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Price jumps on European stock markets☆

Jan Hanousek [a,b,c], Evžen Kočenda [a,b,c,d,e,f,*], Jan Novotný [a,g]

[a] CERGE-EI, a Joint Workplace of Charles University and the Economics Institute of the Academy of Sciences of the Czech Republic, P.O. Box 882, Politickych veznu 7, 111 21 Prague, Czech Republic
[b] The William Davidson Institute, Michigan, USA
[c] CEPR, London, UK
[d] CESifo, Munich, Germany
[e] IOS, Regensburg, Germany
[f] The Euro Area Business Cycle Network
[g] Faculty of Finance, Cass Business School, City University London, 106 Bunhill Row, London EC1Y 8TZ, UK

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Abstract

We analyze the dynamics of price jumps and the impact of the European debt crisis using the high-frequency data reported by selected stock exchanges on the European continent during the period January 2008 to June 2012. We employ two methods to identify price jumps: Method 1 minimizes the probability of false jump detection (the Type-II Error-Optimal price jump indicator) and Method 2 maximizes the probability of successful jump detection (the Type-I Error-Optimal price jump indicator). We show that individual stock markets exhibited differences in price jump intensity before and during the crisis. We also show that in general the variance of price jump intensity could not be distinguished as different in the pre-crisis period from that during the crisis. Our results indicate that, contrary to common belief, the intensity of price jumps does not uniformly increase during a period of financial distress. However, there do exist differences in price jump dynamics across stock markets and investors have to model emerging and mature markets differently to properly reflect their individual dynamics.

JEL classification: C14; C58; F37; G15; G17

Keywords: Stock markets; Price jump indicators; Non-parametric testing; Clustering analysis; Financial econometrics; Emerging markets

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* Corresponding author. CERGE-EI, P.O. Box 882, Politickych veznu 7, 111 21 Prague, Czech Republic. Tel.: +420 224005149.
E-mail addresses: Jan.Hanousek@cerge-ei.cz (J. Hanousek), Evzen.Kocenda@cerge-ei.cz (E. Kočenda), Jan.Novotny.1@city.ac.uk (J. Novotný).
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1. Introduction: motivation and literature

It is widely accepted that periods of financial turbulence cause higher volatility on markets as investors tend to overreact to negative information (Anderson, Bollerslev, Diebold, & Vega, 2007). Further, price jumps have been recognized in the financial literature as a significant part of volatility since the seminal Merton (1976). A price jump is understood as an abrupt price change over a very short time that is related to a broad range of market phenomena that cannot be connected to a noisy Gaussian distribution (Lahaye, Laurent, & Neely, 2011; Lee, 2012; Zheng & Shen, 2008). However, so far research is surprisingly scarce on how the distribution of price jumps change during turbulent periods and whether its pattern differs across mature and emerging financial markets. In this paper we analyze price jumps in market indices reported by

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selected stock exchanges on the European continent and their behavior before and after the European debt crisis unfolded.

The financial literature considers a number of ways to classify market volatility. For our analysis the most important aspect is the decomposition of volatility into regular noise (the Gaussian-like component) and price jumps.[1] The literature supports two main explanations of the source of price jumps. First, price jumps can reflect the market reaction to unexpected information, which indicates that news announcements are the primary source of price jumps (Lahaye et al., 2011; Lee & Mykland, 2008). Second, Bouchaud, Kockelkoren, and Potters (2006) and Joulin, Lefevre, Grunberg, and Bouchaud (2008) advocate that jumps are mainly caused by a local lack of liquidity on the market, an event they term "relative liquidity." In addition, an inefficient provision of liquidity caused by an imbalanced market micro-structure can cause extreme price movements as well (see the survey in Madhavan (2000).

Hence, price jump identification is valuable for a number of reasons. Price jumps can serve as a proxy for information arrival and be utilized as tools for studying market efficiency (Fama, 1970) or phenomena like information-driven trading; see e.g., Cornell and Sirri (1992) or Kennedy, Sivakumar, and Vetzal (2006). Further, non-Gaussian price movements influence the models and indicators employed in finance, such as value-at-risk, or the performance of various financial vehicles (Bates, 1996; Gatheral, 2006; Heston, 1993; Scott, 1997). Also, a good knowledge of price jump distribution is potentially useful for financial regulators to implement the most optimal policies; see Becketti and Roberts (1990) or Tiniç (1995).

The financial literature identifies the key reason underlying the importance of detecting price jumps: the presence of jumps has serious consequences for financial risk management and pricing. The recent literature offers empirical support of this claim. Broadie and Jain (2008) show that the pricing of swaps significantly differs when jumps are taken into account and one cannot appropriately price risk while ignoring jumps. Arshanapalli, Fabozzi, and Nelson (2013) support the need to include the jump component into risk measures to estimate the proper risk-return relationship. Carr and Wu (2010) use a jump diffusion model to simultaneously price stock options and credit default swaps and find a significant presence of the interplay between credit and market risks. A similar confirmation of the change in the pricing mechanism was also shown by Duffie, Pan, and Singleton (2000), Liu, Longstaff, and Pan (2003), and Johannes (2004). Jarrow and Rosenfeld (1984), Nietert, and Pan (2002) study pricing in the presence of jumps and all of them confirm the presence of the jump risk premium. Further, Caporin, Rossi, and Santucci de Magistris (2011) analyze even the presence of price jumps in volatility. Another strand of the literature identifies presence of co-jumps and, for example, Li and Zhang (2013) show the stronger co-jump behavior on the US and Chinese stock markets since the subprime crisis.

Despite the importance of analyzing jumps, the literature on jumps in European stock markets is rather limited. Novotný, Hanousek, and Kočenda (2013) analyze the behavior and performance of multiple price jump indicators across developed and emerging markets by employing high-frequency stock market data from Japan, Germany, France, the United Kingdom, the USA, the Czech Republic, Poland, and Hungary. They identify clusters of price jump indicators with similar performance and show that clusters differ in size and are stable across stock market indices and over time. In this respect the recent 2007–2008 financial crisis did not seem to affect the overall jumpiness of mature or emerging stock markets. Further, Hanousek, Kočenda, and Novotný (2013) show that many price jumps identified on emerging European stock markets are due to foreign macroeconomic news. Further, a significant transfer of price jumps from EU and U.S. markets is also noted, with the latter having a stronger influence. Finally, Hanousek and Novotny (2013) analyze the impact of the Lehman Brothers collapse on volatility and price jumps in the US and Czech stock markets, and show only limited reaction to this type of financial distress.

In this paper we analyze how the financial distress affects the distribution and dynamics of price jumps on several stock markets. The financial distress is represented by the European debt crisis that fully unfolded in May 2010 and evolved into a state where it was difficult or impossible for several Eurozone member countries to repay or re-finance their government debts without the assistance of third parties. We aim to analyze the effect of this market-exogenous event on jump behavior across markets. In particular, we aim to study to what extent one can observe the similarities and transfers of price jumps from developed capital markets to emerging stock markets in Europe. Our choice to study both developed and emerging capital markets in Europe is based on several reasons. First, compared to other emerging stock markets, European emerging markets do not suffer so much from potential economic and political instability. Second, they are under the strong influence of developed stock markets (Hanousek, Kočenda, & Kutan, 2009; Horvath & Petrovski, 2013), hence, the potential for influence is one-directional. In the end we analyze data from developed stock markets in the UK and Germany, while emerging markets are represented by the Czech Republic, Poland, Hungary, Romania, Croatia, Slovenia, and Turkey. The emerging markets share several common features: their overall liquidity and number of traded stocks are rather small, the price formation mechanism is under the strong influence of foreign news originating in mature EU and US markets, and despite their smaller size, the share of overall trading volume performed by foreign investors in the emerging stock markets is substantial (Hanousek & Kočenda, 2011).

The paper is structured as follows. First, we define price jumps and connect them to the period of distress. Second, we

[1] This separation can be seen in the first pioneering papers dealing with price jumps (see e.g., Merton (1976) or a summary in Gatheral (2006)). Recently, the division of the Gaussian-like component and price jumps was used by Giot, Laurent, and Petitjean (2010). Although the original motivation for this decomposition was of a purely mathematical nature, it can be advocated by practitioners as well.