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Efficiency and the Bear: Short Sales and Markets Around the World

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ABSTRACT

We analyze cross-sectional and time-series information from 46 equity markets around the world to consider whether short sales restrictions affect the efficiency of the market and the distributional characteristics of returns to individual stocks and market indices. We find some evidence that prices incorporate negative information faster in countries where short sales are allowed and practiced. A common conjecture by regulators is that short sales restrictions can reduce the relative severity of a market panic. We find strong evidence that in markets where short selling is either prohibited or not practiced, market returns display significantly less negative skewness.

IN FEBRUARY OF 1609, A GROUP OF WELL-CONNECTED Dutch businessmen, led by one of the original subscribers to the Dutch East India Company, Isaac Le Maire, formed a secret association, a "Groote Companie," to short the shares in the East India Company in anticipation of the incorporation of a rival French-chartered trading firm. Le Maire and his colleagues sold shares forward in a "blanco" transaction promising future delivery in 1 or 2 years. Over the next 12 months, their profits mounted, as East India Company shares dropped by 12%, angering shareholders who inevitably learned of their plan. In January of 1610, a year after the formation of the Groote Companie and only 8 years after the official founding of the Amsterdam Exchange, the first regulation against short selling was enacted. Share prices rebounded, a rival French company was not formed, and Isaac Le Maire never succeeded in disentangling himself from the litigation that ensued.[1]

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[1] This account is taken from Montias's (1989) *Vermeer and His Milieu*. The original study of the Le Maire affair may be found in van Dillen (1930) "Isaac Le Maire en de handle in action der

At various times over the last 400 years, short sellers have been blamed for stock market declines, leading market participants to call for regulation against short sales.[2] However, despite centuries of disagreement between speculators and regulators on the topic, no one really knows whether short sales constraints are a good thing or a bad thing. As the above example indicates, while short sales restrictions are nearly as old as organized exchanges, there is little empirical evidence on whether they prevent or facilitate market crashes, or whether they hinder or promote rational price discovery.

In this paper, we use cross-sectional and time-series information from 46 equity markets around the world to examine whether short sales restrictions affect the efficiency of the market and the distributional characteristics of individual as well as market returns. We obtain information regarding the history and current practice of short sales restrictions from market regulators, investment banks, and institutional investors specializing in short sales. This data set allows us to characterize each country in terms of the legality, as well as practice, of short selling for the period 1990 to 2001.

Because the existence of short sales regulation is highly correlated with the development of financial markets, our challenge is to identify the true effects of such regulation on measures of efficiency and market stability that are not driven by other country-specific characteristics. Moreover, because our sample contains only five countries that have changed their short sales regulation over the sample period, identification in the time-series dimension is problematic. However, we exploit the fact that even in countries in which short sales are prohibited, dual-listed stocks may be shortable in another market. One of the most significant institutional changes in international investing in the last decade has been the growth of the depository receipt market in the United States and Europe. Once restricted to a very few bellwether securities from a handful of non-U.S. exchanges, American Depository Receipts (ADRs), Global Depository Receipts (GDRs), and Global Issues now allow domestic investors to achieve considerable exposure to the world equity markets without leaving the comfort of the U.S. or the U.K. regulatory environment. A major feature of these latter environments, of course, is the ability to short.[3] We are therefore

Oost-Indische Companie." For a discussion on the legal and ethical view of short selling in late 16th century Holland, see De Marchi and Harrison (1994).

[2] For an excellent review of the history of short sales restrictions, see "A Short History of the Bear," Chancellor (2001), http://www.prudentbear.com/press_room_short_selling_history.html.

[3] In the case of global offerings, dual-listed stocks can be shorted in the United States and the United Kingdom like any other stock. Regarding ADRs and GDRs, selling them can be difficult because of liquidity issues, unless the security is widely held by institutions. In the United States, on the other hand, the 1934 Securities Exchange Act exempts ADR short positions from the up-tick rule under §10a-1 (e)(8), which applies to companies that are listed on a foreign exchange:

(e) The provisions of paragraphs (a) and (b) of this section (and of any exchange rule adopted in accordance with paragraph (a) of this section) shall not apply to:

(8) Any sale of a security registered on, or admitted to unlisted trading privileges on, a national securities exchange effected for a special international arbitrage account for the bona fide purpose of profiting from a current difference between the price of such security on a securities

able to identify, even within countries in which short sales are not allowed or practiced, a subsample of stocks that can be shorted because they are listed both in the domestic market and in either the United States or the United Kingdom. By using the fact that some stocks in a given country are dual-listed while others are not, we are able to isolate the effect of short sales regulation on equity prices while controlling for major country effects. Our analysis is based on a test of the differences in the behavior of nonshortable stocks (domestic only) versus shortable stocks (dual-listed) in countries in which short sales are restricted, controlling for differences between domestic stocks and dual-listed stocks in countries in which short sales are allowed and practiced.

In this paper, we rely on two measures of market efficiency. The first is a downside-minus-upside R^2 measure of the relative co-movement of individual stock returns with the market, depending on the sign of the market return. It is calculated by estimating two market model regressions of individual stock returns, one on negative market returns and one on positive market returns (downside R^2 and upside R^2, respectively), and then calculating the difference in the R^2 coefficients. We hypothesize that in the presence of short selling restrictions conditional on negative information, less idiosyncratic risk is incorporated into prices and therefore the country's downside-minus-upside R^2 should be lower when short sales are allowed, relative to the case in which short sales are either prohibited or not practiced. Our second measure is based on the difference in cross-autocorrelation between signed-market returns and individual stock returns, with a 1-week lag. Diamond and Verrecchia (1987) predict that when short sales are restricted, individual stock returns adjust slowly to common factor information, conditioning on a negative market return. We also compute the difference in downside-minus-upside cross-autocorrelation, to capture the differential rates of diffusion conditional on constraints and to control for common factors that may determine cross-autocorrelation.

In countries in which short selling is feasible and practiced, we find a marginally but significantly lower downside-minus-upside R^2, and a marginally but significantly lower downside-minus-upside cross-autocorrelation, controlling for a host of other factors. This evidence is weakly consistent with short selling facilitating more efficient price discovery at the individual security level.

A common conjecture by regulators is that short sales restrictions can reduce the severity of price declines. For example, one of the regulators whom we contacted to obtain data for our sample argues that "*forbidding short selling prevents big market swings since the market size is limited*." We test this conjecture by examining the skewness of market returns, as well as the frequency of extreme negative returns. We find strong evidence that the lifting of short sales restrictions is associated with increased negative skewness in market returns. However, short sales have no significant impact on the frequency of crashes,

market not within or subject to the jurisdiction of the United States and on a securities market subject to the jurisdiction of the United States; provided the seller at the time of such sale knows or, by virtue of information currently received, has reasonable grounds to believe that an offer enabling him to cover such sale is then available to him in such foreign securities market and intends to accept such offer immediately.

at least realized crashes. Together, these two results imply not that extreme returns become more frequent, but rather that they become more negative.

Our analysis in this paper sheds light on the costs and benefits of short sales regulation at the individual security level as well. On the one hand, our data support the view that short selling facilitates efficient price discovery, at least to the extent that efficiency is captured empirically by the lack of synchronous movement in weekly returns. On the other hand, short selling may also potentially facilitate severe price declines in the market, at least as defined in terms of negative skewness. Despite the relationship between short sales constraints and skewness at the market level, we find little compelling evidence that short sales constraints prevent or mitigate severe price declines at the individual stock level.

Because of the variety of potentially unobservable factors that differ across international markets, there is a concern about adequate controls. To address this, we use an event study methodology to analyze the five countries in our sample that changed their short sales regulation and practice during the sample period, namely Hong Kong, Norway, Sweden, Malaysia, and Thailand. Even though restricting the sample to only five countries drastically reduces our degrees of freedom, using these countries obviates the need for most controls.[4] Even in this limited sample we find gains in efficiency as measured by one of our proxies for efficiency, and we find a marginal increase in the negative skewness of market returns when short sales become allowed and practiced in these countries.

Figure 1 summarizes our findings regarding the skewness of the market and the synchronicity of stock returns. We plot the downside-minus-upside cross-autocorrelation against market skewness, depending on whether countries allow and commonly practice short sales or not. Furthermore, we exclude from the figure dual-listed stocks in countries in which short sales are not allowed or practiced. In this figure we do not control for a number of factors that potentially influence synchronicity and skewness. However, the raw data are somewhat illustrative: Countries that allow and practice short sales display modestly less cross-autocorrelation difference and more negative skewness.

Note that Hong Kong, Malaysia, Norway, Sweden, and Thailand appear twice in the figure. This can be explained by the fact that each of these markets lifted short sales constraints at some point during our study. For example, short sales restrictions for Hong Kong were eliminated in 1996. The pre-elimination downside-minus-upside cross-autocorrelation is -0.02 and market skewness is -0.18, whereas the post-1996 downside-minus-upside cross-autocorrelation is -0.06 and market skewness is -0.35. Hong Kong's positional shift in the figure represents the common pattern among the countries that relaxed short sales constraints.[5] The international evidence shown in Figure 1 suggests that short

[4] It does not, however, control for the possibility that regulatory changes occurred as a result of changes in return characteristics. We address this issue later in the paper.

[5] Section VII in the paper shows in cross-sectional regressions that the difference in skewness and cross-autocorrelation before and after the change in regulation is significantly different from zero.

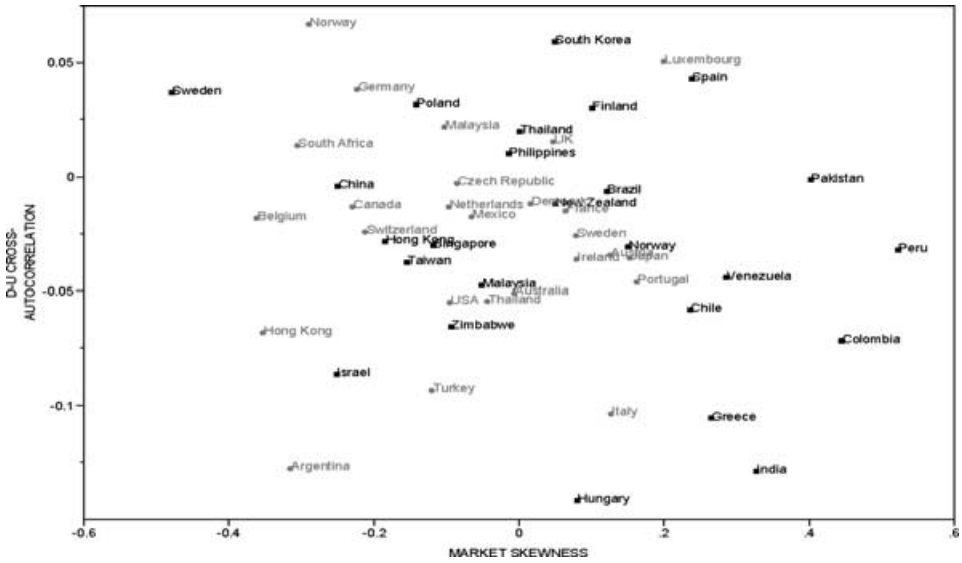

Figure 1. Short sales restrictions, market skewness, and downside-minus-upside cross-autocorrelation, domestic stocks. Market Skewness is the skewness of $\log(1 + r)$, where r denotes market returns. We calculate skewness for each country and year, and then average across all years, depending on the short sales legal status. We compute cross-autocorrelations between 1-week lagged market returns and individual stock returns. In particular, we calculate $\rho^{+}_{ijTD} = \text{corr}(r_{ijt}, r^{+}_{mjt-1})$ and $\rho^{-}_{ijTD} = \text{corr}(r_{ijt}, r^{-}_{mjt-1})$, where r^{+}_{mt} equals the market return when it is either positive or zero, and r^{-}_{mt} equals the market return when it is negative for all stocks i in group D and country j, using weekly observations in each year T. We then average the cross-autocorrelations across stocks and calculate $\rho^{Diff}_{jTD} = \rho^{-}_{jTD} - \rho^{+}_{jTD}$. Countries are classified depending on whether short sales are allowed and practiced (gray, circles), or not (black, squares). The sample includes firms from 46 countries with stock price information available from Datastream.

sales might play an important role in market efficiency and the magnitude of market crashes. In the remainder of this paper, we investigate these potential relationships in econometric detail.

The rest of the paper is organized as follows. In Section I, we review the current literature on short sales and discuss our contributions in the context of related research. In Section II, we summarize short sales regulation and practice in markets around the world. In Section III, we describe our method for classifying stocks within a country into domestic and dual-listed categories. In Section IV, we analyze the relationship between short sales and foreign listings. Section V reports the results of our tests of relative pricing efficiency. Section VI reports the statistical characteristics of market and security returns associated with short sales and tests for differences in skewness conditional upon restrictions. In Section VII, we separately analyze the five countries that changed their short sales regulation over the sample period. In Section VIII, we graphically analyze the distribution of stock returns. In Section IX, we consider the effect of put options as an alternative mechanism to short sales, and Section

X concludes. The Appendix contains an econometric model that illustrates the relationship between a delayed response to information and our measures of market efficiency.

I. Literature Review

Short sales play an important role in asset pricing models and the theory of portfolio choice. Most neoclassical models in finance (see, e.g., Ross (1976)) rely upon the ability of market participants to take offsetting positions in close economic substitutes in order to enforce the law of one price. Considerable research in the last decade explores the effects of short sales and frictions in an asset market. For example, Luttmer (1996), Chen (1995, 2001), He and Modest (1995), Hansen and Jagannathan (1997), Jouini and Kallal (2001), and Duffie, Garleanu, and Pedersen (2002) all address the effect of market frictions, seeking to characterize the magnitude of mispricing that may obtain. Diamond and Verrecchia (1987) explore the effect of short sales constraints on the speed of price adjustment to private information. Building on their model, more recent theoretical work (Abreu and Brunnermeier (2002, 2003), Scheinkman and Xiong (2003)), shows that short sales constraints can be a direct cause of, or at least a necessary condition for, bubbles and excessive volatility. This finding is contrary to the commonly held belief among regulators that short sales constraints can stabilize the market.

Hong and Stein (2003) develop a heterogeneous agent model linking short sales constraints to market crashes. In their model, if some investors are constrained from selling short, their accumulated unrevealed negative information will not be manifest until the market begins to drop, which further aggravates a market decline and leads to a crash. They motivate the model with the observation that the U.S. market displays negative skewness.

Most of the research cited above suggests that short sales constraints have an adverse effect on efficiency—the only question is how much. An interesting exception to this view is that of Allen and Gale (1991), who point out that the potential for financial innovation renders short selling a destabilizing influence in the economy. This is potentially interesting in light of our findings that short sales tend to be allowed in major markets where financial innovations occur, particularly with respect to capital structure and new security development, and that these markets also tend to display relatively higher negative skewness in returns. Bernardo and Welch (2004) develop a model that shows how the fear of financial crisis, instead of a real liquidity shock, is the true cause of financial crises. One implication of their model is that constraints that hinder some market participants from front-running other investors can effectively prevent financial crises from happening, which is consistent with the finding of Allen and Gale (1991) that short sales can potentially destabilize the economy.

Empirical evidence on short selling largely supports the theoretical view that constraining it hinders price discovery. Using early-20th century U.S data, Jones and Lamont (2002) show that stocks that are expensive to short have high valuations and low subsequent returns. Their finding is consistent with the hypothesis that difficult-to-short stocks are overpriced. Using data on DotComs,

Ofek and Richardson (2003) show that short sales constraints in the form of stock option lock-ups have a considerable and persistent negative impact on subsequent stock returns, also supporting the argument that stock prices do not fully incorporate information under short sales constraints. Geczy, Musto, and Reed (2002) use a comprehensive sample of short sales and find that short sales restrictions have a mixed impact on the profitability of well-known arbitrage strategies.

There is also a vast empirical literature that tests the predictions by Diamond and Verrecchia (1987), who argue that short sales constraints impair the diffusion of positive and negative information differently. Asquith and Meulbroek (1995), Aitken et al. (1998), and Danielsen and Sorescu (2001) all find that the introduction of short sales, in the form of changes in the short interest, short sales regulation, or options, is associated with negative future returns. This suggests that negative information is incorporated into prices slowly when shorting is constrained. In addition, Reed (2003) finds that stocks for which short selling is particularly costly have larger price reactions to earnings announcements, especially negative earnings announcements. These studies emphasize the short sale constraints' asymmetric impact on market efficiency: Not only do short sales constraints reduce overall price efficiency, but also such an effect is stronger when there is negative information.

Short selling is an important tool used by speculators to exploit overpriced securities.[6] Bekaert and Harvey (2000) explore the importance of speculators in emerging market efficiency. They find that the cost of capital, an indicator of market efficiency, decreases after a capital market liberalization. Further, they stress the importance of regulatory changes that increase a country's openness to speculators, which naturally extends to short sales restrictions. Thus, our work fits naturally into the literature on the globalization of capital markets.

Most theory and empirical evidence from the U.S. and from a few non-U.S. markets[7] suggest that short sales constraints are an impediment to price discovery, particularly when the news is bad. While some theories argue that limiting short sales may be necessary under certain conditions to achieve equilibrium, thus far there is no empirical test of the contrary proposition. In particular, no study to date has used the power of cross-sectional differences in regulations across countries to test short sales effects.[8] We address this gap in the literature below.

[6] See D'Avolio (2002).

[7] Aitken et al. (1998) offer evidence from the Australian Stock Exchange that suggests short sales trades reflect significant bad news about companies. Biais, Bisiere, and Decamps (1999) find that the spot market in the Paris Bourse, which is subject to leverage and short sales constraints, reflects good news significantly faster than bad news. Poitras (2002) concludes that rights issues trade below the arbitrage boundary because of short sales restrictions on the Stock Exchange of Singapore (SES). Li and Fleisher (2004), using Chinese stock market data, find that the dispersion of domestic analysts' forecasts is negatively correlated to stock returns in the A-share market, where short sales restrictions are binding, and not significantly related to the returns of B-shares, where short sales restrictions are not binding.

[8] One exception is Charoenrook and Daouk (2004), who analyze the effect of short sales on skewness and the cost of capital.

II. Short Sales Restrictions Around the World

Our main data source for short sales regulation and practice is information provided by investment banks. The Morgan Stanley Dean Witter Global Network Management Division (GNM) has compiled information regarding short sales regulations, impediments, and practices from their global network of subcustodian banks for 59 countries; they made a summary of this research available to us. We obtain similar information from the International Securities Lending Division at Goldman Sachs (ISL). The ISL complements the information from GNM in three important respects, as it provides detailed information on the tax effects of short positions, the settlement cycle of short sales, and the registration requirements for shorting in 46 countries. There are some countries for which the GNM and ISL data indicate that short selling is not practiced, despite the fact that a widely used guide, the Worldwide Directory of Securities Lending and Repo (WDSLP), lists institutional investors involved in short sales in those countries. In these cases, we contact the listed institutions to understand the discrepancy. In most cases we find they were not active in short sales, or else they were mostly focused on securities lending. An exception is Singapore, where it appears that even though short selling is not formally allowed, it is widely practiced, typically off-exchange between depository agents. We obtain additional information on securities trading, settlement, and tax laws from the *International Securities Services Association (ISSA) Handbook* (2002). Note, however, that ISSA only provides current information on these issues.

In addition to collecting information from investment banks, industry publications, and market participants, we contact the equivalent of the Securities and Exchange Commissions of the 59 countries in the GNM data set to learn about their respective regulations and practices. Information from market regulators is particularly useful in allowing us to track the history of short sales regulations for each country over the last 15 years. With their help we are able to examine some key regulatory regime shifts in our empirical analysis. We find that in general the information provided by practitioners is more detailed than the information from regulators, although it should not be surprising that Goldman Sachs and Morgan Stanley Dean Witter know more about market practice than regulators themselves. For instance, in one case, while regulators told us that short selling is not practiced in their market, ISL indicates otherwise, observing that most of the short selling transactions for that market take place offshore, outside the purview of the regulatory agency.

Our information about short sales regulation and practice is summarized in Table I. Out of the 59 countries in the GNM data set, we exclude the countries for which we cannot find individual firm stock price data. This leaves a sample of 46 countries. In 35 of them, short selling is currently allowed, at least as of December 2001, the final date of our sample period. In 10 of the 46, short sales were prohibited for the entire sample period of January 1990 to December 2001. In 13 of the 35 countries in which short sales are currently allowed, restrictions existed in 1990 but were lifted at some point during the sample period. These

Table I

Short Selling Restrictions Around the World

For each country in the sample, the table describes the date at which short selling was allowed if this happened on or after 1990. Otherwise, countries are classified as "Allowed Before 1990" or "Not Allowed." Securities Lending refers to the ability of an investor to borrow securities from another party. Short Selling refers to the ability of an investor to sell a borrowed security to a third party. Short Selling is practiced when there are indications from market participants, market regulators, or institutions within a country that short selling is a common practice. The data are obtained from the Global Network Management Division at Morgan Stanley Dean Witter, the International Securities Lending at Goldman Sachs, the corresponding market regulators, the *International Securities Services Association Handbook*, and practitioners listed in the *Worldwide Directory of Securities Lending and Repo.*

Country	When Was Short Selling Allowed	When Was Securities Lending Allowed	Whether Short Selling Is Practiced	Comments
Argentina	Allowed in 1999	Allowed in 1991	No	Equity lending is rare and occurs only between brokers. Short selling cannot last more than 360 days in a row. Only allowed for 16 stocks.
Australia	Before 1990	Before 1990	Yes	Securities can be borrowed from ASX and counterparty. Cash and noncash collateral are accepted at 105% to 110% of the underlying value of the to loan securities. Collateral is marked-to-market daily.
Austria	Before 1990	Before 1990	Yes	
Belgium	Before 1990	Before 1990	Yes	There is no organized market for stock lending and borrowing. A law on securities lending was passed in March 1999 but still pending. There is no official regulation on short selling stocks.
Brazil	Before 1990	Before 1990	No	CBLC has been authorized to maintain a securities lending program. Under CVM Instruction No. 249, only entities that offer settlement, registration, and custody services in the Brazilian market are authorized to provide securities lending services. Accordingly, foreign investors are not authorized to engage in directed/discretionary lending activities that are outside the CBLC program.
Canada	Before 1990	Before 1990	Yes	The market for securities lending is large (40+ billion dollar business) and well developed.
Chile	Allowed in 1999	Allowed in 1999	No	Short selling cannot last more than 360 days in a row. The entity (including individuals) who is lending the stocks maintains the beneficial ownership, except the right to vote.
China	Not allowed	Not allowed	No	
Colombia	Not allowed	Not allowed	No	Securities lending is not authorized.

(*continued*)

Table I—*Continued*

Country	When Was Short Selling Allowed	When Was Securities Lending Allowed	Whether Short Selling Is Practiced	Comments
Czech Republic	Before 1990	Before 1990	Yes	There have been no regulations on short selling since Prague Stock Exchange (PSE) was opened in 1993. It is possible to sell securities only if absent securities are bought or borrowed before the settlement date.
Denmark	Before 1990	Before 1990	Yes	No regulatory barriers inhibiting securities lending.
Finland	Allowed in 1998	Before 1990	No	The transfer tax laws place a serious burden on the activity.
France	Before 1990	Before 1990	Yes	Securities lending was permitted by law in 1987 and 1988. All establishments (domestic and foreign) are eligible for short selling as long as they are recognized as counter parties.
Germany	Before 1990	Before 1990	Yes	A securities lending facility was created in 1989 to improve market liquidity.
Greece	Not allowed	Not allowed	No	Securities lending and borrowing have been legalized by the Greek Parliament but the operational framework has yet to be established.
Hong Kong	Allowed in 1996	Before 1990	Yes	Short selling was allowed for 33 stocks in 1994, and then extended to a wide range of stocks in 1996.
Hungary	Allowed in 1996	Allowed in 1996	No	The 1996 Act CXI does not prohibit short sales. However, the volume is very limited.
Indonesia	Not allowed	Allowed in 1996	No	No guidelines have been provided by BAPEPAM, the Indonesian Regulatory Authority for the Indonesian capital market.
Ireland	Before 1990	Before 1990	Yes	Securities lending volume is still limited.
Israel	Before 1990	Before 1990	No	The TASE does not offer a securities lending program to its members. TASE rules indicate that the securities account of a TASE member at the clearing house may not enter into a short position intentionally.
Italy	Before 1990	Before 1990	Yes	
Japan	Before 1990	Before 1990	Yes	Allowed for stocks listed on the first section of the exchanges.
Luxembourg	Before 1990	Before 1990	Yes	
Malaysia	Allowed in 1995, Prohibited again in 1997	Allowed in 1995, Prohibited again in 1997	Yes	Short selling and securities lending were suspended during the regional financial crisis of 1997. With the economic recovery, improvements in reporting requirements, prudential controls, and the cessation of trading of KLSE-listed securities offshore, short selling and securities lending are expected to be restored.

Mexico	Before 1990	Before 1990	Yes	The system is generally used as a safeguard against failing to deliver rather than securities lending as a product. Foreign investors are eligible to participate in securities lending through a local broker. Margin is 150%.
Netherlands	Before 1990	Before 1990	Yes	There is a central lending facility at the ASE.
New Zealand	Allowed in 1992	Not allowed	No	Tax regulations prevent onshore securities lending from taking off.
Norway	Allowed in 1992	Allowed in 1996	Yes	Securities lending is still in the early stages of development and tax implications are being discussed at the Ministry of Finance.
Pakistan	Not allowed	Not allowed	No	There are no regulations that restrict foreign investors from lending or borrowing securities. Short selling is not allowed.
Peru	Not allowed	Not allowed	No	Offshore lending is prohibited. The Lima Stock Exchange is considering allowing new activities such as securities lending, short selling, and new repo trades in the future.
Philippines	Allowed in 1998	Allowed in 1998	No	Although the SEC has approved the rules on SBL and short selling, the rules are not yet clearly defined in the market.
Poland	Allowed in 2000	Before 1990	No	Neither the full legal nor operational frameworks have been established.
Portugal	Before 1990	Before 1990	Yes	Securities lending is allowed and practiced. BVLP charges 10 b.p. annualized over the initial value (maximum days for calculation is 45) for this service.
Singapore	Not allowed	Before 1990	Yes	Onshore lending is limited while offshore lending is active.
South Africa	Before 1990	Before 1990	Yes	Short selling has always been allowed in JSE.
South Korea	Not allowed	Before 1990	No	Securities lending and borrowing has not been active to date.
Spain	Allowed in 1992	Allowed in 1992	No	Securities lending and short selling have been available since 1992. Since July 1994, SCLV has acted as principal for the lending pool formed by the daily bids from the clearing members. The load must be reported to the SCLV within 2 working days of the sale date.
Sweden	Allowed in 1991	Allowed in 1991	Yes	Widely practiced.
Switzerland	Before 1990	Before 1990	Yes	Securities lending is legal in Switzerland and there are no restrictions on who may borrow or lend. There is no central lending facility and no stamp duties apply to securities lending.

(*continued*)

Table I—*Continued*

Country	When Was Short Selling Allowed	When Was Securities Lending Allowed	Whether Short Selling Is Practiced	Comments
Taiwan	Before 1990	Before 1990	No	Qualified Foreign Institutional Investors (QFIIs) are prohibited from borrowing securities onshore and can only lend securities onshore to brokers to cover their fails. Margin trades and short selling are not allowed for institutional investors. In addition, dealers cannot buy at daily up-limit and sell at daily down-limit. In contrast, major shareholders of listed companies are required to file to the securities authority before they sell their holdings. Individual investors who meet certain qualifications of age, actual trading records, and financial integrity can apply for margin accounts, which can be opened with eligible brokers or securities finance companies. The securities eligible for margin trading are common stocks and beneficiary certificates meeting the standards Governing Margin Purchase and Short Sale of Securities. Since the Asian financial crisis the authorities in Taiwan have been prohibiting investors from short selling when a share is trading below the previous day's close.
Thailand	Allowed in 1997	Allowed in 1999	Yes	Short selling is very limited after being allowed in 1999.
Turkey	Before 1990	Allowed in 1996	No	Securities lending is not widely practiced.
United Kingdom	Before 1990	Before 1990	Yes	Short selling is active in the United Kingdom.
United States	Before 1990	Before 1990	Yes	
Venezuela	Not allowed	Not allowed	No	Securities lending is not specifically prohibited or provided for under current regulations. Free transfers of securities between different beneficial owners cannot be conducted without executing a trade on the exchange. Offshore lending is generally not practiced.
Zimbabwe	Not allowed	Not allowed	No	

countries are: Argentina, Chile, Finland, Hong Kong, Hungary, Malaysia, New Zealand, Norway, Philippines, Poland, Spain, Sweden, and Thailand. In three cases, namely, Malaysia, Hong Kong, and Thailand, restrictions on short selling were removed and later reenacted gradually.[9]

There is clearly a difference between what the law allows and what is common practice. Although short selling is currently legal in most countries, it is only practiced in 25. In some countries, tax rules make shorting very difficult. In Chile, for instance, although short selling and securities lending have been possible since 1999, they are rarely used because lending is considered an immediate, taxable sale. Given that there is no sale price, the relevant price is the highest price of the stock on the day it is lent; if it is higher than the purchase price, capital gains tax will apply. In Turkey, stock lending is treated as a normal transaction by the tax authorities, and as such it is liable to capital gains tax where applicable. In Finland, transfer laws also place a serious burden on this activity. In the Philippines short selling is allowed, but the rules are not yet clearly defined. In Thailand, evidence of the practice is unclear. Regulators in that country believe that short selling is not practiced because the market for borrowing stock is very narrow, especially on the supply side, due to the absence of a futures market.

Note that some other features of short selling practices throughout the world are relevant for our purposes. In some markets only the largest and most liquid stocks may be shorted. Until 1996, Hong Kong only allowed short sales in securities specifically designated by the Hong Kong Exchanges and Clearing Ltd. A similar rule currently operates in Greece. More objective criteria are found in Poland, where any security with a market capitalization of at least 250 million zlotys qualifies. We adopt the convention of classifying Hong Kong as a country in which short selling is allowed only as of 1996, even though it

[9] In Malaysia, the Securities Commission issued the Guidelines on Securities Borrowing and Lending in December 1995, and the Securities Industry Act of 1993 was amended to allow short sales. The regulatory changes came into force on March 7, 1996, and allowed the local exchange—the Kuala Lumpur Stock Exchange—to enact short selling rules. Regulated short selling commenced on September 30, 1996. However, on August 28, 1997, with the onset of the Asian financial crises, these activities were suspended as interim measures to prevent excessive volatility in the markets. In February 2001 the Securities Commission launched the Capital Market Masterplan, which recommended the reintroduction of short selling and securities lending activities.

In Hong Kong, short selling was prohibited before January 3, 1994. The SEHK then allowed 17 out of the 33 constituent stocks of the Hang Seng Index (HSI) to be sold short subject to several restrictions. These restrictions were lifted on March 25, 1996 at the same time that 113 of the firms listed on the exchange, including all the constituent stocks of the index, were allowed to be sold short.

In Thailand, the Securities Exchange Commission first enforced short sales regulations in July 1997, suspending them because of the currency crises. Beginning on January 1, 1998, short sales were allowed again in the Thai capital market, through financial institutions licensed to operate securities borrowing and lending (SBL) business. The practice of short selling has increased gradually: In 1999 there were only three securities companies licensed to operate SBL. Although ISL and GND characterize Thailand as a country in which short sales are a common practice, market regulators were aware of only one transaction since 1997, apart from "mistaken" transactions effected by brokers.

was allowed for a subset of stocks beginning in 1994. For Poland and Greece, GNM reports that short selling is not practiced.

We also regard short selling as allowed and practiced in a country even if some investors are prohibited from entering into these transactions. In Sweden, for example, traders can go short without having borrowed the shares in advance,[10] while individual investors must borrow the shares before they go short. In Greece prior to 2001, short selling was only available to the members of the Athens Derivatives Exchange. Some countries only impose short sales restrictions on foreign investors. In Brazil, for instance, a short seller must have a domestic legal representative. Taiwan is a special case in our sample. In Taiwan, foreign and institutional investors are prohibited from shorting, and individuals can only short upon special authorization by the Ministry of Finance. In addition, the up-tick rule is enforced. Thus, we classify Taiwan as a market in which short sales are allowed but not practiced.[11] It is fair to say that for every country in our sample, there exists a unique constellation of laws, regulations, institutional norms, and fine print governing the ability to take and maintain a short position in a stock. Our challenge in this paper is to categorize the countries in economically meaningful ways.

Although the actual practice of short selling depends upon a market's laws, regulations, frictions, and costs, we are initially forced to reduce these complexities to a single dimension for purposes of analysis. Specifically, we begin by classifying countries in our sample into four groups, depending on whether short selling is legal and practiced. In the first group, we have the countries in which short selling became legal some time before 1990 and in which short selling is currently practiced. This group comprises Australia, Austria, Belgium, Canada, Czech Republic,[12] Denmark, France, Germany, Ireland, Italy, Japan, Luxembourg, Mexico, Netherlands, Portugal, Singapore, South Africa, Switzerland, the United Kingdom, and the United States. The second group consists of countries in which short sales were prohibited as of December 2001. These are China, Colombia, Greece, Indonesia, Pakistan, Peru, South Korea, Venezuela, and Zimbabwe. The third group comprises countries or markets in which short selling is allowed but rarely practiced, that is, Argentina, Brazil, Chile, Finland, Hungary, Israel, New Zealand, the Philippines, Poland, Spain,[13] Taiwan, and Turkey. Finally, the remaining five countries—Hong Kong, Norway, Sweden, Malaysia, and Thailand—comprise a group for which short sales regulation and practice changed sometime between January 1990 and December 2001. Our empirical work then reduces these four groups to a binary variable for a country at a given point in time.

[10] They must borrow the stock before the end of the day, however.

[11] We reestimate our regressions including Taiwan as a market in which short sales are allowed and practiced. There is no qualitative change in our results.

[12] The Prague Stock Exchange was established on November 1992, and the automated trading system started operations in January 1993. We include the Czech Republic in the group of countries in which short selling is allowed and practiced, although we only have data on Czech firms since 1993.

[13] Chile made short selling legal only in 2000, but there is no current practice. Spain legalized short selling in 1992, but only securities lending facilities are common among institutions, as a way of facilitating hedging strategies.

Of course, this classification misses the nuances of expenses and risks that potentially characterize differences in short selling across international markets. In the next section, we describe how we further classify stocks within a country into shortable and nonshortable categories, even in the cases in which short sales are not allowed or not practiced.

III. Equity Market Data and Sources

The international return, volume, and issue data for the 46 markets in our study come from Datastream and Worldscope, and our U.S. data come from CRSP. Prices and returns are measured in local currency. We construct value-weighted market indices for each country in the sample. It is important to note that the number of firms per country varies across years, and thus the volatility of the market index might vary with time as a consequence, since there are typically fewer constituent firms in the indices for some countries in the earlier years of the sample.[14] For this reason we estimate a year-fixed effects model in most of our statistical analysis.

We obtain accounting data from Worldscope for non-U.S. firms and from Compustat for U.S. firms. We also obtain country information from the Economist Intelligence Unit database and from the World Bank. In particular, we characterize each country in our sample by its geographical size, GDP per capita, and variance of GDP growth. Finally, following Mørck, Yeung, and Yu (MYY) (2000), we construct an index of good governance, which we calculate as the sum of the indices of corruption, the risk of government repudiation of contracts, and the risk of expropriation of private property (La Porta et al. (1997)).

IV. Foreign Listing and Short Selling

The classification of countries into two categories, category 1 and category 2, is not perfect. Even when short sales are either not allowed or not practiced, some stocks in a country can still be shorted. A good example is that of Nokia, which represents about two-thirds of the total market capitalization of the Helsinki Stock Exchange (HEX) in 2001. According to our data, Finland is a country in which short sales are not practiced. However, Nokia has been listed on the New York Stock Exchange since July 1, 1994. These Nokia depository receipts can be shorted, although only in the United States.[15] Thus, taking into account shares that list abroad, the shortable percentage of the Finnish market is 70.29% on average between 1999 and 2001 (see Table II). Hence, these shortable components of national exchanges must be considered when examining the effects of short sales restrictions on markets.

[14] Datastream has acceptable coverage only after 1995.

[15] Indeed, there are five Finnish companies in our database that list in the United States: Nokia (direct listing in NYSE since July 1, 1994), Metso Corporation (direct listing in NYSE since July 1, 1999), Stora Enso Oyj (ADR in NYSE since September 1, 2000), UPM-Kymmeny (ADR in NYSE since June 29, 1999), and Instrumentarium Corporation (ADR in Nasdaq since August 18, 1983).

Table II

World Market Capitalization and Short Sales Retrictions. Countries in Which Short Sales Are Not Allowed/Not Practiced

This table classifies the World Market capitalization into shortable and nonshortable stocks, for countries in which short sales are not allowed or not practiced. Market Capitalization is in US$ millions. To calculate the numbers in these columns we have taken into account firms in countries in which short sales are not allowed or not practiced, and that list in markets in which short sales are allowed and practiced, in particular the United States (NYSE and Nasdaq) and the United Kingdom (LSE). Pakistan, Venezuela, and Zimbabwe are not included in the table because we do not have data available on dual-listed firms from these countries.

		1990–1993	1994–1998	1999–2001
	Shortable	$158,923	$933,524	$1991,153
	Nonshortable	$407,657	$2,812,947	$3,573,801
All Countries	Ratio	28.05%	24.92%	35.78%
Argentina	Shortable	$810	$102,431	$62,115
	Nonshortable	$22,995	$154,631	$61,188
	Ratio	3.40%	39.85%	50.38%
Brazil	Shortable	NA	$2,385	$41,217
	Nonshortable	NA	$168,610	$565,240
	Ratio		1.40%	6.80%
Chile	Shortable	NA	$8,303	$892
	Nonshortable	NA	$3,576	$37
	Ratio		69.90%	96.01%
China	Shortable	NA	$8,303	$892
	Nonshortable	NA	$628,297	$1,435,108
	Ratio		1.30%	0.06%
Colombia	Shortable	NA	$14,220	$582
	Nonshortable	NA	$68,272	$20,787
	Ratio		17.24%	2.72%
Finland	Shortable	$253	$82,214	$571,223
	Nonshortable	$53,510	$224,591	$241,469
	Ratio	0.47%	26.80%	70.29%
Greece	Shortable	NA	$1,361	$51,348
	Nonshortable	NA	$48,946	$238,443
	Ratio		2.71%	17.72%
Hungary	Shortable	NA	$2,296	$2,343
	Nonshortable	NA	$26,582	$43,094
	Ratio		7.95%	5.16%
Indonesia	Shortable	NA	NA	$66,660
	Nonshortable	NA	NA	$316,465
	Ratio			17.40%
Israel	Shortable	$2,110	$24,733	$34,194
	Nonshortable	$18,923	$91,540	$102,163
	Ratio	10.03%	21.27%	25.08%
New Zealand	Shortable	$10,176	$46,808	$21,588
	Nonshortable	$20,497	$112,522	$60,186
	Ratio	33.18%	29.38%	26.40%
Peru	Shortable	NA	$4,113	$2,373
	Nonshortable	NA	$29,743	$20,307
	Ratio		12.15%	10.46%

(*continued*)

Table II—*Continued*

		1990–1993	1994–1998	1999–2001
	Shortable	$158,923	$933,524	$1,991,153
	Nonshortable	$407,657	$2,812,947	$3,573,801
All Countries	Ratio	28.05%	24.92%	35.78%
Philippines	Shortable	NA	$18,807	$9,737
	Nonshortable	NA	$230,701	$84,146
	Ratio		7.54%	10.37%
Poland	Shortable	NA	$985	$34,243
	Nonshortable	NA	$8,612	$50,643
	Ratio		10.26%	40.34%
South Korea	Shortable	NA	$209,350	$329,457
	Nonshortable	NA	$313,001	$271,694
	Ratio		40.08%	54.80%
Spain	Shortable	$145,574	$375,643	$562,408
	Nonshortable	$291,732	$665,280	$646,334
	Ratio	33.29%	36.09%	46.53%
Taiwan	Shortable	NA	$39,015	$199,381
	Nonshortable	NA	$600,307	$663,270
	Ratio		6.10%	23.11%
Turkey	Shortable	NA	$859	$1,393
	Nonshortable	NA	$66,035	$188,332
	Ratio		1.28%	0.73%

We compile data on non-U.S. companies that list in NYSE, NASDAQ, and the LSE. We obtain data on U.S. listings directly from the NYSE.[16] Data for the London Stock Exchange comes from the Exchange's website. We obtain the date of the first listing of each foreign firm in these markets via direct listing (IPO), ADRs (in the United States), and GDRs (in the United Kingdom). We also obtain from Datastream stock market information about all firms listed in the 46 countries in our database. Bris, Goetzmann, and Zhu (2004) show, using the same data set, that without taking foreign listings into consideration, the shortable percentage of the world market capitalization varies between 89.35% in 1994 and 94.15% in 1999. When foreign listings are included, they show that up to 96.29% of the world market is shortable as of 2002. The numbers are very similar even when the authors exclude the U.S. markets from the calculations.

In Table II, we specifically consider the countries in which short sales are not allowed or not practiced, but in which there are firms that list in a U.S. or U.K. market. The table illustrates the changing importance of cross listings over time. The aggregate percentage of shortable capitalization via depository receipts for all short sales-restricted countries shows a moderate but significant increase from 28% in 1990 to 1993 to 36% in 1999 to 2001. However, in some countries the shortable capitalization is considerable: in Argentina, Finland, and South Korea, more than 50% of the market is shortable via cross-border

[16] We thank Gustavo Rodríguez from the NYSE for providing us with these data.

listings in the 1999 to 2001 period. In Argentina, the percentage of the shortable market capitalization increases from 3% in the 1990 to 1993 period, to 50% in the 1999 to 2001 period.

Our final sample of countries and regulations includes 46 markets. Within each market, we classify stocks into two groups depending on whether the stocks are dual-listed or not. In countries in which short sales are not allowed or not practiced, the dual-listed stocks constitute a group of stocks that are actually shortable. By analyzing the differences between domestic (stocks without a foreign listing) and dual-listed stocks in the domestic market, and by comparing these differences with the control sample of stocks in countries in which short sales are allowed and practiced, we are able to identify the effect of short selling restrictions on the variables of interest.

For simplicity, in the remainder of the paper we refer to *dual-listed stocks* as the group of stocks within a country that list abroad. Obviously, these are always shortable stocks, and we analyze the price behavior of these stocks in the domestic market. That is, the relevant price that we study is the price of the dual-listed stock in the domestic market.[17] We compute value-weighted market returns for each subgroup of stocks within a country and year. Thus, we have two market returns in each country[18] if there are dual-listed stocks. We refer to stocks without a foreign listing as *domestic stocks*. These are shortable only in countries in which short sales are allowed. Table III shows the descriptive statistics of the variables we use for each of the four groups of stocks in the sample. In the cross-sectional regressions below, we only use groups of firms for which the number of observations is at least five firms.

V. Short Sales Restrictions and the Efficiency of Stock Prices

A. Measures of Price Efficiency

The first question in our analysis is whether short sales restrictions play a role in efficient price discovery. The key implication of Diamond and Verrecchia (1987) is that short sales constraints impede the market's ability to rapidly impound value-relevant information. As the voluminous literature on efficient market theory suggests, there is no universal test for relative market efficiency, although event studies and filter rules have a long history of application. An important recent contribution to the literature on market efficiency is MYY's observation that more efficient markets can be expected to have more idiosyncratic risk, since the ratio of firm-specific information to market-level information is likely to be higher in informational environments that allow market participants to acquire information and act quickly and inexpensively upon it. MYY examine international differences in the degree of co-movement in stock prices across countries around the world, and find that

[17] In cases in which the dual-listed stock is also a dual-class stock in the domestic market, we consider only the share class with cash flow rights, irrespective of which class is dual-listed.

[18] Our results do not change if we estimate our regressions using the overall market index (one index per country, not two).

Table III

Descriptive Statistics

Mean and Median values of the variables used in the paper, classified by Domestic/Dual-listed stocks, as well as by Short Sales Regulation. For each country in our sample, for every year T, and for Domestic and Dual-Listed Stocks, we calculate the R^2 in two modified market regressions of individual stock returns on the domestic market index, and the world market index, where we use only either positive or negative market returns. We then compute the corresponding R^2 coefficients, R^{2+}_{ijTD} and R^{2-}_{ijTD}, and average the R^2s for each country j, year T, and group D. We also compute the difference $R^{2Diff}_{jTD} = R^{2+}_{jTD} - R^{2+}_{jTD}$, as well as the R^2 in a standard market regression (irrespective of the sign of the market return). Market Skewness is the skewness of $\log(1+r)$, where r denotes market returns. We calculate skewness for each country and year. We compute cross-autocorrelations between 1-week lagged market returns and individual stock returns. In particular, we calculate $\rho^{+}_{ijTD} = \text{corr}(r_{ijt}, r^{+}_{mjt-1})$ and $\rho^{-}_{ijTD} = \text{corr}(r_{ijt}, r^{-}_{mjt-1})$, where r^{+}_{mj} equals the market return when it is either positive or zero, and r^{-}_{mj} equals the market return when it is negative for all stocks i in group D and country j, using weekly observations in each year T. We then average the cross-autocorrelations across stocks and calculate $\rho^{Diff}_{jTD} = \rho^{-}_{ijTD} - \rho^{+}_{jTD}$. To compute the frequency of extreme returns, for each firm and year, we calculate the mean and standard deviation of returns, and calculate the number of days for which the return is below the average return, minus two standard deviations. We aggregate this number by group, country, and year, and divide by the total number of firm-days in the year with available stock price information. The sample includes firms from 46 countries with stock price information available from Datastream and CRSP. All variables are defined in the paper. Test of differences are nonparametric Kruskal-Wallis tests. *P*-values are in parentheses.

	R-Squared	Upside *R*-Squared	Downside *R*-Squared	Difference Downside Minus Upside	Cross-Auto-correlation	Upside Cross-Auto-correlation	Downside Cross-Auto-correlation	Difference Downside Minus Upside	Frequency of Extreme Negative Returns	Market Skewness	Mean Skewness of Individual Stock Returns	Mean Skewness of Individual Residual Returns	Market Turnover (Detrended)	Market Return
Domestic Stocks														
Short Sales Not Allowed / Not Practiced														
Number of observations	258	258	258	258	258	258	256	256	259	258	258	258	257	259
Mean	19.38%	12.73%	14.57%	1.84%	3.66%	2.89%	4.51%	1.61%	8.58%	0.0854	0.1142	0.0517	0.0922	12.41%
Median	16.99%	11.33%	12.14%	1.17%	3.48%	3.06%	4.92%	1.79%	6.17%	0.1201	0.0863	0.0307	−0.2008	9.90%
Short Sales Allowed and Practiced														
Number of observations	277	277	277	277	277	277	276	276	277	277	277	277	273	277
Mean	12.87%	9.09%	11.26%	2.17%	2.69%	2.03%	3.36%	1.34%	6.00%	−0.0585	0.0472	0.0357	0.1196	12.16%
Median	9.74%	7.28%	8.88%	2.08%	2.49%	2.04%	3.10%	1.11%	4.93%	−0.0479	0.0561	0.0435	−0.0768	9.78%
Difference (*p*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0053)	(0.0854)	(0.9690)	(0.0496)	(0.6012)	(0.0001)	(0.0041)	(0.0976)	(0.8058)	(0.5522)	(0.6486)
Whole Sample														
Number of observations	535	535	535	535	535	535	532	532	536	535	535	535	530	536
Mean	16.01%	10.85%	12.85%	2.01%	3.16%	2.44%	3.91%	1.47%	7.25%	0.0109	0.0795	0.0434	0.1063	12.28%
Median	13.35%	9.07%	10.56%	1.73%	2.94%	2.44%	3.92%	1.38%	5.41%	0.0152	0.0672	0.0394	−0.1526	9.84%
Dual-Listed Stocks														
Short Sales Not Allowed / Not Practiced														
Number of observations	113	113	113	113	161	161	160	160	161	160	160	160	154	161
Mean	39.75%	31.44%	31.76%	0.32%	2.86%	3.51%	2.24%	1.30%	7.95%	0.0271	0.0387	−0.0343	−0.2488	8.63%
Median	39.03%	28.28%	27.04%	0.26%	2.34%	3.65%	2.93%	1.71%	2.55%	0.0857	0.0886	−0.0129	−0.4071	5.30%
Short Sales Allowed and Practiced														
Number of observations	186	186	186	186	216	216	216	216	216	228	216	216	185	228
Mean	30.75%	22.29%	24.10%	1.81%	1.91%	3.02%	0.79%	2.23%	6.31%	−0.0313	−0.0037	0.0168	−0.1097	11.15%
Median	27.34%	19.08%	19.95%	2.26%	1.87%	3.14%	0.41%	3.07%	2.68%	−0.0505	0.0163	0.0078	−0.3943	11.40%
Difference (*p*-value)	(0.0000)	(0.0001)	(0.0000)	(0.2124)	(0.6953)	(0.1759)	(0.5505)	(0.2211)	(0.0678)	(0.0077)	(0.0255)	(0.8757)	(0.2061)	(0.4639)

(*continued*)

Table III—*Continued*

	R-Squared	Upside *R*-Squared	Downside *R*-Squared	Difference Downside Minus Upside	Cross-Auto-correlation	Upside Cross-Auto-correlation	Downside Cross-Auto-correlation	Difference Downside Minus Upside	Frequency of Extreme Negative Returns	Market Skewness	Mean Skewness of Individual Stock Returns	Mean Skewness of Individual Residual Returns	Market Turnover (Detrended)	Market Return
						Dual-Listed Stocks								
Whole Sample														
Number of observations	299	299	299	299	377	377	376	376	377	388	376	376	339	389
Mean	34.15%	25.74%	26.99%	1.25%	2.31%	3.23%	1.41%	1.83%	7.01%	−0.0072	0.0144	−0.0049	−0.1729	10.11%
Median	32.08%	21.52%	22.46%	1.44%	2.00%	3.27%	1.05%	2.28%	2.68%	0.0118	0.0443	0.0023	−0.4047	8.34%
Short sales not allowed/ not practiced: Difference dual-listed stocks–domestic stocks	(0.0000)	(0.0000)	(0.0000)	(0.2126)	(0.0000)	(0.0000)	(0.2645)	(0.7718)	(0.0000)	(0.9953)	(0.8233)	(0.4396)	(0.0000)	(0.5287)
Short sales allowed and practiced: difference dual-listed stocks–domestic stocks	(0.0000)	(0.0000)	(0.0000)	(0.0217)	(0.0000)	(0.1207)	(0.5401)	(0.0908)	(0.0000)	(0.8793)	(0.1053)	(0.6273)	(0.0036)	(0.8330)
Whole sample: difference dual-listed stocks–domestic stocks	(0.0310)	(0.7332)	(0.5321)	(0.5946)	(0.0000)	(0.0001)	(0.2723)	(0.6398)	(0.0000)	(0.9493)	(0.2474)	(0.4253)	(0.0000)	(0.9046)
Whole sample: difference short sales allowed–prohibited	(0.0000)	(0.0000)	(0.0000)	(0.0077)	(0.0000)	(0.0000)	(0.0000)	(0.1119)	(0.0530)	(0.0001)	(0.0048)	(0.9273)	(0.3159)	(0.4357)

the ratio of idiosyncratic risk in relatively developed markets is higher than in markets that are commonly viewed as less developed, particularly emerging markets.

Our approach differs econometrically from MYY in that we exploit the potential asymmetry in price adjustments under short sales constraints. The MYY measure looks at the efficiency of price moves in both directions. However, if only the price adjustment to bad news is constrained, one would expect idiosyncratic risk to be smaller when market returns are negative, and in particular, in regimes in which short sales are either prohibited or not practiced. The cross-sectional difference in the market efficiency measure can be partly ascribed to differences in country characteristics, including market liberalization and integration. However, such characteristics should not be able to explain why the market efficiency difference is larger for negative market returns than for positive returns. Such a separate measure of market efficiency provides opportunities to test the proposition in Diamond and Verrecchia (1987) that short sales constraints hinder efficiency especially for negative information.

The MYY measures compute the amount of private information incorporated into prices, but not the timing of the price adjustment. Recent work by Hou and Moskowitz (2004) suggests that efficiency can be modeled as a delay in price adjustments. We also measure the speed of individual stock price adjustments to market movements by calculating the cross-autocorrelation between the lagged market return and individual stock returns. In the presence of short sales restrictions, Diamond and Verrecchia (1987) predict that prices will adjust slowly to negative market news. Hong, Lim, and Stein (2000) do not empirically reject the hypothesis that short sales constraints explain the differential reaction of stocks to bad versus good news. They recognize that, in their setting, it is difficult to quantify the magnitude of short sales constraints. Because we have a rich sample of countries with and without restrictions, the difference between downside (negative market return) and upside (positive market return) cross-autocorrelations depending on these prohibitions provides some direct evidence that short sales constraints slow downside price discovery.

B. Computation

B.1. R^2

MYY compute the R^2 for regressions of the form

$$r_{ijt} = \alpha_{ij} + \beta_i^M \times r_{mjt} + \beta_i^W \times r_{wt} + \varepsilon_{ijt}. \tag{1}$$

That is, they regress weekly stock returns on the value-weighted market return and a value-weighted world index for every firm i and in every year t, where week t belongs to year T. This approach is similar to that in Hou and Moskowitz (2004), who estimate regression (1) with different lags on the market return. We calculate two separate measures of individual security co-movement. Let r_{mt}^+ equal the market return when it is either positive or zero, and let r_{mt}^- equal the market return when it is negative. Following MYY, for each country in our

sample, for every year T, and for domestic and dual-listed stocks, we calculate the R^2 in the following two modified regressions:

$$r_{ijt} = \alpha_{ij} + \beta_i^M \times r_{mjt}^+ + \beta_i^W \times r_{wt} + \varepsilon_{ijt} \tag{2}$$

$$r_{ijt} = \alpha_{ij} + \beta_i^M \times r_{mjt}^- + \beta_i^W \times r_{wt} + \varepsilon_{Ijt}. \tag{3}$$

We compute the corresponding R^2 coefficients, R_{ijTD}^{2+} and R_{ijTD}^{2-} respectively, using weekly data for every week t in year T. The subscript D indicates whether the R^2 is calculated for domestic or dual-listed stocks within a country. The market return is value-weighted using data on market capitalization from Datastream and Worldscope. We then average the R^2s for each country j, year T, and group D as in MYY:

$$R_{jTD}^{2+} = \frac{\sum_i R_{ijTD}^{2+} \times SST_{ijTD}}{\sum_i SST_{ijTD}},\ R_{jTD}^{2-} = \frac{\sum_i R_{ijTD}^{2-} \times SST_{ijTD}}{\sum_i SST_{ijTD}}, \tag{4}$$

where SST is the sum of squares in the corresponding regression.

We measure asymmetries by computing the difference $R_{jTD}^{2Diff} = R_{jTD}^{2-} - R_{jTD}^{2+}$. Note that all confounding factors that affect both the upside and the downside fraction of idiosyncratic risk are taken care of in the downside-minus-upside R^2. Finally, and for comparison with MYY, we also compute the total R^2, R_{jTD}^2, from individual stock regressions according to (1).

If short sales restrictions impede the incorporation of negative information into prices, the downside R^2 should decrease more when short sales are allowed and practiced in a country. We propose a simple econometric model in the appendix that shows formally how this can happen. In the model, individual stock returns are determined by a factor model, where the only factor is the market. When short sales are restricted, stock returns respond immediately to positive market information, but they incorporate the current market news only partly if the market return is negative. Therefore, the observed market return also incorporates both current and past market news, if the news is negative. A regression of individual stock returns on the observed market returns, conditional on the sign of the market return, yields a higher downside R^2 the slower market news is incorporated into individual stock prices. The model also shows that the upside R^2 is affected as well by short sales restrictions. Therefore the difference R_{jTD}^{2Diff} drops when short sales are allowed.

In Table III, we report that the average total R^2 is 19.38% when short sales are not practiced, and 12.87% when short sales are allowed (the difference is statistically significant at the 1% level), for domestic stocks. This is consistent with the level of idiosyncratic risk being lower when shorting is prohibited. However, such an effect may depend on some country-specific factors. In general, the downside R^2 is larger than the upside R^2, which is consistent with Hong et al. (2000). We also find significantly smaller coefficients for the

upside and downside R^2 (9.09% and 11.26% vs. 12.73% and 14.57%, respectively, both significant at the 1% level), for domestic stocks. Results are similar, although weaker, for dual-listed stocks. The downside-minus-upside R^2 is also significantly lower when short sales are allowed in domestic stocks, which is inconsistent with the market being more efficient when shorting is possible. However, this does not take into account either the differences across countries or time effects. There is no significant difference in the downside-minus-upside R^2 in dual-listed stocks.

B.2. Cross-Autocorrelation

As an alternative proxy for price efficiency, we compute cross-autocorrelations between market returns lagged 1 week and individual stock returns. In particular, we calculate $\rho^{+}_{ijTD} = \text{corr}(r_{ijt}, r^{+}_{mjt-1})$ and $\rho^{-}_{ijTD} = \text{corr}(r_{ijt}, r^{-}_{mjt-1})$ for all stocks i in group D and country j, using weekly observations in each year T. We then average the cross-autocorrelations across stocks and calculate

$$\rho^{+}_{jTD} = \frac{\sum_{i} \rho^{+}_{ijTD}}{N_{jTD}}, \quad \rho^{-}_{jTD} = \frac{\sum_{i} \rho^{-}_{ijTD}}{N_{jTD}}, \quad \rho^{Diff}_{jTD} = \rho^{-}_{jTD} - \rho^{+}_{jTD}. \tag{5}$$

The cross-autocorrelations are equivalent to estimating regression coefficients of individual stock returns on lagged market returns, as in Hou and Moskowitz (2004). They compare the R^2 of a regression of returns on lagged market returns, with the R^2 of a regression of returns on the contemporaneous market return. The larger the difference, the larger the price delay. The cross-autocorrelation coefficient is an alternative way of standardizing the same measure. With respect to our choice of a 1-week price delay, Hou and Moskowitz (2004) argue that the price delay is best measured on a weekly basis, as there is little variation at the monthly level and too much noise at the daily level. Note that such a measure of price delay has additional explanatory power for cross-sectional returns over traditional factors.

In Table III, we report the total cross-autocorrelation (i.e., irrespective of the sign of the market return), the downside cross-autocorrelation, the upside cross-autocorrelation, and the difference in cross-autocorrelation classified by the short sales regime for domestic and dual-listed stocks. The total cross-autocorrelation is smaller when short sales are allowed (from 3.66% to 2.69% on average, a significant difference at the 10% level), and is significantly lower for dual-listed stocks. This result is consistent with the hypothesis that price discovery is faster for dual-listed stocks (Foerster and Karolyi (1999)), or when a market friction is removed (Hou and Moskowitz (2004)). Consistent with intuition, the downside cross-autocorrelation is larger than the upside cross-autocorrelation. The downside cross-autocorrelation is smaller for domestic stocks when short sales are allowed (significant difference at the 5% level), while there is no significant differential for the upside cross-autocorrelation. Although the downside-minus-upside cross-autocorrelation declines (from 1.61% to 1.34%), the decline is not significantly

different from zero. Regarding dual-listed stocks, we do not find any significant pattern.

C. Multivariate Tests

C.1. R^2

MYY find that developing economies display significantly higher levels of co-movement than more developed ones. In particular, they find that co-movement is explained in the cross section by GDP per capita. They provide several hypotheses as to why this can happen, and show that, when interacted with an index of good governance, the significance of GDP per capita disappears.

One potentially important explanation for such a pattern is that smaller countries have less-diversified stock markets. To address this issue, MYY use country-level and industry-level Herfindahl indices. The former captures cross-industry concentration based upon sales, and the latter captures average within-industry concentration based upon sales. We construct the same measures for the countries in our sample. Liquidity also determines the ability to short a stock. As trading gets cheaper, it is more profitable to invest in the acquisition of fundamental information about individual stocks. Because obtaining measures of liquidity for emerging markets is difficult, we use the simple method described in Bekaert, Harvey, and Lundblad (2005) and measure liquidity as the percentage of returns in a country that are zero. We then compute the frequency of zero returns for each group of stocks (domestic and ADR) for each country-year.

In our analysis, we replicate as closely as possible the estimation and control variables used in MYY, adding a short sales indicator variable. We construct indices of industry concentration (by industry and country, as described in their paper), indices of earnings co-movement, and indices of liquidity,[19] and then calculate the number of listed firms in each country-year. The short sales indicator is a dummy variable that equals 1 whenever short selling is allowed and practiced in a given country-year, and zero otherwise. If a country changed its regulation in a given year, we eliminate that observation from the sample. We also construct two ADR dummies: $ADR0$ equals 1 if the observation corresponds to dual-listed stocks in countries in which short sales are not allowed or not practiced, and zero otherwise, and $ADR1$ equals 1 if the observation corresponds to dual-listed stocks in countries in which short sales are allowed and practiced, and zero otherwise. Because dual-listed stocks in countries in which short sales are prohibited are shortable, we expect $ADR0$ to display a significant coefficient. Because dual-listed stocks in countries in which short sales are practiced are not different from domestic stocks in terms of the possibility

[19] Since we replicate the procedure in MYY, we do not provide details on how most of these variables are computed. For our measure of liquidity, we use the simple method described in Bekaert, Harvey, and Lundblad (2005) and measure liquidity as the percentage of returns in a country that are zero.

of being shorted, we expect the coefficient of *ADR*1 to be insignificant. Finally, because listing abroad has different implications in countries in which short sales are prohibited and not practiced, relative to countries in which short sales are allowed and practiced, we expect the coefficients of *ADR*0 and *ADR*1 to be statistically different. Figure 2 summarizes the interpretation of our dummy variables under the null hypothesis that short sales restrictions reduce market efficiency.

Our final panel with complete data includes 668 observations. The earnings co-movement index is available for only a subset of countries. When we use it, the number of observations is reduced to 375. We estimate the model with

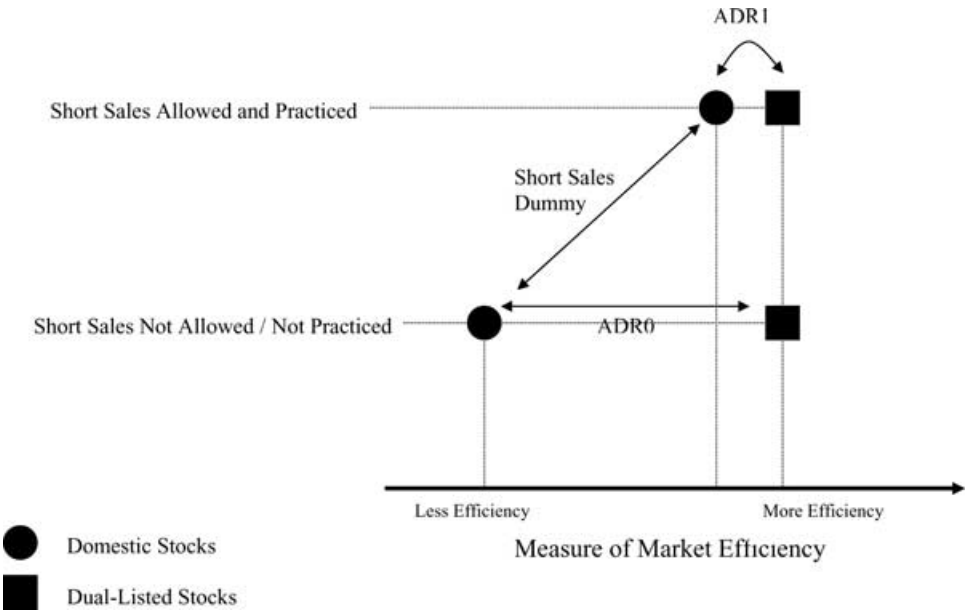

Figure 2. Interactions among dummy variables. The graph shows the expected effect of the dummy variables in the panel estimation under the assumption that removing short sales restrictions improves market efficiency. Irrespective of short-sales restrictions, dual-listed stocks are shortable, and then efficiently priced. However, domestic stocks in countries where short sales are prohibited/not practiced, are not shortable, and hence not efficiently priced. Short Sales Dummy is a variable that equals 1 when short selling is allowed and practiced in the corresponding country and year, and zero otherwise. *ADR*0 equals 1 if the observation corresponds to dual-listed stocks in countries where short sales are not allowed or practiced, and zero otherwise. *ADR*1 equals 1 if the observation corresponds to dual-listed stocks in countries where short sales are allowed and practiced, and zero otherwise. The base case consists of the domestic stocks in countries where short sales are not allowed/not practiced. *ADR*0 and *ADR*1 capture the differences in efficiency between dual-listed stocks and domestic stocks, in countries where short sales are not allowed/not practiced, and in countries where short sales are allowed and practiced, respectively. The short sales dummy then captures the difference between domestic stocks in countries where short sales are allowed and practiced and domestic stocks in countries where short sales are not allowed/not practiced. Under the null hypothesis, the short sales dummy and *ADR*0 should be significantly different from zero, and *ADR*1 should be insignificant.

year-fixed effects and country-fixed effects when possible. We control for several country- and year-specific factors, such as GDP per capita, country and industry Herfindahl indices, and the earnings co-movement index. We also control for time-invariant variables, such as the geographical size of the country, the variance in GDP growth, and the good governance index. In these cases, we estimate the regressions with country-random effects.[20] As in MYY, the dependent variable is transformed into a continuous variable over the range $[-\infty, +\infty]$.[21] We report the results of the estimation in Table IV. Standard errors are adjusted for heteroskedasticity.

The first two regressions in Table IV confirm the MYY findings. However, cross-sectional differences can still proxy for other nonobservable country-specific characteristics. The decomposition of R^2 into upside and downside market movements allows us to control for those unobservable factors. In the last two panels of Table IV we identify a significant decline in both the downside and the upside R^2 coefficients when short sales are allowed and practiced. This is consistent with an overall increase in idiosyncratic risk when shorting prohibitions are removed. We do not find a significant incremental effect of dual-listed stocks in countries in which short sales are prohibited, while in general the two R^2 coefficients are larger for dual-listed stocks in countries in which short sales are allowed. This evidence is consistent with Foerster and Karolyi (1999), who show that dual-listed stocks suffer an order flow migration from the domestic market to the foreign market. Thus, we should expect domestic returns of dual-listed stocks to be less efficient.

The effect of short sales on the downside R^2 is larger in magnitude than for the upside R^2. Short sales are associated with a decline of 0.35 standard deviations in the downside R^2,[22] and 0.30 standard deviations in the upside R^2. Consistent with Diamond and Verrecchia (1987), we find a positive relationship between the downside-minus-upside R^2 and short sales restrictions. Without short sales restrictions the difference in R^2 is 0.19 standard deviations lower (based on model I). The short sales dummy is significant in all models but one.

The effect of short sales on the difference between the downside and the upside R^2 is statistically significant only at the 10% level. Allowing short sales reduces the difference by 9.5%. Therefore, shorting increases efficiency, but the evidence based on R^2 is not too strong.

Dual listing is associated with a reduction in the downside-minus-upside R^2 of 0.34 and 0.24 standard deviations in countries in which short sales are

[20] We do not report estimates of the random-effect models because the results are qualitatively similar.

[21] The transformed R^2 is calculated as $R^{2*} = \log \frac{R^2}{1-R^2}$. Therefore, the downside-minus-upside R^2 varies between $-\infty$ and $+\infty$ as well. Results in cross-sectional regressions are similar if we do not apply the transformation.

[22] To calculate the economic significance, we multiply the corresponding coefficient times the standard deviation of the corresponding variable, and divide by the standard deviation of the dependent variable. To calculate the economic significance of a dummy variable, we do not multiply by its standard deviation.

Table IV
R^2

For each country in our sample, for every year T, and for Domestic and Dual-Listed Stocks, we calculate the R^2 in two modified market regressions of individual stock returns on the domestic market index, and the world market index, where we use only either positive or negative market returns. We then compute the corresponding R^2 coefficients, R^{2+}_{ijTD} and R^{2-}_{ijTD}, and average the R^2s for each country j and for every year T and group D. We also compute the difference $R^{2Diff}_{jTD} = R^{2-}_{jTD} - R^{2+}_{jTD}$, as well as the R^2 in a standard market regressions of individual stock returns on the domestic market index (irrespective of its sign), and the world market index. We transform the R^2 coefficients using the transformation $R^{2*} = \log \frac{R^2}{1-R^2}$. The percent of zero returns is the average number of days a stock has a zero return, divided by the number of days in the year with available return data, averaged across stocks in a given group, country, and year. The number of firms is the number of firms with available stock price data in Datastream, in each country and year. Country Herfindahl index is calculated as the sum of the market shares (squared) of every firm in each country and year, relative to the corresponding country's total sales. Industry Herfindahl index is calculated as the sum of the market shares (squared) of every industry in each country and year, relative to the corresponding country's total sales. The size of the country is the extension of a country in square kilometers, from www.yahoo.com. The earnings co-movement index is calculated as in Mørck et al. (2000). The Good Governance index is the sum of the Risk of Expropriation, Corruption, and Repudiation of Contract indices from La Porta et al. (1997). The Short Selling variable is a dummy variable that equals 1 when short selling is allowed and practiced in a given country and year, zero otherwise. *ADR*0 equals 1 if the observation corresponds to Dual-Listed Stocks in countries in which short sales are not allowed/not practiced, zero otherwise. *ADR*1 equals 1 if the observation corresponds to Dual-Listed Stocks in countries in which short sales are allowed and practiced, zero otherwise. The sample includes firms from 46 countries with stock price information available from Datastream. Macroeconomic variables are from the Economist Intelligence Unit database. Standard errors are robust. The absolute values of the t-statistics are in brackets.

	Mean	St. Dev.	R-Squared Overall (I)	R-Squared Overall (II)	R-Squared Difference Downside Minus Upside (I)	R-Squared Difference Downside Minus Upside (II)	Downside R-Squared (I)	Downside R-Squared (II)	Upside R-Squared (I)	Upside R-Squared (II)
Short sales allowed and practiced	0.598	0.491	−0.306***	−0.247***	−0.095*	−0.106*	−0.224***	−0.165**	−0.188**	−0.141*
			[3.64]	[2.78]	[1.86]	[1.84]	[3.05]	[2.06]	[2.57]	[1.78]
*ADR*0	0.057	0.232	0.11	0.18	−0.165*	−0.159*	−0.125	−0.188*	−0.06	−0.011
			[0.93]	[1.50]	[1.80]	[1.72]	[1.16]	[1.70]	[0.54]	[0.10]
*ADR*1	0.168	0.374	0.185	0.275**	−0.121	−0.109	0.279**	0.360***	0.184	0.252**
			[1.45]	[2.08]	[1.15]	[1.00]	[2.38]	[2.95]	[1.51]	[2.02]
Days with zero return (%)	−0.943	1.004	−0.313***	−0.325***	−0.082***	−0.084***	−0.170***	−0.180***	−0.272***	−0.280***
			[10.26]	[10.53]	[3.06]	[3.08]	[5.92]	[6.17]	[9.01]	[9.18]
Log (number of stocks)	4.605	1.674	−0.120***	−0.096***	0.019	0.022	−0.122***	−0.101***	−0.086***	−0.069**
			[3.93]	[3.01]	[1.06]	[1.13]	[4.58]	[3.55]	[3.22]	[2.48]

(*continued*)

Table IV—*Continued*

	Mean	St. Dev.	*R*-Squared Overall (I)	*R*-Squared Overall (II)	*R*-Squared Difference Downside Minus Upside (I)	*R*-Squared Difference Downside Minus Upside (II)	Downside *R*-Squared (I)	Downside *R*-Squared (II)	Upside *R*-Squared (I)	Upside *R*-Squared (II)
Mean of dependent variable			−1.701	−1.701	0.189	0.189	−1.943	−1.943	−2.133	−2.133
St. dev. of dependent variable			0.781	0.781	0.489	0.489	0.632	0.632	0.631	0.631
Observations			668	667	668	667	668	667	668	667
Number of countries			46	46	46	46	46	46	46	46
Test $ADR0 = ADR1$ (p-value)			0.3900	0.2800	0.0290	0.0260	0.0680	0.0390	0.5900	0.9600
R-squared within			0.58	0.57	0.13	0.13	0.47	0.47	0.4	0.4
R-squared between			0.48	0.51	0.09	0.1	0.39	0.42	0.44	0.49
R-squared total			0.52	0.54	0.12	0.12	0.44	0.45	0.42	0.43
Country and Industry Characteristics				√		√		√		√
Year-fixed effect			√	√	√	√	√	√	√	√
Country-fixed effect			√	√	√	√	√	√	√	√

* significant at 10%; ** significant at 5%; *** significant at 1%.

prohibited and allowed, respectively. However, the coefficient of $ADR1$ is not significantly different from zero, and the coefficients of $ADR0$ and $ADR1$ are significantly different at the 5% level of significance. More liquid markets are associated with less difference between downside and upside R^2, which is consistent with more liquid markets being more efficient.

C.2. Cross-Autocorrelations

In Table V, we report the results of the panel regression estimation for measures of cross-autocorrelation.[23] The first panel shows results for the total cross-autocorrelation, the second panel reports the results for the downside-minus-upside cross-autocorrelation, and the last two panels report the results for the downside and upside cross-autocorrelation separately.

The speed of price adjustment measured by the total cross-autocorrelation is not significantly related to short selling restrictions (first panel). We find that the weekly cross-autocorrelation is negatively related (and, hence, the speed of price adjustment is positively related) to: (1) a foreign listing, irrespective of short sales restrictions, (2) liquidity, (3) economic development, and (4) the country's Herfindahl index.

When we split the cross-autocorrelation depending on the sign of the market return, we find some evidence that allowing short sales is associated with a reduction in the downside cross-autocorrelation. In three of the four model specifications, the downside autocorrelation coefficient is negative and significant at the 5% level. The coefficient in the fourth specification has the same sign but is not significant; however, the sample size is smaller and thus the power of the test is likely weaker—the earnings co-movement index becomes the only significant variable. In model I, allowing short sales reduces the downside cross-autocorrelation by 0.81 standard deviations, which is an economically significant effect. Similarly, dual-listed stocks in countries in which short sales are not allowed or not practiced display downside cross-autocorrelations that are 0.65 standard deviations lower than similar domestic stocks. In countries in which short sales are allowed, foreign listing reduces downside cross-autocorrelation by 0.49 standard deviations.

The results in Table V also provide weak evidence that downside-minus-upside cross-autocorrelation may be related to short sales restrictions. When short sales are allowed and practiced, the difference in cross-autocorrelations is 0.59 standard deviations lower; however, the coefficient is only significant at the 10% level.[24] Taken together, the results of examining cross-autocorrelations

[23] We transform the correlations so they take values between $-\infty$ and $+\infty$, as $\rho^* = \log \frac{\rho+1}{1-\rho}$. Therefore, the downside-minus-upside cross-autocorrelation varies between $-\infty$ and $+\infty$ as well. Results in cross-sectional regressions are similar if we do not apply the transformation.

[24] The coefficient of the short sales dummy ranges from 8% to 9% in the four regressions we specify. The average cross-autocorrelation difference in Table III is 1.47%, which seems to suggest that the effect of short sales is large in magnitude. The reason for such a large coefficient is the country effects (whether fixed or random). To illustrate, the average coefficient for the country dummies in model I is 0.177 for the group of countries in which short sales are not feasible, and -0.21 for the group of countries in which sorting is allowed and practiced (a difference of 38%). These averages exclude the countries that have changed regulation during the period.

Table V

Cross-Autocorrelations

We compute cross-autocorrelations between 1-week lagged market returns and individual stock returns. In particular, we calculate $\rho^{+}_{ijTD} = \text{corr}(r_{ijt}, r^{+}_{mjt-1})$ and $\rho^{-}_{ijTD} = \text{corr}(r_{ijt}, r^{-}_{mjt-1})$, where r^{+}_{mt} equals the market return when it is either positive or zero, and r^{-}_{mt} equals the market return when it is negative for all stocks i in group D and country j, using weekly observations in each year T. We then average the cross-autocorrelations across stocks and calculate $\rho^{Diff}_{jTD} = \rho^{-}_{jTD} - \rho^{+}_{jTD}$. We also compute the correlation between individual stock returns, and the lagged market return (irrespective of its sign). We transform the correlations so they take values from $-\infty$ to $+\infty$, as $\rho^{*} = \log \frac{\rho+1}{1-\rho}$. The percent of zero returns is the average number of days a stock has a zero return, divided by the number of days in the year with available return data, averaged across stocks in a given group, country, and year. The number of firms is the number of firms with available stock price data in Datastream, in each country and year. Country Herfindahl index is calculated as the sum of the market shares (squared) of every firm in each country and year, relative to the corresponding country's total sales. Industry Herfindahl index is calculated as the sum of the market shares (squared) of every industry in each country and year, relative to the corresponding country's total sales. The size of the country is the extension of a country in square kilometers, from www.yahoo.com. The earnings co-movement index is calculated as in Mørck et al. (2000). The Good Governance index is the sum of the Risk of Expropriation, Corruption, and Repudiation of Contract indices from La Porta et al. (1997). The Short Selling variable is a dummy variable that equals 1 when short selling is allowed and practiced in a given country and year, zero otherwise. *ADR*0 equals 1 if the observation corresponds to Dual-Listed Stocks in countries in which short sales are not allowed/not practiced, zero otherwise. *ADR*1 equals 1 if the observation corresponds to Dual-Listed Stocks in countries in which short sales are allowed and practiced, zero otherwise. The sample includes firms from 47 countries with stock price information available from Datastream. Macroeconomic variables are from the Economist Intelligence Unit database. Standard errors are robust. The absolute values of the t-statistics are in brackets.

			Cross-Autocorrelation		Cross-Auto-correlation		Downside Cross-Autocorrelation		Upside Cross-Autocorrelation	
	Mean	St. Dev.	(I)	(II)	(I)	(II)	(I)	(II)	(I)	(II)
Short sales allowed and practiced	0.598	0.491	−0.047	−0.014	−0.093*	−0.085*	−0.104***	−0.086**	−0.011	−0.001
			[0.82]	[0.25]	[1.84]	[1.65]	[2.87]	[2.35]	[0.30]	[0.02]
*ADR*0	0.057	0.232	−0.149**	−0.071	−0.206**	−0.095	−0.084**	−0.059	−0.05	−0.015
			[2.49]	[1.10]	[2.03]	[1.45]	[2.30]	[1.48]	[1.33]	[0.37]
*ADR*1	0.168	0.374	−0.133**	−0.052	0.038	0.047	−0.063*	−0.027	−0.098***	−0.071*
			[2.34]	[0.84]	[0.76]	[0.86]	[1.74]	[0.68]	[2.79]	[1.85]
Days with zero return (%)	−0.943	1.004	0.035**	0.044***	−0.006	−0.005	−0.011	−0.007	−0.005	−0.001
			[2.55]	[3.18]	[0.46]	[0.41]	[1.26]	[0.75]	[0.61]	[0.17]
Log (number of stocks)	4.605	1.674	−0.036**	−0.019	0.009	0.011	−0.009	−0.001	−0.017*	−0.012
			[2.32]	[1.16]	[0.66]	[0.77]	[0.92]	[0.13]	[1.81]	[1.16]

Mean of dependent variable	0.011	0.011	0.033	0.033	0.071	0.071	0.038	0.038
St. dev. of dependent variable	0.183	0.183	0.156	0.156	0.128	0.128	0.126	0.126
Observations	604	602	602	600	603	601	605	603
Number of countries	46	46	46	46	46	46	46	46
Test $ADR0 = ADR1$ (p-value)	(0.4000)	(0.6600)	(0.0160)	(0.0200)	(0.9500)	(0.8100)	(0.0600)	(0.1200)
R-squared within	0.11	0.11	0.06	0.06	0.19	0.19	0.14	0.14
R-squared between	0.36	0.33	0.04	0	0.68	0.71	0.23	0.31
R-squared total	0.1	0.12	0.06	0.06	0.2	0.2	0.14	0.15
Country and industry characteristics		√		√		√		√
Year-fixed effect	√	√	√	√	√	√	√	√
Country-fixed effect	√	√	√	√	√	√	√	√

* significant at 10%; ** significant at 5%; *** significant at 1%.

are suggestive that short sales constraints impede downside price discovery. In sum, our multivariate analyses of both R^2 and cross-autocorrelation provide some evidence in favor of the hypothesis that markets in which short sales are allowed may be more efficient because bad news is more rapidly impounded into prices. We cannot reject the null at traditional confidence levels in every specification for our two independent proxies for efficiency. However, at least some of the weaknesses in our results may be due to issues of degrees of freedom imposed by restricting the sample size for more complete specifications. As we reduce the number of observations, the changes in model specification do not materially change the sign or magnitude of the coefficients, only the standard errors.

VI. Short Sales Restrictions and the Distribution of Stock Returns

In this section, we examine the distribution of stock returns conditional upon short sales restrictions. We compute statistics for three different series for each country and group. First, we construct weekly stock returns for each firm in our sample with at least 100 daily observations available in a given year. We also construct time series of weekly returns for the corresponding market indices. Finally, we run for each firm-year the regressions specified in equation (3) and save the residuals as abnormal firm returns. In a market with many systematic shocks, firms' raw returns may primarily reflect systematic shocks and thus the residual may be of interest. Because equity returns are distributed approximately lognormal, we transform the three groups of returns into their logarithmic representation and compute the skewness of the distributions. We also compute the frequency of extreme returns.

We find some evidence that supports the view of many regulators that short selling constraints help prevent financial panics, at least for market returns: There is a strong negative relationship between market skewness and the ability to short. However, the distribution of individual stock returns in our sample is insignificantly related to short sales restrictions. There is also an insignificant relationship between the frequency of extreme negative returns and short selling restrictions for individual stock returns.

A. Skewness

Table III reports univariate results on our three measures of skewness. For domestic stocks, market skewness is positive and larger in the presence of short sales restrictions (0.085 vs. −0.058, significantly different at the 1% level). Stock return skewness for individual stocks is also larger when short sales are prohibited (the difference is significant at the 10% level). Similar patterns characterize skewness in dual-listed stocks.

Given that skewness is almost certainly affected by country- and time-specific effects, we perform a panel regression analysis that controls for these factors. In addition, we follow Chen, Harrison, and Stein (2001) and include the differenced turnover and past market returns are predictors of skewness. We construct the

average differenced turnover for the countries in our sample as follows. We first calculate the firm-level differenced volume by subtracting the previous year's volume from the current volume.[25] We then calculate the sum of differenced volumes for all firms in a given country, group of stocks, and year, and divide by the total number of shares outstanding for all the firms in the country-group with available data on volume.[26]

Table VI reports the results from the estimation. We find that short sales restrictions are associated with less negative skewness at the market level. Economically, allowing short sales reduces skewness by 0.30 standard deviations (based on model I). Liquidity is positively and significantly related to skewness. The other controls, including GDP per capita and the good government index, are insignificant.[27]

The coefficient of the short sales dummy is significant at the 1% level in one specification, and at the 5% level in the other two. This result raises the question of whether we are capturing a reverse causality between skewness and shorting restrictions. We do not have a direct way to rule this possibility out with the whole data sample. However, in Section VII, we study the five countries that changed their regulations. We show that in the years before the short sales restrictions are lifted, market skewness is fairly level and the frequency of negative extreme returns declines. A decline in the frequency of negative extreme returns seems to be most likely in a protracted bull market. It is still possible that countries ban shorting after a crash, although our sample contains only one case in which shorting was allowed and later prohibited—Malaysia, 1997. In contrast, it appears that a lack of crashes lead to the relaxation of shorting prohibitions. Moreover, for markets in which short selling is either prohibited or not practiced, there is no evidence that returns display significantly less negative skewness at the individual stock level.

In the last models in Table VI, (models IV in each panel) we regress the three different measures of skewness on our controls for the countries in which short sales are not allowed or not practiced. We have 225 observations. The coefficient of the differenced turnover is not significant. Only for individual-stock abnormal returns do we find that lagged market returns help predict skewness.

B. Crashes

Arguably the most important rationale for short sales restrictions is that short selling is responsible for recent market crashes in the world financial

[25] Note that we lose 1 year of observations for every firm.

[26] We try an alternative specification that consists of calculating the market turnover first, and then detrending it. This methodology, similar to Chen, Hong, and Stein (2001), provides qualitatively similar results.

[27] Bae, Lim, and Wei (2006) find that positive skewness is most profound in stock markets with poor corporate governance. Our results do not support this view, although theirs are based on a cross section of countries, rather than a panel.

Table VI

Skewness

The dependent variable is the skewness of $\log(1 + r)$, where r denotes stock returns in each country and year. The skewness of raw returns is calculated as the skewness of the total sample of weekly stock returns (in logs) in each country and year. The skewness of abnormal returns is the skewness of $\log(1 + u)$, where u is the residual of a regression of weekly stock returns on the market index, for each firm in every country and year. The skewness of the market return is the skewness of the value-weighted market index return, in each country and year. The percent of zero returns is the average number of days a stock has a zero return, divided by the number of days in the year with available return data, averaged across stocks in a given group, country, and year. The number of firms is the number of firms with available stock price data in Datastream, in each country and year. Country Herfindahl index is calculated as the sum of the market shares (squared) of every firm in each country and year, relative to the corresponding country's total sales. Industry Herfindahl index is calculated as the sum of the market shares (squared) of every industry in each country and year, relative to the corresponding country's total sales. The size of the country is the extension of a country in square kilometers, from www.yahoo.com. The Good Governance index is the sum of the Risk of Expropriation, Corruption, and Repudiation of Contract indices from La Porta et al. (1997). The Short Selling variable is a dummy variable that equals 1 when short selling is allowed and practiced in a given country and year, zero otherwise. *ADR*0 equals 1 if the observation corresponds to Dual-Listed Stocks in countries in which short sales are not allowed/not practiced, zero otherwise. *ADR*1 equals 1 if the observation corresponds to Dual-Listed Stocks in countries in which short sales are allowed and practiced. We construct the average de-trended turnover for the countries in our sample as follows. We first calculate the detrended volume by firm, by subtracting the previous year's volume from the current volume. We then calculate the sum of detrended volumes for all firms in a given country, group of stocks, and year, and divide by the total number of shares outstanding for all the firms in the country-group with available data on volume. The sample includes firms from 46 countries with stock price information available from Datastream. Macroeconomic variables are from the Economist Intelligence Unit database. Standard errors are robust. The absolute values of the t-statistics are in brackets.

			Dependent Variable: Skewness of Market Indices			Dependent Variable: Skewness of Individual Stock Abnormal Return			Dependent Variable: Skewness of Individual Stock Raw Return		
	Mean	Std. Dev.	(I)	(II)	(IV)	(I)	(II)	(IV)	(I)	(II)	(IV)
Short sales allowed and practiced	0.598	0.491	−0.185***	−0.158**		−0.049	−0.02		0.011	0.02	
			[3.01]	[2.26]		[0.95]	[0.37]		[0.28]	[0.45]	
*ADR*0	0.057	0.232	0.204	0.086	0.01	0.087	0.048	0.054	0.076	−0.007	0.098
			[1.56]	[0.60]	[0.05]	[0.79]	[0.42]	[0.46]	[0.92]	[0.08]	[0.98]
*ADR*1	0.168	0.374	0.275**	0.187		−0.021	−0.039		−0.01	−0.035	
			[2.23]	[1.43]		[0.20]	[0.37]		[0.13]	[0.42]	
Days with zero return (%)	−0.943	1.004	0.116***	0.115***	0.168***	0.006	−0.002	0.015	−0.036*	−0.039*	−0.051**
			[3.34]	[3.17]	[3.59]	[0.22]	[0.05]	[0.49]	[1.68]	[1.71]	[1.99]
Log (number of stocks)	4.605	1.674	0.018	−0.006	−0.05	0.012	0.012	0.007	0.019	0.013	0.038
			[0.69]	[0.19]	[1.11]	[0.55]	[0.52]	[0.25]	[1.13]	[0.67]	[1.56]
Detrended turnover (lagged)	−0.067	0.922	0.025	0.022	0	0.019	0.017	−0.015	0.021	0.02	0.01
			[0.95]	[0.83]	[0.00]	[0.86]	[0.73]	[0.57]	[1.30]	[1.28]	[0.46]
Market return (lagged)	0.110	0.330	−0.07	−0.081	0.027	0.084	0.105	0.163**	0.079*	0.084*	0.066
			[0.94]	[1.06]	[0.27]	[1.35]	[1.63]	[2.49]	[1.77]	[1.88]	[1.20]
Mean of dependent variable			−0.001	−0.001	0.063	0.113	0.113	0.085	0.062	0.062	0.019
St. dev. of dependent variable			0.606	0.606	0.718	0.447	0.447	0.633	0.385	0.385	0.578
Observations			540	526	225	540	526	225	540	526	225
Number of countries			45	45	24	45	45	24	45	45	24
Test $ADR0 = ADR1$ (p-value)			(0.1000)	(0.1100)		(0.6500)	(0.6200)		(0.3000)	(0.6300)	
R-squared within			0.17	0.17	0.23	0.11	0.11	0.24	0.12	0.13	0.13
R-squared between			0.32	0.33	0.36	0.14	0.23	0.17	0.03	0.1	0.29
R-squared total			0.18	0.19	0.25	0.12	0.12	0.24	0.12	0.14	0.17
Country and industry characteristics				√	√		√	√		√	√
Year-fixed effect			√	√	√	√	√	√	√	√	√
Country-fixed effect			√	√	√	√	√	√	√	√	√

* significant at 10%; ** significant at 5%; *** significant at 1%.

markets, particularly the 1987 market crash and the 1997 Asian crises. Our objective in this section is to evaluate the empirical evidence for such a view.

The main difficulty in estimating the probability and severity of a market crash conditional upon the existence of short sales restrictions is the fact that we only have data on realized crashes. One alternative is to measure the extent of market drops during crisis events depending upon the existence of short selling restrictions. However, this would not answer the question of whether crashes are more likely in the presence of short sellers. If we believe market regulators, short selling may not trigger a crash, but simply make it more severe.

We therefore calculate the number of days in our sample period in which stock returns are below two standard deviations from their previous year's average. We divide this number by the total number of trading days, and then compute the frequency of extreme returns. Under the assumption that returns are lognormally distributed, the percentage should equal 2.3%.

In Table VII, we regress the frequency of extreme results on a set of explanatory variables. Short sales restrictions are insignificantly associated with more frequent extreme negative returns. The evidence from this table suggests that the probability of extreme negative returns is not likely to be a function of the short sales practices in countries, but rather is determined by other nonspecified country-specific factors. We do find significant differences between dual-listed stocks depending on short sales restrictions. In particular, extreme returns are less likely for dual-listed stocks in countries in which shorting is allowed, relative to dual-listed stocks in countries in which shorting is prohibited (significant difference at the 5% level). Besides, dual-listed stocks display less extreme returns than domestic stocks, in countries in which short sales are prohibited.

To summarize, while we find strong evidence that market returns are more negatively skewed in markets that permit short sales, we also find that negative extreme returns do not become more frequent. That is, shorting is associated not with more frequent negative extreme returns, but rather with extreme returns that become more negative. This is consistent with the idea that short selling does not cause a crash but may affect its magnitude.[28]

VII. An Event Study: Countries with Regulatory Changes

To shed some light on the relationship between short sales constraints and extreme returns, and in order to eliminate a number of the potential cross-sectional differences that might explain the results thus far, in this section we

[28] An alternative explanation is that when short sales are allowed, the frequency of *positive* extreme returns decreases. This would explain why skewness becomes more negative without a change in the frequency of negative returns. The idea is that short sellers can keep prices from going too high. In unreported analyses, we find that the positive extreme returns have a frequency of 2.84% when short sales are allowed, and 3.03% when they are prohibited or not practiced. The p-value for the difference is 0.09. However, the short sales dummy is not significant in cross-sectional regressions.

Table VII
Frequency of Extreme Negative Returns and Short Selling Restrictions

The dependent variable is the per year number of trading days where the market return is lower than the average market return minus two standard deviations, divided by the total number of trading days. The endogenous variable is mapped on the set of real numbers, with the transformation $\log(x/(1-x))$. The mean and standard deviation of the market return is calculated over the same country and the previous year. The percent of zero returns is the average number of days a stock has a zero return, divided by the number of days in the year with available return data, averaged across stocks in a given group, country, and year. The number of firms is the number of firms with available stock price data in Datastream, in each country and year. Country Herfindahl index is calculated as the sum of the market shares (squared) of every firm in each country and year, relative to the corresponding country's total sales. Industry Herfindahl index is calculated as the sum of the market shares (squared) of every industry in each country and year, relative to the corresponding country's total sales. The size of the country is the extension of a country in square kilometers, from www.yahoo.com. The earnings comovement index is calculated as in Mørck et al. (2000). The Good Governance index is the sum of the Risk of Expropriation, Corruption, and Repudiation of Contract indices from La Porta et al. (1997). The Short Selling variable is a dummy variable that equals one when short selling is allowed and practiced in a given country and year, zero otherwise. *ADR*0 equals 1 if the observation corresponds to Dual-Listed Stocks in countries in which short sales are not allowed/not practiced, zero otherwise. *ADR*1 equals 1 if the observation corresponds to Dual-Listed Stocks in countries in which short sales are allowed and practiced, zero otherwise. The sample includes firms from 46 countries with stock price information available from Datastream. Macroeconomic variables are from the Economist Intelligence Unit database. Standard errors are robust. The absolute values of the t-statistics are in brackets.

	Mean	Std. Dev.	(I)	(II)
Short sales allowed and practiced	0.598	0.491	0.001	0.11
			[0.01]	[1.18]
*ADR*0	0.057	0.232	−0.813***	−0.718***
			[5.39]	[4.65]
*ADR*1	0.168	0.374	−1.171***	−1.097***
			[8.67]	[8.09]
Log (days with zero return)	−0.943	1.004	−0.381***	−0.400***
			[9.91]	[10.33]
Log (number of stocks)	4.605	1.674	−0.132***	−0.104***
			[4.41]	[3.35]
Mean of dependent variable			−2.913	−2.913
St. dev. of dependent variable			0.682	0.682
Observations			668	667
Number of countries			46	46
Test *ADR*0 = *ADR*1 (p-value)			(0.0100)	(0.0100)
R-squared within			0.28	0.28
R-squared between			0.33	0.41
R-squared total			0.27	0.29
Country and industry characteristics				√
Year-fixed effect			√	√
Country-fixed effect			√	√

* significant at 10%; ** significant at 5%; *** significant at 1%.

restrict our attention to the subset of countries that changed their regulations over the period 1990 to 2001. Essentially, this should allow for a good hedonic control on a country-by-country basis, at least under the assumption that the regulatory change is not triggered by shifts in other characteristics. The relevant sample countries are: Hong Kong, Malaysia, Norway, Sweden, and Thailand. In the case of Hong Kong, Norway, Sweden, and Thailand, short sales restrictions were removed in a specific year (not the same calendar year for each country). In Malaysia, as we detail in Section II, short selling was allowed

during the 1995 to 1997 period, and was then prohibited again in August 1997 at the onset of the Asian financial crises. For Malaysia, we only consider the period January 1990 to August 1997.[29]

In Figure 3, we plot both the frequency of extreme events and the market skewness for the five countries around the year in which short sales become effective, as well as the downside R^2 and the downside cross-autocorrelation measures. We further classify stocks into dual-listed and domestic categories, and plot the average within each group by year-to-event.

For the average domestic stock, there is a clear decline in the R^2, which is consistent with Campbell et al. (2001), and an overall increase in idiosyncratic risk. Such a decline happens for both the downside and the upside R^2. The figure shows that the decline is not driven by a particular country. Moreover, this pattern is not so clear when looking at cross-autocorrelations: The total cross-autocorrelation declines, but the downside-minus-upside difference does not.

The frequency of extreme returns drops from 13.34% in year -7 to 4.80% in year $+7$. However, in Sweden, the frequency of extreme results is higher after 1992 than in 1991, when short selling restrictions are lifted. Moreover, in Norway the effect of short sales is a reduction of the percentage of extreme returns 1 year after the law change, but a dramatic increase in years $+3$ and $+4$ (see Figure 4). We obtain similar results for market skewness. It therefore seems that the effect of short sales on crashes may be somewhat country-specific, and thus that the univariate results do not provide conclusive results.

Finally, in Table VIII, we run panel regressions with country- and year-fixed effects.[30] Observations are country-year averages for all variables. We find a decline in the downside-minus-upside cross-autocorrelation, which is both statistically and economically significant: A regulatory change to allow short sales reduces the downside-minus-upside cross-autocorrelation by 0.80 standard deviations. Results for the R^2 are not significant, which shows that the reduction in R^2 that we identify above may be a pure time effect that is unrelated to regulatory changes.

The event study also provides evidence in favor of regulators' claims that short sales make crashes more likely. After short sales are allowed in the five countries with regulatory changes, we find that the distribution of domestic stocks is more negatively skewed, and that the frequency of extreme negative returns increases. This contradicts our earlier univariate results, which do not take secular effects into account. In terms of economic significance, removing short sales restrictions reduces market skewness by 1.38 standard deviations, and increases the frequency of extreme market returns by 0.77 standard deviations. Whether stocks are dual-listed or not in countries in which short sales

[29] Because we want to have as many observations as possible after short sales are allowed, we include in our event study the first 8 months of 1997. This means that market skewness and extreme negative return calculations include 1 month of the Malaysian currency crises (the Thai Baht was devalued in July 1997).

[30] We do not control for time-invariant variables like the size of the country or the quality of governance index as they are not significant in random-effect regressions, and they do not change the qualitative effect of the other variables.

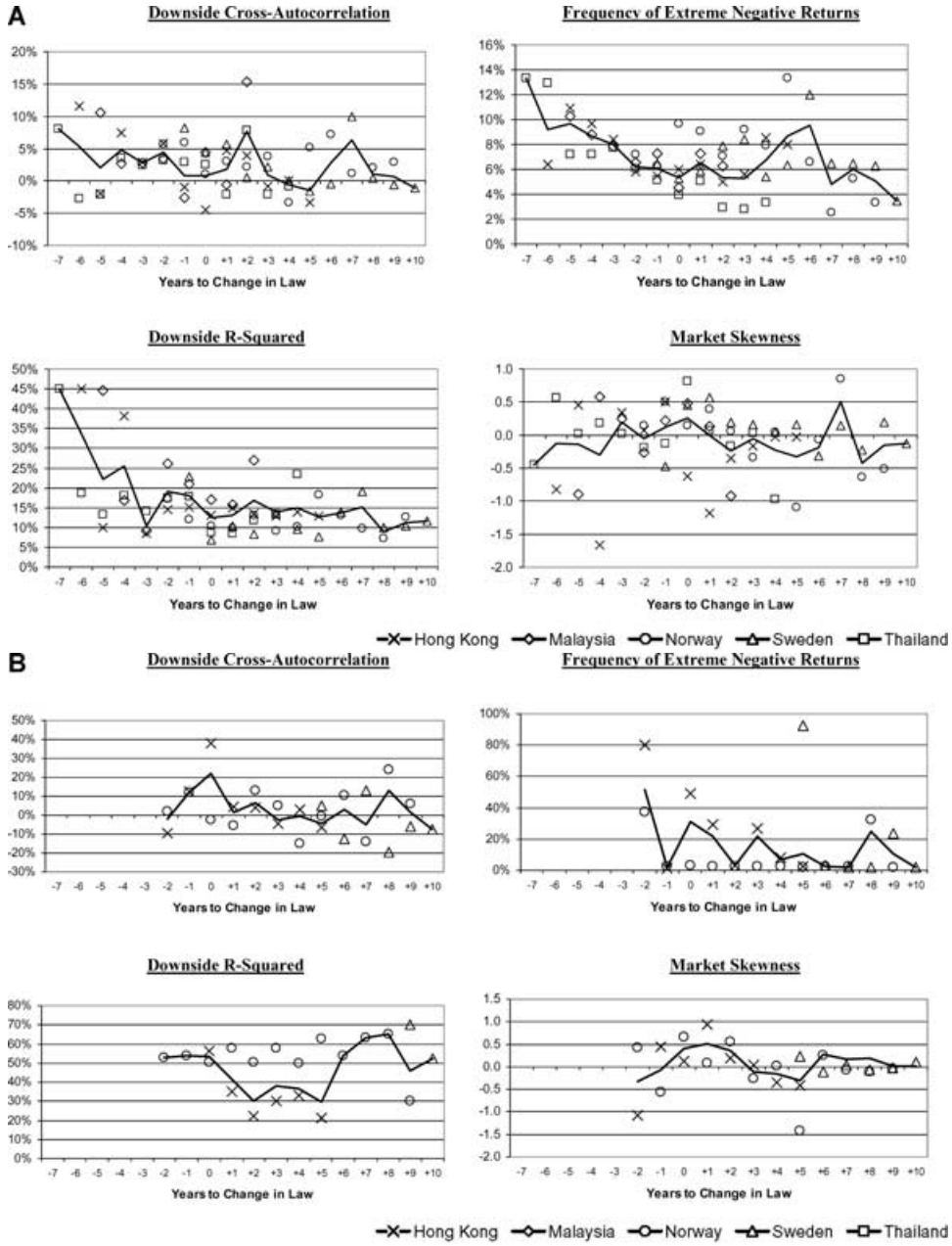

Figure 3. Event study for countries with regulatory changes, Domestic and ADR stocks. Downside cross-autocorrelation, downside R-squared, frequency of extreme negative returns, and market skewness, depending on short sales restrictions. We only plot these variables for the countries that changed their regulation during the sample period: Hong Kong, Malaysia, Norway, Sweden, and Thailand, and we calculate the average across years to the change in the law, where year 0 is the year when short sales are allowed (and become practiced) in the corresponding country.

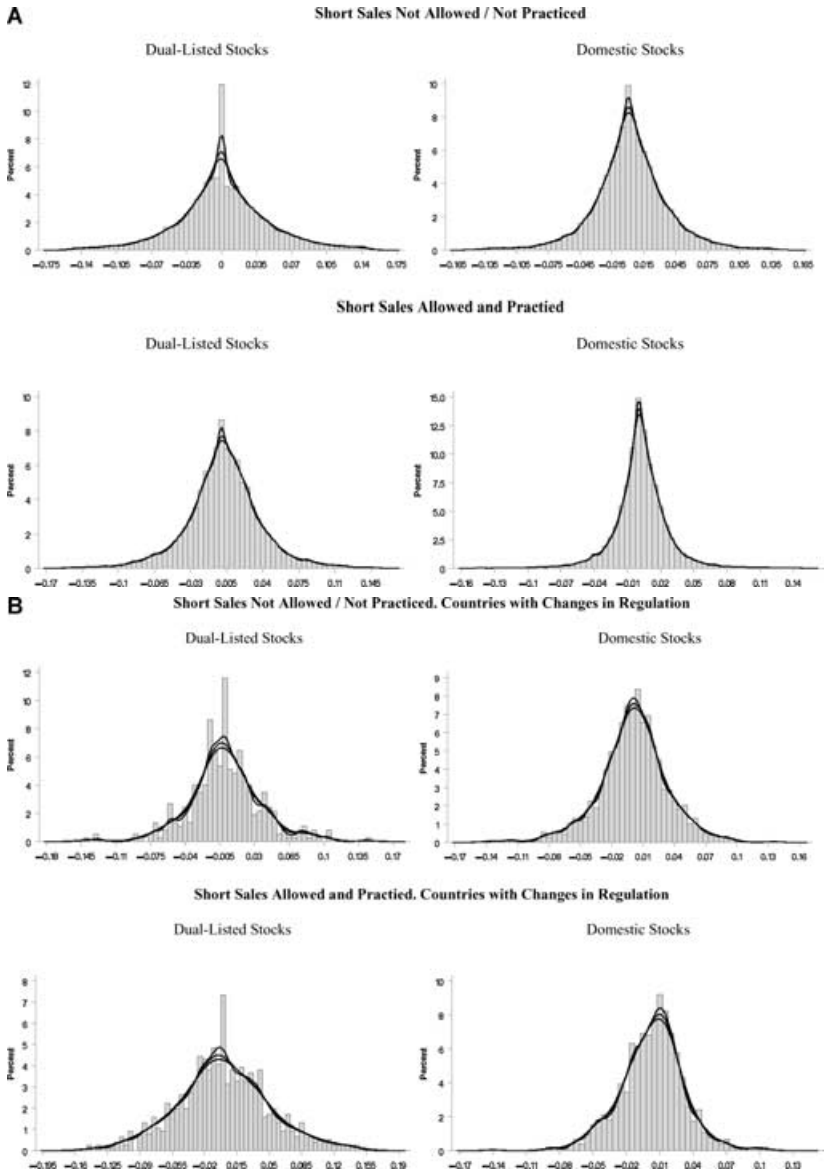

Figure 4. Kernel density estimation. Histogram and kernel density estimation of weekly market log-returns, depending on the existence of short selling restrictions. The kernel density is estimated as detailed in footnote 31. The short selling variable is a dummy variable that equals 1 when short selling is allowed and practiced in a given country and year, and zero otherwise. The sample includes firms from 46 countries with stock price information available from Datastream. Returns are pooled across years. The first four graphs correspond to all the countries in the sample. The last four figures consider only the countries that have changed their regulation during the sample period, Hong Kong, Malaysia, Norway, Sweden, and Thailand. For each variable, we estimate three density curves, two with standardized bandwidths of $\lambda = 0.5$ and $\lambda = 1.0$, and one with a bandwidth that minimizes the approximate mean integrated square error.

Table VIII

Panel Regression, Countries with Regulatory Changes

R^2, Cross-autocorrelation, Probability of Extreme Market Returns, and Market Skewness, for the five countries with regulatory changes between 1990 and 2001: Hong Kong, Norway, Sweden, Malaysia, and Thailand. The sample includes firms from these countries with stock price information available from Datastream. For each country in our sample, for every year T, and for Domestic and Dual-Listed stocks, we calculate the R^2 in the two modified market regressions, where we use only either positive or negative market returns. We then compute the corresponding R-squared coefficients, R^{2+}_{ijTD} and R^{2-}_{ijTD} $^{-}$ and average the R^2s for each country j and for every year T and group D. We also compute the difference $R^{2Diff}_{jTD} = R^{2-}_{jTD} - R^{2+}_{jTD}$. Market Skewness is the skewness of $\log(1 + r)$, where r denotes market returns. We calculate skewness for each country and year. We compute cross-autocorrelations between 1-week lagged market returns and individual stock returns. In particular, we calculate $\rho^{+}_{ijTD} = \text{corr}(r_{ijt}, r^{+}_{mjt-1})$ and $\rho^{-}_{ijTD} = \text{corr}(r_{ijt}, r^{-}_{mjt-1})$, where r^{+}_{mt} equals the market return when it is either positive or zero, and r^{-}_{mt} equals the market return when it is negative for all stocks i in group D and country j, using weekly observations in each year T. We then average the cross-autocorrelations across stocks and calculate $\rho^{Diff}_{jTD} = \rho^{-}_{jTD} - \rho^{+}_{jTD}$. To compute the frequency of extreme returns, for each firm and year, we calculate the mean and standard deviation of returns, and calculate the number of days where the return is below the average return, minus two standard deviations. We aggregate this number by group, country and year, and divide by the total number of firm-days in the year with available stock price information. The percent of zero returns is the average number of days a stock has a zero return, divided by the number of days in the year with available return data, averaged across stocks in a given group, country, and year. The number of firms is the number of firms with available stock price data in Datastream, in each country and year. The Short Selling variable is a dummy variable that equals 1 when short selling is allowed and practiced in a given country and year, zero otherwise. *ADR*0 equals 1 if the observation corresponds to Dual-Listed Stocks in countries in which short sales are not allowed/not practiced, zero otherwise. *ADR*1 equals 1 if the observation corresponds to Dual-Listed Stocks in countries in which short sales are allowed and practiced, zero otherwise. We construct the average de-trended turnover for the countries in our sample as follows. We first calculate the detrended volume by firm, by subtracting the previous year's volume from the current volume. We then calculate the sum of detrended volumes for all firms in a given country, group of stocks, and year, and divide by the total number of shares outstanding for all the firms in the country-group with available data on volume. Macroeconomic variables are from the Economist Intelligence Unit database. Standard errors are robust. The absolute values of the t-statistics are in brackets.

			R-Squared			Cross-Autocorrelation				
	Mean	St. Dev.	Difference Downside-Upside	Upside	Downside	Difference Downside-Upside	Upside	Downside	Market Skewness	Frequency of Extreme Negative Returns
Short sales allowed and practiced	0.430	0.498	−0.628	0.575	−0.053	−0.213**	0.026	−0.188*	−0.731*	0.823*
			[0.85]	[0.89]	[0.17]	[2.13]	[0.34]	[1.94]	[1.69]	[1.91]
*ADR*0	0.129	0.337	2.603	−3.735	−1.132	−0.848***	−0.482***	0.366	1.216	−5.531***
			[0.49]	[0.80]	[0.51]	[3.50]	[2.67]	[1.56]	[1.59]	[5.29]
*ADR*1	0.198	0.400	4.716	−5.926	−1.21	−0.837***	−0.617***	0.219	1.656**	−5.647***
			[0.75]	[1.08]	[0.46]	[3.27]	[3.24]	[0.88]	[2.18]	[5.12]
Log (number of stocks)	4.116	2.454	1.106	−1.245	−0.139	−0.174***	−0.120***	0.054	0.300*	−1.118***
			[0.86]	[1.10]	[0.26]	[3.73]	[3.46]	[1.19]	[1.89]	[5.56]
Days with zero return (%)	−1.244	0.790	−0.165	−0.467	−0.632***	−0.078	−0.004	0.074	0.033	−0.013
			[0.37]	[1.19]	[3.40]	[1.33]	[0.10]	[1.30]	[0.20]	[0.05]
Log (GDP per capita)	9.659	0.650	−2.255	3.741	1.486	0.956*	0.351	−0.606	1.333	−1.22
			[0.55]	[1.05]	[0.88]	[1.88]	[0.92]	[1.23]	[0.72]	[0.56]

Detrended turnover (lagged)	0.000	0.976							−0.019	
									[0.22]	
Market return (lagged)	0.060	0.341							0.059	
									[0.28]	
Constant			14.903	−30.956	−16.054	−8.213*	−2.572	5.641	−14.842	15.006
			[0.42]	[0.99]	[1.08]	[1.74]	[0.73]	[1.23]	[0.81]	[0.74]
Mean of dependent variable			−0.041	0.124	0.164	−0.001	0.025	0.024	−0.098	−2.652
St. dev. of dependent variable			1.255	1.230	0.651	0.266	0.157	0.208	0.527	1.070
Observations			73	73	73	79	79	79	64	79
Number of countries			5	5	5	5	5	5	5	5
Test $ADR0 = ADR1$ (p-value)			(0.1500)	(0.1000)	(0.9700)	(0.2800)	(0.2500)	(0.8200)	(0.0700)	(0.2500)
R-squared within			0.26	0.4	0.47	0.5	0.38	0.49	0.4	0.54
R-squared between			0.33	0.06	0.66	0.85	0.11	0.71	0.74	0.17
R-squared total			0.07	0.02	0	0.17	0.02	0.24	0.01	0.24
Year-fixed effects			√	√	√	√	√	√	√	√
Country-fixed effects			√	√	√	√	√	√	√	√

* significant at 10%; ** significant at 5%; *** significant at 1%.

are prohibited does not seem to make a difference. However, this result must be taken with caution since there are only five country-year observations in which *ADR*0 equals 1.

VIII. Kernel Estimation of Return Distributions

Thus far, we examine various statistics of conditional distributions. It is also instructive to look at the return densities themselves. We perform a kernel estimation of a density function of stock returns with and without short sales constraints that fits the distribution of returns.[31] The advantage of the kernel estimation is that we do not need to constrain the distribution to be normal, or even symmetric.

We estimate the kernel density for the market returns, both for the total sample and for the subsample of countries with regulatory changes, depending on whether short sales are allowed and depending on whether stocks are dual listed. Figure 4 plots the histograms of returns, as well as the densities, depending on the existence of short selling restrictions. Consistent with the results in Table III, Figure 4 shows that (1) the distribution of returns is more leptokurtotic when short sales are allowed and practiced, and (2) the distribution of returns is not symmetric. Focusing on the subsample of domestic stocks, there is an apparent difference in skewness between stocks in countries in which short sales are allowed and practiced, and stocks in countries in which short sales are prohibited, at least in countries that changed their regulations at some point over the 1990 to 2001 period. This supports our results in Section VIII.

IX. Short Sales Constraints and the Existence of Derivatives Markets

Although we focus the paper on the effect of short sales constraints, it is well known that a short position can be replicated using derivatives.[32] Therefore, if

[31] The general form of the kernel density estimator is

$$\hat{f}_{\lambda}(x) = \frac{1}{n_{\lambda}} \sum_{i=1}^{n} N\left(\frac{x - x_i}{\lambda}\right),$$

where $N(\cdot)$ is the kernel function, which we specify to be standard normal, λ is the bandwidth parameter, n is the sample size, and x_i is the i^{th} observation. The kernel density minimizes the mean integrated squared error $\eta\lambda$:

$$\eta_{\lambda} = \int_{x} \left\{E(\hat{f}_{\lambda}(x) - f(x))^2\right\} dx + \int_{x} \text{Var}(\hat{f}_{\lambda}(x))\, dx,$$

where λ is the value that minimizes the estimated mean integrated square error

$$\hat{\eta}_{\lambda} = \frac{1}{4}\lambda^4 \left(\int_{t} t^2 N(t)\, dt\right)^2 \int_{x} (f''(x))^2\, dx + \frac{1}{n\lambda} \int_{t} (N(t))^2\, dt.$$

We additionally consider values for $\lambda = 0.5$ and $\lambda = 1$.

[32] Figlewski (1989) and Figlewski and Webb (1993) find that optionable stocks exhibit significantly higher average level of short interest and option prices are related to short interest. This suggests that options facilitate short selling and information diffusion.

there are countries with short sales constraints that allow the trading of put options, this may be relevant to our analysis. In this section, we analyze the effect of derivatives on our measures of market efficiency and on the distribution of stock returns when short sales are restricted.

One important question is whether short sales constraints inhibit efficient option price discovery. Klemkosky and Resnick (1979) investigate the relationship between short sales restrictions and put–call parity.[33] They find that approximately 55% of all put–call parity violations are due to short sales restrictions. Ofek, Richardson, and Whitelaw (2004) find similar results when they incorporate the effect of the early exercise premium of American options. Lamont and Thaler (2003) argue that irrational investors may not use the options market,[34] and therefore violations of put–call parity may signal irrational mispricing of the underlying stock. Cao, Chen, and Griffin (2005), on the other hand, find evidence that considerable price discovery takes place in the options market. Mayhew and Mihov (2004) examine the issue of whether options markets substitute for the ability to sell short. They argue that, in the presence of short sales restrictions, introducing options should make it easier for investors to take synthetic short positions, and therefore there should be a negative market reaction to the introduction of a new option contract. However, they fail to find such an impact in their empirical tests. Thus, the evidence on the role of options in efficient price discovery is mixed, and the question of whether options facilitate downside price discovery when short sales are restricted remains an open empirical question.

In this section, we examine the effects of derivatives markets on our measures of efficiency, skewness, and market crashes, when short sales are not allowed or not practiced. Charoenrook and Daouk (2004) survey 111 countries and collect information on the ability to short and the ability to write puts. They use this information to study conditional skewness. We combine their data with ours and find that out of the 46 countries we consider, there are 11 countries that had, during at least 1 year, well functioning put option markets but in which short sales were not allowed or not practiced.[35] These cases account for 53 country-year observations out of a total of 535 observations.

We construct a dummy variable that equals 1 when put options are feasible but short sales are not, and we reestimate our previous regressions.[36] In Table IX, we report a summary of our results. We regress the downside-minus-upside R^2 coefficient and the cross-autocorrelation, market skewness,

[33] See also Danielsen and Sorescu (2001).

[34] Indeed, Lamont and Stein (2004) find that, in the presence of shorting constraints, investors do not substitute options for short positions.

[35] The markets in which put options are available but short sales are not comprise: Brazil in 1990 to 2001, Chile in 1995 to 1999, Spain in 1993 to 2001, Finland in 1990 to 2001, Greece in 2001, Hong Kong in 1994 to 1995, Israel in 1994 to 2001, South Korea in 1998 to 2001, Norway in 1991 to 1995, Poland in 2001, and Sweden in 1990.

[36] Note that when short sales are allowed, it is irrelevant whether derivatives trading is possible or not for investors to trade on negative information, since put options can be replicated with a bond and a short position on stocks. That is why we do not consider the opposite case of countries in which short sales are permitted, but put option trading is not.

and frequency of extreme negative returns on all of our time-variant control variables so we can estimate the regressions with country-fixed effects. We also run two sets of regressions, one with the entire sample, and another with the countries that experience changes in regulation over the sample period, as described in the previous section.

We do not find the effect of put options to be significant in the presence of short selling restrictions. With the exception of the downside-minus-upside R^2 in the restricted sample, none of our variables can be significantly explained by put options alone. The significance of the short sales dummy is preserved, if anything with a lower economic significance. Interestingly, controlling for short sales, put options are associated with a reduction rather than an increase in market efficiency, based on R^2 differences in the subsample of five countries: The coefficient of the put-option dummy is positive and significant at the 5% level, which is essentially driven by Norway and, to a lesser extent, by Sweden and Hong Kong. This means that put options alone reduce our R^2 measure of market efficiency by about one standard deviation, which is consistent with Lamont and Thaler (2003) and Mayhew and Mihov (2004).

X. Conclusions

Restrictions on short selling of shares are nearly as old as stock markets themselves. Critics often view short sales as immoral—the exploitation of others' misfortune and an exacerbating factor in periods of market crisis. As recently as the Asian currency crisis of 1997, short sellers were blamed by politicians and journalists for helping to destroy the "Asian Miracle." In the current environment with the growth of hedge funds, concerns about the danger of allowing speculation frequently surface. There is at least some common suspicion that short selling can exacerbate market crashes. Most academic researchers, however, make a strong theoretical case for allowing short sales in markets. Their case is based upon the notion that markets exist to facilitate the efficient pricing of assets, and that restricting short sales reduces market efficiency. Recent empirical evidence by researchers provides some support for the hypothesis that difficulty in short selling is associated with security mispricing. In this paper, we survey the short selling regulations and practices of major stock markets around the world. Using a sample of countries with time-series as well as cross-sectional differences in short sales practice, we find some empirical evidence in support of the academic view that short sales restrictions inhibit downward price discovery. In countries in which short sales are not allowed or not practiced, we also consider the subsample of stocks that list in either the United States or the United Kingdom, and thus are shortable. Using market efficiency measures based on asymmetries in individual stock responses to market returns, we find a negative association between short sales restrictions and the diffusion of negative information into prices. Our analysis of the statistical characteristics of markets, specifically, the skewness of log returns, provides some interesting support for the commonly held regulatory view that short sales restrictions are associated with less negative skewness in market returns.

Table IX

Short Sales Restrictions and the Existence of Put Contracts

R^2, Cross-autocorrelation, Probability of Extreme Market Returns, and Market Skewness, for the whole sample, and for the five countries with regulatory changes between 1990 and 2001: Hong Kong, Norway, Sweden, Malaysia, and Thailand. The sample includes firms from these countries with stock price information available from Datastream. For each country in our sample, for every year T, and for Domestic and Dual-Listed Stocks, we calculate the R^2 in the two modified market regressions, where we use only either positive or negative market returns. We then compute the corresponding R^2 coefficients, R^{2+}_{ijTD} and R^{2-}_{ijTD}, and average the R^2s for each country j and for every year T and group D, as in MYY. We also compute the difference $R^{2Diff}_{jTD} = R^{2-}_{jTD} - R^{2+}_{jTD}$. Market Skewness is the skewness of $\log(1 + r)$, where r denotes market returns. We calculate skewness for each country and year. We compute cross-autocorrelations between 1-week lagged market returns and individual stock returns. In particular, we calculate $\rho^{+}_{ijTD} = \text{corr}(r_{ijt}, r^{+}_{mjt-1})$ and $\rho^{-}_{ijTD} = \text{corr}(r_{ijt}, r^{-}_{mjt-1})$, where r^{+}_{mt} equals the market return when it is either positive or zero, and r^{-}_{mt} equals the market return when it is negative for all stocks i in group D and country j, using weekly observations in each year T. We then average the cross-autocorrelations across stocks and calculate $\rho^{Diff}_{jTD} = \rho^{-}_{jTD} - \rho^{+}_{jTD}$. To compute the frequency of extreme returns, for each firm and year, we calculate the mean and standard deviation of returns, and calculate the number of days for which the return is below the average return, minus two standard deviations. We aggregate this number by country and year, and divide by the total number of firm-days in the year with available stock price information. The percent of zero returns is the average number of days a stock has a zero return, divided by the number of days in the year with available return data, averaged across stocks in a given group, country, and year. The number of firms is the number of firms with available stock price data in Datastream, in each country and year. The Short Selling variable is a dummy variable that equals 1 when short selling is allowed and practiced in a given country and year, zero otherwise. The "Existence of Put Contracts—No Short Sales" dummy is a variable that equals 1 when the Short Selling variable equals 1, and the corresponding market has put options trading. Data on put options is from Charoenrook and Daouk (2004). *ADR*0 equals 1 if the observation corresponds to Dual-Listed Stocks in countries where short sales are not allowed/not practiced, zero otherwise. ADR1 equals 1 if the observation corresponds to Dual-Listed Stocks in countries where short sales are allowed and practiced, zero otherwise. We construct the average detrended turnover for the countries in our sample as follows. We first calculate the detrended volume by firm, by subtracting the previous year's volume from the current volume. We then calculate the sum of de-trended volumes for all firms in a given country, group of stocks, and year, and divide by the total number of shares outstanding for all the firms in the country-group with available data on volume. The sample includes firms from 46 countries with stock price information available from Datastream. Macroeconomic variables are from the Economist Intelligence Unit database. Standard errors are robust. The absolute values of the t-statistics are in brackets.

	All Countries						Countries with Regulatory Changes					
	Mean	St. Dev.	Downside-Minus-Upside R-Squared	Downside-Minus-Upside Cross-Autocorrelation	Market Skewness	Frequency of Negative Extreme Returns	Mean	St. Dev.	Downside-Minus-Upside R-Squared	Downside-Minus-Upside Cross-Autocorrelation	Market Skewness	Frequency of Negative Extreme Returns
Short sales allowed and practiced	0.598	0.491	−0.097*	−0.205***	−0.316**	0.002	0.430	0.498	−0.153	−0.170*	−0.139*	0.28*
			[1.86]	[3.42]	[2.03]	[0.01]			[0.23]	[1.75]	[1.83]	[1.82]
Existence of put contracts—no short sales	0.124	0.330	0.023	−0.011	−0.141	−0.057	0.177	0.384	1.332**	0.043	0.2	−0.609
			[0.17]	[0.27]	[1.44]	[0.39]			[2.12]	[0.45]	[0.62]	[1.49]
*ADR*0	0.057	0.232	−0.208	−0.201***	0.085	−1.941***	0.129	0.337	3.406	0.841***	−0.044	−5.494***
			[0.93]	[3.44]	[0.55]	[9.56]			[0.70]	[3.46]	[0.06]	[5.25]
*ADR*1	0.168	0.374	0.03	0.173***	0.052	−1.881***	0.198	0.400	5.665	0.813***	0.075	−5.454***
			[0.14]	[3.01]	[0.33]	[9.47]			[1.00]	[3.19]	[0.09]	[4.97]
Log (number of stocks)	4.605	1.674	0.193***	0.050***	0.01	−0.359***	4.116	2.454	1.382	0.169***	−0.006	−1.110***
			[3.18]	[3.39]	[0.26]	[6.91]			[1.18]	[3.60]	[0.04]	[5.50]
Days with zero return (%)	−0.943	1.004	−0.198***	0.012	−0.006	−0.155***	−1.244	0.790	−0.423	0.095	−0.055	0.042
			[4.12]	[0.98]	[0.18]	[3.35]			[0.94]	[1.56]	[0.34]	[0.16]
Log (GDP per capita)	4.605	1.674	0.781**	−0.096	−0.541*	0.612	9.659	0.650	−2.178	−1.129**	1.469	−1.531
			[2.07]	[0.87]	[1.76]	[1.52]			[0.56]	[2.19]	[0.83]	[0.69]
Detrended turnover (lagged)	−0.067	0.922			0.003		0.000		0.976		0.007	
					[0.14]						[0.08]	

(*continued*)

Table IX—*Continued*

	All Countries						Countries with Regulatory Changes					
	Mean	St. Dev.	Downside-Minus-Upside R-Squared	Downside-Minus-Upside Cross-Autocorrelation	Market Skewness	Frequency of Negative Extreme Returns	Mean	St. Dev.	Downside-Minus-Upside R-Squared	Downside-Minus-Upside Cross-Autocorrelation	Market Skewness	Frequency of Negative Extreme Returns
Market return (lagged)	0.110	0.330			0.089 [1.52]		0.060	0.341			−0.229 [1.07]	
Constant			−8.371** [2.31]	0.616 [0.58]	5.094* [1.80]	−7.340* [1.90]			13.067 [0.37]	10.020** [2.01]	−13.74 [0.83]	19.171 [0.89]
Mean of dependent variable			0.189	0.033	−0.001	−2.913			−0.041	−0.001	−0.098	−2.652
St. dev. of dependent variable			0.489	0.156	0.606	0.682			1.255	0.266	0.527	1.070
Observations			823	908	763	913			75	81	66	81
Number of countries			46	46	45	46			5	5	5	5
Prob > F			(0.0160)	(0.0360)	(0.6600)	(0.6000)			(0.0800)	(0.8200)	(0.0760)	(0.9400)
R-squared within			0.11	0.06	0.10	0.22			0.32	0.51	0.40	0.53
R-squared between			0.02	0.55	0.36	0.00			0.24	0.86	0.88	0.24
R-squared total			0.02	0.17	0.10	0.07			0.10	0.19	0.00	0.13
Year-fixed effects			√	√	√	√			√	√	√	√
Country-fixed effects			√	√	√	√			√	√	√	√

* significant at 10%; ** significant at 5%; *** significant at 1%.

Appendix: Econometric Model

A.I. Setup

Consider a collection of N securities generated by an underlying stochastic process Λ_t. The process Λ_t represents a common market factor. Since we are interested in the idiosyncratic price adjustment according to the sign of the market return, the individual stock price is determined by four equi-probable models:

$$r_{it} = \mu_i + \beta_i \Lambda_t^+ + \epsilon_{it} \qquad \text{if } \Lambda_t \geq 0, \quad \Lambda_{t-1} \geq 0 \tag{A1}$$

$$r_{it} = \mu_i + \beta_i (\Lambda_t^+ + (1-q)\Lambda_{t-1}^-) + \epsilon_{it} \qquad \text{if } \Lambda_t \geq 0, \quad \Lambda_{t-1} < 0 \tag{A2}$$

$$r_{it} = \mu_i + \beta_i (q\,\Lambda_t^-) + \epsilon_{it} \qquad \text{if } \Lambda_t < 0, \quad \Lambda_{t-1} \geq 0 \tag{A3}$$

$$r_{it} = \mu_i + \beta_i (q\,\Lambda_t^- + (1-q)\Lambda_{t-1}^-) + \epsilon_{it} \qquad \text{if } \Lambda_t < 0, \quad \Lambda_{t-1} < 0, \tag{A4}$$

where Λ_t and ϵ_{it} are zero-mean normal with variance σ_Λ^2 and σ^2, respectively, $\Lambda_t^\pm$ indicates the conditional distribution of Λ_t on the positive or negative sign of Λ_t, and q represents the proportion of the negative shock Λ_t that is incorporated into r_{it} in the current cycle ($1-q$ is incorporated in next cycle).

In our model, q is a measure of short sales constraints. When $q = 1$, shorting is fully allowed and current stock returns fully reflect all current market returns. When $q = 0$, there is a delay of one period from the realization of a negative market return until it is incorporated into individual stock returns. We also assume Λ_t is the common factor for all stocks, temporarily and cross-sectionally independent and identically distributed (i.i.d.) at all leads and all lags, and independent of ϵ_{it-k} for all i, t, and k. The noise ϵ_{it} is also i.i.d. for all i and t.

We also assume $\mu_i = 0$ for all i. This assumption is without loss of generality. Moreover, we assume that $\beta_i > 0$ for all i. It can be shown that our conclusions below remain even if we do not assume that all betas are positive.[37] Following Lo and MacKinlay (1990), we define r_t as the observable market portfolio return in period t, such that:

$$r_t = \frac{1}{N} \sum_i r_{it}.$$

Aggregating across all stocks, we can easily calculate the asymptotic distribution of the market return.

A.II. Skewness

Let us define p as the probability that $\Lambda_t^+ + (1-q)\Lambda_{t-1}^- > 0$. It is easy to compute p as $p = \frac{2}{\pi} \arctan \frac{1}{1-q}$. Then, using the Bayes's rule, we can compute

[37] Equivalently, we can assume $E(\beta_i) > 0$ for all i.

the unconditional distribution of returns:

$$\mathbb{P}(r_t > 0) = \frac{1+p}{4} \tag{A5}$$

$$\mathbb{P}(r_t < 0) = \frac{3-p}{4}. \tag{A6}$$

As $0 \leq p \leq 1$, we have the following result:[38]

PROPOSITION 1: *The market skewness when $q = 1$ is lower than for any q^o such that $0 < q^o < 1$. The expected market return is zero.*

A.III. R^2

Individual-stock R^2 is the R^2 of a regression of r_{it} on the observable market return, r_t. In our model, it is easy to see that R_i^2 equals the square of the correlation between r_{it} and r_t. Let us define R_i^{2+}as the R^2 of the regression of r_{it} on r_t, conditional on $r_t \geq 0$. Therefore

$$\begin{aligned} R_i^{2+} &= \mathrm{Corr}(r_{it}, r_t \,|\, r_t > 0)^2 \\ &= \frac{(\mathrm{Cov}(r_{it}, r_t \,|\, r_t > 0))^2}{\mathrm{Var}(r_{it} r_t > 0)\mathrm{Var}(r_t \,|\, r_t > 0)}. \end{aligned} \tag{A7}$$

We define R_i^{2-} similarly. Therefore we can derive expressions for $R^{2\pm}$, where $R^{2+} = \frac{1}{N}\sum_i R_i^{2+}$ and $R^{2-} = \frac{1}{N}\sum_i R_i^{2-}$, as follows:

$$R^{2+} = \frac{1}{1 + \dfrac{m \cdot (1+p)}{1 + M_2^+ - \dfrac{1}{1+p}(a + M_1^+)^2}} \tag{A8}$$

$$R^{2-} = \frac{1}{1 + \dfrac{m \cdot (3-p)}{Q}}, \tag{A9}$$

where

$$Q = 2 \cdot q^2 + M_2^- + (1-q)^2 + 2 \cdot q(1-q)a^2 - \frac{1}{3-p}(M_1^- - q \cdot a - a)^2 \tag{A10}$$

$$M_1^+ = a \times \left[\sqrt{2 + (-2+q) \cdot q} - (1-q)\right] \tag{A11}$$

$$M_2^+ = a^2 \times [(2 - q \cdot [2-q]) \cdot \mathrm{arccot}[1-q] - (1-q)] \tag{A12}$$

[38] Proofs are available from the authors upon request.

$$M_1^- = a\left[1 - \sqrt{2 - q \cdot (2 - q)}\right] \tag{A13}$$

$$M_2^- = \frac{1}{\pi} \cdot [\pi \cdot (2 + q \cdot (q - 2)) - 2 \cdot (1 - q) - 2 \cdot (2 + q \cdot (q - 2)) \cdot \operatorname{arccot}[1 - q]] \tag{A14}$$

$$a = \sqrt{\frac{2}{\pi}} \qquad m = \frac{\sigma^2}{\beta^2 \sigma_\Lambda^2}. \tag{A15}$$

The expressions for R^{2+} and R^{2-} are not monotone in q. However, we can easily prove the following result.

PROPOSITION 2: *There exists* $\overline{q} \in [0, 1]$ *such that, for all* $q < \overline{q}$, *the downside* R^2 *is decreasing in* q.

The model predicts that as q gets closer to 1, then the downside R^2 may increase[39] (depending on the ratio $\frac{\sigma^2}{\beta_i^2 \sigma_\Lambda^2}$. The reason is that, as above, as q tends to 1, the only information that is incorporated into the current returns is the information that is contained in the current market return (whether it is positive or negative), and therefore the R^2 increases. In the limit, when $q = 1$, both the upside and the downside R^2 are equal.

Finally, we can prove, in a similar fashion, a negative relationship between q and the difference $(R^{2-} - R^{2+})$.

PROPOSITION 3: *If* $0 < \frac{\sigma^2}{\beta_i^2 \sigma_\Lambda^2} < \infty$, *the difference* $(R^{2-} - R^{2+})$ *is decreasing in q for all* $q < \overline{q}$.

Our model also shows how the upside R^2 is also affected by the prohibition of short sales, that is, when negative market information cannot be immediately impounded into prices. The reason is that even if the current market shock is positive, then individual stock returns will fully incorporate the current positive market return if the previous market shock was negative, but it will also incorporate part of the negative past shock, so the upside R^{2-} is indeed lower.

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