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Price jumps in Visegrad-country stock markets: An empirical analysis

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ABSTRACT

We employ high frequency data to study extreme price changes (i.e., price jumps) in the Prague, Warsaw, Budapest, and Frankfurt stock market indexes from June 2003 to December 2010. We use the price jump index and normalized returns to analyze the distribution of extreme returns. The comparison of jump distributions across different frequencies, periods, up and down moves, and markets suggests a possible relationship with different market regulation and microstructure. We also show that the recent financial crisis resulted in an overall increase in volatility; however, this was not translated into an increase in the absolute number of jumps.

1. Literature review and motivation

The volatility of financial markets has been a deeply studied phenomenon in the financial literature for more than a century (see, e.g., the original work of Bachelier in Bachelier et al., 2006, or the recent survey of Gatheral, 2006). There exists an enormous stream in the literature that directly separates volatility into two parts: the noise and irregular and extreme price movements known as price jumps. See Merton (1976) for an early reference or the recent discussion of how to decompose volatility by Giot et al. (2010). However, most of the attention has so far been focused on the part of volatility known as regular

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noise, which can be described by a standard Gaussian distribution. The volatility of real assets, however, does not follow a simple Gaussian motion and the true volatility dynamics is more complex. (There is a wide range of technical literature devoted to non-Gaussian price-generating models, for example based on chaos theory, see the survey in Chorafas, 1994, based on fractal Brownian motion, see the introductory paper of Mandelbrot and Van Ness, 1968, or models with positive feedback, see Lin et al., 2009. In the recent literature, price jumps attract more attention despite the fact that they are difficult to explicitly define or handle mathematically (Broadie and Jain, 2008; Johannes, 2004; Nietert, 2001; Pan, 2002).

Price jumps can be connected to important issues in market micro-structure, such as the efficiency of price formation, the provision of liquidity or the interaction between market players, as can be seen in Madhavan (2000). From a practical point of view, traders and portfolio managers are also interested in analyzing price jumps since they are a part of volatility and therefore associated with potential big losses and gains. Moreover, one see interesting applications of price jumps distributions for financial engineers computing appropriate risk measures, including modified value at risk. Thus, understanding price jumps helps to avoid big losses, improves portfolio performance and better hedges positions. Finally, knowledge of price jumps is needed by financial regulators; see Becketti and Roberts (1990), Tiniç, (1995), Beirne et al. (2010), and Li and Rose (2009).

In this paper, we empirically estimate a broad range of price jump properties for the main stock indexes of the Central and Eastern European (CEE) emerging markets. For our analysis we employ a discrete-time framework, which is suitable for markets with low and irregular frequency of trades. In particular, we are interested in measuring to what extent the jumpiness of the selected CEE markets has been affected by the recent financial crisis and how price jump indexes depend on a chosen frequency, as well as analyzing the (a)symmetry of the underlying jump distribution. In such a setup, the exact prediction of a price jump is not the primary concern, rather we want to compare the propensity of indexes to jump using a non-parametric framework.

We use high-frequency (five-minute) data on the CEE stock market indexes covering the Czech Republic, Poland, and Hungary. These countries belong to the Visegrad region—small emerging economies regionally and culturally close to each other.[1] An analogous country setup was used by Jayasuriya (2011), who studied the effect of the Chinese market on its emerging market neighbors. In our country group we employed the German DAX index from the Frankfurt stock exchange as a benchmark for two main reasons. First, Germany is by far the most important foreign trade partner for all CEE firms, and second, the German stock market is geographically the closest mature market and a very good proxy for Eurozone financial markets.

The data spans from June 2003 to the end of 2010 and thus covers the period before the recent financial crisis, the phase before the crisis, as well as part of the recovery phase. To our knowledge, this is the first study of price jumps for small emerging markets that includes economic and financial interference and discusses the impact of a financial crisis on extreme price movements. Moreover, it is the first study suggesting comparisons of jump propensities across markets and time periods.

The rest of the paper is structured as follows. Section 2 gives a short overview and classification of various price jump indicators. Section 3 briefly describes our methodology, in particular how we use non-parametric measures to compare stock market jumpiness across time and markets. Section 4 describes the data, Section 5 is devoted to our results, and finally Section 6 concludes the paper.

2. Measuring and identifying price jumps: price jumps indicators

One of the major problems associated with price jumps is the lack of theoretical foundations and very different views about their origins presented in the literature. The lack of a theoretical explanation of price jumps means that empirical analysis is currently the only tool one can employ. The appearance of price jumps is associated with several explanations running from changes in market mood to flows of new information (both macro and firm announcements) and insider trading to herd behavior. Basically, most

[1] The Visegrad region actually consists of four countries: the Czech Republic, Poland, Hungary and Slovakia. The sample does not include Slovakia since its financial market has very low capitalization and extremely low turnover, and therefore it is not suitable for any high-frequency statistical analysis.