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Martin T. Bohl,
Department of Business and Economics,
Westfälische Wilhelms-Universität Münster

and

Badye Essid,
Autorité des marchés financiers, Montréal

and

Pierre Siklos
Balsillie School of International Affairs and
Department of Economics, Wilfrid Laurier University,

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Martin T. Bohl*
Westfälische Wilhelms-University, Münster, Germany

Badye Essid
Autorité des marchés financiers, Montréal, QC, Canada

Pierre L. Siklos
Wilfrid Laurier University and Balsillie School of International Affairs,
Waterloo, ON, Canada

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ABSTRACT

This paper begins with the observation that short-selling bans spread globally in 2008. We find some evidence that the bans were unsuccessful at least insofar as they did not take into account the global component a short-selling ban which reduced equity returns in about a third of the 17 countries sampled, most notably in some of the major advanced economies. In the individual countries we examine, the bans had relatively little impact. Our results are suggestive as evidence that the bans stemmed further deterioration in stock prices that policy makers sought to avoid, at least in a few economies.

JEL Classification codes: G10, G12

Keywords: Short-selling bans, Spillovers, Stock markets, Dynamic conditional correlations

1. Introduction

Although the past few years have, for the most part, seen several stock markets surge around the world fears of an imminent correction in stock prices is always on the minds of investors, especially as central banks contemplate removing extraordinarily loose monetary policies, albeit very gradually and, with the possible exception of the US, not imminently. Events such as the 2013 'taper tantrum', and signals that central bank quantitative easing will eventually end, have all contributed to giving the impression that any upward trend in stock markets will be reversed. The BIS (2014, Chapter II), among others, points out that the compression of yields in bonds and similar financial instruments has spilled over into stocks in advanced economies especially, and there is every chance that the recent stock price rises will be undone once monetary conditions tighten. Indeed, some emerging market economies have experienced a sell-off of stocks although there is no evidence to date that a persistent downward movement in stock indices is underway. Arguably, recent events have contributed to raising policy uncertainty.[1] In the event of a stock market downturn, or if loose monetary policies are viewed by financial markets as being withdrawn too early, or there is an increase in regulatory uncertainty, a sharp or persistent decline in stock prices is more likely.[2] Since short sale bans tend to be imposed without warning (Battalio and Schultz 2011) studying the potential global spread of such bans remains relevant.

In the present study we are able to identify sharp changes in the dynamic conditional correlations across stock markets. Indeed, we report sharp increases in these correlations across markets that were previously uncorrelated. We attribute part of the increase to the global spread

[1] These phenomena are also reflected in the index of economic policy uncertainty developed by Baker, Bloom and Davis (2016).

[2] As this is written equity prices in China have declined rapidly and while a form of quantitative easing has been adopted by the People's Bank of China it also includes short selling restrictions (e.g., Wildau 2015). The global contribution of China's equity markets was also explored by Burdekin and Siklos (2011).

of short-selling bans during the financial crisis of 2008-2009. Since policy makers may well have reacted to what they perceived to be a common shock the imposition of the bans also had a comparable impact across the globe. We also find that the bans were not universally successful or had little or no impact in some of the individual countries examined. On this score, one cannot therefore exclude the possibility that the bans prevented a deterioration of returns, at least in some countries.

The possibility of a significant downturn in stock markets implies that short-sellers may well lead the way. As a result, the perennial question concerning whether short-selling exacerbates a downturn in stock prices is always on the minds of policy makers and academics. History is replete with episodes when regulators banned short-selling. However, a distinguishing characteristic of the global financial crisis that erupted in 2008 is that short-selling was quickly banned in many parts of the globe. The combination of greater global financial market integration and loose monetary policies has also resulted in a rise in the systemic component of risk (e.g., IMF 2014). Hence, policy makers who might otherwise not follow the lead of other jurisdictions and impose a short selling ban may well be tempted to follow suit even if observable economic conditions might not warrant such a step.

It is well-known that financial markets may appear coupled because comparable fundamentals drive asset price movements. Financial globalization has made it easier for investors to buy and sell stocks around the world. Yet, financial globalization should be associated with less not greater business cycle synchronisation (e.g., Kalemi-Ozcan et al. 2013). Hence, there might be less reason to expect the global spread of bans.

Accordingly, this paper begins with the observation, documented below, that short-selling bans spread globally beginning in 2008. We find some evidence that the extant literature has not been fully taken into account the global component associated with the bans. In the individual countries we investigate, the bans had relatively little impact. Nevertheless, the fact that the decline in stock returns was halted may be seen as evidence that the bans may have played a role in preventing an even greater deterioration in stock prices that policy makers sought to avoid.

It should also be borne in mind that, as the bans spread, central banks and governments would soon begin a historic loosening of monetary policy, some fiscal expansion, and the eventual reaching of the zero bound in nominal interest rates. While these events may also have contributed to giving the impression that the bans were delivering what they promised this would be a misinterpretation of events. These additional responses, however, came well after the imposition of short selling bans and took some time to take effect. Moreover, it is doubtful that investors could properly discount their impact as there was (and continues to be) considerable scepticism that unconventional monetary policies, in particular, would be effective and revers the effects of the global financial crisis.[3] Finally, the crisis of 2008, although up to a point certainly global in nature, did not produce a response in most economies comparable to the ones in the two advanced economies initially most directly implicated in the global financial crisis, namely the US and the UK.[4]

As will be shown later short selling bans spread quickly around the globe in the wake of the global financial crisis (also see Beber and Pagano 2013). Nor was this development unique to the events of 2007-2009 (e.g., Bris et al. 2007). Superficially then, these phenomena suggest the

[3] A large literature on the consequence of the financial crisis has, of course, emerged. Good general overviews of the events and the pros and cons of the policies enacted by central banks include Blinder (2013), Irwin (2013), and Bernanke (2015).
[4] The Eurozone would not enact similar policies until after the sample in this study ends.

possibility of inter-connectedness in the response of policy makers to developments, especially negative ones, in their own stock market. Investigating the correlation in stock returns and the role played by the imposition of short-selling bans requires that the resulting estimates should be conditioned on other factors that could also explain co-movements in returns. Moreover, since stock returns are volatile and there is the potential for a large number of stock markets to investigate researchers must be aware of the potential for the dimensionality of the problem to become large. For all these reasons we empirically investigate the links arising from the imposition of short-selling bans using an econometric technique appropriate to handling the difficulties just described. We estimate a model of stock returns relying on the dynamic conditional correlations (DCC) approach combining it with a GARCH model. The latter is typically the preferred methodology under the circumstances to estimate conditional volatilities. It should also be noted that we also experimented with other methodologies (see below), as a test of robustness, but do not report the relevant results as our principal conclusions are unaffected.

The rest of the paper is organized as follows. In section 2 we provide a brief literature review focusing on the nature and type of short-selling bans put in place in recent memory. Data employed are discussed in section 3 and in section 4 we provide a description of the econometric methodology. The empirical evidence is discussed in section 5 before concluding in section 6.

2. Short-Selling Bans and Stock Market Performance

Financial crises tempt policy makers to impose short-selling bans. The often stated fear is that large scale shorting will drive down stock prices contributing to a massive loss of confidence in financial markets. One feature of the financial crisis which originated in the US in 2007 is that short-selling restrictions appeared ‘contagious’. The reason is that several countries imposed restrictions of various durations and severity, in some cases simultaneously (Reuters 2009,

Mackintosh et al. 2009). Gruenewald et al. (2010a, 2010b) provide a descriptive overview of the legal aspects of the most recent bout of short sale restrictions imposed around the world.[5]

Table 1 provides a list of the markets in our sample and provides some information about the timing of short-selling bans. Beber and Pagano (2013), and Jain et al. (2013), are two other sources for the dates when short-selling bans were imposed. The dates are virtually the same across the sources examined.[6] The UK led the way followed closely by the US. Countries in the Eurozone tend to have banned financial stocks with most retaining a ban well after the worst of the crisis ended. Of course, the sovereign debt crisis in the single currency area continues to linger. In a few other countries (e.g., Canada, the UK, the US) the bans were short-lived. With only two exceptions (Malaysia and India) the bans were introduced on the heels of the global financial crisis which erupted in the US in 2008. Bans are equally distributed in the data set between ones that were applied to all stocks versus a ban of financial stocks.[7]

There exists a rich and diverse literature assessing the impact of short selling restrictions. Space constraints prevent a complete analysis of various facets of the impact of imposing short-selling constraints. We focus on a very few aspects that are germane to our empirical study. Bris et al. (2007) provide many of the most important references on the topic (also, see Bai et al. 2006). Beber and Pagano (2013) and Jain et al. (2013) are studies that, like ours, take a global view of the short-sale restrictions during the 2007-2009 period.

[5] Recent comprehensive economic and statistical analyses of the impact of short sale constraints are found in Bris et al. (2007), and Charoenrook and Daouk (2009).

[6] Beber and Pagano's (2013) data set also includes Belgium, the Czech Republic, Finland, Hong Kong (no ban imposed), Hungary, Ireland, Israel (no ban imposed), Luxembourg, Netherlands, Poland, Singapore (no ban imposed), Slovenia, and Spain. Ten of the thirteen countries not examined in our study are in Europe and the other three did not impose a short-selling ban.

[7] We also collected data on financial sector stock indexes for those countries that imposed a ban on financial stocks. There does not seem to be any difference between focusing on aggregate versus sector-specific indexes. Hence, in what follows, the evidence reported below is based on market-wide equity returns.

The onset of a crisis appears to whet the appetite of regulators in favour of banning of short-selling opportunities. Their logic is that a downward movement in stock prices will be exacerbated by short sellers. Yet, as pointed out by Engelberg et al. (2012), the evidence that short-selling bans of all types create a variety of distortions in stock markets is "overwhelming". Similarly, other observers (e.g., Blinder 2013, p. 282) have suggested that "…short-selling probably kept the housing and bond bubbles from blowing up even bigger than they did." Nevertheless, a theoretical exists that short-selling restrictions can increase the likelihood of stock market crashes (Abreu and Brunnermeier 2003, Scheinkmann and Xiong 2003). Theoretical models also find that short-selling bans increase the prospect of stock market bubbles and lead to excessive stock market volatility. Of course, a short-selling ban is often introduced at a time when economic conditions are weaker.[8]

Short-selling distorts markets because it hinders the ability of markets to engage in price discovery (Boehmer and Wu 2009). In the absence of short-sale restrictions, stock prices ought to be determined according to underlying fundamentals. Instead, a ban will exclude relatively well-informed market participants leading to the overpricing of equities (Miller 1977). Banning the shorting of stocks also impacts liquidity which is reduced as informed investors withdraw from the market (e.g., Boehmer et al. 2008). Moreover, models of investor behaviour have implications for higher moments of the distribution of returns, reflected in the volatility and skewness of returns.[9] Yet, the fear that engaging in short selling increases the frequency of large negative returns (i.e., stock market crashes) is not supported by the available empirical evidence

[8] Empirical evidence suggests that the volatility of stocks is higher in recessions (Hamilton and Lin 1996) or when returns are negative (Bekaert and Wu 2000). Changes in the volatility of stock returns have also been associated with increases in political tensions (Bittlingmayer 1998).

[9] Bris et al. (2007) report strong evidence that the removal of short sale restrictions is associated with more negative skewness in returns, based on a large cross-section of countries including China. In an equally large panel analysis by Charoenrook and Daouk (2009) find no significant impact on skewness from short selling bans.

(Bris et al. 2007, Saffi and Sigurdson 2008). Indeed, short selling bans produce may result in asymmetric effects in the behaviour of higher moments in the distribution of stock returns (e.g., Bohl et al. 2012).

From the perspective of this study we are also interested in the role of information as it pertains to the impact of short-selling bans. However, our focus is on the global impact of this type of policy as well as on the influence that bans have on aggregate equity prices.[10] As noted above, this aspect of the relevant literature has not been investigated as intensively. Financial globalization has prompted regulators to consider that they must deal with spillovers onto other markets. This raise the issue of the reach of regulators as well as the possibility that the global spread of short selling bans during the global financial crisis was no accident. It is with this in mind that we proceed next to an empirical investigation of the international consequences arising from the imposition of various short selling bans around the world since 2007.

[10] An issue that is occasionally raised is whether the type of short sale ban can make a difference. Generally, bans come in three types. The most prevalent is the covered short selling ban, followed by naked short selling bans (i.e., sale of securities without borrowing them for delivery to the buyer). Short sale bans can also be influenced by the regulators' disclosure requirements. Although the differences may matter empirical evidence (e.g., see Bernal et al. 2014, Liu et al. 2013) suggest that these distinctions matter less for our proposed empirical study. Finally, the claim has been made that, in the event of a ban on short selling, investors turn to options. Battalio and Schultz (2012) find strong evidence against this claim (also, see Bohl et al. (2012) for a similar conclusion in the case of Taiwan).

3. Data

We rely on daily stock price indices from December 1995 to December 2013, covering global stock markets from Europe, Asia and North America. A total of 18 stock markets are considered.[11] The choice of a long sample is to facilitate investigating the impact of short-selling bans before, during and after the policies were put into place. The data set includes FTSE price indices for Australia, Japan, South Korea, India, Indonesia, Malaysia, Canada, US, Norway, Denmark, Germany, Austria, Switzerland, France, Portugal, Greece and Italy. All data were obtained from Datastream. Hence, a selection of both advanced and emerging market economies are included. Although the financial crisis that began in 2007 was global economic activity in the latter group of countries was less affected.

All of the countries included in our set imposed some sort of a ban on short -selling. More often than not the ban was limited to financial stocks. Occasionally, the short-selling ban extended to all stocks. In the cases of Japan, Germany and Portugal there were also bans on naked short-selling. We considered these on the same footing as ordinary short-selling bans. For our purposes, and the literature review of the previous section provides some support for this view, we make no distinction between the two types of short-selling bans.[12]

[11] There is the risk that our sample is selectively biased. However, this is unlikely to pose a difficulty for at least four reasons. First, the timing, duration, and precise details of the bans (see Table 1) differs across countries. Second, there are other regulatory constraints (e.g., limitations of capital mobility) that may also play a role in how returns are internationally correlated. Third, our hypothesis does not rest specifically on fundamentals to explain changes in correlation of returns; finally, our sample includes periods when there were no short selling bans at all. Hence, we can compare ban and no ban samples. Nevertheless, as will be emphasized below, our evidence is suggestive, and not causal, nor can we exclude the possibility that other latent factors are also at play, especially during the global financial crisis.

[12] In any event, attempts to empirically distinguish among types of bans did not alter our conclusions.

4. Methodology

Our aim is to investigate the consequences of the spread of short selling bans around the world. Accordingly, we estimate DCC multivariate GARCH models developed by Engle (2002).[13] The multivariate DCC-GARCH model provides all possible correlations for the index returns included in our set. Therefore, we are able to study the behavior of the returns during periods of particular interest.

Our empirical estimation of the cross-country spillovers in the adoption of short-selling restrictions on the stock market is based on the following specification:

$$r_t^i = \alpha_{i,0} + \sum_{k=1}^{4} \alpha_{i,k} D_{kt} + \beta_{i,1} r_{t-1}^i + \beta_{i,2} r_{t-1}^* + \beta_{i,3} r_{t-1}^i D_t^* + \beta_{i,4} D_t^i + \varepsilon_{i,t} \quad (1)$$

$$h_{ii,t} = \omega_i + \gamma_{i,1} \varepsilon_{i,t-1}^2 + \gamma_{i,2} h_{ii,t-1} \quad (2)$$

$$q_{ij,t} = \overline{\rho}_{ij}(1-a-b) + b q_{ij,t-1} + a \xi_{i,t-1} \xi_{j,t-1} \quad (3)$$

$$\rho_{ij,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t}}\sqrt{q_{jj,t}}}, \text{ for i} \neq \text{j} \quad (4)$$

Equation (1) is the mean equation; equations (2) and (3) are the variance equation; (4) represent the dynamic conditional correlations. Returns for country i (r_t^i) are defined as 100 times the logarithmic difference in the levels of the indices, $r^i{}_t = \ln P^i{}_t - \ln P^i{}_{t-1}$, and the residual term in equation (1), $\varepsilon_{i,t} = N(0, h_{ii,t})$, denotes the unpredictable component of stock index returns.

[13] Empirical findings on EGARCH, MGARCH and DCC models are available on request largely because none of the conclusions reported below are affected. Moreover, it is well known that MGARCH models easily become over-parameterized and this is especially the case when the investigator wishes to allow for asymmetric effects. Also, there are a number of other outstanding statistical issues around the estimation of such models that remain unanswered (Silvennoinen and Teräsvirta 2008).

$\sum_{k=1}^{4} D_{kt}$ is a day of the week dummy variables for Tuesday, Wednesday, Thursday and Friday $k = 1,...,4$. D_t^i is a dummy that captures the period of ban on short-selling for country i. $\beta_{i,3}$ represents the interaction effect of the bans on stock market returns. Hence, $\beta_{i,4}$ measures the own-country impact of the short-selling ban. The dummy variable takes on the value of 1 for days of ban and 0 otherwise.

Equation (1), therefore, posits that domestic stock returns are driven by own country and foreign country returns. Additionally, we allow for possible day of the week effects. Our principal interest, however, lies in estimating the impact from the imposition of short-selling bans which are modelled via shift and interaction dummies. Other than the mean specification the remaining equations are standard. Equation (2) is the widely used GARCH(1,1) specification. Equation (3) is a generalized version of Bollerslev's (1990) constant conditional correlation estimator. One of the focuses of the empirical analysis below is equation (4) which represents the time-varying conditional correlations (also see, for example, Tsay (2010), chapter 10).

To estimate interdependence in the imposition of short-selling bans, we interacted the dummy variable for bans in the first country which imposed the ban with the returns of each country (D^*). Both London and New York, globally both the largest and most important financial centres, originated the bans. The transmission of bans from the UK (or the US) to other countries serves as the starting point for possible 'contagion' like spread of bans around the world.[14] Therefore, we are especially interested in estimates for $\beta_{i,3}$ since this coefficient captures return behavior in country *i* conditional the first mover country's decision to ban short selling. In other

[14] Since decisions to impose short selling bans is made without any explicit mechanism for the relevant authorities to coordinate them the UK (or US) decisions can be viewed as exogenous.

words, the interaction term represents a proxy for the cross-country spillover effects from the imposition of the short selling bans.[15] We also add a variable to capture the purely domestic impact of short sale restrictions. Therefore, $\beta_{i,4}$ measures the effect of local short selling bans in market i on local returns. The addition of lagged stock index returns, r_{t-1}, serves to detect autocorrelation of returns.

While the DCC approach has the virtues of simplicity and is able to deal with the curse of dimensionality in a straightforward manner, which is critical when estimating relatively large systems of equations, it no panacea. Aielli (2013) points out that DCCs can be inconsistently estimated while Caporin and McAleer (2012) suggest that the multivariate GARCH approach is preferable, at least in small systems, because the standardization employed in typical DCC estimation is not unique. Caporin and McAleer (2013) highlight other problems. Nevertheless, the literature does seem to strongly support the DCC technique as a useful diagnostic and inference tool.

5. Empirical Results

For ease of exposition we present the results of the multivariate DCC-GARCH model estimated for a variety of country groupings chosen according to geographical areas.[16] As noted previously, all data are daily and cover the sample from December 1995 to December 2013. The focus of the analysis centres on the global financial crisis, dated from June 7, 2007 to July 15, 2010.[17]

[15] The US, Canada, and Switzerland also imposed bans on the same day.
[16] This also simplifies problems arising from different closing hours on markets around the world.
[17] The dates are based on the chronology of the financial crisis published by the Federal Reserve Bank of St. Louis. See https://www.stlouisfed.org/financial-crisis/full-timeline#2010.

An obvious alternative to the UK as the benchmark is to use the US. However, the US ban was imposed for such a short time (19 days) it is doubtful that the tests conducted here would be able to pick up any impact. US regulators also made it clear that the ban was to be temporary. UK regulators were less clear on the length of time the ban would be in place. In addition the UK serves as a good benchmark since half the countries in our sample (9) are in Europe. Note also that the sample in Beber and Pagano (2013) is also heavily represented by European markets.

Because of events in Europe since 2010[18] we also further sub-divide countries in Europe according to whether they were directly impacted economically by the sovereign debt crisis in that continent. The groupings are: Europe 1 (Norway, Denmark and Germany), Europe 2 (Portugal, Greece and Italy). The Asia-Pacific is also sub-divided by geography and proximity, as follows: Asia 1 (Australia, Japan and South Korea), Asia 2 (India, Indonesia and Malaysia). Finally, the North American continent consists only of two countries, namely Canada and the US. Experimentation with larger country groupings as well as different combinations of countries did not impact the conclusions (not shown).

Table 2 presents the coefficient estimates for the spillover effects from the imposition of short-selling bans ($\beta_{i,3}$). For the full sample the coefficient estimates shown consider the impact of excluding day of the week dummies to determine how sensitive the results are to changes in the specification. With the exception of Germany and Italy, excluding the day of the week dummies has no impact on estimates of the interaction effect between short selling band and returns. Nevertheless, in the remaining specifications, we retain these dummies.

[18] May 2010 (May 5th in particular) is sometimes thought to be the start of the crisis in Europe since it marks the date when the European Union announced loan packages to deal with solvency problems in some of the member countries.

More precisely, the coefficient estimates shown show the impact on domestic returns arising from the interaction effect between the ban by the first mover (here the UK), where this policy was first initiated and which serves as the potential trigger for bans elsewhere in the world, and the impact on lagged returns from the imposition of short-selling bans.[19] To the extent that too much weight might be given to the role of the first mover in the global spread of short-selling bans we also estimate a variety of factor models. These factor models (results not shown) are used to identify a 'global' element in returns.[20] Hence, we provide an alternative proxy for the possibility that there exists an international component in the spread of short-selling bans that builds on the first move taken here by UK authorities. Alternatively, one may view the factor model as seeking to capture the bandwagon effect of the short-sale bans as these spread across the globe. Finally, we also present estimates for sub-samples that exclude or include the period of the global financial crisis as well as full sample estimates where first mover returns are replaced by the first principal component from all the returns in the data set. The sub-sample estimates are meant to address the possibility that spillover effects may have been more intensive or more likely to have become significant during the height of the financial crisis, that is, beginning in September 2008, than when at least one of widely adopted chronologies dates the financial crisis as having been well underway by June 2007, that is, before any short-sale bans were put into place.

Notably, we find that in the US, the short-selling ban did not lead to lower returns during the crisis samples alone. However, if we also consider the full sample the bans did not prevent lower returns. If 'normal' times represent the appropriate benchmark then the full sample estimates

[19] Our specification also controls for lagged UK returns to avoid confounding the impact of the ban and any other changes related to developments in UK financial markets.
[20] This is a common approach used in the literature, especially dealing with the effects of the global financial crisis on financial markets. For example, see Rogers, Scotti, and Wright (2014).

suggest that the ban was ineffective. This result also holds for Australia, South Korea and Germany.

With the possible exception of India, whether or not spillover effects are found are insensitive to whether first mover returns are used or a single global factor is used to represent spillovers from international stock markets (alternative case shown in table 2). There is relatively little impact from dating the sample as beginning in June 2007 versus September 2008. Only for the US, India, Denmark and Austria are the spillover effects sensitive to sample choice (sub sample cases shown in table 2). India's equity markets are likely divorced from those in the other parts of the world included in our sample in large part because of capital controls (e.g., see Hutchison et al. 2011). Therefore, estimates that focus on the period around the GFC would likely see few spillovers into India from short-selling bans in advanced economies.

Economies in our sample in the Eurozone or in the European Union did not see a reduction in stock returns an indication that the spillover effects from the core of the crisis had no impact. The estimates therefore are not inconsistent with the success of the ban in some economies. However, it is worth noting again that the dominant economy, namely Germany, was not spared the negative effects from the ban. The fact that the negative spillover effects did not extend globally is worthy of note. Nevertheless, the bans did not prevent a negative impact in some critical advanced economies, notably the US, South Korea, and Germany. Overall then there is considerable evidence of some spillover effects which supports our contention that there was a global dimension to the imposition of a short sale ban.

Table 3 asks whether, conditional on spillover effects from abroad, there are domestic repercussions to the imposition of a ban on short-selling (The coefficient shown is $\beta_{i,4}$ in

equation (1)). In Germany the local ban found to further depress domestic stock returns beyond the global effects of the short-sale ban first imposed by UK authorities (GFC and SS ban columns). In the case of Korea the results are sensitive to sample choice and, hence, do not appear to be reliable. In the case of Malaysia since the results are significant for samples that focus on the period of the global financial crisis when Malaysian authorities already had a long standing a short sale ban (see Table 1) it is conceivable that the Malaysian market reflects a safe haven of sorts from the ban on short-selling. Note that the global factor is still negative so even in this case the international impact of the short sale ban could not be avoided entirely. Finally, for Japan and the US, the two largest economies in the data set, the ban is only seen to have a small return reducing effect either when the global financial crisis period is assumed to extend back to 2007 or when global returns are considered as the mechanism through which external returns influence domestic returns. Nevertheless, the US effect is large and reflects its central position in the global financial system.

Table 4 presents a selection of DCC model estimation results. These confirm substantial time-varying co-movements in conditional volatility. Indeed, estimates of parameters *a* and *b* in equation (3) as well as the DCC estimates shown suggest a high degree of volatility persistence. The fact that the estimates are comparable across the different grouping of countries considered also suggest that larger country groupings, which were also examined (not shown) do not have a significant impact on the conclusions discussed above.

Finally, Figure 1 provides some additional insights obtained by estimating dynamic conditional correlations approach by focusing on two interesting cases. They are: Canada, the US, Japan and Korea. Canada and the US represent two highly integrated economies and have been so, both financially and economically, for a considerable period of time. Nevertheless, it is

well-known that Canada did not experience any crisis in its financial system following the events of 2008-2009 although it was pulled into a brief but relatively milder recession than its neighbour to the South. In the case of Japan and Korea the former country has been mired in a mild deflation and continues to suffer from the aftermath of bubbles that burst two decades ago while Korea is a relatively rapidly growing economy hard hit by the global financial crisis.

The dynamic correlations between the US and Canada are seen to remain high throughout the entire sample. Only during the height of the financial crisis are there signs of a sharp fall in the correlation of returns. In other words, the high degree of economic integration between the two economies but different experiences in the fallout from the financial crisis in their respective financial sectors did result in some decoupling. Thereafter the historical pattern of dynamic correlations resumes.

Turning to the case of Japan and Korea we see the rapid rise in dynamic correlations during the early 2000s as financial globalization gains pace and in spite of the dot com financial crisis in the US. By the mid-2000s the correlations reach levels already attained for some time between Canada and the US. It is also notable that the dynamic correlations rose during the early phases of the global financial crisis only to be reversed. Hence, and in spite of the differential impact of the global financial crisis on the real and financial sectors of both economies, both equity markets are influenced by the global component of movement in stock returns. It may also be noted that Korea was one of the countries that benefited from swap arrangements with the Fed and this, as well as the fact that Asia was a less directly affected region by the crisis may also have contributed to the behaviour of dynamic correlations during the GFC. Nevertheless, as in the Canada-US example, a complete decoupling is not evident.

The foregoing two illustrations confirm that the spread of short selling bans did not succeed in decoupling equity markets. Of course, our estimates are unable to determine the counterfactual, namely whether stock returns might have declined even more had short sale bans not spread globally.

6. Conclusions

To the extent that regulators around the globe sought to prevent further reductions in stock returns through the imposition of a ban on short-selling there is some evidence that they were unsuccessful at least insofar as this did not factor in the possibility that there is a global component to the impact that such a ban might have had which further depressed equity returns in several countries. Domestically, the bans had less or little impact though the fact that returns do not appear to show a decline may be seen by proponents of a ban as evidence that the bans stemmed further deterioration in stock prices that policy makers sought to avoid. Whether the bans themselves can take the credit is unclear although one might have expected further reductions in returns as a result of deteriorating financial and economic conditions after 2007 offset by liquidity and confidence boosting policies in the immediate aftermath of the global financial crisis.

Our results add to the analysis of short selling bans by drawing attention and empirically measuring the spillover effects of such bans. Even if the global financial crisis had different economic and financial effects around the globe regulators reacted in a similar fashion by showing a tendency to ban the short-selling of stocks. Nevertheless, there were differences in both the kind of stocks banned from short sale trades as well as the length of time the bans were in place. It is likely that future financial crises, combined with a sharp rise in dynamic

conditional correlations across equity markets in recent years may raise more persistent spillovers leading to authorities reacting jointly to perceived threats in stock markets.

The proximate explanation for this development is, of course, the concern to maintain financial system stability. What is unclear is whether the global response of policy makers who, more or less simultaneously, imposed short selling bans had unintended consequences. Based on the extant literature and the results reported in this study, it is unlikely that the degree of coupling or decoupling of global financial markets is affected. In contrast, regulatory uncertainty will have increased. Future research ought to attempt to more precisely pin down the sources of changes, if any, spillovers in the quality (i.e., price effects, bid-ask spreads) from the global imposition of bans. Moreover, in view of the potential difficulties with DCC estimation, alternative estimation approaches could also be applied. Scope for future research is also given by an empirical investigation of the importance of cross listed stocks as potential drivers of correlation of stock returns across countries. In addition, the quantitative impact of alternatives to short-selling, like put options as a substitute for short-sales, could be considered as an explanation for the limited impact of short-selling bans. Moreover, different bank and company characteristics with respect to their impact on the empirical findings could be taken into account.

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Table 1 Short-Selling Bans Around the World

Country	Authority	Ban Introduced	Ban Repealed	Nature of the Ban
		MM/DD/YEAR		
Australia	ASIC	09/21/2008	05/25/2009	SS Ban – ALL
Austria	WB	10/26/2008	In effect	SS Ban/NSS - FIN
Canada	OSC	09/19/2008	10/08/2008	SS Ban - ALL
Denmark	Finanstilsynet	10/13/2008	11/01/2012	SS Ban/NSS – FIN*
France	AMF	22/09/2008	In effect	SS Ban/NSS – FIN
Germany	BaFin	09/20/2008	03/31/2011	NSS Ban - FIN
Greece	HCMC	10/10/2008	06/01/2009	SS Ban - ALL
India	BSE	05/04/2009	In effect	SS Ban - ALL
Indonesia	IDX	10/01/2008	04/30/2009	SS Ban - ALL
Italy	Consob	09/22/2008	In effect	SS Ban/NSS Ban - ALL
Japan	FSA	10/20/2008	07/31/2010	NSS Ban - ALL
Malaysia	Bank Negara	08/08/1997	03/24/2006	SS Ban - ALL
Norway	Kredittilsynet	10/08/2008	10/09/2008	SS Ban - FIN
Portugal	CMVM	09/23/2008	In effect	NSS Ban - FIN
South Korea	FSC	10/01/2008	06/01/2009	SS Ban – ALL**
Switzerland	SIX	09/19/2008	01/16/2009	SS Ban - FIN
UK	FSA	09/19/2008	01/16/2009	SS Ban - FIN
US	SEC	09/19/2008	10/08/2008	SS Ban - FIN

NOTES: * unless for hedging; some ban on naked short-selling still in place. ALL means all stocks, FIN means financial stocks. SS ban refers to a ban on short-selling; NSS refers to a ban on naked short-selling.

Table 2 Spillover Effects from Short-Selling Bans: Global Evidence

	Sub samples				Alternative
Period	sept 2008-July 2010 GLOBAL FINANCIAL CRISIS		June 2007-Dec2013		Full sample
	No D_{kt} (day of the week dummy)	With D_{kt} (day of the week dummy)	With SS ban Dummy	With GFC dummy	Global Factor
Country					
Canada	0.082 (.074)	0.083 (.071)	0.098 (.073)	0.098 (.073)	0.012 (.062)
US	-0.155** (.075)	-0.155** (.074)	-0.088 (.075)	-0.088 (.075)	-0.203*** (.070)
Japan	-0.120 (.077)	-0.123* (.068)	-0.084 (.066)	-0.085 (.066)	-0.098 (.078)
Australia	-0.161** (.085)	-0.162** (.077)	-0.164*** (.066)	-0.164*** (.066)	-0.149** (.073)
South Korea	-0.150* (.085)	-0.150* (.081)	-0.121* (.064)	-0.121* (.063)	-0.142* (.077)
India	-0.172* (.093)	-0.169* (.095)	-0.151 (.097)	-0.151 (.097)	-0.114 (.085)
Indonesia	-0.092 (.099)	-0.099 (.107)	0.050*** (.010)	0.049*** (.010)	0.098 (.097)
Malaysia	-0.175** (.083)	-0.174* (.091)	-0.168*** (.076)	-0.168** (.076)	-0.054 (.068)
Norway	0.052 (.065)	-0.018 (.054)	0.024 (.043)	0.024 (.043)	-0.008 (.050)
Germany	-0.016 (.073)	-0.134*** (.044)	-0.133*** (.046)	-0.133*** (.046)	-0.084*** (.033)
Denmark	0.123** (.064)	0.076 (.048)	0.133*** (.043)	0.133*** (.043)	0.092** (.040)
Austria	0.049	0.061	0.090**	0.101*	0.075

	(.061)	(.055)	(.044)	(.054)	(.056)
Switzerland	-0.073 (.063)	-0.020 (.037)	-0.005 (.036)	0.001 (.034)	-0.035 (.046)
France	-0.074 (.059)	-0.031 (.026)	-0.024 (.028)	-0.021 (.029)	-0.061** (.029)
Portugal	-0.028 (.070)	0.012 (.047)	0.029 (.051)	0.031 (.051)	-0.004 (.045)
Greece	-0.023 (.070)	0.078 (.061)	0.123 (.072)	0.112* (.071)	0.048 (.065)
Italy	-0.011 (.069)	0.098*** (.035)	0.071* (.037)	0.061 (.039)	0.059 (.040)

Note: Estimates of $\beta_{i,3}$ in equation (1). Standard errors in parenthesis. *** Means statistically significant at the 1% (**, 5%; *, 10%) level. The various dummies are described in the text. GFC means global financial crisis, SS is short selling. See text for additional details.

Table 3 Own-Country Impact of Short Selling Bans

Country	Full	GFC	SS Ban	Global Factor
Canada	-0.176 (.950)	-0.542 (1.039)	-0.490 (.995)	-0.719 (.631)
USA	-1.133 (.871)	-1.060 (.930)	-1.017 (.919)	-1.213 (.676)*
Japan	-0.009 (.048)	-0.055 (.043)	-0.077 (.042)*	-0.020 (.053)
Australia	0.045 (.126)	0.037 (.142)	0.032 (.140)	0.022 (.130)
South Korea	0.018 (.034)	0.036 (.065)	0.100 (.037)***	0.019 (.027)
India	0.057 (.035)*	-0.047 (.083)	0.124 (.116)	-0.071 (.040)*
Indonesia	0.123 (.184)	0.177 (.193)	0.128 (.202)	0.236 (.150)
Malaysia	-0.029 (.019)	0.766 (.000)***	0.201 (.000)***	-0.036 (.022)*
Norway	1.609 (2.152)	3.393 (2.353)	3.284 (1.840)*	1.493 (1.833)
Germany	-0.037 (.030)	-0.057 (.029)**	-0.051 (.042)	-0.009 (.022)
Denmark	0.015 (.022)	0.020 (.039)	0.021 (.042)	0.025 (.022)
Austria	0.006 (.034)	-0.0003 (.046)	-0.026 (.082)	-0.003 (.028)
Switzerland	-0.043 (.065)	-0.004 (.115)	-0.106 (.117)	-0.069 (.131)
France	-0.013 (.018)	-0.026 (.032)	-0.027 (.044)	-0.006 (.016)
Portugal	-0.005 (.026)	0.035 (.058)	NA	0.007 (.028)
Greece	0.009 (.074)	0.040 (.077)	NA	-0.001 (.073)
Italy	-0.017 (.026)	0.020 (.005)	NA	-0.008 (.025)

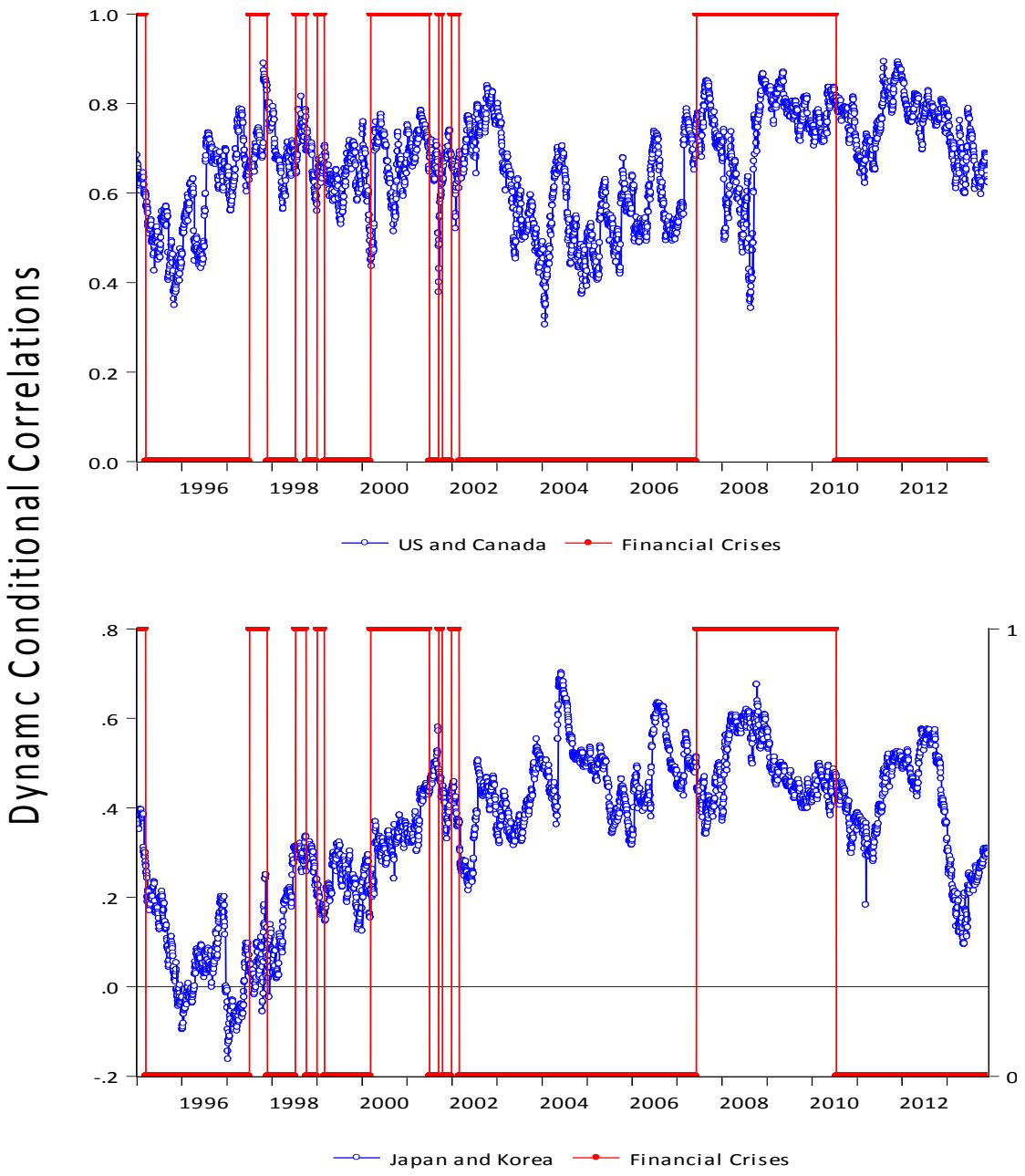
Note: Standard errors in parenthesis. *** Means statistically significant at the 1% (**, 5%; *, 10%) level. The coefficients shown are estimates of $\beta_{i,4}$. See Table 2 for sample definitions. Also, see notes to Table 2.

Table 4 Time-Varying Co-movements and Volatility Persistence

Country	a	b	DCC(1)	DCC(2)
USA	0.074 (.005)	0.893 (.011)		
Canada	0.065 (.005)	0.917 (.009)	0.028 (.004)	0.967 (.005)
Australia	0.065 (.006)	0.889 (.003)		
Japan	0.063 (.006)	0.840 (.027)		
South Korea	0.063 (.005)	0.886 (.014)	0.014 (.002)	0.984 (.002)
India	0.092 (.005)	0.896 (.012)		
Indonesia	0.096 (.008)	0.906 (.011)		
Malaysia	0.084 (.007)	0.868 (.023)	0.013 (.002)	0.986 (.002)
Norway	0.051 (.006)	0.958 (.007)		
Germany	0.075 (.007)	0.908 (.013)		
Denmark	0.067 (.008)	0.855 (.025)	0.010 (.0001)	0.990 (.002)
Austria	0.051 (.004)	0.927 (.010)		
France	0.046 (.005)	0.911 (.016)		
Switzerland	0.043 (.005)	0.925 (.023)	0.021 (.002)	0.978 (.002)
Portugal	0.046 (.006)	0.895 (.022)		
Greece	0.063 (.007)	0.926 (.010)		
Italy	0.056 (.006)	0.890 (.015)	0.009 (.002)	0.990 (.002)

Note: All estimates shown above are statistically significant at the 1% level of significance. The coefficients are from equation (3), $q_{ij,t} = \overline{\rho}_{ij}(1 - a - b) + bq_{ij,t-1} + a\xi_{i,t-1}\xi_{j,t-1}$. See the text for more details.

Figure 1 Dynamic Conditional Correlations, Financial Crises and Short Selling Bans



Note: the vertical lines represent various major events thorough the sample, including the global financial crisis (June 7, 2007 – July 15, 2010). The others include the dot com bubble, September 2011, the LCTM crisis, Russian and other defaults.