ascension	0.0792	86.8643	0.0000	-0.0034	-2.6063	0.0092

Table 3.5: Difference-in-difference regression on return, intraday volatility, and liquidity

Return, Intraday decline, Intraday ascension and Turnover and Return are regressed on the Treatment dummy and its interaction with the SSCB dummy, SSCB*Treatment. Treatment equals to one if the stock is in the target group (subject to the single stock circuit breaker) and zero otherwise. SSCB is a dummy indicating whether the date is in the post-breaker period (February 02, 2012 to December 31, 2016) and zero in the pre-breaker period (January 1, 2007 to February 01, 2012). All regressions include firm fixed effect and intercepts are dropped to avoid perfect collinearity.

Return	Coefficient	Rob. Std. Err	t-stat	p-value	
Treatment	-0.002208	0.000594	-3.7195	0	***
SSCB	0.000364	0.000172	2.1148	0.035	**
SSCB*Treatment	-0.000523	0.000229	-2.2811	0.023	**
R-squared=0.00006					
F=6.975577	p-value=0.0001				
Intraday decline	**Coefficient**	**Rob. Std. Err**	**t-stat**	**p-value**	
Treatment	-0.001166	0.000992	-1.1763	0.24	
SSCB	0.000145	0.000317	0.4568	0.648	
SSCB*Treatment	0.00125	0.000404	3.0969	0.002	***
R-squared=0.00012					
F=10.906028	p-value=0				
Intraday ascension	**Coefficient**	**Rob. Std. Err**	**t-stat**	**p-value**	
Treatment	-0.000862	0.000695	-1.2391	0.216	
SSCB	0.000363	0.000378	0.96	0.337	
SSCB*Treatment	-0.002197	0.000437	-5.0299	0	***
R-squared=0.00012					
F=10.906028	p-value=0				
Turnover	**Coefficient**	**Rob. Std. Err**	**t-stat**	**p-value**	
Treatment	-0.016617	0.028932	-0.5743	0.566	
SSCB	-0.031491	0.008965	-3.5126	0	***
SSCB*Treatment	0.022031	0.01287	1.7118	0.087	
R-squared=0.00035					
F=4.533371	p-value=0.0036				

Table 3.6: Effect of CB Halt on Realized Intraday Volatility – Complete Sample vs. Single Halt Sample

The table below presents the regression results of the intraday realized volatility on the interval in which the stock was halted (halt interval) and the intervals surrounding the halt. Open is a dummy variable that takes a value of one if the interval is the opening 5-minutes interval starting 9:30 am and ending at 9:35 am and zero otherwise. Close is a dummy variable that takes a value of one if the trade occurs in the last five minutes intervals (3:55 pm - 4:00 pm). EARLYTRADE is a dummy variable that takes a value of one if the interval happens before 9:50 am and after 9:35 am. Log(MarketCap) is the logarithm of the firms market capitalization. IIROCPRE is a dummy variable that takes a value of one if the halt happens before the 2nd of February 2015 and zero otherwise. EARLYTRADEPRE is a dummy variable that takes a value of one for EARLYTRADE intervals that happened before the 2nd of February 2015 and zero otherwise. LATETRADE is a dummy variable that takes a value of one if the interval happens after 3:30 pm and before 3:55 pm. "No Multiple Halt on the Same Day" represents the sample after deleting the stocks that are halted multiple time on the same day. *, **, *** represent significance at 10%, 5%, and 1% respectively. Huber-White heteroskedasticity-corrected standard errors t-stat are presented in parenthesis underneath.

	(Realized Vol x 10^4)					
	All Stock-Halt Data			No Multiple Halt on the Same Day		
	All	Ret_Halt < 0	Ret_Halt => 0	All	Ret_Halt < 0	Ret_Halt => 0
Intercept	-0.1142	1.9078	-0.7501	3.7078**	4.8718	3.5278***
(t-stat)	(-0.07)	(0.76)	(-0.54)	(2.14)	(1.5)	(4.23)
Interval (t = -5)	-0.2621	-0.5918	-0.1659	0.3162	-0.784	0.655
(t-stat)	(-0.18)	(-0.2)	(-0.16)	(0.19)	(-0.17)	(0.67)
Interval (t = -4)	6.4965	3.5874	11.646*	6.2769	1.6786	13.0247*
(t-stat)	(1.59)	(0.71)	(1.72)	(1.64)	(0.75)	(1.84)
Interval (t = -3)	0.5807	-0.8051	2.5132	0.8973	-0.3722	2.1338
(t-stat)	(0.43)	(-0.46)	(1.4)	(0.82)	(-0.35)	(1.35)
Interval (t = -2)	3.009*	0.978	5.3202*	3.2348***	3.034**	4.1146**
(t-stat)	(1.87)	(0.56)	(1.93)	(2.62)	(2.32)	(1.99)
Interval (t = -1)	11.5311***	16.3156**	7.8771*	7.4912***	12.2975***	5.146***
(t-stat)	(2.72)	(2.22)	(1.94)	(3.56)	(3.15)	(2.81)
Halt Interval (t = 0)	85.6342***	133.1246***	32.9165***	81.3216***	137.1631***	30.3066***
(t-stat)	(5.58)	(5.23)	(5.41)	(4.71)	(4.4)	(5.48)
Interval (t = +1)	32.9131***	43.3613***	21.2538***	31.8595***	43.849**	21.0969***
(t-stat)	(4.07)	(2.96)	(3.64)	(3.71)	(2.54)	(3.53)
Interval (t = +2)	19.0771***	17.8428**	19.4822	9.3177***	13.2004**	5.1468***
(t-stat)	(2.69)	(2.19)	(1.65)	(2.96)	(2.05)	(2.87)
Interval (t = +3)	11.8272**	15.7702	7.5085*	5.3101***	6.7204***	4.0091***
(t-stat)	(1.99)	(1.46)	(1.77)	(3.79)	(2.74)	(2.73)
Interval (t = +4)	2.1716**	2.2533	1.9413	2.9388***	3.7319**	2.1586*
(t-stat)	(2.06)	(1.38)	(1.52)	(3.06)	(2.4)	(1.86)
Interval (t = +5)	9.4831*	5.3667**	13.7716	4.0404***	5.8156**	2.3613**
(t-stat)	(1.66)	(2.41)	(1.18)	(3.12)	(2.38)	(2.34)
Open	25.6005*	37.2191*	6.7713	36.2617**	62.2598**	6.9168
(t-stat)	(1.84)	(1.65)	(0.94)	(2.29)	(2.3)	(0.91)
Close	-0.8029	-1.6685**	-0.0354	1.173*	1.1054*	1.083
(t-stat)	(-1.08)	(-2.08)	(-0.03)	(1.68)	(1.82)	(0.93)
Log(MarketCap)	0.6739**	0.5001	0.618**	-0.3932	-0.5028	-0.4***
(t-stat)	(2.25)	(1.21)	(2.21)	(-1.31)	(-0.91)	(-3.04)
IIROCPRE	-5.5927***	-6.8144***	-3.9853***	-1.53***	-2.6189**	-0.6496**
(t-stat)	(-8.71)	(-7.29)	(-4.82)	(-2.83)	(-2.5)	(-2.39)
EARLYTRADE	16.7738***	21.928**	6.4527	18.0887***	24.3599**	9.7252**
(t-stat)	(2.84)	(2.35)	(1.51)	(3.02)	(2.38)	(2.07)
EARLYTRADEPRE	-20.7725**	-27.2991**	-6.5158	-25.9202***	-37.9011**	-10.3015*
(t-stat)	(-2.54)	(-2.15)	(-1.27)	(-2.58)	(-2.18)	(-1.84)
LATETRADE	-1.5994***	-2.3226***	-1.2096*	0.3818	0.0439	0.3431
(t-stat)	(-3.51)	(-3.39)	(-1.88)	(1.18)	(0.07)	(1.07)
Adj-R^2	0.1734	0.2543	0.0891	0.2682	0.3857	0.258
N	5,434	2,807	2,627	4,576	2,105	2,471

Table 3.7: Effect of CB Halt on Realized Intraday Volatility: Material News vs. No Material News Sample Groupings

The table below presents the regression results of the intraday realized volatility on the interval in which the stock was halted (halt interval) and the intervals surrounding the halt. We differentiate the sample according to whether their triggers are associated with Material News on Factiva (first three columns) or with no material news on Factiva (last three columns). Open is a dummy variable that takes a value of one if the interval is the opening 5-minutes interval starting 9:30 am and ending at 9:35 am and zero otherwise. Close is a dummy variable that takes a value of one if the trade occurs in the last five minutes intervals (3:55 pm - 4:00 pm). EARLYTRADE is a dummy variable that takes a value of one if the interval happens before 9:50 am and after 9:35 am. Log(MarketCap) is the logarithm of the firms market capitalization. IIROCPRE is a dummy variable that takes a value of one if the halt happens before the 2nd of February 2015 and zero otherwise. EARLYTRADEPRE is a dummy variable that takes a value of one for EARLYTRADE intervals that happened before the 2nd of February 2015 and zero otherwise. LATETRADE is a dummy variable that takes a value of one if the interval happens after 3:30 pm and before 3:55 pm. *, **, *** represent significance at 10%, 5%, and 1% respectively. Huber-White heteroskedasticity-corrected standard errors t-stat are presented in parenthesis underneath.

	(Realized Vol x 10^4)					
	With Material News on Factiva			No Material News on Factiva		
	All	Ret_Halt < 0	Ret_Halt => 0	All	Ret_Halt < 0	Ret_Halt => 0
Intercept	0.1331	2.7833	-1.1409	1.5551	4.3626***	-0.2393
(t-stat)	(0.07)	(1.05)	(-0.67)	(1.05)	(2.84)	(-0.11)
Interval (t = -5)	-0.0288	-0.7175	-0.2148	-0.9656	-0.5271	-2.3976
(t-stat)	(-0.02)	(-0.21)	(-0.18)	(-0.94)	(-1.24)	(-0.74)
Interval (t = -4)	7.1454	3.9838	11.3456	9.1616	-0.4206	12.0767
(t-stat)	(1.59)	(0.71)	(1.41)	(1.09)	(-0.73)	(1.11)
Interval (t = -3)	1.1769	-0.8312	3.3236*	-0.0436	-0.5767	-0.9679
(t-stat)	(0.83)	(-0.41)	(1.66)	(-0.05)	(-1.2)	(-0.39)
Interval (t = -2)	3.3775*	0.8794	5.5956*	3.7074	0.7334	3.9763
(t-stat)	(1.95)	(0.44)	(1.78)	(1.18)	(0.76)	(0.96)
Interval (t = -1)	11.8838**	15.7314**	9.122*	8.6802	21.4772	0.8593***
(t-stat)	(2.54)	(2.02)	(1.93)	(1.15)	(1.21)	(2.77)
Halt Interval (t = 0)	90.6265***	140.8136***	30.3752***	44.0854***	37.9674**	47.6135***
(t-stat)	(5.35)	(5.24)	(4.63)	(3.86)	(2.52)	(3.09)
Interval (t = +1)	35.5636***	46.7971***	21.9404***	10.6704*	0.2813	16.6448*
(t-stat)	(3.95)	(2.97)	(3.31)	(1.68)	(0.61)	(1.9)
Interval (t = +2)	20.6492***	18.6825**	21.6452	5.5421**	3.4454*	6.541
(t-stat)	(2.59)	(2.1)	(1.57)	(2.11)	(1.71)	(1.63)
Interval (t = +3)	12.8712*	16.7966	8.2103*	3.5451**	3.9513	3.0423*
(t-stat)	(1.93)	(1.44)	(1.66)	(2.01)	(1.12)	(1.91)
Interval (t = +4)	2.4509**	2.4417	2.2673	-0.1842	-0.3482	-0.3449
(t-stat)	(2.09)	(1.39)	(1.53)	(-0.53)	(-0.93)	(-0.5)
Interval (t = +5)	10.6434*	5.6382**	16.272	0.4921	1.7259	-0.5073
(t-stat)	(1.65)	(2.38)	(1.19)	(0.63)	(1.08)	(-0.71)
Open	27.6478*	39.8391*	5.5462	8.5602	0.5822	12.5355
(t-stat)	(1.8)	(1.67)	(0.66)	(0.97)	(0.73)	(0.99)
Close	-0.8946	-1.8529**	-0.0332	-0.0117	-0.4197	0.0904
(t-stat)	(-1.06)	(-2.06)	(-0.02)	(-0.04)	(-1)	(0.19)
Log(MarketCap)	0.733**	0.4956	0.748**	-0.1441	-0.5767**	0.1798
(t-stat)	(2.21)	(1.14)	(2.17)	(-0.67)	(-2.48)	(0.57)
IIROCPRE	-6.3365***	-7.8029***	-4.4389***	-1.469***		-2.0324***
(t-stat)	(-8.71)	(-7.64)	(-4.45)	(-2.98)		(-3.4)
EARLYTRADE	18.6289***	24.707**	6.7602	2.6088	-0.2697	6.0408
(t-stat)	(2.74)	(2.32)	(1.37)	(1.27)	(-0.66)	(1.35)
EARLYTRADEPRE	-22.9241**	-30.8174**	-5.8904	-5.6088		-10.398
(t-stat)	(-2.46)	(-2.19)	(-1)	(-1.07)		(-1.28)
LATETRADE	-1.9157***	-2.6979***	-1.6335**	1.5536	-0.008	2.1353
(t-stat)	(-3.8)	(-3.52)	(-2.41)	(1.45)	(-0.03)	(1.55)
Adj-R^2	0.1794	0.2696	0.0796	0.408	0.4721	0.4566
N	4,810	2,573	2,237	624	234	390

Table 4.1: Summary statistics

The Option Metrics Ivy DB database is the source for the data on options. For every month included in the sample period, one call and one put has been chosen for each month of the sample period. The time to expiration of all options is one month and their moneyness is closest to one. Firstly, the time-series average of the volatilities for every stock is calculated. Next, the cross-sectional average of average volatilities is obtained. The method employed in the estimation of the remaining statistics is in parallel; the calculation of historical volatility (HV) is conducted with the standard deviation of daily realized stock returns over the latest 12 months for each and every month and stock. For each month and stock, the implied volatilities (IV) are calculated as the average of the implied volatilities of the call and put contracts that are closer to being at the money and having one month to maturity. Then, the annualized volatilities are reported. There are 4250 individual securities and 78,731 monthly pairs of call and put contracts in the sample. The period from 1997 to 2016 is covered within the sample.

	Mean	Median	StDev	Min	Max	Skew	Kurt
HV	0.5027	0.4821	0.1099	0.3864	0.7249	0.6989	3.2558
IV	0.4796	0.4626	0.1089	0.3532	0.7055	0.6693	3.2583
ΔHV	-0.0034	-0.0030	0.0167	-0.0350	0.0259	-0.1408	4.2394
ΔIV	-0.0057	-0.0064	0.0712	-0.1152	0.1096	0.0862	2.7530

Table 4.2: Formation period statistics of portfolios classified according to difference between HV and IV

Portfolios 1 through 10 are obtained by sorting stocks into deciles based on the log difference between historical volatility (HV) and implied volatility (IV). These 10 portfolios are equally weighted. All statistics are first averaged across stocks in each portfolio and then averaged across time. The sample includes 4250 individual securities and 78,731 monthly pairs of call and put contracts. The sample period is January 2010 to April 2016.

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
HV_t-IV_t	-0.295	-0.144	-0.078	-0.028	0.014	0.055	0.098	0.148	0.214	0.399
HV_t	0.389	0.395	0.391	0.405	0.420	0.429	0.450	0.474	0.514	0.625
IV_t	0.526	0.454	0.422	0.416	0.413	0.405	0.406	0.408	0.413	0.422
Delta call	0.546	0.545	0.542	0.543	0.540	0.537	0.537	0.536	0.533	0.534
Delta put	-0.455	-0.456	-0.460	-0.459	-0.462	-0.465	-0.466	-0.466	-0.469	-0.468
Gamma	0.117	0.121	0.122	0.123	0.126	0.128	0.131	0.135	0.141	0.169
Vega	5.003	5.290	5.315	5.413	5.392	5.340	5.254	5.297	5.211	4.774

Table 4.3: Post-formation returns of portfolios classified according to the difference between HV and IV

Portfolios are formed as in Table 2. The returns on options are constructed using, as a reference beginning price, the average of the closing bid and ask quotes and, as the closing price, the terminal payoff of the option depending on the stock price and the strike price of the option. The options monthly returns are equal-weighted across all the stocks in the portfolio. Returns on long decile 10 short decile 1 portfolio are calculated by taking into cash collateral requirements based on CBOE margin manual. CE is the certainty equivalent. CE is computed from a utility function with constant relative risk-aversion parameters of one, three and five. There are 4250 individual securities and 78,731 monthly pairs of call and put contracts in the sample. The sample period is 1997 to 2016. Descriptive statistics for value-weighted CRSP portfolio is given for comparison

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**10-1**	**Value-weighted CRSP**
Mean	-0.067	-0.012	-0.024	-0.013	0.026	0.006	0.022	0.029	0.038	0.066	0.046	0.009
Median	-0.084	-0.050	-0.058	-0.065	-0.027	-0.050	-0.029	-0.018	-0.020	0.009	0.037	0.015
Min	-0.581	-0.552	-0.484	-0.719	-0.523	-0.539	-0.547	-0.608	-0.427	-0.476	-0.277	-0.194
Max	0.989	1.205	1.395	1.298	1.619	1.509	1.693	1.676	2.290	1.451	0.582	0.164
Std	0.227	0.270	0.269	0.298	0.324	0.292	0.305	0.342	0.336	0.337	0.116	0.049
Sharpe R	-0.297	-0.046	-0.088	-0.045	0.079	0.020	0.073	0.085	0.114	0.197	0.396	0.190
Sortino R	-0.367	-0.074	-0.137	-0.077	0.157	0.037	0.143	0.177	0.255	0.448	0.920	0.277
CE (γ=1)	-0.093	-0.045	-0.056	-0.052	-0.017	-0.030	-0.016	-0.016	-0.003	0.021	0.040	0.008
CE (γ=3)	-0.142	-0.104	-0.113	-0.126	-0.088	-0.092	-0.080	-0.092	-0.067	-0.052	0.028	0.005
CE (γ=5)	-0.192	-0.157	-0.162	-0.222	-0.149	-0.148	-0.136	-0.161	-0.117	-0.112	0.017	0.003

Table 4.4: Risk Adjusted spread straddle returns under different transaction cost assumptions

Independent variables for the linear factor model regression are the returns to spread straddle strategy under different effective spread to quoted spread ratio assumptions. The risk factors are the Fama and French (1993) three factors (MKT–Rf, SMB, and HML), and the Carhart (1997) momentum factor (UMD). The coefficients and their p-values for each factor model are presented in their corresponding panel. The sample period is 1996 to 2016.

ESPR/QSPR	MidP	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Mean	0.046	0.041	0.036	0.032	0.027	0.022	0.017	0.012	0.007	0.002	-0.003
p-value	0.000	0.000	0.000	0.000	0.000	0.004	0.024	0.103	0.324	0.746	0.721

CAPM Model

ESPR/QSPR	MidP	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
ά	0.049	0.044	0.040	0.035	0.030	0.025	0.020	0.015	0.010	0.005	0.000
p-value	0.000	0.000	0.000	0.000	0.000	0.001	0.007	0.040	0.164	0.472	0.974
$\beta_{RM\text{-}RF}$	-0.431	-0.425	-0.420	-0.415	-0.410	-0.406	-0.401	-0.397	-0.393	-0.390	-0.388
p-value	0.098	0.100	0.102	0.104	0.106	0.109	0.111	0.113	0.115	0.117	0.119

Fama-French Three Factor Model

ESPR/QSPR	MidP	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
ά	0.049	0.044	0.039	0.035	0.030	0.025	0.020	0.015	0.010	0.005	0.000
p-value	0.000	0.000	0.000	0.000	0.000	0.001	0.008	0.043	0.172	0.485	0.990
$\beta_{RM\text{-}RF}$	-0.405	-0.399	-0.393	-0.387	-0.381	-0.375	-0.370	-0.365	-0.360	-0.355	-0.352
p-value	0.117	0.120	0.123	0.127	0.131	0.135	0.139	0.144	0.148	0.152	0.156
β_{SMB}	-0.140	-0.143	-0.146	-0.149	-0.153	-0.156	-0.161	-0.165	-0.171	-0.177	-0.186
p-value	0.757	0.752	0.746	0.740	0.733	0.726	0.718	0.709	0.699	0.688	0.672
β_{HML}	0.051	0.059	0.067	0.074	0.081	0.088	0.094	0.100	0.106	0.110	0.112
p-value	0.885	0.867	0.850	0.833	0.817	0.802	0.788	0.775	0.764	0.756	0.752

Table 4.4 continued

Carhart(1997) Model

ESPR/QSPR	MidP	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
ά	0.049	0.044	0.039	0.034	0.029	0.024	0.019	0.014	0.009	0.004	-0.001
p-value	0.000	0.000	0.000	0.000	0.000	0.003	0.018	0.078	0.251	0.602	0.906
$\beta_{RM\text{-}RF}$	-0.386	-0.377	-0.368	-0.359	-0.350	-0.342	-0.333	-0.325	-0.317	-0.309	-0.301
p-value	0.215	0.224	0.234	0.244	0.255	0.266	0.277	0.289	0.301	0.314	0.326
β_{SMB}	-0.145	-0.149	-0.152	-0.156	-0.161	-0.165	-0.170	-0.176	-0.182	-0.189	-0.199
p-value	0.755	0.748	0.741	0.734	0.727	0.719	0.710	0.701	0.690	0.678	0.661
β_{HML}	0.078	0.089	0.101	0.112	0.124	0.135	0.145	0.156	0.165	0.174	0.182
p-value	0.776	0.742	0.709	0.677	0.646	0.616	0.587	0.560	0.535	0.513	0.496
β_{UMD}	0.052	0.059	0.067	0.075	0.082	0.090	0.098	0.107	0.116	0.125	0.135
p-value	0.863	0.843	0.823	0.803	0.783	0.763	0.743	0.722	0.701	0.678	0.654

Table 4.5: Risk Adjusted spread straddle returns under different transaction cost assumptions (January1997 to August 2006)

Independent variables for the linear factor model regression are the returns to spread straddle strategy under different effective spread to quoted spread ratio assumptions. The risk factors are the Fama and French (1993) three factors (MKT–Rf, SMB, and HML), and the Carhart (1997) momentum factor (UMD). The coefficients and their p-values for each factor model are presented in their corresponding panel. The sample period is January1997 to August 2006.

ESPR/QSPR	MidP	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Mean	0.067	0.063	0.058	0.054	0.049	0.045	0.040	0.036	0.031	0.027	0.022
p-value	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.005	0.014	0.035	0.080

CAPM Model

ESPR/QSPR	MidP	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
ά	0.070	0.065	0.061	0.056	0.052	0.047	0.043	0.038	0.034	0.029	0.025
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.017
β_{RM-RF}	-0.294	-0.298	-0.303	-0.307	-0.312	-0.316	-0.321	-0.325	-0.330	-0.335	-0.339
p-value	0.521	0.513	0.506	0.498	0.491	0.483	0.476	0.469	0.462	0.455	0.448

Fama-French Three Factor Model

ESPR/QSPR	MidP	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
ά	0.070	0.066	0.061	0.056	0.052	0.047	0.043	0.038	0.033	0.029	0.024
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.011	0.032
β_{RM-RF}	-0.297	-0.297	-0.297	-0.297	-0.297	-0.297	-0.296	-0.296	-0.296	-0.296	-0.296
p-value	0.505	0.503	0.500	0.498	0.496	0.494	0.492	0.490	0.488	0.486	0.484
β_{SMB}	-0.107	-0.111	-0.114	-0.117	-0.120	-0.123	-0.127	-0.130	-0.134	-0.137	-0.141
p-value	0.854	0.849	0.844	0.839	0.834	0.829	0.824	0.818	0.813	0.807	0.801
β_{HML}	-0.052	-0.039	-0.027	-0.014	-0.002	0.011	0.023	0.035	0.047	0.060	0.072
p-value	0.928	0.945	0.963	0.980	0.998	0.985	0.968	0.950	0.933	0.916	0.899

Table 4.5 continued

Carhart(1997) Model

ESPR/QSPR	MidP	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
ά	0.073	0.068	0.063	0.059	0.054	0.049	0.045	0.040	0.035	0.031	0.026
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.009	0.025
β_{RM-RF}	-0.370	-0.369	-0.367	-0.366	-0.365	-0.363	-0.362	-0.361	-0.360	-0.359	-0.358
p-value	0.473	0.472	0.472	0.472	0.472	0.472	0.472	0.473	0.473	0.473	0.473
β_{SMB}	-0.061	-0.065	-0.069	-0.073	-0.077	-0.081	-0.085	-0.089	-0.093	-0.097	-0.102
p-value	0.914	0.908	0.902	0.896	0.890	0.884	0.878	0.871	0.865	0.858	0.851
β_{HML}	-0.097	-0.083	-0.070	-0.057	-0.043	-0.030	-0.017	-0.004	0.009	0.021	0.034
p-value	0.851	0.871	0.891	0.911	0.932	0.952	0.973	0.993	0.986	0.966	0.946
β_{UMD}	-0.235	-0.231	-0.227	-0.223	-0.219	-0.215	-0.212	-0.208	-0.205	-0.201	-0.198
p-value	0.607	0.613	0.619	0.625	0.631	0.637	0.643	0.649	0.654	0.660	0.666

Table 4.6: Risk Adjusted spread straddle returns under different transaction cost assumptions (August 2006 to April 2016)

Independent variables for the linear factor model regression are the returns to spread straddle strategy under different effective spread to quoted spread ratio assumptions. The risk factors are the Fama and French (1993) three factors (MKT–Rf, SMB, and HML), and the Carhart (1997) momentum factor (UMD). The coefficients and their p-values for each factor model are presented in their corresponding panel. The sample period is August 2006 to April 2016

ESPR/QSPR	MidP	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Mean	0.025	0.020	0.015	0.010	0.005	0.000	-0.005	-0.010	-0.016	-0.021	-0.027
p-value	0.002	0.013	0.060	0.208	0.531	0.986	0.503	0.184	0.047	0.008	0.001

CAPM Model

ESPR/QSPR	MidP	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
ά	0.029	0.024	0.019	0.014	0.009	0.004	-0.001	-0.007	-0.012	-0.018	-0.023
p-value	0.000	0.003	0.017	0.077	0.260	0.636	0.850	0.391	0.127	0.028	0.004
β_{RM-RF}	-0.574	-0.558	-0.542	-0.527	-0.512	-0.497	-0.483	-0.469	-0.457	-0.445	-0.436
p-value	0.021	0.022	0.024	0.025	0.027	0.029	0.031	0.033	0.036	0.038	0.040

Fama-French Three Factor Model

ESPR/QSPR	MidP	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
ά	0.030	0.025	0.020	0.014	0.009	0.004	-0.001	-0.006	-0.012	-0.017	-0.023
p-value	0.000	0.003	0.017	0.075	0.251	0.613	0.885	0.424	0.146	0.035	0.006
β_{RM-RF}	-0.570	-0.550	-0.530	-0.511	-0.492	-0.472	-0.453	-0.433	-0.414	-0.394	-0.374
p-value	0.005	0.005	0.006	0.006	0.007	0.009	0.010	0.012	0.015	0.019	0.024
β_{SMB}	-0.325	-0.330	-0.335	-0.341	-0.349	-0.357	-0.366	-0.377	-0.391	-0.409	-0.436
p-value	0.399	0.392	0.383	0.375	0.365	0.355	0.343	0.330	0.314	0.294	0.265
β_{HML}	0.231	0.221	0.211	0.200	0.189	0.177	0.165	0.151	0.137	0.120	0.100
p-value	0.541	0.558	0.576	0.595	0.615	0.637	0.661	0.686	0.715	0.749	0.792

Table 4.6 continued

Carhart(1997) Model

ESPR/QSPR	MidP	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
ά	0.029	0.024	0.019	0.014	0.008	0.003	-0.002	-0.007	-0.013	-0.018	-0.024
p-value	0.000	0.002	0.014	0.072	0.261	0.667	0.786	0.328	0.092	0.017	0.002
β_{RM-RF}	-0.486	-0.465	-0.444	-0.423	-0.402	-0.380	-0.359	-0.338	-0.316	-0.295	-0.272
p-value	0.010	0.012	0.014	0.018	0.022	0.027	0.034	0.044	0.056	0.073	0.096
β_{SMB}	-0.296	-0.300	-0.305	-0.311	-0.318	-0.325	-0.334	-0.344	-0.357	-0.375	-0.401
p-value	0.391	0.382	0.373	0.363	0.352	0.339	0.326	0.311	0.293	0.270	0.239
β_{HML}	0.568	0.564	0.559	0.555	0.551	0.546	0.541	0.536	0.529	0.521	0.510
p-value	0.077	0.078	0.079	0.081	0.083	0.085	0.088	0.091	0.095	0.101	0.110
β_{UMD}	0.394	0.401	0.409	0.417	0.424	0.433	0.441	0.450	0.460	0.470	0.481
p-value	0.128	0.120	0.112	0.105	0.098	0.091	0.084	0.078	0.071	0.064	0.057

Table 4.7: Second Order Stochastic Dominance Test Results for Option Trader and Index Trader

The index trader is assumed to invest his wealth in the CRSP Value Weighted Index. The option trader, on the other hand, is assumed to invest notional amount equivalent to 10% of his initial wealth in the spread straddle and satisfy cash collateral requirements. Remaining wealth is invested in the CRSP Value Weighted Index. The option trader is assumed to rebalance his portfolio on the second Tuesday following the third Friday. All statistical tests are performed by scaling holding period returns to monthly (31 day) arithmetic returns. Maximal t-statistics for the Davidson and Duclos (2000) test are compared to critical values of the Studentized Maximum Modulus Distribution tabulated in Stoline and Ury (1979) for nominal levels of 1%, 5%, and 10% with k = 15 and $\nu = \infty$. The p values for the Davidson and Duclos (2013) test are based on 999 bootstrap trials.

			DD(2000) p value	DD (2013) p-value H_0: OT $\ngtr_2$ IT, for [x,y] range x% of observation pairs from left tail and (100-y)% of observation pairs from right tail are trimmed								
ESPR/QSPR	**μ_{OT}-μ_{IT}**	**p**	**H_0: IT $>_2$ OT**	**[0,100]**	**[0,95]**	**[0,90]**	**[5,100]**	**[5,95]**	**[5,90]**	**[10,100]**	**[10,95]**	**[10,90]**
MidP	1.09%	0.00	<0.01	0.424	0.424	0.424	0.010	0.010	0.010	0.000	0.000	0.000
10%	0.94%	0.00	<0.01	0.422	0.422	0.422	0.000	0.000	0.000	0.000	0.000	0.000
20%	0.78%	0.00	<0.01	0.407	0.408	0.409	0.000	0.000	0.000	0.000	0.000	0.000
30%	0.63%	0.00	<0.01	0.364	0.364	0.364	0.009	0.009	0.009	0.009	0.009	0.009
40%	0.48%	0.02	<0.01	0.298	0.298	0.302	0.032	0.033	0.033	0.032	0.033	0.033
50%	0.33%	0.08	<0.01	0.169	0.169	0.168	0.169	0.169	0.168	0.169	0.169	0.168
60%	0.18%	0.23	<0.01	0.368	0.368	0.367	0.368	0.368	0.367	0.368	0.368	0.367
70%	0.03%	0.46	<0.01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
80%	-0.12%	0.70	<0.01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
90%	-0.28%	0.88	<0.01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
100%	-0.44%	0.97	<0.01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 4.8: Second Order Stochastic Dominance Test Results for Option Trader and Index Trader (January1997 to August 2006)

The index trader is assumed to invest his wealth in the CRSP Value Weighted Index. The option trader, on the other hand, is assumed to invest notional amount equivalent to 10% of his initial wealth in the spread straddle and satisfy cash collateral requirements. Remaining wealth is invested in the CRSP Value Weighted Index. The option trader is assumed to rebalance his portfolio on the second Tuesday following the third Friday. All statistical tests are performed by scaling holding period returns to monthly (31 day) arithmetic returns. Maximal t-statistics for the Davidson and Duclos (2000) test are compared to critical values of the Studentized Maximum Modulus Distribution tabulated in Stoline and Ury (1979) for nominal levels of 1%, 5%, and 10% with k = 15 and $\nu = \infty$. The p values for the Davidson and Duclos (2013) test are based on 999 bootstrap trials.

			DD(2000) p value	DD (2013) p-value H_0: OT $\not>_2$ IT, for [x,y] range x% of observation pairs from left tail and (100-y)% of observation pairs from right tail are trimmed								
ESPR/QSPR	**μ_{OT}- μ_{IT}**	**p-value**	**H_0: IT $>_2$ OT**	**[0,100]**	**[0,95]**	**[0,90]**	**[5,100]**	**[5,95]**	**[5,90]**	**[10,100]**	**[10,95]**	**[10,90]**
MidP	1.68%	0.00	<0.01	0.437	0.437	0.437	0.006	0.006	0.006	0.001	0.001	0.001
10%	1.54%	0.00	<0.01	0.416	0.416	0.416	0.005	0.005	0.005	0.002	0.002	0.002
20%	1.40%	0.00	<0.01	0.397	0.398	0.398	0.010	0.010	0.010	0.003	0.003	0.003
30%	1.26%	0.00	<0.01	0.375	0.375	0.375	0.008	0.008	0.008	0.002	0.002	0.002
40%	1.12%	0.00	<0.01	0.350	0.351	0.351	0.008	0.008	0.008	0.005	0.005	0.005
50%	0.98%	0.00	<0.01	0.294	0.294	0.294	0.012	0.014	0.014	0.004	0.004	0.004
60%	0.85%	0.01	<0.01	0.250	0.253	0.254	0.014	0.014	0.014	0.006	0.006	0.006
70%	0.71%	0.03	<0.01	0.204	0.208	0.208	0.016	0.016	0.016	0.022	0.023	0.023
80%	0.57%	0.06	<0.01	0.167	0.170	0.170	0.012	0.013	0.013	0.034	0.036	0.037
90%	0.43%	0.13	<0.01	0.184	0.184	0.184	0.184	0.184	0.184	0.184	0.184	0.184
100%	0.29%	0.22	<0.01	0.295	0.295	0.295	0.295	0.295	0.295	0.295	0.295	0.295

Table 4.9: Second Order Stochastic Dominance Test Results for Option Trader and Index Trader (August 2006 to April 2016)

The index trader is assumed to invest his wealth in the CRSP Value Weighted Index. The option trader, on the other hand, is assumed to invest notional amount equivalent to 10% of his initial wealth in the spread straddle and satisfy cash collateral requirements. Remaining wealth is invested in the CRSP Value Weighted Index. The option trader is assumed to rebalance his portfolio on the second Tuesday following the third Friday. All statistical tests are performed by scaling holding period returns to monthly (31 day) arithmetic returns. Maximal t-statistics for the Davidson and Duclos (2000) test are compared to critical values of the Studentized Maximum Modulus Distribution tabulated in Stoline and Ury (1979) for nominal levels of 1%, 5%, and 10% with $k = 15$ and $\nu = \infty$. The p values for the Davidson and Duclos (2013) test are based on 999 bootstrap trials.

			DD(2000) p value	DD (2013) p-value H_0: OT $\not\succ_2$ IT, for [x,y] range x% of observation pairs from left tail and (100-y)% of observation pairs from right tail are trimmed								
ESPR/QSPR	$\mu_{OT}-\mu_{IT}$	**p-value**	H_0: IT $>_2$ OT	**[0,100]**	**[0,95]**	**[0,90]**	**[5,100]**	**[5,95]**	**[5,90]**	**[10,100]**	**[10,95]**	**[10,90]**
MidP	0.51%	0.04	<0.01	0.560	0.561	0.572	0.053	0.053	0.059	0.055	0.055	0.060
10%	0.35%	0.12	<0.01	0.175	0.175	0.174	0.175	0.175	0.174	0.175	0.175	0.174
20%	0.19%	0.26	<0.01	0.348	0.348	0.343	0.348	0.348	0.343	0.348	0.348	0.343
30%	0.03%	0.47	<0.01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
40%	-0.14%	0.68	<0.01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
50%	-0.30%	0.85	<0.01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
60%	-0.46%	0.94	<0.01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
70%	-0.63%	0.98	<0.01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
80%	-0.80%	1.00	<0.01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
90%	-0.97%	1.00	<0.01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
100%	-1.16%	1.00	<0.01	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Appendix

Appendix A

This table lists the company ticker, name, the industry, index membership, market capitalization, intraday ascension(decline) turnover ratio on the SSCB day for a sample of 80 SSCB events at the firm level during the period between February 2012 and December 2016

Ticker	Date	Name	Industry	S&P/TSX Composite Index Const.	Market Cap. (in million $)	Intraday decline	Intraday incline	turnover
XG	20120217	EXTORRE GOLD MINES LIMITED J	MINERAL EXPL & DEV	Yes	761.43	-8.27%	1.94%	0.76%
TCW	20120326	TRICAN WELL SERVICE LTD.	OIL SERVICES	Yes	2,261.48	-0.85%	4.75%	0.81%
UUU	20120518	URANIUM ONE INC. J	URANIUM EXPL & DEV	Yes	2,105.82	-14.46%	3.33%	0.51%
R	20120601	ROMARCO MINERALS INC. J	GOLD EXPL & DEV	Yes	414.86	-3.17%	27.42%	0.29%
GBU	20120606	GABRIEL RESOURCES LTD. J	MINERAL EXPL & DEV	Yes	919.77	-0.90%	26.48%	0.34%
EXE	20120705	EXTENDICARE INC.	HEALTHCARE FACILITY	Yes	638.86	-0.95%	3.94%	0.32%
CLC	20121108	CML HEALTHCARE INC.	MEDICAL LAB SERVICES	Yes	643.20	-18.40%	0.00%	4.14%
PSN	20121116	POSEIDON CONCEPTS CORP. J	ENERGY SERVICES	Yes	384.40	-13.15%	5.00%	13.01%
PRE	20121203	PACIFIC EXPLORATION & PRODUCTION CORPORATION	OIL/GAS EXPL & DEV	Yes	6,575.77	-1.77%	3.69%	0.47%
NXY	20121207	NEXEN INC.	RES EXPL & DEV	Yes	12,344.29	-14.46%	3.48%	0.67%
TRQ	20130130	TURQUOISE HILL RESOURCES LTD.	MINERAL EXPL & DEV	Yes	7,913.56	-10.62%	1.23%	0.25%

Appendix A (continued)

Ticker	Date	Name	Industry	S&P/TSX Composite Index Const.	Market Cap. (in million $)	Intraday decline	Intraday incline	turnover
TXP	20130314	TOUCHSTONE EXPLORATION INC.	OIL/GAS EXPL & DEV	Yes	68.32	-1.61%	14.75%	0.44%
THO	20130403	TAHOE RESOURCES INC. J	PRECIOUS MTL EXPL	Yes	2,476.97	-4.70%	11.54%	1.70%
ATD.B	20130422	ALIMENTATION COUCHE-TARD INC. CL 'B' SV	RETAIL FOOD CHAIN	Yes	8,224.34	-3.11%	2.64%	0.54%
ARZ	20130528	AURIZON MINES LTD. J	MINERAL EXPL & DEV	Yes	604.96	-8.86%	9.02%	0.64%
CG	20130531	CENTERRA GOLD INC.	GOLD EXPL & DEV	Yes	902.96	-15.18%	5.51%	3.97%
TXP	20130627	TOUCHSTONE EXPLORATION INC.	OIL/GAS EXPL & DEV	No	52.70	-3.06%	13.68%	0.44%
PVG	20131009	PRETIUM RESOURCES INC. J	PRECIOUS MTL EXPL	Yes	511.60	-34.95%	6.86%	3.28%
ATH	20131018	ATHABASCA OIL CORPORATION J	OIL EXPL & DEV	Yes	2,512.78	-21.41%	1.29%	3.52%
AC. B	20131106	AIR CANADA CLASS 'B'	AIRLINE	No	1,423.23	-12.09%	2.09%	3.74%
PVG	20131122	PRETIUM RESOURCES INC. J	PRECIOUS MTL EXPL	Yes	580.93	-3.49%	97.40%	4.70%
MRE	20131125	MARTINREA INTERNATIONAL INC.	METAL PRODUCTS MFG	Yes	711.71	-20.73%	1.20%	2.73%
BNK	20140609	BANKERS PETROLEUM LTD. J	OIL/GAS EXPL & DEV	Yes	1,692.75	-13.23%	1.36%	2.42%
CG	20140611	CENTERRA GOLD INC.	GOLD EXPL & DEV	Yes	1,018.86	-0.73%	12.78%	0.62%
CS	20140807	CAPSTONE MINING CORP. J	MINERAL EXPL & DEV	Yes	1,050.35	-5.57%	1.41%	0.27%

Appendix A (continued)

Ticker	Date	Name	Industry	S&P/TSX Composite Index Const.	Market Cap. (in million $)	Intraday decline	Intraday incline	turnover
AR	20140829	ARGONAUT GOLD INC. J	GOLD EXPL & DEV	Yes	685.95	-0.96%	17.59%	0.98%
FR	20141208	FIRST MAJESTIC SILVER CORP. J	SILVER MINING & EXPL	Yes	545.30	-15.50%	1.93%	1.13%
TLM	20141208	TALISMAN ENERGY INC.	RES EXPL & DEV	Yes	4,455.51	-11.80%	5.20%	0.61%
PXX	20141218	BLACKPEARL RESOURCES INC. J	OIL/GAS EXPL & DEV	Yes	372.56	-0.95%	27.72%	0.60%
PRE	20150114	PACIFIC EXPLORATION & PRODUCTION CORPORATION	OIL/GAS EXPL & DEV	Yes	1,330.76	-27.96%	3.46%	2.57%
GTE	20150120	GRAN TIERRA ENERGY INC. J	OIL/GAS EXPL & DEV	Yes	781.81	-38.28%	0.00%	2.57%
COS	20150130	CANADIAN OIL SANDS LIMITED	CRUDE OIL/GAS EXPL	Yes	3,804.19	-12.20%	36.03%	4.59%
MSL	20150206	MERUS LABS INTERNATIONAL INC. J	PHARM PRODUCT/DSTR	No	172.98	-3.30%	11.96%	1.60%
TECK.B	20150330	TECK RESOURCES LIMITED CL 'B' SV	MINERAL EXPL & DEV	Yes	11,024.37	-1.31%	15.28%	1.32%
SVY	20150406	SAVANNA ENERGY SERVICES CORP.	OIL FIELD SERVICE	No	175.09	-6.56%	19.78%	0.65%
CNL	20150724	CONTINENTAL GOLD INC. J	MINERAL EXPL & DEV	No	367.21	-5.71%	23.95%	0.73%
RKN	20150806	REDKNEE SOLUTIONS INC. J	SOFTWARE DEV/MKT/SERV	No	419.45	-32.55%	0.00%	1.13%
NAL	20150807	NEWALTA CORPORATION	WASTE MGT SERVICES	Yes	658.53	-4.07%	19.30%	0.27%
CFW	20150824	CALFRAC WELL SERVICES LTD.	URANIUM EXPL & DEV	Yes	375.70	-27.36%	30.28%	1.47%

Appendix A (continued)

Ticker	Date	Name	Industry	S&P/TSX Composite Index Const.	Market Cap. (in million $)	Intraday decline	Intraday incline	turnover
CFW	20150824	CALFRAC WELL SERVICES LTD.	URANIUM EXPL & DEV	Yes	375.70	-27.36%	30.28%	1.47%
HBC	20150824	HUDSON'S BAY COMPANY	DEPT STORES	Yes	4,175.55	-19.73%	3.65%	0.21%
LNR	20150824	LINAMAR CORPORATION	MACHINE EQUIP MFG	Yes	4,167.35	-16.88%	22.47%	0.55%
TVE	20150824	TAMARACK VALLEY ENERGY LTD. J	OIL/GAS EXPL & DEV	No	202.28	-3.68%	14.74%	0.08%
WJA	20150824	WESTJET AIRLINES LTD. VARIABLE VOTING & V	AIRLINE	Yes	2,443.56	-20.73%	29.55%	0.68%
NHC	20151009	NOBILIS HEALTH CORP.	MEDICAL FACILITY	No	330.49	-30.94%	3.82%	6.91%
CXR	20151021	CONCORDIA INTERNATIONAL CORP. J	PHARM PRODUCT/DSTR	Yes	1,273.07	-30.44%	3.99%	13.26%
VRX	20151021	VALEANT PHARMACEUTICALS INTERNATIONAL, INC.	PHARM PRODUCTION	Yes	52,615.06	-40.00%	1.54%	0.91%
CEU	20151030	CANADIAN ENERGY SERVICES & TECHNOLOGY CORP.	ENERGY RSCH & DEV	No	1,228.84	-2.32%	11.11%	0.36%
IT	20151217	INTERTAIN GROUP LIMITED (THE) J	GAMING OPERATIONS	No	689.21	-20.81%	0.65%	1.10%
PRE	20151217	PACIFIC EXPLORATION & PRODUCTION CORPORATION	OIL/GAS EXPL & DEV	Yes	581.61	-9.84%	62.79%	2.16%
BXO	20160104	BOULDER ENERGY LTD.	CRUDE OIL/GAS EXPL	No	78.53	-5.39%	15.15%	0.19%

Appendix A (continued)

Ticker	Date	Name	Industry	S&P/TSX Composite Index Const.	Market Cap. (in million $)	Intraday decline	Intraday incline	turnover
WJX	20160113	WAJAX CORPORATION	DIVERSIFIED SERV	No	288.95	-3.06%	8.42%	0.31%
POU	20160121	PARAMOUNT RESOURCES LTD. CLASS A	OIL/GAS EXPL & DEV	Yes	419.62	-9.04%	35.19%	2.22%
AYA	20160303	AMAYA INC. J	GAMING PROD & SERV	No	2,652.84	-2.56%	11.90%	1.00%
PSG	20160308	PERFORMANCE SPORTS GROUP LTD.	SPORTS EQUIPMENT	No	177.71	-67.30%	0.00%	7.10%
BDI	20160321	BLACK DIAMOND GROUP LIMITED	LIMITED PARTNERSHIP	No	198.93	-7.86%	13.18%	1.20%
AYA	20160323	AMAYA INC. J	GAMING PROD & SERV	No	1,973.24	-26.17%	9.29%	3.80%
PRE	20160404	PACIFIC EXPLORATION & PRODUCTION CORPORATION	OIL/GAS EXPL & DEV	No	312.93	-41.14%	10.88%	7.05%
RKN	20160411	REDKNEE SOLUTIONS INC. J	SOFTWARE DEV/MKT/SERV	No	199.16	-31.67%	1.90%	1.19%
CXR	20160421	CONCORDIA INTERNATIONAL CORP. J	PHARM PRODUCT/DSTR	Yes	1,971.15	-4.45%	27.77%	3.20%
CXR	20160602	CONCORDIA INTERNATIONAL CORP. J	PHARM PRODUCT/DSTR	Yes	1,874.87	-23.60%	11.43%	7.85%
LUC	20160629	LUCARA DIAMOND CORP. J	DIAMOND EXPL & DEV	Yes	1,275.78	-18.31%	1.53%	0.81%
CFP	20160711	CANFOR CORPORATION	FOREST PRODUCTS	Yes	1,795.52	-1.95%	2.54%	0.11%
IAG	20160809	INDUSTRIAL ALLIANCE	INSURANCE	Yes	4,643.22	-14.11%	1.10%	0.41%

Appendix A (continued)

Ticker	Date	Name	Industry	S&P/TSX Composite Index Const.	Market Cap. (in million $)	Intraday decline	Intraday incline	turnover
BNK	20160811	BANKERS PETROLEUM LTD. J	OIL/GAS EXPL & DEV	No	494.34	-13.27%	0.00%	1.16%
PSG	20160815	PERFORMANCE SPORTS GROUP LTD.	SPORTS EQUIPMENT	No	109.82	-65.56%	0.25%	9.24%
PSG	20160816	PERFORMANCE SPORTS GROUP LTD.	SPORTS EQUIPMENT	No	123.03	-8.80%	14.94%	3.74%
POT	20160830	POTASH CORPORATION OF SASKATCHEWAN INC.	POTASH MINE & PROD	Yes	19,558.78	-0.38%	13.01%	1.06%
AYA	20161007	AMAYA INC. J	GAMING PROD & SERV	No	3,393.53	-3.16%	9.14%	0.17%
PSG	20161011	PERFORMANCE SPORTS GROUP LTD.	SPORTS EQUIPMENT	No	238.77	-4.53%	14.43%	1.20%
NHC	20161028	NOBILIS HEALTH CORP.	MEDICAL FACILITY	No	345.95	-8.87%	16.13%	2.00%
EFL	20161110	ELECTROVAYA INC.	BATTERY TECHNOLOGY	No	150.84	-26.61%	2.83%	1.71%
CGG	20161111	CHINA GOLD INTERNATIONAL RESOURCES CORP LTD J	MINERAL EXPL & DEV	No	1,201.13	-14.74%	8.97%	0.27%
KLG	20161111	KIRKLAND LAKE GOLD INC. J	MINERAL EXPL & DEV	No	944.72	-6.37%	4.08%	0.31%
IT	20161115	INTERTAIN GROUP LIMITED (THE) J	GAMING OPERATIONS	No	640.06	-21.40%	2.25%	1.22%
CGC	20161116	CANOPY GROWTH CORPORATION J	BIOPHARM PROD/MKT	No	1,324.88	-29.55%	32.79%	20.92%
CGC	20161121	CANOPY GROWTH CORPORATION J	BIOPHARM PROD/MKT	No	1,217.96	-18.57%	3.75%	8.09%

Appendix A (continued)

Ticker	Date	Name	Industry	S&P/TSX Composite Index Const.	Market Cap. (in million $)	Intraday decline	Intraday incline	turnover
CXR	20161122	CONCORDIA INTERNATIONAL CORP. J	PHARM PRODUCT/DSTR	No	196.42	-17.69%	0.46%	2.37%
RKN	20161209	REDKNEE SOLUTIONS INC. J	SOFTWARE DEV/MKT/SERV	No	173.20	-27.59%	14.05%	1.45%
AZ	20161214	ARIZONA MINING INC. J	MINERAL EXPL & DEV	No	663.83	-20.86%	0.00%	1.96%
NVC	20161220	NEOVASC INC. J	MEDICAL PRODUCTS	No	188.84	-8.97%	18.22%	1.21%

Appendix B

This table reports the following characteristics of the SSCB events during the period between January 2012 and December 2016. The date shows the SSCB date, news, a dummy variable equal to one if the circuit breaker is associated with firm-specific non-material news, zero otherwise, and details of Factiva search lists the corresponding detailed news information found in Factiva on the event day. The AVIX is the difference between the VIX index on the day of the SSCB relative to the average index level in the SSCB event month.

Ticker	Date	AVIX	News	Details of Factiva search	Source
XG	20120217	-0.80	1	XG Extorre Gold cancels $50-million prospectus offering	Marketwire
TCW	20120326	-2.07	0	No news	
UUU	20120518	3.12	1	Uranium producers wary of market damage from DOE plan to release and enrich federal uranium	Associated Press
R	20120601	3.53	1	Romarco receives EIS schedule from US Army Corps	ENP Newswire
GBU	20120606	0.73	1	Environment clearance on Rosia Montana Mine to be reassessed	Marketwire
EXE	20120705	0.62	0	The single stock circuit breaker was triggered in error.	Marketwire
CLC	20121108	0.99	1	Third Quarter 2012 Financial Results	Marketwire
PSN	20121116	1.53	1	Third Quarter 2012 Financial Results	Canada Stockwatch
PRE	20121203	0.54	1	Pacific Rubiales Announces Dividend	Marketwire
NXY	20121207	-0.35	1	Government OK's foreign bids for Nexen Energy	cbc.ca
TRQ	20130130	0.89	1	Rio Tinto considering halting work at Oyu Tolgoi mine over dispute	Financial Post
TXP	20130314	2.26	1	Audited annual financial statements	SEDAR
THO	20130403	-0.39	1	Tahoe's Escobal Project Receives Final Permit	Marketwire
ATD.B	20130422	0.29	1	Labour groups in Quebec and Norway are joining forces to push Alimentation Couche-Tard to recognize the union rights of workers in their convenience stores.	The Canadian Press

Appendix B (cont.):

Ticker	Date	News	Details of Factiva search	Source
ARZ	20130528	1	Aurizon Announces Receipt of Investment Canada Act Approval for the $796-million takeover of the company by Hecla Mining.	Marketwired
CG	20130531	1	Centerra Gold Inc. has been forced to halt mining operations in Kyrgyzstan after protestors disrupted power supply to the company's Kumtor gold mine	Financial Post
TXP	20130627	0	no news	
PVG	20131009	1	Pretium shares plunge 30.5% as independent consultant resigns	Financial Post
ATH	20131018	1	The Alberta Court of Appeal Issues Decision	DJ Institutional News
AC.B	20131106	1	October load factor down for Air Canada	Canada Stockwatch
PVG	20131122	1	Mine output surpasses target of 4,000 ounces of gold at valley of the Kings bulk sample program	DJ Institutional News
MRE	20131125	1	Martinrea International Inc. Update on Litigation	Marketwired
BNK	20140609	1	Expanding Margins, Encouraging Initial Water and Polymer Flood Results and 5-Year Development Outlook	PR Newswire (U.S.)
CG	20140611	1	Kyrgyzstan approves Centerra Gold's 2014 mine plan, avoids shutdown	Marketwired
CS	20140807	1	CAPSTONE MINING REPORTS RECORD CASH FLOW FOR 2014 SECOND QUARTER	Canada Stockwatch
AR	20140829	1	AR Argonaut releases San Agustin 43-101 resource estimate	SEDAR
FR	20141208	1	Supreme Court of Canada Dismisses Appeal Application by Hector Davila Santos	DJ Institutional News

Appendix B (cont.):

Ticker	Date	News	Details of Factiva search	Source
TLM	20141208	1	Repsol Said to Revive Talks with Talisman on Transaction	Bloomberg
PXX	20141218	1	Blackpearl Resources Inc: RBC cuts target price to C$1.25 from C$2.25	Reuters News
PRE	20150114	1	Pacific Rubiales reduces 2015 capital budget to $1.3B (U.S.) FROM $1.5b	Reuters News
GTE	20150120	1	Press Release: Gran Tierra Energy Provides Operations Update	DJ Institutional News
COS	20150130	1	Canadian Oil Sands fourth-quarter profit tumbles, cuts dividend	Reuters News
MSL	20150206	1	Merus Labs Announces Record Q1 2015 Results	Marketwired
TECK.B	20150330	1	Rumours about merger with Antofagasta	Marketwired
SVY	20150406	1	Savanna Energy Services Corp. Announces the Elimination of Dividend	Marketwired
CNL	20150724	0	No specific news	
RKN	20150806	1	RKN Redknee Solutions loses $5.54-million (U.S.) in Q3	Canada NewsWire
NAL	20150807	1	Interim financial statements	SEDAR
CFW	20150824	1	China's slowdown, uncertainty in Greece and the rest of the eurozone, the stronger dollar, the prospect of higher interest rates, stretched stock valuations	Canada NewsWire
HBC	20150824	0	No news	Canada Stockwatch

Appendix B (cont.):

Ticker	Date	News	Details of Factiva search	Source
LNR	20150824	1	Trans-Pacific Partnership trade pact without better terms for automotive sector.	Canada Stockwatch
TVE	20150824	1	Final approval for the listing of the Company's common shares on the Toronto Stock Exchange.	Canada Stockwatch
WJA	20150824	0	No news	
NHC	20151009	1	Seeking Alpha published a report on Nobilis asserting accounting red flags, questionable marketing practices and substantial insider sales.	Marketwired
CXR	20151021	1	political and legal scrutiny in the United States over increases to some drug prices.	Marketwired
VRX	20151021	1	political and legal scrutiny in the United States over increases to some drug prices.	Marketwired
CEU	20151030	0	No news	Marketwired
IT	20151217	1	Short seller (SPRUCE POINT CAPITAL) publish report	Canada Stockwatch
PRE	20151217	0	No news	
BXO	20160104	0	No news	
WJX	20160113	0	No news	
POU	20160121	1	POU Paramount Resources reduces work force by 15%	Canada Stockwatch
AYA	20160303	1	Non-binding proposal from CEO to take the company private for C$21 a share	Canada Stockwatch
PSG	20160308	1	Performance Sports Group Revises Fiscal 2016 Outlook and Reports Preliminary Fiscal 3Q Results	DJ Institutional News
BDI	20160321	1	Black Diamond Group cuts dividend by 50 pct. to $0.025/shr	Canada Stockwatch
AYA	20160323	1	Quebec Securities Regulator Files 23 Charges Against 3 Individuals, 3 Companies in Amaya Probe	Canada Stockwatch

Appendix B (cont.):

Ticker	Date	News	Details of Factiva search	Source
PRE	20160404	1	Colombian Constitutional Court's decision instructing the Company to suspend operations near Quifa Block.	Reuters News
RKN	20160411	1	Redknee Solutions sees Q2 2016 revenue $39 mln-$41 mln	Reuters News
CXR	20160421	1	Concordia Healthcare Announces Formation of Special Committee to Review Strategic Alternatives	SEDAR
CXR	20160602	1	Blackstone, Carlyle walk away from Concordia Healthcare's Sale Process	DJ Institutional News
LUC	20160629	1	Lucara Provides Exploration Update	Canada Stockwatch
CFP	20160711	1	CFP Canfor deleted from S&P/TSX Composite Buyback	Canada Stockwatch
IAG	20160809	1	Q2 Financial Reports	Canada Stockwatch
BNK	20160811	1	Bankers Petroleum Q2 loss per share $0.083	Reuters News,
PSG	20160815	1	Performance Sports Group says delay in annual report on form 10-k	Reuters News
PSG	20160816	1	Moody's downgrades Performance Sports Group's (PSG's) CFR to Caa2; rating outlook is negative	Moody's Investors Service
POT	20160830	1	Potash Corp, Agrium talk merger	Bloomberg
AYA	20161007	1	Amaya Gets Buyout Offers from William Hill and GVC	Reuters News
PSG	20161011	1	Competition Bureau penalized Reebok CCM Hockey Inc. (competitor) for inaccurate advertising	Reuters News
NHC	20161028	1	Nobilis Health Corp. Announces Completion of Acquisition of Arizona Vascular Clinics & New $82.5 Million Credit Facility; Updated 2016 Guidance	Marketwired

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Appendix B (cont.):

Ticker	Date	News	Details of Factiva search	Source
EFL	20161110	1	Electrovaya Provides Business Update	DJ Institutional News
CGG	20161111	1	BRIEF-China Gold international Q3 revenue rose 10 pct. to $109.6 mln	Reuters News
KLG	20161111	1	EXCLUSIVE-Gold Fields, Silver Standard offer C$1.4 bln for miner Kirkland Lake	Reuters News
IT	20161115	1	IT Intertain Group loses $31.8-million in Q3	Canada Stockwatch
CGC	20161116	1	Canopy Q2 profit exceeds analyst expectations	Canada Stockwatch
CGC	20161121	1	Rumors about legal recreational weed tax rates as high as 25 per cent.	Canada NewsWire
CXR	20161122	0	no specific news	
RKN	20161209	1	Redknee Solutions Inc. Announces US$80 Million Private Placement	DJ Institutional News
AZ	20161214	1	The Global Mining Observer article of Sunday, December 11, 2016 on the Company	SEDAR
NVC	20161220	1	Neovasc Regains Compliance with NASDAQ Listing Requirements	Canada NewsWire