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Which Short-Selling Regulation is the Least Damaging to Market Efficiency? Evidence from Europe

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Abstract

Exploiting cross-sectional and time-series variations in European regulations during the July 2008 – June 2009 period, we show that: 1) Prohibition on covered short selling raises bid-ask spread and reduces trading volume, 2) Prohibition on naked short selling raises both volatility and bid-ask spread, 3) Disclosure requirements raise volatility and reduce trading volume, and 4) No regulation is effective against price decline. Overall, all short-sale regulations harm market efficiency. However, naked short-selling prohibition is the only regulation that leaves volumes unchanged while addressing the failure to deliver. Therefore, we argue that this is the least damaging to market efficiency.

JEL Codes: G18, G14, G01, K20, O52

Keywords: short selling, disclosure requirement, market efficiency, regulation, volatility.

1. Introduction

Short sellers are the usual suspects for financial turmoil and price decline. In Europe in particular, short sellers are blamed for the debt crisis. Therefore, since September 2008 European regulators have taken action to curtail short-selling activities. However, the new regulations have been introduced in a highly dispersed way. In this paper, we take advantage of the opportunity offered by this natural experiment involving fourteen European markets over a one-year period. Exploiting both cross-sectional and time-series variations in regulatory regimes, we study the effects of short-sale constraints on market efficiency in Europe.

Our conclusions are especially relevant in light of the recent developments in the European regulatory landscape. New measures on short selling became applicable in EU countries as from 1 November 2012. These measures include public disclosure requirements on net short positions and restrictions on naked short sales (Council of the European Union, 2012). Compared to existing work, this paper makes two methodological innovations. First, we compare the effects of three regulatory regimes (prohibition on naked short sales, prohibition on covered short sales, and disclosure requirement) on individual stocks' daily bid-ask spreads, intraday volatility, and trading volume, and weekly returns. Disclosure regimes, in particular, have been ignored in the empirical literature so far.¹ Second, we examine the effects of those regimes while controlling for the impact of the global financial environment.

¹ Beber and Pagano (2013) do actually use a disclosure dummy, but their analysis does not focus on the impact of this dummy.

Two main theoretical articles study the impact of short-sale prohibition and restrictions on market prices. First, Miller (1977) suggests that short-sale prohibition leads to asset overvaluation because it prevents pessimists who do not own the asset from selling, while optimists can always buy. Second, Diamond and Verrecchia (1987) argue that short-sale prohibition leads to slower price adjustment and higher bid-ask spreads, since information driven by short sales is lost. Thus, Miller (1977) and Diamond and Verrecchia (1987) share the argument that short-sale prohibitions stifle market efficiency, either by distorting prices or by slowing down price adjustments and widening bid-ask spreads.

In line with theory, international evidence supports the view that short-sale regulations create market distortions. The empirical research on this issue starts with Bris et al. (2007) who exploit the cross-sectional differences between national regulations. They find that stocks traded in countries where short sales are practiced incorporate information faster, and have lower asymmetric response to bad-versus-good news. Chen and Rhee (2010) test Diamond and Verrecchia's hypothesis on the Hong Kong market, which has a list of shortable stocks updated every three months. They confirm that the prices of shortable stocks adjust faster to new information.

The regulations on short sales put in place following the outburst of the 2008 financial crisis can be broken into three categories:² 1) prohibition of covered (and also naked) short selling (PCSS), 2) prohibition of naked short selling (PNSS), and 3) regulatory disclosure for short selling (RDSS), i.e., requirement to disclose short positions to the market's regulator.

² This corresponds to the classification adopted by the European Commission (2010a).

Table 1 summarizes the results obtained in the literature on the impacts of PCSS, PNSS, and RDSS on bid-ask spreads, stock intraday volatility, trading volume, and the level of weekly returns, respectively. Table 1 shows that the impacts of the three types of regulations have not been fully disentangled so far. Such disentanglement is precisely the aim of this paper, which concentrates on the European stock market.

Table 1: State of the art on the impact of short-sale regulations during the 2008-2009 crisis

Table 1 summarizes the findings of recent empirical studies on short-sale regulations during the 2008-2009 crisis. Results concern the effects of different types of regulations (PCSS: prohibition on covered short selling; PNSS: prohibition on naked short selling; RDSS: disclosure requirement for short positions) on bid-ask spread, volatility, traded volume, and return, which can be positive (+), non significant (=) or negative (-).

Authors	Data set	Type of regulation	Impact on bid-ask	Impact on	Impact on volume	Impact on return	Other
Boehmer et al. (2011)	US 2008	PCSS	+	+	-		
Autore et al. (2011)	US 2008	PCSS				+	
Kolasinski et al. (2013)	US 2008	PNSS & PCSS					Information content of trades (+)
Fotak et al. (2009)	US 2008	PNSS			-	=	
Harris et al. (2009)	US 2008	PCSS				+	
Gagnon and Witmer	US 2008	PCSS	+		-	+	
Hansson and Fors (2009)	UK 2008-9	PCSS	+	=	-	=	
FSA (2009)	UK 2008-9	RDSS	+	+	-	=	
Marsh and Payne (2012)	UK 2008-9	PCSS	+	+	-	=	Bilateral trading (+)
Oliver Wyman (2010)	UK 2008-9	RDSS	+	+	-		
AMF (2009)	France 2008	PNSS & RDSS	=	=	-	+	
Helmes et al. (2010)	Australia 2008-9	PCSS	+	+	-	=	
Beber and Pagano (2013)	World 2008-9	PNSS, PCSS (& RDSS)	+			=	Speed of price adjustment (+)

The U.S. were the first country to take action during the 2008-2009 financial crisis, with the Securities and Exchange Commission (SEC) banning naked short selling on nineteen financials from 21 July until 12 August 2008. Later, on 19 September 2008, the SEC issued a temporary ban on all short sales, which affected almost 1,000 financial stocks and lasted until 8 October 2008. Analyzing the US stock market, Boehmer et al. (2011) find that PNSS reduces daily volumes and raises bid-ask spreads and intraday volatilities. Harris et al. (2009) show that PCSS also leads to price inflation while Autore et al. (2011) confirm Miller's hypothesis that highly volatile stocks are more likely to be overvalued. Consistent with Diamond and Verrecchia's restriction-effect hypothesis, Gagnon and Witmer (2010) demonstrate that short-sale restrictions impede arbitrage activities. In the same vein, Kolasinski et al. (2013) find that these restrictions increase the informational content of trades. This confirms that PNSS affects non-informed short sellers differently than well-informed ones. Lastly, Fotak et al. (2009) show that PNSS reduces trading volumes. Moreover, they find no evidence that short sales are responsible for the sharp declines in financial stocks during the 2008 crisis. Notably, Helmes et al. (2010) find similar results on Australian data.

European regulations have also captured attention. Hansson and Fors (2009) focus on the UK PCSS, effective from 19 September 2008 until 16 January 2009. They find a significant decrease in volumes and a widening of bid-ask spreads, but no impact on intraday volatility and abnormal returns. These findings are confirmed by a study performed by the UK Financial Services Authority (FSA, 2009). In addition, the consultancy firm Oliver Wyman (2010) shows that the UK public disclosure regime is detrimental for spreads and trading volumes. Marsh and Payne (2012) point out that these negative effects merely affected the financial sector and

encouraged bilateral off-market trading. The French regulator (AMF, 2009) made an impact assessment of its 2008 disclosure regime and naked short-selling ban on financials. This small-scale study³ shows a rather small impact of the regulatory measures.

In one of the most comprehensive studies to date, Beber and Pagano (2013) make an overview of the 2008-2009 regulations around the world. They find that both PNSS and PCSS increase bid-ask spreads. This effect is stronger for small-cap stocks, high-volatility stocks, and stocks with no tradable options. Furthermore, Beber and Pagano (2013) find no evidence of stock overvaluation except in the U.S. Finally, both prohibition types are associated with a slow-down in price discovery, especially on down-market days.

Our study encompasses the previous ones performed on European markets. This is made possible by fully exploiting the cross-sectional dimension of our sample made of fourteen markets. Overall, our results confirm the theoretical predictions from both Miller (1977) and Diamond and Verrechia (1987), with some nuances however. We show that European PCSSs lead to higher bid-ask spreads and lower trading volume. On the other hand, PNSSs permanently raise intraday volatility and bid-ask spreads but, strikingly, have no impact on either volumes or stock returns. Requirements to disclose short positions to the regulator or to the public are associated with volume reductions, likely because they represent extra costs for short sellers in terms of both administrative burden and revelation of trading strategies. These requirements also increase volatility. As far as market efficiency is concerned, our results thus

³ It is an impact study comparing the five days after the introduction of the regulation to the five days before it. This study is admittedly performed in a situation where controlling for the specificities of the financial sector stocks is hardly feasible.

raise serious doubts on the adequacy of both the national regulations implemented in the past and the pan-European regulation which has become law in all Member States on 1 November 2012.

Yet, examining the impact of regulations on financial markets raises concerns about potential endogeneity. Reverse causality could stem from the determinants of the introduction and lift of regulations. Regulators are indeed tempted to take action at times when market conditions are unfavorable. To address this issue, Beber and Pagano (2013) perform a robustness check based on instrumental variables.⁴ They show that accounting for potential endogeneity does not affect their overall conclusions. In addition, working with daily data like we do reduces the likelihood of facing significant reverse causality. In particular during the one-year period under investigation here, stock prices experienced large swings and regulators were mostly unable to react in real-time to those swings.

This paper is organized as follows. Section 2 depicts the European short-selling regulatory landscape. Section 3 describes the data set. Section 4 introduces the methodology. Section 5 discusses our results. Section 6 concludes.

⁴ Alternatively, Helmes et al. (2010) and Boehmer et al. (2011) use a matching methodology to account for the specificities of the financial stocks, which were especially targeted by regulators.

2. Short Selling in Europe

In a short sale, the seller does not own the asset on the trading day, say T , but has to deliver this asset when the transaction is settled, i.e., on day $(T+3)$, typically (IOSCO, 2009).⁵ Moreover, a short sale is either covered (i.e., the seller has borrowed the asset in T) or naked (i.e., uncovered). A naked short sale entails the risk of failure to deliver. In Europe, the volume of short sales remains unknown because most countries have no flagging system distinguishing short from normal sales. Actually, in the EU-27 only Poland and Greece have – recently – introduced flagging systems (European Commission, 2010a) such as those existing in the U.S. and Hong Kong (Chen and Rhee, 2010). When taking the level of securities lending as a proxy, the short interest (i.e. the net total number of shares sold short) is estimated at 1 to 3% of market capitalization in Europe (European Commission, 2010c). In comparison, for the New York Stock Exchange (NYSE) in 2004, the short interest in stocks was around 2% of market capitalization, while short sales represented 12.9% of the traded volume (Boehmer et al., 2008). The European short-sale volume likely reaches a similar figure.

Short selling comes at a cost. As long as her position is open, the covered short seller has to pay to the lender the dividends, if any, and borrowing fees. In the equity loan market, the borrower usually gives cash as collateral, and gets interest on such collateral at a rate (called the rebate rate) lower than the market rate (Gruenewald et al., 2010b). In addition, Shiller

⁵ Short sales are used to benefit either from a price decline or from a relative price change (Gatev et al., 2006). Actually, a short sale is not the only way to take on a short position. Derivatives can create a similar exposure. Sharpe (1991) argues that financial innovations such as stock index futures help to better respect the Capital Asset Pricing Model (CAPM) assumption that investors can take negative holdings in assets.

(2003) mentions psychological costs associated to the risk of a “short squeeze” with potentially unlimited loss. Importantly, regulatory restrictions can bring extra costs.

In fact, short sales have been regulated for almost as long as stock exchanges exist (Bris et al., 2007). Currently, however, the debate on short selling regulation is in full glory. Indeed, in the aftermath of the collapse of Lehman Brothers on 15 September 2008, the SEC and the FSA announced on 18 September 2008 emergency actions to prohibit covered and naked short selling in securities issued by financial institutions.⁶ Their example was followed around the world. Notably, in Continental Europe, most national regulators took emergency measures in late September 2008. These uncoordinated measures exhibited ample variations.

Overall, the European regulatory landscape is highly fragmented. In reaction to this lack of coordination, the European Commission adopted on 15 September 2010 a proposal targeting short selling and credit default swaps (European Commission, 2010b). Regarding short selling, this proposal includes: 1) a two-tiered disclosure regime⁷ and a flagging system, 2) the regulator’s empowerment to prohibit short sales of financial stocks temporarily and to introduce a circuit breaker, 3) a locate rule, and 4) the obligation for trading venues to have buy-in procedures and fines for late settlement. Market making activities are exempted from these rules. Interestingly, the European Commission explicitly states market efficiency as a concern: *“[the] requirements to be imposed should address the identified risks without unduly*

⁶ The SEC had already banned naked short selling on nineteen financial stocks starting 21 July until 12 August 2008.

⁷ Net short positions above 0.2% of issued share capital have to be disclosed to the regulator, and net short positions above 0.5% of issued share capital have to be disclosed publicly to the market, in line with the CESR 2010 disclosure proposal (CESR, 2010).

detracting from the benefits that short selling provides to the quality and efficiency of the markets" (European Commission, 2010b, p. 13).

Since 15 September 2010, negotiations with the European Parliament and the Council have been ongoing. Parties have eventually come to an agreement in March 2012. In the final text published in the *Official Journal of the European Union* on 24 March 2012 (European Parliament and Council, 2012), the initial locate rule has been relaxed to allow intraday naked short-selling. Likewise, the requirement of a flagging system has been abandoned. This new regulation has become directly effective in all Member States on 1 November 2012. Also, the European Securities Market Authority (ESMA), successor to the Committee of European Securities Regulators (CESR), now has enhanced powers to coordinate actions, issue opinions on national regulations, and adopt temporary measures.

3. Data

3.1. Construction of the Database

Among the EU-27 countries, we have selected the fourteen jurisdictions where both short sales are practiced and daily stock information is available. These countries are: Austria, Belgium, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom. For these countries, the three regulatory regimes (PNSS, PCSS, and RDSS) are illustrated. However, drawing a cross-country analysis requires sufficient heterogeneity in the regulations. Therefore, we opted for the period of investigation

that stretches from 1 July 2008 to 30 June 2009. This leaves us with 253 days of market activity. During this period, the European short-sale regulations exhibited large variations as featured in Figure 1. Starting in September 2008, countries indeed decided to adapt, extend or drop temporary measures on short sales. Our study is meant to exploit the variety in scope and time of these measures.

For each country, we have selected the stocks included in the national Datastream Global Equity Index.⁸ However, this Index does not take liquidity into account, which is relevant when dealing with short sales. In order to circumvent this limitation, we have excluded stocks with low traded volume.⁹ Further, in order to avoid giving excessive weight to UK stocks - which account for almost a third of the initial sample - we have excluded half of them at random. This leaves us with 1,360 stocks (see Table 2). For each of them, we have collected daily observations of the regulatory dummy variables (PNSS, PCSS, and RDSS) from various sources: national regulators' websites, newspapers, client alerts issued by firms (Citigroup, 2011; Latham and Watkins, 2011), ESMA updates of the members' regulation (ESMA, 2011), and Gruenewald *et al.*'s (2010a) article. The right side of Table 2 confirms that regulatory regimes exhibited large geographical heterogeneity over the period under scrutiny.

⁸ Each Datastream Global Equity Index is composed of stocks representing at least 75-80% of its national market capitalisation (Thomson Reuters, 2008).

⁹ The selected stocks fulfill two criteria: 1) the volume of trade is strictly positive during at least 177 days, and 2) the average number of traded shares over the period is at least 200 shares per day.

Figure 1: Timeline of regulatory regimes in fourteen European countries (July 2008 - June 2009)

Figure 1 shows the three types of regulatory regimes introduced in the fourteen European countries included in the database. RDSS stands for a regulatory disclosure of short positions, PNSS stands for a prohibition of naked short selling, and PCSS stands for a prohibition of covered short selling. We distinguish regimes targeting all stocks (all), financial stocks only (fin), or non-financial stocks only (non fin).

Sources: ESMA (2011), Gruenewald et al. (2010a), Latham and Watkins (2011), and national regulators' websites.

Table 2: Overview of the final database

The stocks are those included in the Datastream Global Equity Index of each country, which satisfy the additional criteria of (1) a minimum number of days for which the stock was traded (at least 177 out of the 253 days for which the volume traded was strictly positive) and (2) a minimum average number of shares traded (an average of at least 200 shares traded per day). For the U.K., half of the stocks were removed at random. For any stock-day observation, the PCSS, PNSS and RDSS dummy variables equal one if the particular stock was targeted on the particular day by the corresponding ban.

Country	# of stocks in DS	# of stocks in final database	# of stock-day observations	PCSS=1	PNSS=1	RDSS=1
Austria	50	40	10,120	0	676	7,760
Belgium	90	74	18,722	0	776	776
Denmark	50	45	11,385	1,074	0	0
Finland	50	48	12,144	0	0	0
France	250	214	54,142	0	2,134	2,134
Germany	248	174	44,022	0	1,746	0
Hungary	48	25	6,325	0	0	4,725
Ireland	49	33	8,349	585	0	579
Italy	160	153	38,709	11,715	16,245	0
Netherlands	132	73	18,469	648	40	736
Portugal	50	37	9,361	0	576	567
Spain	123	113	28,589	0	28,589	2,496
Sweden	70	68	17,204	0	0	0
United Kingdom	550	263	66,539	810	0	1,930
Total	1,920	1,360	344,080	14,832	50,782	21,703

Next, for each stock, we have computed four time-varying characteristics: daily bid-ask spreads, daily intraday volatilities, daily traded volumes, and weekly returns. For the sake of comparability, these characteristics are defined along the lines of previous papers (Boehmer et al., 2011; FSA, 2009; AMF, 2009; Beber and Pagano, 2013). First, the daily bid-ask spread (*Spread*) is the difference between the closing ask price (PA) and the closing bid price (PB), divided by the quote midpoint:

$$Spread = \frac{PA - PB}{(PA + PB)/2} \quad (1)$$

Second, intraday volatility (*Volatility*) is defined as the daily relative price range, i.e., the difference between the highest price (PH) and the lowest price (PL), divided by the closing price (P):

$$Volatility = \frac{PH - PL}{P} \quad (2)$$

Third, the daily traded volume (*Volume*) is the total number of traded shares. As most European countries do not have flagging systems, short sales are not traceable. Fourth, following Bris et al. (2007) the weekly stock return (*Return*) is taken as the Wednesday-to-Wednesday discrete return. The weekly time span avoids the noise of daily data while showing sufficient variation for our study. Like Hansson and Fors (2009), we also use the excess return (*Excess_return*) defined as the difference between the stock return and the corresponding country's index return (*Country_return*).

3.2. Descriptive Statistics

Table 3 displays the countries' mean and median values of our four variables of interest (spread, volatility, volume, and return) over the whole sample period. These computations include all available non-zero¹⁰ observations. Notably, means are higher than medians for all four variables, reflecting skewed distributions and the presence of outliers. Therefore, in line with Beber and Pagano (2013), we have removed the observations corresponding to the top 1% quantiles of these four variables. Moreover, because volume is highly skewed, we use its logarithm, like Hansson and Fors (2009). Robustness checks will be performed to assess the impact of these choices.

Table 3: Descriptive statistics of stock variables: global and disaggregated by country

Table 3 presents descriptive statistics of stock variables per country over the period from 1 July 2008 until 30 June 2009. Spread is the difference between ask and bid prices at the close, divided by the quote midpoint. Volatility is the daily difference between the highest and lowest prices, divided by the price at the close. Volume is the daily number of shares traded, expressed in thousands. Return is the Wednesday-to-Wednesday stock return. Only non-zero observations are included. P-values for the equality of means and medians are based on ANOVA F-tests and Kruskal-Wallis tests, respectively.

Country	Spread			Volatility			Volume ('000 shares)			Return		
	Mean	Median	Obs.	Mean	Median	Obs.	Mean	Median	Obs.	Mean	Median	Obs.
All	1.51%	0.69%	335,548	4.92%	4.03%	330,499	1,930	106	335,082	-0.21%	-0.51%	65,239
Austria	1.55%	0.76%	5,724	5.49%	4.38%	9,214	331	67	9,664	-0.59%	-0.69%	1,935
Belgium	1.50%	0.81%	18,512	4.31%	3.48%	17,723	493	18	18,243	-0.28%	-0.40%	3,557
Denmark	0.99%	0.53%	11,057	5.01%	4.17%	10,920	309	50	10,951	-0.48%	-0.91%	2,159
Finland	0.85%	0.38%	11,659	4.79%	4.19%	11,712	1,368	358	11,757	-0.24%	-0.51%	2,279
France	0.96%	0.41%	53,894	4.35%	3.69%	52,899	967	66	53,304	-0.23%	-0.40%	10,338
Germany	1.53%	0.97%	43,472	4.80%	3.85%	42,565	30	4	41,858	-0.50%	-0.69%	8,445
Hungary	6.76%	3.77%	6,116	5.26%	4.13%	5,677	345	15	5,744	-0.15%	-0.50%	1,158
Ireland	3.28%	1.68%	8,153	7.62%	5.53%	7,416	1,173	246	7,811	0.21%	-0.99%	1,551
Italy	2.09%	1.03%	38,331	4.68%	4.06%	38,140	5,643	265	38,379	-0.19%	-0.58%	7,412
Netherlands	1.95%	0.64%	18,220	5.47%	4.26%	17,647	1,420	104	18,092	-0.39%	-0.77%	3,465
Portugal	1.94%	0.88%	9,299	4.43%	3.56%	8,617	1,556	278	9,060	-0.06%	-0.58%	1,702
Spain	1.35%	0.58%	28,411	5.01%	4.22%	27,900	2,700	160	28,373	-0.31%	-0.67%	5,303
Sweden	0.74%	0.39%	16,996	4.91%	4.27%	16,937	2,907	725	16,986	0.14%	0.25%	3,264
United Kingdom	1.19%	0.51%	65,704	5.24%	4.24%	63,132	2,600	509	64,860	0.06%	-0.34%	12,671
<i>P-value eq. test</i>	<i>0.00</i>	<i>0.00</i>		<i>0.00</i>	<i>0.00</i>		<i>0.00</i>	<i>0.00</i>		<i>0.18</i>	<i>0.10</i>	

¹⁰ Zero observations are not included, in order to avoid a non-trading bias.

Table 3 also highlights large discrepancies between European countries. The lowest spread is found for Sweden (mean value of 0.74%) while the highest one is found for Hungary (6.76%). Trading activity is the lowest in Germany (mean daily volume of 30,000 shares) and the highest in Italy (5,643,000 shares), although the U.K. has the highest number of stocks in our sample.¹¹ Expectedly, returns and volatilities exhibit less heterogeneity.

Figure 2: Evolutions of the studied variables (July 2008 - June 2009)

Figure 2 shows the evolution of average stock characteristics (un-weighted arithmetic means). Spread is the difference between ask and bid prices at the close, divided by the quote midpoint. Volatility is the daily difference between the highest and lowest prices, divided by the price at the close. Volume is the daily number of shares traded, expressed in thousands. Return is the discrete Wednesday-to-Wednesday return.

¹¹ German figures should, however, be interpreted with caution. Since July 1998, *Deutsche Börse AG* measures volumes according to the so-called *Orderbuchstatistik* which includes sell-side transactions only (Thomson Reuters, 2008). To acknowledge this peculiarity, we successfully performed a robustness check excluding German data from volume series (results not reported).

Fig. 2 shows the evolution of average stock characteristics (un-weighted arithmetic means). The observed time variations are likely attributable to large market swings during the sample period. Accordingly, we either introduce time fixed effects in the regressions, or control for the worldwide stock market returns.

Typically, financial stocks were targeted by partial prohibitions. Table 4 takes a closer look at financial stocks and compares them to non-financial stocks. Financial stocks exhibit lower spreads, higher volatilities, higher volumes, and lower returns

Table 4: Comparison of financial and non-financial stocks

Financial and non-financial stocks are from countries that introduced, at some point, partial bans on stocks issued by financial institutions. ‘Undifferentiated’ stocks are from other countries. Spread is the difference between ask and bid prices at the close, divided by the quote midpoint. Volatility is the daily difference between the highest and lowest prices, divided by the price at the close. Volume is the daily number of shares traded, expressed in thousands. Return is the Wednesday-to-Wednesday stock return. Only non-zero observations are included. P-values for the equality of means and medians are based on ANOVA F-tests and Kruskal-Wallis tests, respectively.

Stock type	Spread			Volatility			Volume ('000)			Return		
	Mean	Median	Obs.	Mean	Median	Obs.	Mean	Median	Obs.	Mean	Median	Obs.
Financial	1.05%	0.46%	23,868	5.53%	4.36%	24,130	7,934	497	24,271	-0.09%	-0.69%	4,691
Non-financial	1.51%	0.75%	276,909	4.86%	3.98%	272,043	1,399	81	276,324	-0.24%	-0.52%	53,847
Undifferentiated	1.84%	0.48%	34,771	4.93%	4.22%	34,326	1,956	351	34,487	-0.04%	-0.31%	6,701
<i>P-value eq. test</i>	<i>0.00</i>	<i>0.00</i>		<i>0.00</i>	<i>0.00</i>		<i>0.00</i>	<i>0.00</i>		<i>0.18</i>	<i>0.10</i>	

Table 5 gives a first glimpse of the impact of regulations on stock characteristics by providing means conditional on each regulatory dummy, and paired difference tests. At the 1% level for all three regulatory regimes, the bid-ask spreads, volatilities and daily volumes are significantly higher for regulated stock-day observations than for non-regulated ones. For volumes in particular, this evidence is counterintuitive. However, volumes could primarily be driven by stock characteristics, which would then obscure regulatory impacts. For instance, financial stocks typically exhibit higher volumes, irrespectively of the regulatory context. The regressions will take this feature into account.

Table 5: Descriptive statistics disaggregated by regulatory regime (July 2008 - June 2009)

The three regulatory regimes are: prohibition on covered short selling (PCSS), prohibition on naked short selling (PNSS), and disclosure requirements for short sales (RDSS). Spread is the difference between ask and bid prices at the close, divided by the quote midpoint. Volatility is the daily difference between the highest and lowest prices, divided by the price at the close. Volume is the daily number of shares traded, expressed in thousands. Return is the Wednesday-to-Wednesday stock return. Only non-zero observations are included. P-values for the equality of means and medians are based on ANOVA F-tests and Kruskal-Wallis tests, respectively. Only non-zero observations are included. P-values are obtained from t-tests for the equality between means.

		Spread		Volatility		Volume (in '000)		Return	
		Mean	Obs.	Mean	Obs.	Mean	Obs.	Mean	Obs.
PCSS	0	1.47%	321,147	4.87%	315,907	1,712	320,396	-0.21%	62,450
	1	2.30%	14,401	5.98%	14,592	6,668	14,686	-0.09%	2,789
	<i>P-value test</i>	<i>eq.</i>	0.00	0.00		0.00		0.49	
PNSS	0	1.48%	285,209	4.89%	280,579	1,661	284,643	-0.26%	55,595
	1	1.70%	50,339	5.07%	49,920	3,445	50,439	0.12%	9,644
	<i>P-value test</i>	<i>eq.</i>	0.00	0.00		0.00		0.00	
RDSS	0	1.45%	316,521	4.83%	310,016	1,808	314,192	-0.22%	61,073
	1	2.44%	19,027	6.20%	20,483	3,759	20,890	0.03%	4,166
	<i>P-value test</i>	<i>eq.</i>	0.00	0.00		0.00		0.09	

4. Methodology

Before testing existing theories on impacts of short-selling regulations, we need to classify the actual regulations into full bans and restrictions.¹² Making such distinction is crucial since theoretical predictions heavily rest upon the trading possibilities accessible to the traders. For instance, the Diamond and Verrecchia (1987) model unambiguously predicts that bid-ask spreads widen in the presence of a full ban. However, the predicted impact of restrictions on

¹² The main proxies used in the literature for the level of constraints on short sales are: borrowing costs and stock lending supply, existence of tradable options, and regulatory regimes. For instance, Jones and Lamont (2002) confirm Miller's overvaluation hypothesis by analyzing the US stocks that had their borrowing costs published between 1926 and 1933. Reed (2007) shows that US stocks that were costly to short over the period 1998-1999 exhibited higher excess returns on earning announcement days, especially when earnings were lower than expected. Saffi and Sigurdsson (2011) show that stocks constrained by low lending supply have lower speed of price adjustment. Danielsen and Sorescu (2001) explain negative abnormal returns following option introduction by the reduction of constraints on short sales.

these spreads is ambiguous as it depends on implied costs. The bid-ask spreads would increase only if these costs are high enough to deter informed short to trade.

In line with Boehmer et al. (2011) and Beber and Pagano (2013), we consider PCSS as a full ban and PNSS as a restriction. PNSS indeed leaves short sales accessible but imposes extra borrowing costs. RDSS has not been analyzed for its own sake in previous academic papers. We classify it as a restriction because it imposes extra compliance costs to short sellers under the form of administrative burden and trading strategy disclosure.

Accordingly, the Diamond and Verrecchia model predicts an increase in the bid-ask spreads associated to PCSS, but would tolerate any impacts on these spreads under both PNSS and RDSS. By the same token, the Diamond and Verrecchia model predicts higher volatilities for stocks subject to PCSS, but not necessarily so for stocks subject to PNSS and RDSS. Meanwhile, all short-selling regulations should reduce the trading volumes, by increasing the number of forbidden or costlier short sales.

Importantly, Miller's theory predicts stock overvaluation under full ban. This expected impact of PCSS likely constitutes the basic motivation of regulators. In contrast, the Diamond and Verrecchia model excludes any overvaluation regardless of the nature of the short-selling regulation. This is because market participants are supposed to take constraints into account when making their trading strategies. The two models are thus compatible except for the impact of PCSS on stock returns.

To test all these theoretical predictions, we use a two-way fixed effect panel regression. The panel approach takes advantage of both the cross-section and time-series dimensions in the regulatory regimes introduced in Europe. This approach prevents regulatory dummies from acting as proxies for country- or stock-specific effects.¹³ It also allows us to control for unobserved individual and/or time characteristics (Hsiao, 2003). For our analysis in particular, this feature is valuable. Indeed, we likely omit some stock characteristics correlated with the explanatory variables. For instance, several countries have introduced sector-sensitive regulations (notably for the financial sector). Similarly, time characteristics can influence the dependent variables while being correlated with the regulatory regime. In particular, regulatory regimes were often introduced during market turmoil, when liquidity and volatility were affected by other time-related events.

We consider the following specification for the panel regression:

$$Y_{it} = \mu + \alpha_i + \gamma_t + \beta_1 PCSS_{it} + \beta_2 PNSS_{it} + \beta_3 RDSS_{it} + \beta_4 X_{it} + \varepsilon_{it}, \quad (3)$$

where index i denotes the stock and index t denotes the day. Y_{it} will successively represent the spread, the volatility, the volume, and the return of stock i at time t . $PCSS_{it}$, $PNSS_{it}$ and $RDSS_{it}$ take the value one if the concerned regulation applies to stock i on day t , and zero otherwise. Vector X_{it} summarizes the control variables that vary across model specifications. Constant μ is a scalar. The unobservable stock-specific effect is denoted by α_i and is time-invariant. The

¹³ Panel regression models are used by Bris *et al.* (2007), and Boehmer *et al.* (2009). Hansson and Fors (2009) use a two-way fixed effects panel regression model. Beber and Pagano (2013) use a panel regression with fixed effects at the stock level and occasional time-effects. Additional regressions (not reported here) show that omitting either the stock or the time fixed effect would have distorted our results.

unobservable time-specific effect is denoted by γ_i and is stock-invariant. Both effects are modelled as fixed rather than random, which is recommended when the unobservable effects are possibly correlated with the explanatory variables (Greene, 2008), and when inferences are confined to in-sample effects (Hsiao, 2003).

Eq. (3) is estimated by ordinary least squares (OLS). Confidence intervals are computed using robust covariance-matrix estimators correcting for contemporaneous correlation between stocks and cross-section heteroskedasticity (Wooldridge, 2002).

5. Results

This section presents and discusses the results of our regressions for each of the four explained variables, successively. In each case, Eq. (3) is estimated.

5.1. Bid-Ask Spreads

Table 6 proposes six specifications to assess the impact of short-selling regulations on bid-ask spreads using time-specific effects. In specifications (1) to (3) the regulatory variables are taken separately. Specification (4) brings them together while specifications (5) and (6) control for volatility, and volatility and lagged spread, respectively. Although volatility is likely endogenous, it is worth checking whether taking it into account would alter the estimates.

The results in Table 6 show that in all six cases PCSS and PNSS significantly raise bid-ask spreads. For instance, based on specification (4), PCSS and PNSS increase the bid-ask

spreads by 0.96%, and 1.14%, respectively. A Fisher test reveals that these two coefficients are not significantly different from each other at the 10% level. Importantly, these effects are high compared to the average spread of 1.32%. Adding volatility and lagged spread to the specification slightly dampens these effects, which however remain significant at the 1% level. In contrast, stocks subject to a disclosure regime (RDSS) exhibit lower bid-ask spreads (a decrease of 0.50%).

Table 6: Impacts of short-selling regulations on spreads: Panel regressions with time-specific effects (July 2008 - June 2009)

Spread is the difference between ask and bid prices at the close, divided by the quote midpoint. The three regulatory regimes, represented by dummy variables, are: prohibition on covered short selling (*PCSS*), prohibition on naked short selling (*PNSS*), and disclosure requirements for short sales (*RDSS*). Volatility is the daily difference between the highest and lowest prices, divided by the price at the close. *Spread(-1)* is the lagged spread. Robust *t*-statistics are reported in italics below the parameter estimate. ***: significant at the 1% level.

		(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable		<i>Spread</i>	<i>Spread</i>	<i>Spread</i>	<i>Spread</i>	<i>Spread</i>	<i>Spread</i>
Explanatory variable	<i>Intercept</i>	0.0130*** 280.85	0.0121*** 280.85	0.0113*** 858.66	0.0113*** 307.81	0.0092*** 117.23	0.0083*** 64.08
	<i>PCSS</i>	0.0038*** 3.49			0.0096*** 9.88	0.0096*** 9.98	0.0101*** 38.59
	<i>PNSS</i>		0.0072*** 11.44		0.0114*** 46.97	0.0111*** 46.57	0.0085*** 9.69
	<i>RDSS</i>			-0.0024*** -8.73	-0.0050*** -16.84	-0.0052*** -18.14	-0.0050*** -18.05
	<i>Volatility</i>					0.0427*** 29.08	0.0399*** 28.38
	<i>Spread(-1)</i>						0.0883*** 8.47
	<i>Stock fixed effects</i>	yes	yes	yes	yes	yes	yes
	<i>Day fixed effects</i>	yes	yes	yes	yes	yes	yes
	R ²	57.64%	58.00%	57.55%	58.61%	58.77	60.23%
	Total panel obs.	332,193	332,193	332,193	332,193	332,193	326,771

5.2. Intraday Volatilities

Table 7 proposes five specifications with time-specific effects to assess the impacts of short-selling regulations on intraday volatilities. In specifications (1) to (3) the regulatory variables are taken separately. Specification (4) brings them together while specifications (5) controls for lagged volatility.

Table 7: Impacts of short-selling regulations on volatilities: Panel regressions with time-specific effects (July 2008 - June 2009)

Volatility is the daily difference between the highest and lowest prices, divided by the price at the close. The three regulatory regimes, represented by dummy variables, are: prohibition on covered short selling (*PCSS*), prohibition on naked short selling (*PNSS*), and disclosure requirements for short sales (*RDSS*). *Volatility(-1)* is the lagged volatility. Robust *t*-statistics are reported in italics below the parameter estimate. ***: significant at the 1% level.

		(1)	(2)	(3)	(4)	(5)
Dependent variable		<i>Volatility</i>	<i>Volatility</i>	<i>Volatility</i>	<i>Volatility</i>	<i>Volatility</i>
Explanatory variable	<i>Intercept</i>	0.0473*** <i>1739.78</i>	0.0464*** <i>1739.78</i>	0.0469*** <i>1110.04</i>	0.0464*** <i>391.66</i>	0.0358*** <i>159.76</i>
	<i>PCSS</i>	-0.0032*** <i>-5.18</i>			-0.0011* <i>-1.70</i>	-0.0008 <i>-1.37</i>
	<i>PNSS</i>		0.0049*** <i>9.10</i>		0.0043*** <i>7.46</i>	0.0033*** <i>5.97</i>
	<i>RDSS</i>			0.0034*** <i>4.83</i>	0.0029*** <i>4.31</i>	0.0019*** <i>3.08</i>
	<i>Volatility(-1)</i>					0.2260*** <i>55.33</i>
	<i>Stock fixed effects</i>	yes	yes	yes	yes	yes
	<i>Day fixed effects</i>	yes	yes	yes	yes	yes
R ²		38.36%	38.40%	38.35%	38.42%	42.91%
Total panel obs.		327,192	327,192	327,192	327,192	323,146

The results show that PNSS and RDSS impact volatilities positively. In particular, specification (4) exhibits that PNSS increases volatility by 0.43 percentage points, while RDSS

increases volatilities by 0.29 percentage points.¹⁴ On an average volatility of 4.71%, these effects are economically significant, in addition to being statistically significant at the 1% level. The negative impact of PCSS is hardly significant when all regulatory dummies are considered simultaneously (specification (4)), and even disappears when an autoregressive term is added (specification (5)). These variations are in line with the literature which remains divided on the impact of PCSS on volatilities (see Table 1). However, given the overwhelming evidence of autoregressive structure in volatility series,¹⁵ we conclude that PCSS does not impact volatilities when time-specific effects are accounted for.

5.3.Traded Volumes

Volumes are measured by the logs of daily numbers of trades. Table 8 proposes six specifications with time-specific effects to assess the impacts of short-selling regulations on volumes. In specifications (1) to (3) the regulatory variables are taken separately. Specification (4) brings them together while specifications (5) and (6) control for volatility, and volatility and lagged volume, respectively.

The results in Table 8 show that the expected decreases in volumes are indeed observed for PCSS and RDSS. On the other hand, PNSS has a significantly positive impact on traded volumes in specifications (2) and (4), which seems counterintuitive. However, this impact

¹⁴ Regressions on the natural logarithm of relative daily price ranges, however, show that *RDSS* is not associated with significant changes in price ranges.

¹⁵ This is attested, e.g., by the common use of ARCH models in empirical finance.

disappears when controlling for volatility¹⁶ (specifications (5) and (6)). We therefore adopt the conservative conclusion that PNSS has no impact on traded volumes.

Table 8: Impacts of short-selling regulations on volumes: Panel regressions with time-specific effects (July 2008 - June 2009)

Logvolume is the natural logarithm of the daily number of shares traded. The three regulatory regimes, represented by dummy variables, are: prohibition on covered short selling (*PCSS*), prohibition on naked short selling (*PNSS*), and disclosure requirements for short sales (*RDSS*). Volatility is the daily difference between the highest and lowest prices, divided by the price at the close. *Logvolume(-1)* is the lagged volume in log. Robust *t*-statistics are reported in italics below the parameter estimate. ***: significant at the 1% level.

		(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable		<i>Logvolume</i>	<i>Logvolume</i>	<i>Logvolume</i>	<i>Logvolume</i>	<i>Logvolume</i>	<i>Logvolume</i>
Explanatory variable	<i>Intercept</i>	4.4118*** <i>4204.28</i>	4.4383*** <i>4204.28</i>	4.4050*** <i>3596.05</i>	4.4088*** <i>1267.19</i>	3.9459*** <i>244.79</i>	2.5545*** <i>105.68</i>
	<i>PCSS</i>	-0.3598*** <i>-14.57</i>			-0.3237*** <i>-13.07</i>	-0.3116*** <i>-13.51</i>	-0.2042*** <i>-10.58</i>
	<i>PNSS</i>		0.1908*** <i>7.20</i>		0.0644*** <i>3.10</i>	0.0092 <i>0.48</i>	-0.0009 <i>-0.06</i>
	<i>RDSS</i>			-0.1382*** <i>-6.90</i>	-0.1321*** <i>-6.42</i>	-0.1832*** <i>-10.46</i>	-0.1454*** <i>-8.55</i>
	<i>Volatility</i>					0.0984*** <i>30.31</i>	0.0857*** <i>29.69</i>
	<i>Logvolume(-1)</i>						0.3370*** <i>72.71</i>
	<i>Stock fixed effects</i>	yes	yes	yes	yes	yes	yes
	<i>Day fixed effects</i>	yes	yes	yes	yes	yes	yes
	R ²	90.59%	90.56%	90.56%	90.59%	91.66%	92.70%
	Total panel obs.	331,731	331,731	331,731	331,731	331,731	323,667

5.4. Stock Returns

Table 9 proposes five specifications with time-specific effects to assess the impacts of short-selling regulations on weekly returns. In specifications (1) to (3) the regulatory variables are

¹⁶ Karpoff (1987) points out that the interaction of volume and volatility is complex, especially in high frequency data.

taken separately. Specification (4) brings them together while specifications (5) controls for lagged return. Globally, no significant effect is detected. Table A1 in Appendix A demonstrates that the same conclusion holds true for excess returns.

Table 9: Impacts of short-selling regulations on returns: Panel regressions with time-specific effects (July 2008 - June 2009)

Return is the Wednesday-to-Wednesday stock return. The three regulatory regimes, represented by dummy variables, are: prohibition on covered short selling (*PCSS*), prohibition on naked short selling (*PNSS*), and disclosure requirements for short sales (*RDSS*). *Return(-1)* is the lagged return. Robust *t*-statistics are reported in italics below the parameter estimate. ***: significant at the 1% level.

		(1)	(2)	(3)	(4)	(5)
Dependent variable		<i>Return</i>	<i>Return</i>	<i>Return</i>	<i>Return</i>	<i>Return</i>
Explanatory variable	<i>Intercept</i>	-0.0027*** <i>-12.56</i>	-0.0021*** <i>-3.06</i>	-0.0026*** <i>-7.09</i>	-0.0031*** <i>-2.85</i>	-0.0032*** <i>-2.74</i>
	<i>PCSS</i>	0.0071 <i>1.41</i>			0.0076 <i>1.32</i>	0.0080 <i>1.35</i>
	<i>PNSS</i>		-0.0016 <i>-0.35</i>		0.0012 <i>0.24</i>	0.0014 <i>0.25</i>
	<i>RDSS</i>			0.0045 <i>0.76</i>	0.0040 <i>0.72</i>	0.0044 <i>0.74</i>
	<i>Return(-1)</i>					-0.0799*** <i>-3.10</i>
	<i>Stock fixed effects</i>	yes	yes	yes	yes	yes
<i>Day fixed effects</i>		yes	yes	yes	yes	yes
R ²		29.46%	29.45%	29.45%	29.46%	30.18%
Total panel obs.		65,226	65,226	65,226	65,226	63,893

5.5. Summary of the Results and Robustness Checks

Table 10 summarizes the previous results regarding the impacts of the three regulatory variables (*PCSS*, *PNSS*, and *RDSS*) on the four market characteristics (bid-ask spread, intraday volatility, traded volume, and stock return). It reports the main conclusions reached from the last –and most comprehensive– specification.

Both PCSS and PNSS are associated with higher bid-ask spreads. The results on PCSS confirm the findings of Beber and Pagano (2012). They are also consistent with Diamond and Verrecchia's prohibition effect. Moreover, disclosure regimes induce lower bid-ask spreads, especially during the financial crisis, that is, when information is likely the most beneficial to market efficiency. In line with Diamond and Verrecchia's theory, this could indicate that disclosure requirements induce costs that are prohibitive for non-informed short sellers, but do not deter well-informed short sellers from trading. Hence, sell trades become more informative because they more likely originate from well-informed short sellers. The informational benefit of disclosure would then outweigh the informational loss resulting from missing short sales.

Table 10: Summary of the results

The table summarizes our results regarding the impacts of regulatory regimes on market characteristics. The three regulatory regimes are: prohibition on covered short selling (PCSS), prohibition on naked short selling (PNSS) and disclosure requirements for short sales (RDSS). The impacts are either positive (+), non significant (=), or negative (-).

	PCSS	PNSS	RDSS
Bid-Ask Spreads	+	+	-
Intraday Volatilities	=	+	+
Traded Volumes	-	=	-
Stock Returns	=	=	=

Regulatory regimes are not associated with decreasing intraday volatilities. On the contrary, PNSS and RDSS increase intraday volatilities. Overall, our results are consistent with theory, but disprove the regulators' assumption that short-selling impediments reduce volatilities. Our conclusions meet those reached by Oliver Wyman (2010) on the UK public disclosure regime. In contrast, the AMF (2009) finds that the French prohibition on naked short

selling and disclosure regime on financial stocks were associated with unchanged volatilities for the targeted stocks even though the market as a whole became more volatile. However, the AMF itself confesses the difficulty of assessing these impacts in the absence of a comparable control group.

The insignificant impact of PCSS on intraday volatilities seems paradoxical when compared to the positive effect of the lighter PNSS. However, this outcome could be indirectly driven by the negative effect of PCSS on traded volumes (this effect is absent for PNSS). Indeed, volumes and volatilities are positively related. As a consequence, the insignificant effect of PCSS on volatilities can be interpreted as the combination of a positive effect (such as with PNSS) mitigated by the decrease in volumes PCSS brings along. Assessing this conjecture would require a bivariate specification.

Traded volumes are unaffected by PNSS and negatively affected by both PCSS and RDSS. These impacts are likely driven by a decrease in short trades. We thus confirm the findings of the FSA (2009) regarding the UK prohibition on covered short selling, and of Oliver Wyman (2010) regarding the UK public disclosure regime. This result however contradicts the AMF (2009) finding of a negative impact for the French PNSS combined with a disclosure regime. A possible interpretation is that the banned naked short trades are replaced by covered short trades or by other investment strategies.

Stock returns are insensitive to short-selling regulations. This is consistent with Diamond and Verrecchia's view that market participants take constraints into account when valuing stocks, which would prevent any stock overvaluation.

The robustness of our main results is already attested by the different estimations performed for each explained variable and by the two sub-period decompositions. In addition, Appendix B offers robustness checks focusing on country-specific aspects. Overall, these checks confirm the impacts summarized in Table 10 for PCSS and PNSS. However, the results for RDSS seem slightly weaker than the others. Lastly, we consider three additional sets of robustness checks. To save on space, however, we do not report here the detailed results. First, for bid-ask spreads and returns, panel regressions in logs deliver similar effects as before in both signs and significance levels, with the exception of the RDSS effect on volatility which is significantly positive in level, but insignificant in log. Second, including outliers (i.e., the top 1% quantile stocks for each explained variable) does not significantly affect the estimation outcomes. Actually, outliers were removed in the first place to both stick to the methodology of previous studies and use significance tests in an appropriate statistical framework.

6. Conclusion

This article assesses the impact on stock returns of prohibitions on short selling and disclosure requirements of short selling positions implemented in Europe since September 2008. A panel analysis of stocks from fourteen European countries shows that intraday volatility decreases

under no regulatory regime. Neither do the regulations counter negative stock returns. Moreover, all prohibitions on short sales are associated with wider spreads. Traded volumes decrease under the prohibition on covered short sales and disclosure regimes, but exhibit no significant changes under the prohibition on naked short selling. Theory-wise, this paper reveals that disclosure requirements increase bid-ask spreads, as predicted by Diamond and Verrechia (1987).

Overall, our results also show that all short-selling regulations introduced in Europe since 2008 have been detrimental to market efficiency, but along different dimensions. Therefore, answering the question “Which short-selling regulation is the least damaging to market efficiency?” inevitably requires an assessment of the relative importance of these dimensions.

From the perspective of financial theory, fair valuation is the essence of efficient markets. It should therefore come first. Volumes are likely the second in line, because low trading activity hampers price adjustments. Higher bid-ask spreads relate to transaction costs, but do not *per se* distort prices, especially if volumes remain constant. Volatilities refer to price instability, which is *stricto sensu* not directly linked to market efficiency (Adam and Szafarz, 1993). According to our results, PNSS is the only regulation that keeps both returns and volumes unaffected.¹⁷ It also has the merit of reducing the risk of failure to deliver, a benefit

¹⁷ Nevertheless, Appendix B stresses a lack of robustness in the results concerning the impacts of RDSS.

not estimated in our study. Therefore, we argue that the moderate restriction on naked short selling is the least damaging to market efficiency.

The priorities of regulators may, however, diverge from those of financial theoreticians. In particular, European regulators are concerned with volatility reduction. They also devote much of their attention to putting in place stringent disclosure obligations, including the obligation to report individual short positions. Evidently, the release of information is instrumental to the efficient market theory (Fama, 1970). However, notwithstanding the beneficial effects of disclosure requirements on spreads, the public reporting of individual positions may raise privacy concerns. Moreover, such measure does not address the real risks associated with short selling, and can seriously damage the trading activity.¹⁸ An alternative way to inform the market could consist in adopting a flagging system like in the US and Hong Kong. Private disclosure to regulators combined with aggregate public disclosure could ensure transparency while limiting both the costs to short sellers and the detrimental effect on market efficiency. Logically, less intrusive disclosure requirements should mitigate the decrease in traded volumes pointed out in this paper.¹⁹ In addition, European harmonization will undoubtedly reduce regulatory arbitrage and compliance costs.

This research has limitations. Although our econometric design allows us to control for time-constant stock-specific characteristics and stock-constant time-specific effects, it does not account for possible time-varying heterogeneity among stocks. Stocks could indeed have

¹⁸ The specific risks associated with short selling and identified by regulators are: the lack of transparency, the risk of failures to deliver, and the risk of price decline amplification (European Commission, 2010c).

¹⁹ Less intrusive disclosure requirements are also broadly viewed by investors as more appropriate (Oliver Wyman, 2011).

different characteristics under different regulatory regimes for reasons not directly linked to these regimes. For instance, volatility spill-over effects could be associated to contagion. Another extension could include a detailed analysis of the *modus operandi* of short-selling restrictions. In particular, it could be interesting to scrutinize how short-selling constraints interact with stock characteristics such as: idiosyncratic risk, firm size, existence of derivatives, etc. Improvements can also be made on the measurement of regulatory constraints. Dummy variables inevitably induce a loss of information about the specificities of the regulations and their level of enforcement. A refinement in this direction is offered by Jain et al. (2013) who build a short-selling enforcement index across countries.

In sum, Europe can still improve its regulation in order to fully reflect the importance of short sellers for efficient capital markets. Too strict restrictions on short sales heavily distort market efficiency, and can push capital flows away from Europe. A major lesson from the European experience concerns temporary measures. As emphasized by Boehmer and Wu (2013) and Fotak et al. (2009), there is no definite proof that short sellers should be blamed for price declines or market destabilization. In addition, the model proposed by Szafarz (2012) shows that excess volatility is actually fuelled by long-term fundamentalists who restrain market liquidity rather than by short-term speculators. The main message from our empirical exercise is that no regulation on short selling is effective to counter price decline and volatility. The evidence shows that the regulatory measures introduced in Europe missed their target, and this should be remembered in the future.

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Appendix A

Table A1: Impacts of short-selling regulations on excess returns: Panel regressions with time-specific effects (July 2008 - June 2009)

Excess-return is the difference between the Wednesday-to-Wednesday returns of the stock and of its country index. The three regulatory regimes, represented by dummy variables, are: prohibition on covered short selling (*PCSS*), prohibition on naked short selling (*PNSS*), and disclosure requirements for short sales (*RDSS*). *Return(-1)* is the lagged return. Robust *t*-statistics are reported in italics below the parameter estimate. ***: significant at the 1% level.

		(1)	(2)	(3)	(4)	(5)
Dependent variable		<i>Excess_return</i>	<i>Excess_return</i>	<i>Excess_return</i>	<i>Excess_return</i>	<i>Excess_return</i>
Explanatory variable	<i>Intercept</i>	0.0023*** <i>11.67</i>	0.0028*** <i>4.45</i>	0.0025*** <i>8.52</i>	0.0023*** <i>2.61</i>	0.0027*** <i>2.92</i>
	<i>PCSS</i>	0.0047 <i>1.01</i>			0.0047 <i>0.94</i>	0.0057 <i>1.15</i>
	<i>PNSS</i>		-0.0020 <i>-0.47</i>		-0.0001 <i>-0.02</i>	0.0007 <i>0.16</i>
	<i>RDSS</i>			0.0001 <i>0.01</i>	-0.0001 <i>-0.03</i>	-0.0007 <i>-0.14</i>
	<i>Excess_return(-1)</i>					-0.0816*** <i>-3.11</i>
	<i>Stock fixed effects</i>	yes	yes	yes	yes	yes
	<i>Day fixed effects</i>	yes	yes	yes	yes	yes
	R ²	4.70%	4.69%	4.69%	4.70%	5.43
	Total panel obs.	66,576	66,576	66,576	66,576	65,216

Appendix B: Robustness Checks

In this Appendix we address two specific issues that can affect the validity of our results. First, while our analysis is based on a large number of stocks, the number of shocks is limited. To tackle the possibility of within-market dependencies, we cluster the standard errors at the country level.²⁰ The results are summarized in Table B1. The comparison with Table 10 shows that, except for one borderline case (the impact of RDSS on volatility), our previous results are robust to country clustering.

Table B1: Estimation with standard errors clustered at the country level

The table summarizes our results regarding the impacts of regulatory regimes on market characteristics when standard errors are clustered at the country level. The three regulatory regimes are: prohibition on covered short selling (PCSS), prohibition on naked short selling (PNSS) and disclosure requirements for short sales (RDSS). The impacts are either positive (+), non-significant (=), or negative (-).

	PCSS	PNSS	RDSS
Bid-Ask Spreads	+	+	-
Intraday Volatilities	=	+	=
Traded Volumes	-	=	-
Stock Returns	=	=	=

Second, we examine the regulations for each country separately. To do so, we run the non-parametric quantile-based approach suggested by Gelbach et al. (forthcoming). We estimate a standard OLS regression for each country. Parameter significance is then tested

²⁰ See Cameron et al. (2011) and Petersen (2008) for a detailed discussion on the different forms of clustering, and the way to proceed to obtain robust inference.

using sample quantiles as critical values. This approach is particularly suitable when the number of events of interest is small. Tables B2 to B5 summarize the results. Finland and Sweden have been removed from the sample because no regulatory change took place in either country. Overall, the effects are fairly heterogeneous across jurisdictions, probably because sample sizes vary markedly. In contrast to the UK market (250 stocks), the regressions for Ireland (49 stocks) deliver mostly insignificant results. In addition, European countries implemented the short-selling regulations independently and at different points in time. While our panel approach benefits from this heterogeneity, the country-specific approach, which does not account for time-specific effects, is hampered by it. Nevertheless, the significant impacts of short-selling regulations confirm the results in Section 5.²¹ Two notable exceptions concern the impacts of RDSS on spreads and volumes. Country-wise, no positive effect is detected on spreads (Table B2) while the tests fail to establish any impact on volumes (Table B4). These findings contrast with the global results in Tables 6 and 8. Altogether, the results from Table B1 to B4 tend to indicate that the impacts of RDSS on market characteristics are still slight and probably country-specific.

²¹ Interestingly, PCSS seems to enhance volatility more than is captured in specification (5), reported in Table 7. This effect is however in line with specification (1). This is logical since, like Table B3, specification (1) explains volatility with the PCSS regulation only. The fact that PCSS may affect volatility reinforces our conclusions.

Table B2: Impacts of short-selling regulations on spreads: Country-specific results

Spread is the difference between ask and bid prices at the close, divided by the quote midpoint. The three regulatory regimes are: prohibition on covered short selling (PCSS), prohibition on naked short selling (PNSS), and disclosure requirements for short sales (RDSS). “NA” means the country did not experience the regulation in question. The impacts are either positive (+), non-significant (=), or negative (-). ***: significant at the 1% level, **: significant at the 5% level, *: significant at the 10% level.

<i>Spread</i>	PCSS	PNSS	RDSS
Austria	NA	+ ***	=
Belgium	NA	=	=
Denmark	=	NA	NA
France	NA	+ ***	+ ***
Germany	NA	+ *	NA
Hungary	NA	NA	+ ***
Ireland	+ **	NA	=
Italy	=	=	NA
Netherlands	=	=	=
Portugal	NA	=	=
Spain	NA	NA	=
UK	+ ***	NA	+ *

Table B3: Impacts of short-selling regulations on volatilities: Country-specific results

Volatility is the daily difference between the highest and lowest prices, divided by the price at the close. The three regulatory regimes are: prohibition on covered short selling (PCSS), prohibition on naked short selling (PNSS), and disclosure requirements for short sales (RDSS). “NA” means the country did not experience the regulation in question. The impacts are either positive (+), non-significant (=), or negative (-). ***: significant at the 1% level, **: significant at the 5% level, *: significant at the 10% level.

<i>Volatility</i>	PCSS	PNSS	RDSS
Austria	NA	=	=
Belgium	NA	+ *	+ *
Denmark	+ *	NA	NA
France	NA	=	=
Germany	NA	+ *	NA
Hungary	NA	NA	=
Ireland	=	NA	=
Italy	+ ***	=	NA
Netherlands	+ **	+ *	+ **
Portugal	NA	=	=
Spain	NA	NA	=
UK	+ ***	NA	+ **

Table B4: Impacts of short-selling regulations on volumes: Country-specific results

Logvolume is the natural logarithm of the daily number of shares traded. The three regulatory regimes are: prohibition on covered short selling (PCSS), prohibition on naked short selling (PNSS), and disclosure requirements for short sales (RDSS). “NA” means the country did not experience the regulation in question. The impacts are either positive (+), non-significant (=), or negative (-). ***: significant at the 1% level, **: significant at the 5% level, *: significant at the 10% level.

<i>Logvolume</i>	PCSS	PNSS	RDSS
Austria	NA	=	=
Belgium	NA	+ *	+ *
Denmark	+ *	NA	NA
France	NA	=	=
Germany	NA	+ *	NA
Hungary	NA	NA	=
Ireland	=	NA	=
Italy	+ ***	=	NA
Netherlands	+ **	+ *	+ **
Portugal	NA	=	=
Spain	NA	NA	=
UK	+ ***	NA	+ **

Table B5: Impacts of short-selling regulations on returns: Country-specific results

Return is the Wednesday-to-Wednesday stock return. The three regulatory regimes are: prohibition on covered short selling (PCSS), prohibition on naked short selling (PNSS), and disclosure requirements for short sales (RDSS). “NA” means the country did not experience the regulation in question. The impacts are either positive (+), non-significant (=), or negative (-). **: significant at the 5% level, *: significant at the 10% level.

<i>Return</i>	PCSS	PNSS	RDSS
Austria	NA	- *	=
Belgium	NA	=	=
Denmark	- *	NA	NA
France	NA	=	=
Germany	NA	=	NA
Hungary	NA	NA	=
Ireland	=	NA	=
Italy	- *	=	NA
Netherlands	=	=	=
Portugal	NA	=	=
Spain	NA	NA	+ **
UK	=	NA	=