Are Shorts Equally Informed?

A Global Perspective

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Keywords: Pricing Efficiency, Short Selling, Costs of Short Selling, Short Sale Regulations.

JEL code: G14, G12

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Abstract

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1. Introduction

Theory suggests that short selling plays an important role in preventing overpricing and the creation of price bubbles (Hong and Stein, 2003). Diamond and Verrecchia (1987) argue that a concentration of informed traders is more likely among short sellers because of the higher risk and costs of these trades. A number of U.S. studies provide empirical support for these claims, showing that short sellers target overvalued stocks (Desai, Ramesh, Thiagarajan, and Balachandran, 2002; Asquith, Pathak, and Ritter, 2005) and effectively avoid underpriced stocks (Boehmer, Huszár, and Jordan, 2010). Active shorting and/or large short positions have also been found to predict negative returns in Canada (Ackert and Athanassakos, 2005), Australia (Aitken, Frino, McCorry, and Swan, 1998), Hong Kong (Chang and Yu, 2004; Chan, Wan Kot, and Ni, 2012), and Japan (Takahashi, 2010). On the other hand, regulations and market quality differ significantly across countries, and it might not be surprising that shorts aren't necessarily informative everywhere. For instance, in countries with strict short sale regulation and/or poor market liquidity, such as China or South Africa, shorting could be too costly and/or too limited in scale to be an effective tool for arbitrage.

In this paper, we ask whether short sales are informed across all countries, and if there are cross-country differences, we consider economic mechanisms that can explain the differences. To be more specific, we examine short's predictive power for stock returns in 25 countries from July 2006 to August 2010. We construct seven measures of shorting activity that measure shorting intensity, and supply of shorting in terms of fees and shares available. With the exception of stock loan supply, our short-sale constraint measure, all of our measures significantly predict risk-adjusted future returns. But the magnitude of these results, and the channels through which short selling affects future prices, differ significantly across countries.

We explain these differences using data on country-level regulation on short selling, market quality measures, and country openness measures. More restrictive regulations, such as naked shorting bans or uptick rules, as well as high openness and better investor protection, strengthen the return predictability of shorting measures. On the other hand, the existence of a centralized stock lending market and low trading activity in the market weakens the return predictability of shorting. Overall, regulations, market quality and market openness characteristics help to explain cross-country variation in the predictive power of shorts sales for future returns. Our findings suggest that one-size-fits-all short-sale regulation is unlikely to deliver the intended results. Instead, to be effective, regulation needs to be tailored to each market's institutional and existing regulatory environment.

Comparing with the existing cross-country studies, we are the first to offer global insights on which short measures work across countries and why. Most current studies focus on regulatory issues, such as whether short-sale restrictions are beneficial in maintaining price stability or harmful in delaying or reducing price discovery. Bris, Goetzmann, and Zhu (2007) and Saffi and Sigurdsson (2011) find that markets that permit shorting or those in which short selling is actively practiced exhibit greater price efficiency and a lower frequency of extreme returns. Complementary evidence is provided by studies that examine new restrictions introduced in the wake of the recent global financial crisis, such as bans on naked short selling. Beber and Pagano (2013) and Boehmer, Jones, and Zhang (2013) both find that the bans on financial stocks and the naked short bans introduced in several countries are associated with a decline in market quality. There are also international studies exploring short sellers' role in price discovery around corporate events (Massa, Zhang, and Zhang, 2012) and default prediction (Maffatt, Owan, and

Srinivasan, 2013). They suggest that the presence of short sellers is a corporate governance tool that reduces earnings manipulation and enhances price informativeness.

We expand previous studies into two directions. First, we are one of the first studies to examine various shorting measures' informativeness across a wide set of countries. We find that the majority of the shorting measures are informative across countries, but their informativeness varies substantially across countries. For instance, the informativeness of the shorting measures is stronger in developed countries than in emerging markets, while there is not much difference across geographic regions. We also find that in the PIGS countries shorting is relatively uninformative, possibly because government interventions and the ongoing debt crisis systemically disrupted information processing in asset markets.

Second, we investigate how these cross-country differences arise by connecting shorts' predictive power to measures of short sale regulation, market quality and country openness. We consider three types of market regulations—an uptick rule, a naked short ban, and the presence of a centralized securities borrowing and lending (SBL) market. We find that more restrictive regulations significantly increase shorts' informativeness, consistent with the idea that increasingly expensive short selling drives less well informed short sellers out of the market. We are the first to show that a centralized lending market weakens the return predictability of short sales, possibly reflecting the same argument. A centralized lending market reduces the cost of short selling, and thus attracts less well informed traders. Lower trading costs improve the return predictability of shorting, reflecting the higher arbitrage profits that are necessary to break even with higher transaction costs. For the openness measures, countries with better accessibility and better invest protections have better informed shorts.

The paper is organized as follows. Section 2 introduces our data and variables. Section 3 reports our basic results about the cross-country variation in short-sales informativeness. Section 4 links the cross-country variation to short sale regulations, market quality measures and country openness measures. Section 5 concludes.

2. Data and Variables

2.1. Data

Our data cover world-wide stock lending from July 3, 2006 to August 13, 2010. Our time frame is restricted by data availability on stock lending from Data Explorers (now Markit Securities). We additionally collect data on stock returns, trading volume, share prices, total number of shares, and book equity from Datastream for all countries with reliable coverage in Data Explorers. We exclude Brazil, China, Indonesia, Malaysia, Greece, Ireland, Israel, New Zealand, Thailand and the Philippines either because Data Explorers on average reports on fewer than 10 stocks for these countries, or because the available time span is limited. Our final sample includes 25 countries, for which we have at least 10 stocks for each trading day with data coverage from both Data Explorers and Datastream.

To stay away from outliers, we apply filters to our return and short-selling data. For each country, we exclude observations with fee spread that's higher than the 99 percentile of the country's fee spread. We exclude observations with fees between 0 and 0.01bp, and observations with shorting supply that's higher than total shares outstanding.

In our empirical analysis, we link short-sale measures (discussed in detail in the next section) to future returns while controlling for common firm characteristics. Our key dependent variable is the risk-adjusted 20-day return. For risk adjustment in global market, we adopt the linear factor model in Bekaert, Hodrick, and Zhang (2009), which include both global and country-specific market, size, and value premium factors. We first compute historical betas to various factors using previous one-year rolling data. The risk adjusted returns is the difference between the return and the model-implied return, which is the product of historical betas and current factor values. For robustness check, we also examine results using 20-day raw returns, 5-day raw and risk adjusted returns. The results are qualitatively similar.

Our control variables include size (*Logsize*), book-to-market ratio (*BM*), lagged 1-month returns ($LagRet_{-1m}$), lagged 1-month average turnover ($LagTurn_{-1m}$), and standard deviation of the previous month's daily returns ($LagstdRet_{-1m}$).

A summary list of all key variables with definitions is in Table 1.

[Table 1 about here]

2.2. Measures of Shorting Activity

We construct measures of shorting intensity and shorting supplies. In terms of shorting intensity, many studies use the aggregate number of shares shorted for each stock divided by shares outstanding, *SIR*, as their main measure of short selling. For example, Dechow et al. (2001), Desai et al. (2002), Asquith et al. (2005) and Boehmer et al. (2010), among others, use *SIR* to show that stocks with a high (low) *SIR* or large increase in *SIR* subsequently underperform (outperform). Some studies use shorting flow data. For example, Boehmer, Jones and Zhang (2008) use daily shorting flow relative to daily trading volume to investigate the informativeness of short selling. Others use data from the U.S. Security and Exchange Commission's (SEC) 2005

Reg SHO pilot project, which provides transaction-level data on short selling in U.S. markets (e.g., Diether, Lee, and Werner, 2009a, 2009b; Boehmer and Wu, 2013).[2]

Following previous literature, we construct three shorting intensity measures. First, the short interest ratio, $SIR_{-5,-1}$, is the number of shares out on loan divided by the number of shares outstanding, both measured over the previous five days.[3] Second, the days-to-cover ratio, $DTCR_{-5,-1}$, measures the number of shares on loan relative to the average daily trading volume during the corresponding five days, respectively. The third measure, $Uti_{-5,-1}$, represents the number of shares lent out as a fraction of shares available for lending. These measures, all related to the realized shorting demand, should predict negative returns if short sellers are informed.

Using stock lending data from the Great Depression, when the NYSE had their own lending market, Jones and Lamont (2002) emphasize the importance of short-sale constraints. They find that stocks with high shorting costs are overpriced and that the prices correct (revert to fundamentals) only when short-sale constraints are relaxed in the lending pit. D'Avolio (2002) documents the distribution of lending fees, and notes that borrowing costs are generally negligible. However, these costs can be extremely high when shorting demand is high for smaller, illiquid stocks, which can occur in an arbitrage situation. Evans, Geczy, Musto, and Reed (2009) suggest that active short sellers may strategically fail to deliver. They find that stocks with high borrowing fees are associated with a high frequency of fail-to-deliveries, implying that short sellers may strategically fail-to-deliver on stocks that are expensive in the

[2] In the wake of the 2008 global financial crisis, disclosure requirements were introduced worldwide in an attempt to better understand the effects and potential harm of large short positions. Jones, Reed, and Waller (2013) explore such data from Europe, including short positions in excess of 0.25% of all shares outstanding, and find that the disclosed large shorts are associated with slightly negative stock performance on average. They also find that the negative stock performance is concentrated in stocks with right issues. These findings are consistent with Kolasinski, Reed, and Thornock (2013)'s findings that short sellers have superior news/information processing capabilities.

[3] Not all stock loans necessarily represent shorting activity, which means that this measure may not be a pure measure of shorting activity.

lending market. Overall, the findings of recent studies suggest that high shorting costs capture negative information from short sellers because the high fees are driven by high shorting demand in the presence of high frictions, low supply, or high search costs.

We construct four shorting measures from the supply side. The first three are fee measures, $Feespread_{-5,-1}$, $Logcurrfee_{-5,-1}$, and $Logallfee_{-1}$. Variable $Feespread_{-5,-1}$ is the natural logarithm of the daily average fee spread in the past five days. The spread, a measure of uncertainty about shorting costs, is the difference between the highest and lowest annualized fee (in basis points) on all outstanding contracts on a specific day. The fee spread increases when there is more disagreement among providers of equity loans, which makes shorting more costly. In this sense, higher fee spreads lead to lower future stock returns, and the expected sign of fee spread for future stock return is negative if shorts are informed.

The $Logcurrfees_{-5,-1}$ and $Logallfees_{-1}$ measures are the natural logarithm of 1 plus the average annualized lending fee (in basis points) based on newly opened contracts in the past five days or on all outstanding contracts, respectively. Because of the high positive skewness of the lending fees, we use reciprocals of $Logcurrfees_{-5,-1}$ and $Logallfees_{-1}$ in our empirical analyses. Ex ante, we posit that higher fees are associated with more negative future returns because high fees generally capture high shorting demand in conjunction with other constraints and/or risks. Therefore, the expected signs on both fee measures, as reciprocals, should be positive.

The last shorting supply measure is the average 5-day lending supply, $Supply_{-5,-1}$, as a percentage of the total number of shares available for borrowing, is used to proxy for short-sale constraints. Sufficient lending supply is important to facilitate efficient pricing. If the supply is very low, then the stocks is expected to have binding short-sale constraints, which would result in restricted shorting and in turn overpricing where the stock price only (mostly) reflects the opinion optimist traders. Thus, stocks with low *Supply* are expected to have lower future returns, if prices correct; and stocks with greater *Supply* are expected to have less negative or more positive returns. However, this measure has a caveat. If *Supply* is constrained consistently over time, the stock may remain mispriced, and we may not observe strong relationship between *Supply* and future returns.

2.3. Summary Statistics

In Table 2, we report summary statistics of our seven shorting measures. We first list the number of days, firms, and observations in our sample. Next we report the percentage of zero shorting events, the variable *misscover*. To construct this measure, we first check whether the stock has either shares available for lending or actual shares lent out over the previous five days. If yes, we consider the stock covered by DataExplorer, and misscover is set to zero, and otherwise one. For each day, we then compute the median percentage of firms that are not covered. Table 2 reports the time-series average of these firm-level medians for each country.

[Table 2 about here]

From the *misscover* variable, we observe relatively low shorting activity outside of the U.S. For the US, the percentage of zero shorting activity is 5.50%, while all other countries have zero shorting activity between 26% and 94%. The low shorting demand may be cause for concern. The zero shorting is either "real" zero shorting demand from Data Explorer, or a case where shorting is possible but not reported to DataExplorer, or a missing observation. The main reason for the low averages is incomplete coverage. We address this potential selection issue in our empirical analyses by using a *misscover* dummy to distinguish stocks with valid Data Explorer coverage from stocks with potentially missing coverage.

The first shorting measure is the short interest ratio. The average *SIR* for U.S. is 261bps, which is comparable to earlier U.S. studies, such a Boehmer et al (2010). For Japan, we report 27bps, which is consistent with current Japanese studies. We also notice shorting is relatively more active in Spain, Austria, and the Netherlands. In many countries, shorting is concentrated in handful of stocks. In these countries, the country medians often truthfully reflect zero realized shorting. The utilization rates (*Uti*) convey a more realistic picture. We find that utilization rates are highest for the U.S., Spain, and Portugal. In these three countries, where active institutions are likely drive demand, the time-series average utilization rates are above 10%.

The fee spread is the lowest in the U.S., South Korea, South Africa, Canada, Singapore, Switzerland, and Taiwan. This low spread in fees could be the results of an active and competitive lending market, like in the U.S., while in the other markets it is more likely the result of centralized or controlled securities lending. Lending fees are relatively small for the majority of the stocks in the U.S. market, where high fees are concentrated in a handful of stocks (see D'Avolio, 2002). Loan supply often, but not always, exceeds the reported loans outstanding (SIR). Only 5 countries have more than 5% average loan supply, consistent with limited short selling in most countries. We report the highest loan supply (*Supply*) with 18.91% of the total shares available for lending in the U.S. market, where short selling is prevalent and institutional ownership is readily able to supply lendable shares.

3. Cross-country Variation in Short-sales Informativeness

In this section, we establish the informativeness of various shorting measures. We present the average results across all countries in Section 3.1 and discuss the country level differences in Section 3.2 and Section 4.

3.1. The Informativeness of Shorts: Averages Across All Countries

To investigate how shorting predicts future returns, we estimate the following model:

$$r_{i,C,t} = \alpha_{C,t} + b_{C,t} \times SHORT_{i,C,t-1} + c_{C,t} \times misscover_{i,C,t-1} + \sum_{h=1}^{H} d_{h,C,t-1} \times X_{h,i,t-1} + \varepsilon_{i,C,t} \quad (1)$$

where the dependent variable is the 20-day future risk-adjusted cumulative return on stock *i* in country *C* on day *t*. The independent variable, *SHORT*, is one of the seven short sale measures. In each regression, we use only one shorting measure at a time to find out whether this particular measure is predictive, without the influence of other short measures. The variable *misscover* is a dummy variable that takes on value of one for stocks without short sale coverage. The vector *X* includes the firm-level controls size, the book-to-market ratio, lag returns, lag return volatility, and lag turnover. The independent variables $SHORT_{i,C,t-1}$ are measured from day *t*-5 to day *t*-1, and control variables $X_{h,i,C,t-1}$ are measured over the previous month. Both are normalized to have zero mean and unit standard deviation within each country *C* on day *t*.

We estimate the regression using a Fama-MacBeth (1973) approach. For each country each day, we estimate the above specification, which allows coefficients to vary over time and across countries. We conduct statistical inference on the time-country panel of cross-sectional coefficients. To control for time-series persistence in the coefficients, we use Newey-West standard errors with 20 lags because the dependent variable is 20-day future return.

We summarize the cross-country averages of the return predictability of our seven short sale measures in Table 3. Panels A presents the distribution of the signs and significances across countries, and Panel B presents parameter estimates for all countries and subsample of countries. We infer shorting’s predictive power for future returns by examining country-level coefficient estimates on the seven alternative shorting measures, where the country-level estimates are the averages of the time-series coefficient estimates from the Fama-MacBeth regressions in equation (1).

[Table 3 about here]

Based on our discussion in section 2.2, we display the expected sign for each coefficient estimate in the first row of Table 3 Panel A. The sign indicates whether the shorting measure should predict future returns negatively or positively. To show whether the coefficients estimates are significant and consistent with theory, we report the percentage of countries with correct (wrong) signs and with statistical significance at 5% in the next three rows. We observe that majority of the country level coefficients have correct signs, except for the short interest ratio measure, where only 48% of the country level coefficients have the expected negative sign. Out of the correct coefficients, 36% to 76% of the country-level estimates are also statistically significant at the 5% level. We also report the percentage of countries with wrong signs that are statistically significant. This percentage is quite small, ranging between 0% and 24%. Overall, on average across countries, the effect of shorting on future returns is consistent with expectations and previous literature.

Panel B shows cross-country averages for the coefficient estimates of each of the seven shorting measures. We consider both value-weighting using past market capitalization and equal-weighting of averages. The idea behind value weighting is to allow large countries to have greater weight, while the idea behind equal weighting is to allow small countries to have same weight as large countries. For each weighting scheme, we investigate the cross-country averages and averages by four regional subgroups, namely developed countries, emerging markets, PIGS countries, and non-PIGS countries. The PIGS countries include Portugal, Italy, Greece, and Spain, which suffered the most during European sovereign debt crisis.

When we use market capitalization as weights, across all countries, six out of the seven shorting variables are significant with expected signs. Only the lending supply measure is insignificant. Between developed and emerging markets, the significance is always stronger for developed markets. It is conceivable that shorts are more informed in the developed countries because liquidity and investor protection is more prevalent in more mature markets. In comparing non-PIGS and PIGS countries, with value-weighting, we find more shorting measures are informative in non-PIGS countries, and the difference seems sizable. Interestingly, the supply measure is significant in PIGS countries but not elsewhere. As we mentioned earlier, the results using value weighting allows more weights on larger countries, which tend to be more developed countries, which explains why short selling is more informative overall with value-weighting.

The results become weaker with equal-weighting. Still, six out of the seven short measures are statistically significant across countries. The SIR measure loses its significance, while supply gains significance with expected sign. As with value-weighting, the informativeness of shorts is still stronger in developed countries than in emerging markets. In fact, none of the shorting measures are statistically significant in the emerging market sample, even though most of the coefficient estimates carry the correct signs. With regards to non-PIGS and PIGS countries, the significance is less pronounced with equal-weighting.[4]

3.2. The Informativeness of Shorts: Cross-Country Variations

The evidence in Table 3 on the informativeness of short selling across countries is consistent with prior single-country analyses of short selling. Yet, our analysis shows that the coefficient estimates on all shorting measures have substantial dispersion across countries. In fact, many estimates are not statistically significant or even have the wrong sign.

[4] In results not shown, we also separate the 25 countries into geographical groups, such as Asia-Pacific, Europe and America. We do not find significant differences across these regions.

This cross-country variation may be concentrated in smaller, less active markets; but it could also emanate from the larger markets. In this section, we present country-level parameter estimates and discuss their distribution and dispersion in Table 4. In next section, we proceed to explain the cross-country differences with market quality and local short selling regulations information.

[Table 4 about here]

In the first three columns of Table 4, we present country level coefficients on the three shorting activity measures, *SIR*, *DTCR*, and *Uti*. According to previous literature, more short transactions imply more negative news about the firm and this leads to negative returns. Therefore, the coefficient estimates on these three measures should all be negative. For the short interest ratio variable, the coefficients are negative and significant for Germany, Belgium, Spain, Finland, Italy, Japan, Mexico, Norway, the UK, and the US. However, for countries such as Australia, Canada, South Korea, Portugal, Sweden, and Singapore, the coefficients are actually positive and significant. For the days-to-cover variable, DTCR, the coefficients are negative and significant for Australia, Spain, Finland, Italy, Japan, South Korea, the Netherlands, Norway, Sweden, Switzerland, and UK. However, the signs flip and become positive for four countries, with all of them being statistically significant. The third variable is utilization variable, *Uti*. For 14 countries, such as Germany and Canada, the coefficients are negative and significant. But it does turn positive for Japan, Mexico, Austria, Portugal, South Africa, Switzerland, and UK, yet none of these coefficients are statistically significant. For all three short transaction variables, there seems to be wide variations across countries and across variables.

The next three variables are based on lending fees. The general intuition is that higher fees and higher fee spread lead to higher cost of shorting, and thus the reciprocal of fees should carry positive signs, and the fee spread should carry a negative sign. For the fee spread all but five countries (Denmark, Austria, Taiwan, Turkey and U.K.) have the expected negative signs, and two of them are statistically significant. For both current fees and total fees, the coefficients are predominantly positive and significant. A small number of countries, such as Mexico and Austria, have negative coefficients, but they are mostly statistically insignificant. Because a decline of lendable shares implies more constrained shorting, the expected sign of supply should be positive. That is the case for 18 countries, with 13 of them being statistically significant. Again, we observe substantial cross-country variation for the role of lending fees and lending supply.

To visualize the cross-country differences in the predictive power of each shorting variables, we plot their coefficients in Figure 1. We plot country level coefficients for four shorting measures, the short interest ratio, the day-to-cover variable, the utilization ratio, and the all fee variable. We don't report the current fee results because they are very similar to those of all fees.

[Figure 1 about here]

Consistent with our discussion on Table 4, Figures 1 shows significant variation across countries in the coefficient estimates on the shorting measures. For the short interest ratio and days-to-cover variables, half of the countries have expected negative coefficients, while the other half countries have the opposite signs. For the utilization ratio and all fee variables, majority of the countries have expected signs, but still there are few countries with opposite signs.

4. Cross-country Variation in the Informativeness of Short Selling

We investigate alternative mechanisms that might lead to the cross-country variation in shorting's informativeness about future returns. We evaluate three channels that might affect shorting's informativeness. We consider country-level shorting regulations in Section 4.1, country-level market quality in Section 4.2, and country-level openness in Section 4.3. We pool all three categories of explanations in Section 4.4.

4.1. Shorting Informativeness vs. Short Sale Regulations

Prior studies show that country-level shorting regulation significantly affects market efficiency, which directly links to the effectiveness of short selling. For instance, Bris et al. (2007) find that stock markets that restrict short selling are less efficient. Saffi and Sigurdsson (2011) examine the relation between weekly price efficiency and return distributions and short-sale constraints in 26 countries from 2005 to 2008. On the other hand, Kolasinski, Reed, and Thornock (2013) show newly imposed regulatory constraints on shorting enhance the informativeness of short selling, consistent with Diamond and Verrecchia (1987).

To address the cross-country short-sale regulatory differences, we focus on three short-sale regulatory efforts: uptick rules (or, more generally, price tests), naked short sale bans, and the presence of a centralized stock lending market. [5]

We define an uptick dummy to be one for days on which some form of price test is in place in a given country, and zero otherwise. The typical price-test rule prevents shorting below a certain benchmark price. Usually, the current quote midpoint, last trade, or current bid price are used as benchmarks. Price tests force short sellers to trade patiently in a way that provides liquidity to the market. The uptick rule makes shorting more costly, and presumably increases the informativeness of shorts.

[5] We have two form of centralized lending markets, one form is where the exchange regultaors directly or indirectly manage a regulated stock lending market (e.g., Japan, Taiwan) and a private company manages centralized lending market in Europe under SecFinex. SecFinex introduced the first a stock loan electronic platform with the a private bilateral market until the new owner, NYSE, shut down operations in 2011.

Our second regulatory measure captures naked short sale bans, which were broadly adopted in the midst of the 2008 Financial Crisis. Naked short-sale restrictions require short sellers to borrow (or at least locate) shares in advance, thereby introducing significant direct cost for short sellers and complicating the precise timing of short transaction. Our naked-short dummy takes a value of one for days on which a naked short-sale ban is in effect in a given country. Besides naked-short bans, a number of countries also introduced outright short sale ban on financial stocks or on all stocks. For example, Australia and South Korea restricted short selling for all stocks, or for all major stocks during the recent financial crisis.[6] In our empirical analyses, we report the effect of the naked short sale ban. Results using the outright bans are quite similar and not reported (available upon request). Previous studies, such as Beber and Pagano (2013), show that shorting bans adversely affect market quality worldwide, while Boehmer, Jones, and Zhang (2013) document similar results using data on actual short selling for the U.S. Similar to the uptick rule, naked bans make shorting more costly, and presumably increase the informativeness of short selling.

The CCP dummy takes on the value of one for market-years when a centralized lending market is available. The CCP allows short sellers to borrow in a centralized lending market, often managed by exchange regulators, in an organized, standardized and highly regulated manner. While the CCP market can alleviate short sale constraints for retail investors, institutional investors generally prefer the OTC stock-lending market because of greater flexibility and lower costs. Countries where stock lending is only available through CCP, such as Brazil, are generally not in our sample. Some countries, such as Taiwan, have a CCP with limited OTC lending, where regulators control total shorting volume and thereby effectively

[6] South Korea just announced on Nov. 13, 2013, to lift the five year shorting ban on financial stocks. South Korea was one of the few countries to introduce market wide short sale ban in 2008 which was lifted after a couple of weeks but the regulators maintained shorting ban on important financial stocks to protect the financial market.

restrict OTC lending and borrowing. The existence of a CCP eliminates counterparty risk for short sellers, thus reducing the cost of short selling. According to Diamond and Verrecchia (1987), this should reduce the average information content of shorts.

We present summary statistics for the regulation variables in Table 5. For the uptick rule, seven out of the 25 countries have an uptick rule throughout our sample period. Only one country, the U.S., have a change in regulation, as the uptick rule was lifted for the second part of the sample period.[7] For the naked ban, the majority of the countries implemented bans, for at least part of the sample, only seven countries didn't impose ban on naked shorting. For the CCP dummy, half of the countries have some form of active centralized lending market..

[Table 5 about here]

In Table 6, we examine how the informativeness of shorting depends on short-sale regulations. Specifically, we use the day-country panel of coefficient estimates from the Fama-MacBeth regressions in equation (1), and regress the coefficients on country-level regulatory variables:

$$b_{C,t} = \alpha + e \times DREG_{C,t} + \varepsilon_{C,t} \qquad (2)$$

where the dependent variable is the daily Fama-MacBeth coefficient estimate from Table 4 for country *C* on day *t*. Variable $DREG_{C,t}$ is a specific short sale regulatory dummy, representing either an uptick rule, a naked shorting ban, or a CCP. When the regulation dummies are zero, the mean level of $b_{C,t}$ is *a*; when the regulation dummy is one, the mean level of $b_{C,t}$ becomes *a*+*e*. If the regulation dummies affect the predictive power of shorting measures, the coefficient *e* would be significantly different from zero. We present the regression results in Table 6.

[Table 6 about here]

[7] A revised uptick rule was introduced in February 24, 2010, requiring short selling to be halted for stocks which experience 10% price decline in a day, allowing existing shareholders to sell their shares before any new short selling. This is less restrictive uptick rule is applicable only to the last five months of our sample period and is not considered as an uptick rule in the current analyses.

In Panel A, we report how the uptick rule dummy is related to shorting informativeness for future 20-day risk adjusted returns. For each shorting measure, we report the coefficients when the uptick rule is not in place, *DREG*=0, and when the uptick rule is in place, *DREG*=1. We also present the difference between the two. If the regulation is economically important, the difference should be statistically significant.

For both with and without an uptick rule, shorting is, as before, significantly related to future returns in the expected direction. For the 20-day risk-adjusted returns, the existence of the uptick rule makes the short interest ratio and the all fee variable (*1/Logallfees*) more informative, but it significantly reduces the informativeness of *DTCR*, *Utilization,* and the fee spread. Overall, we find that the uptick rule appears to have a secondary and somewhat mixed effect on the informativeness of short selling.

In Panel B, we examine how naked-shorting bans are related to shorting informativeness. Almost all short measures are significant with and without the naked ban. More interestingly, the naked ban increases the informativeness of all measures, and five of the differences are statistically significant (all except the short interest ratio and the all fee measure). The results indicate that naked short bans enhance the informativeness of short selling.

With a CCP, the results in Panel C show that most of the shorting demand measures are significant no matter whether there is a centralized stock lending market. But with a CCP, some of them lose either magnitude or significance. With the exception of the SIR measure, the informativeness of the other shorting measures is smaller in markets with a CCP. In terms of significance, the difference is significant *Uti*, *Feespread*, *1/Logallfees* and *supply*.

Overall, Table 6 results suggest that the presence of a naked ban makes shorting more informative, while the existence of a CCP reduces the informativeness of shorting,

4.2. Short Selling Informativeness and Market Quality

A market's quality, in terms of transaction costs and liquidity, should affect the informativeness of any trading strategy. As transaction costs decline and/or as liquidity improves, the profitability of any given trading strategy might increase and the costs of arbitrage might decrease. Thus, we expect more shorting and greater associated informtiveness. Conversely, high transaction costs or low liquidity would deter short sellers from trading as suggested by Au et al. (2009) and Boehmer et al. (2010).

In this section, we examine how transaction costs and other measures of market quality affect the informativeness of shorts. To capture the daily variation in stock market quality for national markets, we use value-weighted effective spreads (*ES*). We measure average information content of trades using the permanent price impact (PPI). Following Madhavan (2000), we calculate the average daily permanent price impact (*PPI*), defined as the average mid-quote return during the five minutes following a trade. We expect more informed short selling to show up both in the informativeness of shorting and in the permanent price impact. We measure trading intensity using turnover (*Turnover*). When liquidity increases, turnover would increase. We expect higher turnover would improve informativeness of the shorting measures. Finally, greater volatility reduces liquidity supply and thus makes trading, including short sales, more difficult. Meanwhile, higher volatility also means higher uncertainty and higher dispersion, which can possibly lead to more profitable shorting. We measure realized volatility as the absolute returns (*AbsRet*) and as squared returns (*Retsq*). Our prior on how volatility affects the informtiveness of shorting is mixed.

Table 5 presents the summary statistics for these market quality variables. Trading in the U.S. markets is associated with the lowest costs across countries, but the permanent proportion of the spread (PPI) is relatively high, reflecting the informational efficiency of the U.S. market.

Similarly to equation (2), we link short informativeness measures, the daily panel of coefficient estimates from the Fama-MacBeth regression by country as in equation (1), to market quality measures:

$$b_{C,t} = \alpha + e \times MKTCHAR_{C,t} + \varepsilon_{C,t} , \tag{3}$$

where the dependent variable is the daily Fama-MacBeth coefficient estimate from Table 4 for country C on day t of regression future 20-day risk adjusted returns on short-sale measures. Variables, $MKTCHAR_{C,t}$, are the market quality measures, such as effective spread (*ES*), permanent price impact (*PPI*), turnover (*Turnover*), absolute return *(AbsRet*), and squared return (*Retsq*). We report the results in Table 7.

[Table 7 about here]

Notice that we have seven shorting measures, three are on shorting intensity, and four are on shorting supply. It is conceivable that market quality measures above are more direct linked towards shorting intensity measures than shorting supply measures, because the shorting intensity measures are realized transactions by short-sellers, while the supply measures are indicative for possible transactions, and are determined by providers of shares. Therefore, below we discuss the impact of market quality on the informativeness of the shorting intensity and short supply measures separately.

For 20-day future risk-adjusted returns, higher effective spreads reduce the informativeness of all three shorting intensity measures (the short interest ratio, days to cover, and utilization ratio), and two of them are significant. Similar pattern is observed for the price impact measure and turnover measure, indicating that higher transaction cost and lower liquidity reduce the informativeness of shorting intensity measures. For the last two volatility measures, higher volatility increases informativeness of short interest ratio, and days to cover, but decreases informativeness of the utilization ratio. All coefficients are significant, and thus provide a mixed message.

For the bottom four measures on short supply, the pattern differs from the shorting intensity results. High effective spread and pricing impact most of the time improve the informativeness of the short measures, especially for the all fee measure and the supply measure, with statistical significance. Turnover's effect is mixed. It reduces informativeness of both fee spread and short supply, with significance, but it increases informativeness of both fee measures. For the last volatility measures, they both significantly reduce the predictive power of the supply measure.

Overall, we find some evidence that market quality matters for the informativeness of shorting, more so for the shorting intensity measures.

4.5. Short Selling Informativeness and the Macro Environment

Previous studies, such as Bailey, Karolyi, and Salva (2006) show that the degree of informed trading and market efficiency are related to the country openness and levels of investor protection. Following their results, we adopt variables such as market openness (measured as international trade as percentage of GDP), GDP-per-capita (GDPPC), an anti-director rights index (AD), and an accounting standards index (AS) to explain the cross-country difference in informativeness of shorting measures. The hypothesis is that a country with greater openness, higher GDP per capita, and better investor protection would facilitate more informed short selling.

Similar to equations (2) and (3), we link short informativeness measures, the daily panel of coefficient estimates from the Fama-MacBeth regression in equation (1), to these macro variables as follows:

$$b_{C,t} = \alpha + e \times MACRO_{C,t} + \varepsilon_{C,t}, \tag{3}$$

where the dependent variable is the daily Fama-MacBeth coefficient estimate from Table 4 for country C on day t of regression future returns on short-sale measures. Variables, $MACRO_{C,t}$, are the macro measures.

[Table 8 about here]

Table 8 presents results for future 20-day risk-adjusted returns. Since the macro-economic environment might affect short-sellers and providers of shorts differently, we separate our discussion on shorting intensity measures and short supply measures.

For the first three shorting intensity measures, greater openness is significantly associated with lower informativeness of short interest ratio and days to cover, and higher informativeness of the utilization ratio. The results are mixed. For the GDP per capita, it increases the informativeness of all three measures, and two of them are significant. For the anti-directory right index, it significantly reduces the informativeness of short interest and utilization ratio measure. Finally, high accounting standard index significantly improves the informativeness of all three shorting intensity measures.

For the four short supply measures at the bottom, the picture becomes different. For the openness measure, the pattern is opposite from shorting intensity. Higher openness now significantly increases the informativeness of all four shorting supply measures. For the GDP per capita measure, it improves the informativeness of three measures, except for the all fee measure.

For both AD and AS index, most of the time they significantly improve the informativeness of shorting supply measures.

Overall the results suggest more developed markets captured by higher GDPPC, with better anti-director rights, and higher accounting standards have more informative shorts.

4.4. Combined Effect of Regulations and Market Characteristics on Short Sales Informativeness

In this section, we pool the three alternative explanations, short sale regulation, market quality, and macro environment, to explain cross-country differences in shorts' informativeness. As before, we use the daily coefficient estimates from the Fama-MacBeth regressions by countries in equation (1) and relate the coefficients to regulations and market characteristics as:

$$b_{C,t} = \alpha + e \times DREG_{C,t} + f \times MKTChar_{c,t} + g \times Macro_{C,t} + \varepsilon_{C,t}, \tag{4}$$

where the dependent variable is the daily Fama-MacBeth coefficient estimates from Table 4 for country *C* on day *t* of regressing future returns on short-sale measures. Our goal is two-fold. First, we would like to identify the dominant explanation when controlling for the others. Second, we would like to assess how much of the cross-country variation these variables can explain. Another perspective for this exercise is to examine which regulation is beneficial for shorts, while controlling for market level information, such as market quality and country development.

[Table 9 about here]

Table 9 reports the estimation results for equation (4), using future 20 day risk-adjusted returns. To make the results more readable, we pick the significant coefficients, and report numbers of significance for each variable in Figure 2. The blue and red columns represent number of cases when an increase in the variable leads to higher and lower predictive power of the shorting variables, respectively.

[Figure 2 about here]

Among the three regulation variables, the uptick rule dummy generally increases the informativeness of the short variables, but lacks statistical significance. The dominating variable is the naked ban dummy, is statistically significant for six out of seven shorting measures. It significantly increases predictive power of all 3 shorting intensity measures and 2 shorting supply measures. The CCP dummy, representing a centralized loan market, significantly affects 5 shorting measures. In particular, it improves the shorting predictiveness of 2 out of 3 shorting intensity measures, and it reduces the shorting predictiveness of 2 out of 4 shorting supply measures.

For the market quality measures, the first two variables, the effective spread increases shorting informativeness for 3 shorting measures, mostly shorting supply measures, and decrease shorting informativeness for 3 shorting measures, mostly shorting intensity measures. For the price impact variable, the results are more mixed. For the turnover variable, it significantly increase informativeness of four out of seven short measures, both for shorting intensity and shorting supply. We also observe statistical significance of the absolute return measure, which significantly increases the informativeness of SIR, DTCR, and feespread, but significantly reduces informativeness of three short supply variables.

Finally, among the macro variables, the GDPPC has the clearest impact. Openness improves the informativeness of one shorting intensity variable, and three shorting supply variable. But it reduces the informativeness of the SIR and DTCR measures. The GDPPC improves the predictive power of two out of three shorting intensity variables, yet it has not much impact on the shorting supply variable. For the AD, it reduces the predictive power of all three shorting intensity variables, while AS increases the predictive power of all three. The impact on the shorting supply variables are more mixed.

The last two rows of Table 8 report the R-squares, which are mostly below 1%. The reason for the very low R-square is that two groups of the three explanations, the regulation variables and the macro variables, are generally constant over time and thus cannot capture the time variation in the Fama-MacBeth regression coefficients.

Overall, our results suggest that the informativeness of short selling differs substantially across countries. The most important determinant of these differences are short sale bans, transaction costs, and GDP per person.

5. Conclusion

We examine the information content of short selling internationally, using detailed information on short selling, market quality, and shorting regulations in 25 countries between 2006 and 2010. We use seven measures of short selling, focusing on shorting transactions, the degree to which short selling is constrained, uncertainty about shorting fees, the level of fees, and shorting supply. We show that, on average, short selling is informed about future returns across countries. These overall results, however, mask, substantial cross-country variation in shorting's informativeness for future returns. To explain the cross-country differences, we relate the time and country variation in shorting informativeness to country level short-sale regulations, market quality and macro environment measures. We find that the presence of naked shorting bans, higher turnover, and higher GDPPC improve the informativeness of short selling. This variation should be taking into account by regulators, by traders who use short sales, and by researchers who interpret international evidence on short selling.

6. References

Ackert, L. F. and Athanassakos, G. 2005. The relationship between short interest and stock returns in the Canadian market. *Journal of Banking and Finance 29* (7), 1729-1749.

Aitken, M.J., Frino, A., McCorry, M.S. and Swan, P.L., 1998. Short sales are almost instantaneously bad news: Evidence from the Australian stock exchange. *Journal of Finance* 53(6), 2205-2223.

Alexander, G. J. and Petersen, M. A., 1999. Short selling on the New York Stock Exchange and the effects of the uptick rule. *Journal of Financial Intermediation* 8, 90-116.

Au, A. S., Doukas, J. A., and Onayev, Z., 2009. Daily short interest, idiosyncratic risk, and stock returns. *Journal of Financial Markets* 12, 290-316.

Bailey, W., Karolyi, A. G., and Salva, C., 2006. The economic consequences of increased disclosure: Evidence from international cross-listings, *Journal of Financial Economics*, 81, 175-213.

Bekaert, G., Hodrick, R. J., and Zhang, X. (2009). International stock return comovements. *Journal of Finance*, 64: 2591–2626.

Beber, A., and Pagano M., 2013. Short-selling bans around the world: Evidence from the 2007–09 Crisis. *Journal of Finance* 68 (1), 343–381.

Boehmer, E., Huszár, Z. R., and Jordan, B. D., 2010. The good news in short interest. *Journal of Financial Economics* 96 (1), 80-97.

Boehmer, E., Jones, C. M., and Zhang, X., 2013. Shackling short sellers: The 2008 shorting ban. *Review of Financial Studies* 26 (6), 1363-1400.

Boehmer, E., Jones, C. M., and Zhang, X., 2013. What do short sellers know? Working paper.

Boehmer, E., and Fong, K. Y. L. and Wu, J., 2013. International Evidence on Algorithmic Trading (June 2, 2014). AFA 2013 San Diego Meetings Paper. Available at SSRN: http://ssrn.com/abstract=2022034

Boehmer E. and Wu, J., 2013. Short selling and the price discovery process. *Review of Financial Studies* 26, 287-322.

Bris, A., Goetzmann, W. N., and Zhu, N., 2007. Efficiency and the bear: short sales and markets around the world. *Journal of Finance* 62 (3), 1029-1079.

Chan, K., Wan Kot, H., and Ni, S. X., 2012. Does option trading affect the return predictability of short selling activity? Working paper

Cohen, L., Diether, K., and Malloy, C., 2007. Supply and demand shifts in the shorting market. *Journal of Finance* 62: 2061-2096.

D'Avolio, G., 2002. The market for borrowing stock. *Journal of Financial Economics* 66 (2-3), 271-306.

Dechow, P., Hutton, A., Meulbroek, L., and Sloan, R., 2001. Short-sellers, fundamental analysis, and stock returns. *Journal of Financial Economics* 61, 77–106.

Desai, H., Ramesh, K., Thiagarajan, S.R., and Balachandran, B.V., 2002. An investigation of the informational role of short interest in the NASDAQ market. *Journal of Finance* 57, 2263–2287.

Desai, H., Krishnamurthy, S., and Venkataraman, K., 2006. Do short sellers target firms with poor earnings quality? Evidence from earnings restatements. *Review of Accounting Studies* 11, 71-90.

Diamond, D. and Verrecchia, R., 1987. Constraints on short-selling and asset price adjustment to private information. *Journal of Financial Economics* 18, 277–311.

Diether, K. B., Lee, K-H., and Werner, I. M., 2009a. It's SHO Time! Short-sale price tests and market quality *Journal of Finance* 64 (1), 37-73.

Diether, K. B., Lee, K-H., and Werner, I. M., 2009b. Short-sale strategies and return predictability, *Review of Financial Studies*, 22 (2), 575-607.

Duffie, D., Garleanu, N., and Pedersen, L., 2002. Securities lending, shorting, and pricing. *Journal of Financial Economics* 66, 307–339.

Engelberg, J., Reed, A.V., and Ringgenberg, M., 2012. How are shorts informed? Short sellers, news and information processing, *Journal of Financial Economics* 105 (2), 260-278.

Evans, R., Geczy, C., Musto, D., and Reed, A. V., 2009. Failure is an option: Impediments to short selling and options prices. *Review of Financial Studies 22 (5), 1955-1980*.

Hong, H. and Stein, J. C., 2003, Differences of opinion, short-sales constraints, and market crashes, *Review of Financial Studies* 16 (2), 487-525

Jain, A., Jain, P., McInish, T., and McKenzie, M. D., 2013. Worldwide reach of short selling regulations, *Journal of Financial Economics* 109, 177-197, 2013

Jones, C. M., and Lamont, O., 2002. Short sale constraints and stock returns. *Journal of Financial Economies* 66, 207-239.

Jones, C. M., Reed, A. V., and Waller, W., 2013. Revealing shorts: An examination of large short position disclosures. 2013 AFA Working paper.

Kolasinski, A. C., Reed, A. V., and Thornock, J. R., 2013. Can short restrictions actually increase the informativeness of short selling, *Financial Management* 42 (1), 155-181.

Madhavan, A., 2000. Market microstructure: A survey, *Journal of Financial Markets* 3: 205-258.

Massa, M., Zhang, B., Zhang, H., 2012. The invisible hand: Does short selling discipline earnings manipulation. Working paper, Insead.

Miller, E. M., 1977. Risk, uncertainty, and divergence of opinion, *Journal of Finance* 32 (4), 1151-1168.

Nagel, S., 2005. Short sales, institutional investors and the cross-section of stock returns. *Journal of Financial Economics* 78 (2), 277-309.

Saffi, P. C. and Sigurdsson, K., 2011. Price efficiency and short selling. *Review of Financial Studies* 24 (3): 821-852.

SEC, 2009. SEC seeks comment on alternative uptick rule, 2009-185.

SEC. 2014. Equity market structure literature review: Part II: High frequency trading, division of trading and markets, U.S. Securities and Exchange Commission

Takahashi, H., 2010. Short-sale inflow and stock returns: Evidence from Japan, *Journal of Banking and Finance* 34 (10), 2403-2412.

Table 1. Descriptions of variables

A. Shorting information variables	
$SIR_{-5,-1}$	Average number of shares out on loan during the last five days relative to the total shares outstanding during the same period.
$DTCR_{-5,-1}$	Average number of shares out on loan during the last five days relative to the average daily trading volume during the same period.
$Uti_{-5,-1}$	Utilization rate is the shares on loan, scaled by shares available for loan.
$Feespread_{-5,-1}$	The last five days average of difference between the highest and lowest annualized fee across all contracts in bps.
$1/Logallfees_{-1}$	The reciprocal of the Log (1+ annualized lending fee in basis points based on all outstanding loans as reported last 1 day).
$1/Logcurrfees_{-5,-1}$	The reciprocal of the Log (1+ annualized lending fee in basis points based on new stock lending transactions in the last five days).
$Supply_{-5,-1}$	The average percentage of total shares available for lending during the last five days.
B. Firm characteristics	
Logsize	Log of size in previous month
BM	Previous month Book-to-market ratio
$LagRet_{-1m}$	Previous one month cumulative return
$LagTurn_{-1m}$	Average daily turnover in percentage, during previous one month
$LagStdRet_{-1m}$	Stock return volatility, during previous one month
C. Other variables	
misscover	1 for stocks without DE coverage or without any stock borrowing.
Duptick	1 if there is an uptick rule, 0 otherwise
Dnakedban	1 if there is a ban on naked short, 0 otherwise
Absret	The median of the daily absolute return on the specific market (stock exchange)
Retsq	The median of the daily squared return on the specific market (stock exchange)
Turnover	Median daily turnover on the specific market (stock exchange)
ES	Daily median effective spread on the specific market (stock exchange)
PPI	Daily median permanent price impact as proxy for informed trading on the specific market (Madhavan, 2000)
Openness	Total trade (sum of exports of goods and services) as % of total GDP.
GDPPC	GDP per capita, in current US dollar as the total GDP divided by midyear population.
AD	Anti-director rights index
AS	Accounting Standard Index

Table 2. Summary Statistics of Shorting Measures by Countries

In this table, we report the time-series means of the daily medians of the alternative short measures, for the sample period of July 3rd, 2006 to August 13th 2010. Detailed variable descriptions are in Table 1.

Country	N (day)	N (firm)	N (obs)	Misscover	$SIR_{-5,-1}$ (bps)	$DTCR_{-5,-1}$ (bps)	$Uti_{-5,-1}$ (%)	$Feespread_{-5,-1}$ (bps)	$Logcurrfees_{-5,-1}$ (bps)	$Logallfees_{-1}$ (bps)	$Supply_{-5,-1}$
Australia	1075	2105	1597238	77.09%	0.00	0.00	0.01	200.07	0.00	0.00	2.00%
Germany	1073	975	807083	67.24%	0.02	0.25	0.03	206.84	0.00	6.41	1.94%
Belgium	1075	168	138353	55.87%	2.23	34.32	0.03	197.55	17.49	263.70	1.65%
Canada	969	1504	1147049	56.48%	0.41	3.75	0.02	145.85	6.91	86.16	6.76%
Denmark	1069	220	185399	67.04%	0.05	0.82	0.03	243.53	0.31	33.53	1.06%
Spain	1073	151	137916	26.43%	49.27	247.86	0.22	411.01	415.85	458.74	2.25%
Finland	1073	155	146721	52.90%	2.76	35.88	0.04	264.47	80.74	282.03	2.36%
France	1075	920	733086	64.53%	0.10	1.57	0.04	254.79	0.85	55.70	1.08%
Hong Kong	1072	1189	1032289	77.79%	0.00	0.00	0.00	176.38	0.00	0.00	1.07%
Italy	1073	361	328179	40.82%	15.40	96.62	0.06	267.78	306.32	389.91	1.72%
Japan	1068	2571	2519402	34.01%	26.64	97.06	0.06	238.74	347.98	387.43	2.44%
South Korea	1073	1734	1566800	87.93%	0.00	0.00	0.01	76.86	0.00	0.00	0.36%
Mexico	1075	137	85559	43.51%	4.43	39.90	0.04	310.97	356.20	452.35	2.02%
Netherlands	1075	150	132544	40.54%	42.76	179.36	0.09	241.35	305.53	302.79	6.42%
Norway	1069	282	211690	58.90%	0.47	6.06	0.07	273.18	7.86	167.52	1.73%
Austria	1073	109	77272	44.00%	27.56	185.50	0.09	220.56	201.44	304.93	3.48%
Portugal	1075	68	47283	48.75%	12.13	82.46	0.14	311.30	234.07	280.71	1.49%
South Africa	1075	406	315158	71.07%	0.01	0.06	0.00	47.39	0.28	7.15	1.47%
Sweden	1073	515	443002	62.89%	0.03	0.40	0.05	200.75	0.87	37.19	1.91%
Singapore	1075	672	572895	79.45%	0.00	0.00	0.00	137.79	0.00	0.00	1.03%
Switzerland	1071	299	268402	37.95%	17.88	204.40	0.03	112.07	291.44	301.09	7.25%
Taiwan	1054	1335	1289231	94.04%	0.18	0.23	0.01	19.82	1.43	10.43	0.32%
Turkey	1070	328	318967	86.54%	0.00	0.00	0.01	199.25	0.00	0.00	0.71%
UK	1075	2171	1544936	80.04%	0.00	0.00	0.01	259.58	0.00	0.00	6.52%
US	1037	5625	4227703	5.55%	261.33	371.25	0.12	149.46	260.74	239.49	18.91%

Table 3. Summary of the country level coefficients on alternative shorting measures

We estimate the following regression using Fama-MacBeth method for each country:

$$r_{i,C,t} = \alpha_{C,t} + b_{C,t} \times SHORT_{i,C,t-1} + c_{C,t} \times misscover_{i,C,t-1} + \sum_{h=1}^{H} d_{h,C,t-1} \times X_{h,i,C,t-1} + \varepsilon_{i,C,t} \quad (1)$$

The dependent variables are the future 20-day risk adjusted cumulative returns for stock *i* in country *C* from day *t*. $SHORT_{i,C,t}$ is a lagged shorting measure (as listed in Table 1) for stock *i* in country *C* at time *t* (each shorting measures enters in univariate setting). $X_{h,i,C,t}$ vector of lagged firm control variables such as *Logsize*, *BM*, $LagRet_{-1m}$, $LagStdRet_{-1m}$, and $LagTurn_{-1m}$ for stock *i*, in county *C*, at day *t* as defined in Table 1. *DE* dummy variable takes on the value of one for stocks with valid information from Data Explorers in the last five days. The lagged independent variables $SHORT_{i,C,t-1}$ and $X_{h,i,C,t-1}$ are normalized to have zero mean and unit standard deviation within each country C at time *t*-1. Below we report cross countries average of the time series average of the coefficient estimates for the alternative shorting measures with ***, **, and * to reflect 1%, 5%, and 10% statistical significance, respectively. Under *Exp. Sign* we denote the expected sign of the coefficient estimate of the short sale measures on the return predictability of the alternative shorting measures.

Panel A. Distribution of coefficient's signs and significances

Shorting variables	$SIR_{-5,-1}$ (*100)	$DTCR_{-5,-1}$(*100)	$Uti_{-5,-1}$(*100)	$Feespread_{-5,-1}$ (*100)	$1/Logcurrfees_{-5,-1}$ (*100)	$1/Logallfees_{-1}$ (*100)	$Supply_{-5,-1}$
Exp. Sign	–	–	–	–	+	+	+
% countries w. correct sign	48%	72%	72%	80%	80%	92%	72%
% countries w. correct sign and 5% significance	36%	36%	48%	44%	56%	76%	52%
% countries w. wrong sign and 5% significance	24%	16%	0%	8%	0%	4%	16%

Panel B. Averages for different weightings and different regions

Shorting variables		$SIR_{-5,-1}$ (*100)	$DTCR_{-5,-1}$(*100)	$Uti_{-5,-1}$(*100)	$Feespread_{-5,-1}$ (*100)	$1/Logcurrfees_{-5,-1}$ (*100)	$1/Logallfees_{-1}$ (*100)	$Supply_{-5,-1}$
VW Average Coef.	**All**	-8.95***	-53.20***	-9.30***	-11.42***	36.66***	45.41***	-1.91
	Developed	-9.34***	-56.27***	-9.34***	-12.18***	35.11***	43.65***	-3.00
	Emerging	-2.70	-4.09	-8.63	0.85	61.42*	73.44	15.52
	Non PIGS	-9.02***	-54.69***	-8.22***	-10.58***	35.75***	44.53***	-3.26
	PIGS	-7.40	-20.21**	-33.20**	-29.97**	56.73*	64.67	27.92***
EW Average Coef.	**All**	-4.00	-11.58*	-12.51***	-10.32***	42.77***	72.30***	11.53**
	Developed	-3.42	-15.98**	-14.40***	-13.84***	48.61***	65.28***	12.52**
	Emerging	-6.32	6.01	-4.96	3.74	19.39	100.37	7.55
	Non PIGS	-4.63	-11.87	-11.25***	-8.64**	42.26***	73.28***	10.19**
	PIGS	0.65	-9.44	-21.77	-22.66*	46.51	65.08*	21.28**

Table 4. Country level coefficients on alternative shorting measures

We estimate the following regression using Fama-MacBeth method for each country:

$$r_{i,C,t} = \alpha_{C,t} + b_{C,t} \times SHORT_{i,C,t-1} + c_{C,t} \times misscover_{i,C,t-1} + \sum_{h=1}^{H} d_{h,C,t-1} \times X_{h,i,C,t-1} + \varepsilon_{i,C,t} \quad (1)$$

The dependent variables are the future 20-day risk adjusted cumulative returns for stock *i* in country *C* from day *t*. $SHORT_{i,C,t}$ is the alternative shorting measure for stock *i* in country *C* at time *t*. $X_{h,i,C,t-1}$ are lagged firm specific control variables such as *Logsize*, *BM*, $LagRet_{-1m}$, $LagStdRet_{-1m}$, and $LagTurn_{-1m}$ for stock *i*, in county *C*, at day *t* as defined in Table 1. *DE* is a dummy variable that takes on the value of one for stocks with valid information from Data Explorers in the last five days. The independent variables $SHORT_{i,C,t}$ and $X_{h,i,C,t}$ are normalized to have zero mean and unit standard deviation within each country C at time t. We compute Newey-West standard errors with 20 lags. The significance is denoted with ***, **, * at the 1 %, 5% or 10% levels, respectively.

Country	**$SIR_{-5,-1}$ (*100)**	**$DTCR_{-5,-1}$ (*100)**	**$Uti_{-5,-1}$ (*100)**	**$Feespread_{-5,-1}$ (*100)**	**$1/Logcurrfees_{-5,-1}$**	**$1/Logallfees_{-1}$**	**$Supply_{-5,-1}$**
Australia	8.08***	-24.75***	-1.99	-25.91***	1.17***	1.37***	30.83***
Germany	-29.94***	-1.39	-52.30***	-30.03***	0.43***	0.55***	-0.75
Belgium	-21.89***	-38.75	-22.63***	-10.77*	0.30*	0.52***	-5.27
Canada	6.84***	14.46***	-20.51***	-23.51***	0.57***	0.42***	25.67***
Denmark	9.07	16.89**	-32.44***	11.45	0.67***	1.21***	50.71***
Spain	-11.43*	-33.49***	-52.90***	-49.13***	1.03***	1.25***	40.84***
Finland	-26.31***	-35.97***	-1.45	-1.57	-0.19	0.15	-15.73**
France	1.96	-11.10	-7.75*	-0.06	0.28***	0.31***	10.25***
Hong Kong	4.39	9.19***	-14.43***	-42.20***	1.40***	1.89***	23.16***
Italy	-6.76**	-11.89***	-19.05***	-14.70***	0.17	0.07	18.31***
Japan	-16.02***	-27.37***	2.31	-9.66***	0.42***	0.58***	0.21
South Korea	7.94**	-8.77***	-21.29***	-3.87	0.72***	0.63***	24.05***
Mexico	-34.45***	-12.86	6.57	-5.26	-0.42	-0.68	-40.54***
Netherlands	-1.89	-11.90*	-1.90	-31.56***	0.60***	0.48***	-0.49
Norway	-21.50***	-30.81***	-30.22***	-24.26***	0.43**	0.63***	7.68
Austria	9.38	-6.19	12.18	16.26	-0.17	-0.64**	10.05
Portugal	20.14**	17.07**	6.63	-4.15	0.20	0.63**	4.71
South Africa	2.93	2.52	2.75	-4.00	0.29	0.57***	16.52***
Sweden	16.46***	-10.70***	-21.45***	-6.45	1.14***	1.19***	35.10***
Singapore	15.02***	-1.08	-29.15***	-19.83***	1.23***	1.75***	55.68***
Switzerland	3.22	-6.26*	5.35	-4.86	-0.15	0.46***	7.37
Taiwan	-9.87	-15.00	-2.98	5.45**	1.38	0.69	23.13***
Turkey	1.88	64.17	-9.85**	26.36***	-1.01	3.80***	14.60**
UK	-12.38***	9.09	1.95	4.29	0.10*	0.08	-32.73***
US	-14.78***	-134.66**	-8.31*	-10.14***	0.11**	0.13***	-15.22***

Table 5. Time series mean of country's major stock market daily liquidity measures, regulations and countries' macro/information environment variables

The sample period is July 3rd, 2006 to August 13th 2010. Full descriptions of the variables are provided in Table 1.

Country	N(day)	Uptick	Naked Ban	Short ban	CCP[8]	ES	PPI	Turnover *100	AbsRet *100	Retsqr *100	Openness	GDPPC	AD	AS
Australia	1017	No	Yes (since 2001)	Yes	No	246.02	6.44	0.12	1.83	0.04	42.14	44529.80	4	75
Germany	1018	No	Yes (since 2008)	No	Yes	78.86	21.97	0.01	1.43	0.03	86.31	40641.92	1	62
Belgium	1026	No	Yes (2008-2009)	No	Yes	70.59	25.94	0.06	1.03	0.01	157.87	43734.31	0	61
Canada	914	Yes	No	Yes*	Yes	130.80	47.27	0.12	1.62	0.03	63.47	44346.92	5	74
Denmark	993	No	No	Yes*	No	154.28	5.64	0.06	1.06	0.02	99.39	57266.07	2	62
Spain	1018	No	Yes (since 1992)	No	No	47.05	28.30	0.19	1.24	0.02	56.75	31613.28	4	64
Finland	1007	No	No	No	No	87.65	7.97	0.07	1.13	0.02	82.97	46033.63	3	77
France	1026	No	Yes (since 2008)*	No	Yes	90.27	29.99	0.05	1.00	0.01	53.50	40538.40	3	69
Hong Kong	987	Yes	Yes(since 1994)	No	No	109.40	38.00	0.13	1.70	0.04	398.73	30836.43	5	69
Italy	1015	No	Yes (2008-2009)	No	No	63.03	26.86	0.14	1.25	0.02	54.82	36147.25	1	62
Japan	966	Yes	Yes (since 2008)	No	Yes	39.75	32.08	0.18	1.42	0.03	31.03	37655.08	4	65
South Korea	992	Yes	Yes	Yes	No	69.17	39.94	0.38	1.62	0.04	88.31	20879.61	2	62
Mexico	1007	Yes	Yes	No	Yes	54.34	29.31	0.07	1.09	0.02	57.55	8806.70	1	60
Netherlands	1026	No	Yes (2008-2009)	No	Yes	40.34	22.50	0.21	1.24	0.02	139.81	48213.54	2	64
Norway	999	No	Yes (since 2008)*	No	No	123.92	18.83	0.10	1.27	0.02	72.38	84193.64	4	74
Austria	994	No	Yes (2008-2010)*	No	Yes	64.29	31.07	0.13	1.05	0.02	106.56	45714.39	2	54
Portugal	1026	No	Yes (since 2008)*	No	Yes	55.69	28.56	0.13	1.08	0.02	70.30	22090.40	3	36
South Africa	1004	No	Yes	No	No	128.34	32.15	0.07	0.88	0.01	63.62	5863.49	5	70
Sweden	1007	No	No	No	No	117.31	14.74	0.11	1.33	0.02	94.80	48407.12	3	83
Singapore	1012	No	Yes	No	Yes	207.56	75.64	0.09	1.03	0.02	399.20	39592.04	4	78
Switzerland	987	No	Yes (2008-2009)*	Yes*	Yes	77.08	19.96	0.06	0.94	0.01	94.76	64063.90	2	68
Taiwan	972	Yes	No	No	Yes	47.61	33.10	0.49	1.60	0.04	134.08	17121.05	3	65
Turkey	996	Yes	No	No	No	83.58	65.33	0.65	1.57	0.03	49.66	9334.98	2	51
UK	1020	No	No	Yes *	Yes	118.29	19.05	0.20	1.60	0.03	59.23	40929.64	5	78
US	999	Yes/No	Yes (2008)	Yes *	No	9.56	2.24	0.84	1.72	0.05	27.51	47737.81	5	71

[8] In the CCP column, "No" is used for countries where no CCP clearing or securities lending is available at all. We denote "Yes" for countries which have some form of CCP, even if it is relatively underdeveloped and informal. For example, CCP by SecFinex was available in Europe even though the centralized market was very limited. In case of the non-European countries, such as Taiwan and Singapore, CCPs are regulated and managed by the exchange to facilitate securities borrowing and lending (SBL).

* sign in the column "naked ban" and "short ban" whether the ban is/was relevant only to financial stocks, or specific financial stocks, not to the whole market. Only Australia and Korea had market wide short sale ban (Jain et al., 2012).

Table 6. Regression analyses of informativeness of short sales in conjunction with country (exchange) regulations

Using time series FM loadings for each country obtained from Table 3, we analyze the impact of regulations on these loadings. We estimate panel regression of FM loadings on regulation variables,

$$b_{C,t} = \alpha + e \times DREG_{C,t} + \varepsilon_{C,t} \tag{2}$$

where the dependent variable is the daily Fama-MacBeth coefficient estimate from the 20-day risk-adjusted return regressions from Table 4 for country *C* on day *t* on one of the seven alternative short-sale measure. In Panel A, $DREG_{C,t}$ takes value of 1 if there is an uptick rule in place. In Panel B, $DREG_{C,t}$, takes on a value of one if there was a naked ban. In Panel C, $DREG_{C,t}$ takes value of 1 if the country market has CCP. Under *Exp.Sign* we denote the expected sign of the coefficient estimate of the short sale regulation proxies. ***, **, * denote that coefficient estimate is significant at the 1%, 5% and 10%, respectively.

Panel A. Short sale general informativeness and in relation with the uptick rule

	Exp. Sign	**DREG=0**	**DREG=1**	**diff**
$SIR_{-5,-1}$	-	-0.03***	-0.06***	-0.026
$DTCR_{-5,-1}$	-	-0.18***	0.03	0.206***
$Uti_{-5,-1}$	-	-0.14***	-0.09***	0.047**
$Feespread_{-5,-1}$	-	-0.12***	-0.07***	0.045**
$1/Logcurrfees_{-5,-1}$	+	0.43***	0.39***	-0.032
$1/Logallfees_{-1}$	+	0.60***	1.02***	0.420***
$Supply_{-5,-1}$	+	0.12***	0.10***	-0.024

Panel B. Short sale informativeness in relation with the 2008 naked ban

	Exp. Sign	**DREG=0**	**DREG=1**	**diff**
$SIR_{-5,-1}$	-	-0.03***	-0.05***	-0.023
$DTCR_{-5,-1}$	-	0.03	-0.31***	-0.335***
$Uti_{-5,-1}$	-	-0.10***	-0.15***	-0.051***
$Feespread_{-5,-1}$	-	-0.06***	-0.16***	-0.093***
$1/Logcurrfees_{-5,-1}$	+	0.23**	0.66***	0.427***
$1/Logallfees_{-1}$	+	0.64***	0.82***	0.176
$Supply_{-5,-1}$	+	0.06***	0.18***	0.120***

Panel C. Short sale informativeness in relation with CCP

	Exp. Sign	**DREG=0**	**DREG=1**	**diff**
$SIR_{-5,-1}$	-	-0.02*	-0.06***	-0.034**
$DTCR_{-5,-1}$	-	-0.16***	-0.08*	0.085
$Uti_{-5,-1}$	-	-0.18***	-0.08***	0.098***
$Feespread_{-5,-1}$	-	-0.12***	-0.09***	0.037**
$1/Logcurrfees_{-5,-1}$	+	0.49***	0.35***	-0.135
$1/Logallfees_{-1}$	+	1.07***	0.39***	-0.680***
$Supply_{-5,-1}$	+	0.20***	0.04***	-0.160***

Table 7. Regression analyses of informativeness of short sales in conjunction with market development

Using time series FM loadings for each country obtained from Table 3 step 1, we analyze the effect of market level indices on these loadings. We run panel regression of single shorting variable FM loadings on market level indices:

$$b_{C,t} = \alpha + e \times MKTCHAR_{C,t-1} + \varepsilon_{C,t} \tag{3}$$

where the dependent variable is the daily Fama-MacBeth coefficient estimate from the 20-day risk-adjusted return regressions from Table 4 for country *C* at day *t* on one of the seven alternative short-sale measure. The market characteristics, *MKTCHAR*, include *ES* (average weighted effective spread), *PPI* (average weighted price impact), *Turnover* (average turnover), *AbsRet* (average absolute return) and *Retsqr* (average return squares). Under *Exp.Sign* we denote the expected sign of the coefficient estimate of the short sale regulation proxies. ***, **, * denote that coefficient estimate is significant at the 1%, 5% and 10%, respectively.

	Exp. Sign	**ES*(100)**	**PPI*(100)**	**Turnover(/100)**	**AbsRet(/100)**	**RetSq(/100)**
$SIR_{-5,-1}$	-	0.06***	0.09**	-0.10***	-4.66***	-0.56***
$DTCR_{-5,-1}$	-	0.05	0.48***	-0.57***	-9.58***	-1.19**
$Uti_{-5,-1}$	-	0.04***	0.03	0.03	3.52***	0.50***
$Feespread_{-5,-1}$	-	-0.01	0.13***	0.16***	-0.29	-0.08
$1/Logcurrfees_{-5,-1}$	+	0.14	-0.72**	0.41	-12.66	-2.19
$1/Logallfees_{-1}$	+	0.30***	0.96***	1.02***	1.93	-0.55
$Supply_{-5,-1}$	+	0.10***	0.22***	-0.11***	-6.36***	-0.82***

Table 8. Regression analyses of informativeness of short sales in conjunction with country macro/information environment

Using time series FM loadings for each country obtained from Table 3 step 1, we analyze the effect of market level indices on these loadings. We run panel regression of single shorting variable FM loadings on countries macro environment indices:

$$b_{C,t} = \alpha + e \times Macro_{C,t-1} + \varepsilon_{C,t} \quad (3)$$

where the dependent variable is the daily Fama-MacBeth coefficient estimate from the 20-day risk adjusted return regressions from Table 4 for country *C* at day *t* on one of the seven alternative short-sale measure. The macro environment variables, *Macro*, include *Openness* (trade in % of GDP), *GDPPC* (GDP per capita), *AD* (Anti-director rights index), and *AS* (Accounting standard index). Under *Exp.Sign* we denote the expected sign of the coefficient estimate of the short sale regulation proxies. ***, **, * denote that coefficient estimate is significant at the 1%, 5% and 10%, respectively.

	Exp. Sign	**Openness*(100)**	**GDPPC*(100000)**	**AD*(10)**	**AS*(100)**
$SIRprc_{-5,-1}$	-	0.04***	-0.04	2.50***	-0.14*
$DTCR_{-5,-1}$	-	0.06**	-0.62***	-3.37*	-1.02***
$Uti_{-5,-1}$	-	-0.03***	-0.15***	1.19*	-0.29***
$Feespread_{-5,-1}$	-	-0.06***	-0.27***	-3.01***	-0.50***
$1/Logcurrfees_{-5,-1}$	+	0.32***	0.59	14.44***	2.53***
$1/Logallfees_{-1}$	+	0.30***	-0.66**	8.88**	-0.23
$Supply_{-5,-1}$	+	0.09***	0.08	2.56***	0.27***

Table 9. Relation between FM coefficients and regulations, market development, and macro environment

We estimate the following regression:

$$b_{C,t} = \alpha + e \times DREG_{C,t} + f \times MKTChar_{c,t} + g \times Macro_{C,t} + \varepsilon_{C,t},$$

where the dependent variable is the daily Fama-MacBeth coefficient estimate from the 20-day risk-adjusted return regressions from Table 4 for country *C* on day *t* for one of the seven short-sale measures. We include regulation dummies for country days where uptick rule or naked ban is in effect and the presence of CCP, respectively. We also include market characteristic such as *ES* (average weighted effective spread), *PPI* (average weighted price impact), *Turnover* (average turnover), *AbsRet* (average absolute return) and *Retsqr* (average return squares). In addition, countries' macro/information environment variables, *Openness* (trade in % of GDP), *GDPPC* (GDP per capita), *AD* (Anti-director rights index), and *AS* (Accounting standard index), are included in the regression. ***, **, * denote that coefficient estimate is significant at the 1%, 5% and 10%, respectively.

	SIR$_{-5,-1}$	**DTCR$_{-5,-1}$**	**Uti$_{-5,-1}$**	**Feespread$_{-5,-1}$**	**1/Logcurrfees$_{-5,-1}$**	**1/ Logallfees$_{-1}$**	**Supply$_{-5,-1}$**
Exp. Sign	-	-	-	-	+	+	+
Intercept	0.39***	1.21***	0.07	0.12*	-1.10*	1.64***	0.20**
Uptick	-0.03	0.19**	0.04	-0.02	0.13	0.30**	0.01
Nakedban	-0.10***	-0.56***	-0.08***	-0.10***	0.49***	-0.14	0.06***
CCP	-0.06***	-0.16**	0.14***	0.03	0.22	-0.71***	-0.20***
ES*(100)	0.76***	1.02*	1.16***	0.64***	2.30	3.97***	0.50**
PPI*(100)	0.04	0.32*	-0.21***	0.15***	-1.65***	0.30	0.30***
Turnover(/100)	-0.82*	-9.41***	0.49	1.69***	12.80***	10.26***	-0.36
AbsRet(/10)	-0.58***	-0.67*	0.30**	-0.22*	-1.75*	-1.80**	-1.09***
Openness*(100)	0.04***	0.07*	-0.03**	-0.06***	0.36***	0.32***	0.06***
GDPPC*(100000)	-0.05	-0.69***	-0.20***	-0.26***	0.35	0.19	0.26***
AD*(10)	0.46***	0.44*	0.31***	-0.22***	0.19	0.23	0.11
AS*(100)	-0.75***	-1.38***	-0.50***	-0.10	1.25	-2.20***	-0.28**
R^2	0.64%	0.58%	0.53%	0.63%	0.24%	0.46%	1.14%
Adj R^2	0.60%	0.53%	0.49%	0.59%	0.20%	0.41%	1.10%

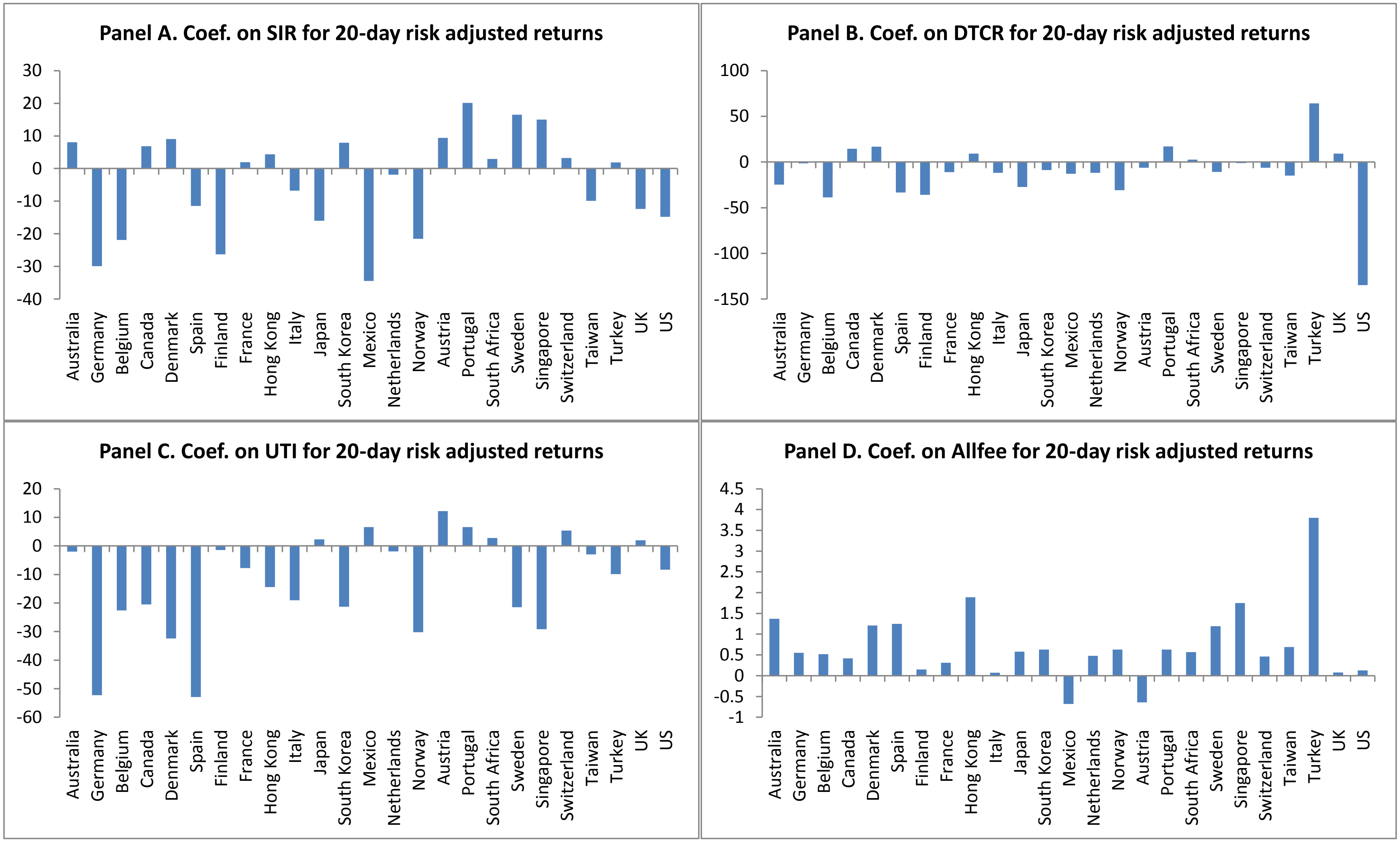

Figure 1. Alternative short sale measures return predictability at the 20-day horizon
Coefficient estimates from stock level regression of future 20-day abnormal returns by country in relation with shorting variables, Short interest ratio (*SIR*), Days-to-cover ratio (*DTCR*), Utilization ratio (*Uti*) and all fee variable. The variable definitions are provided in Table 1.

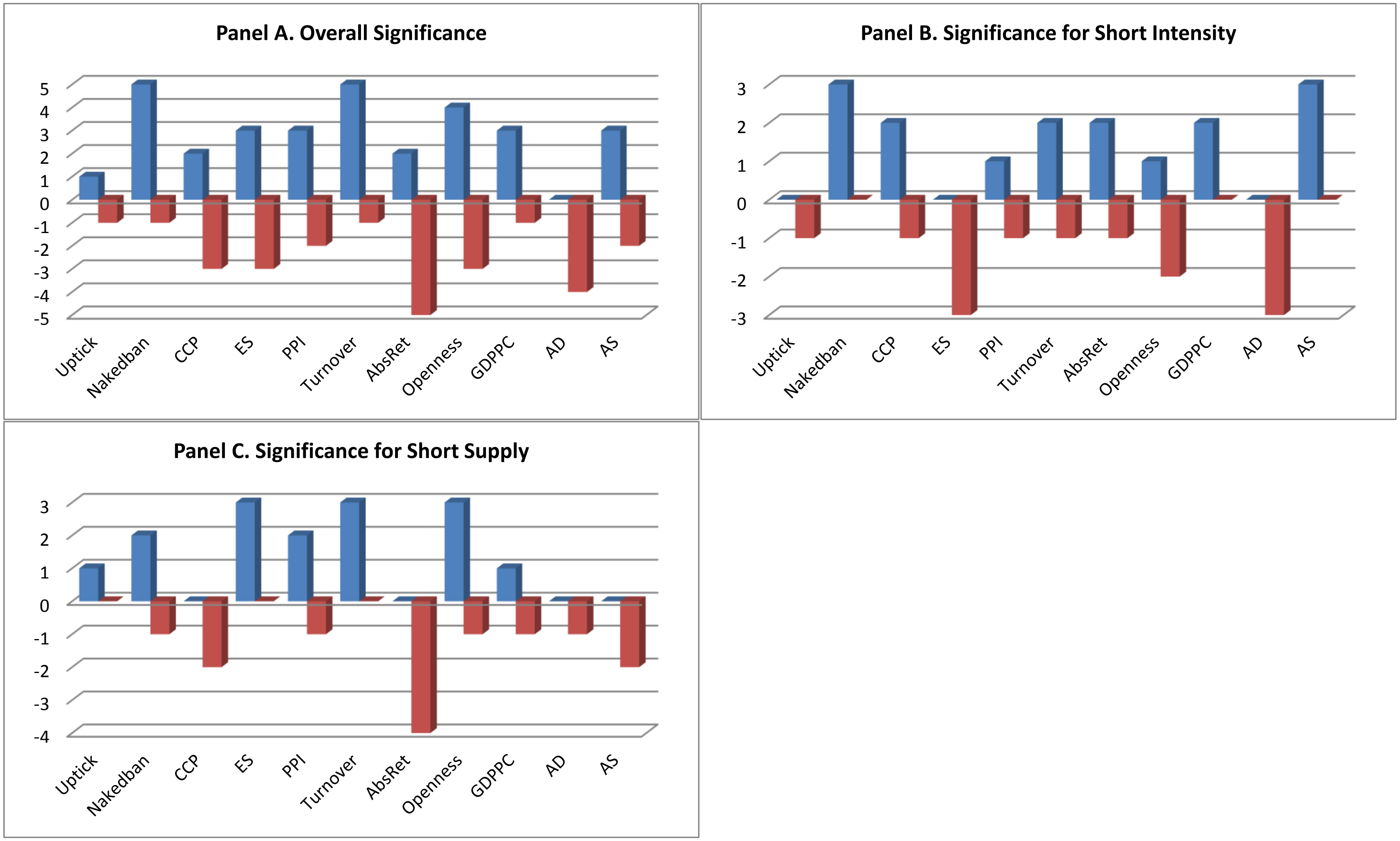

Figure 2. Significance of Various variables for Increasing and Decreasing Short's Informativeness
Coefficient estimates are reported in Table 9. In this figure, we report number of significance cases for all seven short measures in Panel A, all three shorting intensity measures in Panel B, and all four shorting cost and supply measures in Panel C.