

Full Title: **The Delay of Stock Price Adjustment to Information: *An Aggregate Country-level Measure***

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Abstract: This study proposes an aggregate price delay measure to assess the speed with which aggregate stock market in each country responds to global market-wide public information. Our empirical results show that there are wide variations in the price delay values over time and across countries. Subsequent panel analysis confirms previous firm-level evidence that market size, trading volume, short sales restrictions and the degree of investability are significant determinants of price delay.

Keywords: Informational efficiency; Relative efficiency; Speed of adjustment; Price delay; Stock market.

JEL Classifications: G14; G15

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1. Introduction

The speed of information incorporation is central to market efficiency, given that an efficient market is characterized as one in which stock prices respond instantaneously to the arrival of new information. Since the seminal work of Fama *et al.* (1969), event studies have become the primary tool for assessing the speed of stock price adjustment to specific types of events. Another strand of emerging literature considers more general information signals using the price delay measure popularized by Hou and Moskowitz (2005), though it has been proposed much earlier by Brennan *et al.* (1993) and Mech (1993). Unlike standard event study methodology, the price delay measure not only enables previous studies to gauge the speed of information incorporation, but also to identify those factors responsible for delaying stock price reactions to local market-wide information. Among the important determinants identified via their cross-sectional or panel regressions are firm size (Brennan *et al.*, 1993), analyst coverage (Brennan *et al.*, 1993), transaction cost (Mech, 1993), trading volume (Chordia and Swaminathan, 2000), short sales restrictions (Chen and Rhee, 2007; Boehmer and Wu, 2008), and the degree of stock accessibility to foreign investors (Bae *et al.*, 2008).

The above-cited price delay studies are largely confined to the U.S. market using firm-level data, running a regression of each individual stock's weekly returns on contemporaneous and four weeks of lagged domestic market index returns. If the stock responds immediately to local market-wide news, then the coefficient for contemporaneous market returns will be significantly different from zero, but none of the coefficients for lagged market returns will differ from zero. We extend the literature by proposing a price delay measure at the aggregate level that captures cross-country differences in the speed of adjustment to global market-wide public information, using world market returns as the common benchmark. This is motivated by the growing interest in comparing the relative efficiency of international stock markets, with the market model R -square statistic the most popular empirical measure (see, for example, Morck *et al.*, 2000; Jin and Myers, 2006; Fernandes and Ferreira, 2009).¹ Even the World Bank's Financial Sector Development Indicators (FSDI) project has constructed a composite indicator for this purpose.² Our study also complements the work by DeFond *et al.* (2007) and Griffin *et al.* (2008) who explore cross-country differences in stock price reactions to a specific event, namely earnings announcements.

This paper is organized as follows. Section 2 briefly describes our proposed country-level price delay measure. Using data from 49 countries, Section 3 explores whether the reactions to global market information vary widely over time and across countries, and then proceed to determine the underlying determinants via panel regression analysis. The final section concludes this paper.

2. The Aggregate Country-level Price Delay Measure

All of the earlier cited studies employ price delay measure to assess the speed of individual stock price adjustment to information, in which domestic market index returns are employed

¹ Despite its popularity, the information-efficiency interpretation of market model R^2 does not go unchallenged (see Teoh *et al.*, 2008 and references cited therein).

² The World Bank's composite efficiency index for stock markets of 58 countries can be downloaded from <http://www.fsd.org/>.

as the relevant local market-wide news to which stock responds. The only exception is Bae *et al.* (2008) who consider global market-wide news by regressing individual stock returns on contemporaneous and lagged world market returns.³ A logical extension is to compare the speed with which aggregate stock market in each country reacts to global market-wide public information.

This involves the following unrestricted model:

$$r_{i,t}^m = \alpha_i + \beta_i r_t^w + \sum_{k=1}^4 \delta_{i,k} r_{t-k}^w + \varepsilon_{i,t} \quad (1)$$

where $r_{i,t}^m$ is the domestic market index return for country i and r_t^w is the world market return in week t .

The restricted model constrains the coefficients on the lagged world market returns to zero:

$$r_{i,t}^m = \alpha_i + \beta_i r_t^w + \varepsilon_{i,t} \quad (2)$$

The R -squares from equations (1) and (2) are used to calculate the commonly used price delay measure:

$$Delay = 1 - \frac{R_{restricted}^2}{R_{unrestricted}^2} \quad (3)$$

The larger the value of the delay measure, the more variations in the domestic market index returns captured by lagged world market returns, indicating greater delay in the response of aggregate stock market to global market-wide news that has common effects across countries.

3. Empirical Results

3.1 The stock data

We collect country indices at the weekly frequency (Wednesday price) for 49 stock markets over the sample period of 1995-2007 from Morgan Stanley Capital International (MSCI). The MSCI All-Country World Index is used as a proxy for world portfolio. All the indices are transformed into continuously compounded percentage return series. The country-level price delay measure is computed annually for each country.

3.2 Time-series variation in the country-level price delay values

Figure 1 plots the evolution of the computed country-level price delay values, averaged across all countries in three different groups- all markets, developed markets, and emerging markets. The figure shows that, in all our sampled 13 years, emerging markets always respond slower than developed markets to global market information. However, the gap between these two groups is becoming narrower since 2004.

<<Insert Figure 1 about here>>

³ The importance of global market information is also acknowledged by studies using market model R -square statistic though the U.S. market index return is used to proxy for global market news (see Morck *et al.*, 2000; Jin and Myers, 2006; Fernandes and Ferreira, 2009).

3.3 Cross-sectional variation in the country-level price delay values

The computed values of price delay for developed and emerging markets are averaged over the 1995-2007 period, and plotted in Figure 2 and Figure 3, respectively. As expected, most developed markets exhibit lower values of price delay than their emerging counterparts, confirming the conventional wisdom that the former are more efficient in incorporating information into stock prices. In unreported exercise of sorting all markets in descending order, Mexico is the only representative from emerging category that manages to break into the top-10 list, occupying the fifth spot. At the tail end of the chart, the final 11 spots are all taken up by stock markets from developing countries. Figure 4 compares our result with other country-level studies using market model R^2 statistic, and it is clear that the difference between developed and emerging group is the largest for our price delay measure.

<<Insert Figures 2-4 about here>>

3.4 Panel analysis

This section seeks to identify what factors are important for explaining the time series and cross-sectional variation in price delay measure. More specifically, we examine whether those significant firm-level determinants of price delay can explain the documented variation at the country-level. Due to data availability, our analysis focuses on the aggregate counterparts for firm size, trading volume, short sales restrictions, and the degree of investibility. Firstly, the logarithm of market capitalization of listed companies is used to proxy for the size of the stock market. Secondly, our proxy for trading volume is the logarithm of one plus the turnover ratio. The panel data for market capitalization and turnover ratio are collected from *World Development Indicators*. Thirdly, we utilize the dataset on the legality and feasibility of market-wide short selling assembled by Daouk and Charoenrook (2005). The short sales dummy variable equals one if either short selling or put options trading is feasible in a given country and year, zero otherwise. Finally, we construct the country-level degree of investibility using the ratio of the number of firms in the Global Index (IFCG) and Investable Index (IFCI), extracted from the *Emerging Stock Markets Factbook* (1996-2002) and the *Global Stock Markets Factbook* (2003-2007). However, the data are only available for the period up to 2006.

Table 1 presents the fixed-effects panel regression results. In univariate regressions, market size and the degree of investibility are significant at the 1% level. Short sales feasibility and trading volume are significant at the 5% and 10% levels, respectively. More importantly, all the explanatory variables have the expected negative coefficients, consistent with firm-level evidence. In multivariate regression, all the variables are still negatively and significantly related to the country-level price delay. Our results hence imply that a slower response to global market-wide information is associated with smaller market size, lower level of trading volume, infeasibility of short selling, and higher degree of restrictions on foreign investors.

<<Insert Table 1 about here>>

4. Conclusion

The speed of stock price adjustment to new information is central to market efficiency, and the price delay measure has emerged as a useful tool. We propose an aggregate price delay measure to assess the speed with which aggregate stock market in each country responds to global market-wide public information. Our empirical results show that there are wide

variations in the price delay values over time and across countries. Subsequent panel analysis identifies market size, trading volume, short sales restrictions and the degree of investability as significant factors that could impede the swift information of global market-wide news. It would be interesting for future studies to explore other potential determinants such as the information dissemination mechanism (see Griffin *et al.*, 2008) and the legal institution (see DeFond *et al.*, 2007; Griffin *et al.*, 2008). Another avenue is to test the investor inattention hypothesis for explaining investor underreaction to public information (see Hirshleifer *et al.*, 2009 and references cited therein).

References

- Bae, K.H., Ozoguz, A., Tan, H., 2008, Do foreigners facilitate information transmission? SSRN working paper, available at <http://ssrn.com/abstract=1160063>.
- Boehmer, E., Wu, J.J., 2008, Short selling and the informational efficiency of prices, SSRN working paper, available at <http://ssrn.com/abstract=972620>.
- Brennan, M.J., Jegadeesh, N., Swaminathan, B., 1993, Investment analysis and the adjustment of stock prices to common information, *Review of Financial Studies* 6, 799-824.
- Chen, C.X., Rhee, S.G., 2007, The impact of short sales on the speed of price adjustment: evidence from the Hong Kong stock market, Working Paper, University of Hawaii.
- Chordia, T., Swaminathan, B., 2000, Trading volume and cross-autocorrelations in stock returns, *Journal of Finance* 55, 913-935.
- Daouk, H., Charoenrook, A., 2005, A study of market-wide short-selling restrictions, SSRN working paper, available at <http://ssrn.com/abstract=687562>.
- DeFond, M., Hung, M., Trezevant, R., 2007, Investor protection and the information content of annual earnings announcements: International evidence, *Journal of Accounting and Economics* 43, 37-67.
- Fama, E.F., Fisher, L., Jensen, M.C., Roll, R., 1969, The adjustment of stock prices to new information, *International Economic Review* 10, 1-21.
- Fernandes, N., Ferreira, M.A., 2009, Insider trading laws and stock price informativeness, *Review of Financial Studies*, in press.
- Griffin, J.M., Hirschey, N.H., Kelly, P.J., 2008, Why does the reaction to news announcements vary across countries? Working Paper, University of Texas at Austin.
- Hirshleifer, D., Lim, S.S., Teoh, S.H., 2009, Driven to distraction: Extraneous events and underreaction to earnings news, *Journal of Finance*, forthcoming.
- Hou, K., Moskowitz, T.J., 2005, Market frictions, price delay, and the cross-section of expected returns, *Review of Financial Studies* 18, 981-1020.
- Jin, L., Myers, S.C., 2006, R^2 around the world: New theory and new tests, *Journal of Financial Economics* 79, 257-292.
- Mech, T.S., 1993, Portfolio return autocorrelation, *Journal of Financial Economics* 34, 307-344.
- Morck, R., Yeung, B., Yu, W., 2000, The information content of stock markets: Why do emerging markets have synchronous stock price movements? *Journal of Financial Economics* 58, 215-260.
- Teoh, S.H., Yang, Y.G., Zhang, Y., 2008, R-square: Noise or firm-specific information? SSRN Working Paper, available at <http://ssrn.com/abstract=926948>.

Figure 1: The Evolution of Country-level Price Delay over the 1995-2007 Period

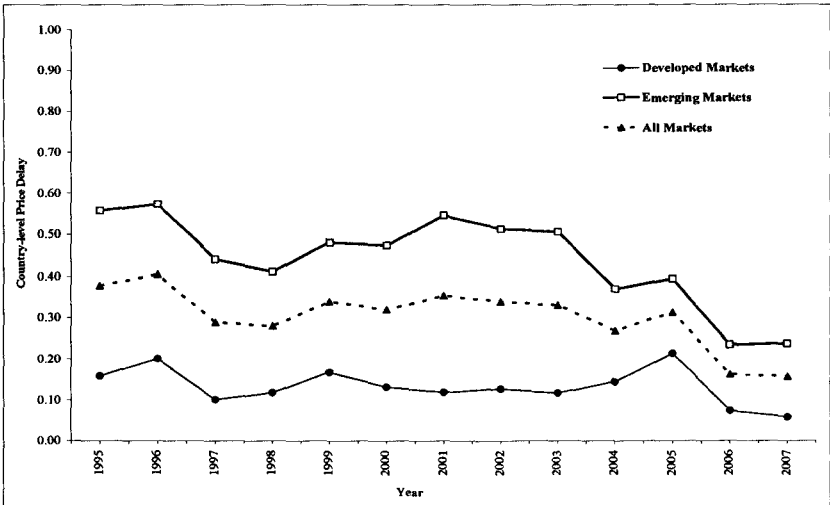


Figure 2: The Country-level Price Delay across Developed Markets

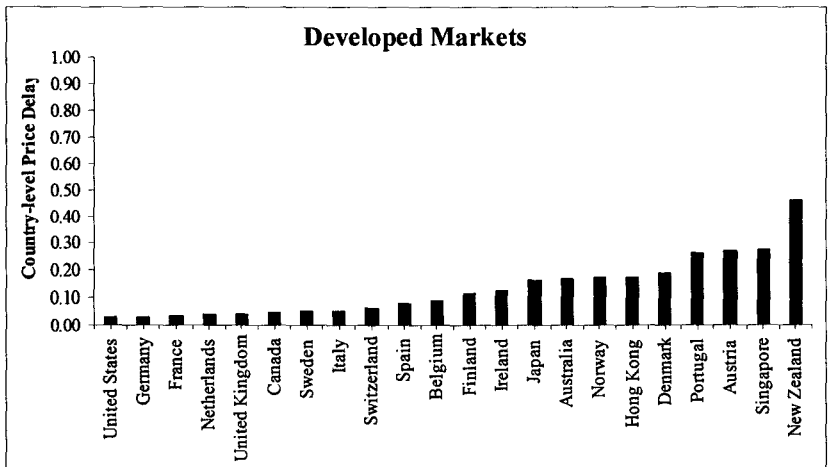


Figure 3: The Country-level Price Delay across Emerging Markets

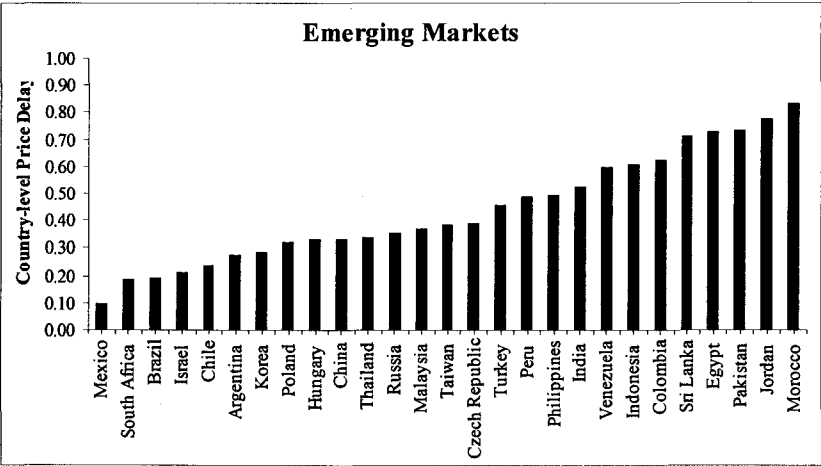
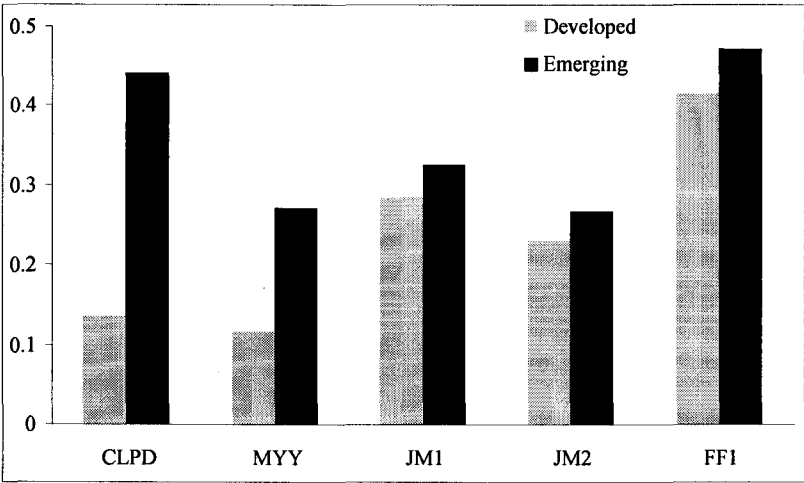


Figure 4: Comparison with Previous Country-level Efficiency Studies



Notes: CLPD is our country-level price delay measure; MYY refers to Morck *et al.* (2000); JM1 is the equal-weighted R^2 while JM2 the variance-weighted R^2 from Jin and Myers (2006); FF1 stands for the market model R^2 computed from Fernandes and Ferreira (2009).

Table 1: Potential Determinants for Aggregate Country-Level Price Delay

	(1)	(2)	(3)	(4)	(5)
MCAP	-0.1345 (0.0000)				-0.1113 (0.0000)
TV		-0.0391 (0.0693)			-0.0365 (0.0761)
SSALE			-0.1207 (0.0236)		-0.0839 (0.0808)
INVEST				-0.2876 (0.0001)	-0.1729 (0.0156)
Country Dummies	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes
Number of observations	637	637	637	588*	588*
Number of countries	49	49	49	49	49
R-squared	0.6527	0.6270	0.6286	0.6393	0.6631

Notes: The dependent variable is the aggregate price delay measure constructed for each country in each year over the 1995-2007 period, capturing the delay with which aggregate stock market responds to global market-wide public information. MCAP is the logarithm of market capitalization to proxy for the size of the stock market. TV represents trading volume, proxied by the logarithm of one plus the turnover ratio. SSALE is the short sales dummy variable which equals one if either short selling or put options trading is feasible in a given country and year, zero otherwise. INVEST is the country-level degree of accessibility to foreign investors, with higher value indicates greater degree of stock market openness. The data for all explanatory variables are available for the full sample period of 1995-2007, with the exception of INVEST which is only up to 2006.

Entries in parentheses are the two-tailed *p*-values. The standard errors for the OLS regressions are adjusted for heteroscedasticity and within-country correlation of the error terms.