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Assessing international financial integration: do industry and firm-specific characteristics matter? Evidence from the Japanese market

Mei-Ping Chen[a], Dai-Tzung Chung[b] and Yu-Hui Lin[c]

[a]Department of Accounting Information, National Taichung University of Science and Technology, Taichung, Taiwan; [b]Department of Finance, National Sun Yat-sen University, Kaohsiung, Taiwan; [c]Department of Business Administration, Nan Kai University of Technology, Caotun, Taiwan

ABSTRACT

International financial integration has received much attention among professional investors. The purpose of this study is to investigate the relationship between financial integration and industry and firm-specific characteristics through analysing cross-listing premiums (determined by the price difference between American Depositary Receipts (A.D.R.s) and their underlining stocks) in Japan. Employing autoregressive models to examine convergence speeds of a shock to the price difference and non-linear Band-threshold autoregressive models to identify non-arbitrage bands, we find that firms integrate well when they are larger in size, sales growth, turnover, performance, institutional holdings, or marked by merger activity, overseas subsidiaries, industrial or consumer goods industries, and a longer history of A.D.R. listing. That is, the A.D.R. with the abovementioned characteristics tends to have less scope for arbitrage. However, cross-market premiums for firms which have large shareholders and a larger extent of earnings management converge more slowly and have longer half-lives, implying more arbitrage opportunities exist. The explanatory variables applied explain over 35% of variance of premium, and most of the variables remain significant determinants of half-lives whether autoregressive or threshold autoregressive modules are used, but firm leverage is not. The results show that the metals and mining industry converges notably slower than other industries, indicating arbitrage is possible.

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Cross-listing premium; Band-threshold autoregressive model (Band-TAR); financial integration; half-life; American depositary receipts

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1. Introduction

Financial integration decreases the cost of capital (Bailey & Jagtiani, 1994); increases economic growth (Bekaert, Harvey, Lundblad, & Siegel, 2007); mitigates agency problems and enhances governance quality (Doidge, Karolyi, & Stulze, 2004). There are numerous well-documented studies which investigated financial integration amongst several equity

CONTACT Yu-Hui Lin lin2138@nkut.edu.tw

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markets (Gochoco-Bautista & Mapa, 2010; Law, 2008). However, the literature reports a negligible role of the specific firm characteristics that influence financial integration. Diverting from current studies discussing the national level of financial integration, this study drills down to the specific features of firm level-affected financial integration and cross-listing premium. There are no existing studies demonstrating the kinds of firm-specific characteristics, industry, corporate governance factors, or American depositary receipt (A.D.R.) features that affect financial integration, cross-listing premiums, half-lives (i.e., convergence speeds of a shock to the cross-listing premium), and no-arbitrage bands (i.e., zones where deviations between an A.D.R. and its related stock prices are not arbitraged away). This study looks at firms' features that cause the price-based evidence of financial integration. It is thus a first attempt to operationalise financial integration at firm level.

The Japanese stock market is world's second largest. The behaviour of the cross-listing premium from A.D.R. and its underlying stock provides a useful price-based measure of integration. In particular, Japanese firms possess special features (Tsuji, 2012), and are the second biggest issuers of depository receipts (D.R.) after the U.S. As a way for U.S. investors to diversify their investment portfolio internationally, a Japanese A.D.R. represents ownership in a Japanese company, trades as conventional shares on U.S. exchanges, and provides identical cash flows as its underlying home stock (Alsayed & McGroarty, 2012). If the U.S. stock market is efficient, the price of an A.D.R. should trade at parity. More specifically, in a fully integrated market, the cross-listing premium should be approximately zero. Full integration of A.D.R. and its underlying Japanese stock might be disrupted by firm or industry factors, because the benefits of dual listing tend to be firm-specific (Alaganar & Bhar, 2004). What and how do Japanese firm characteristics affect the cross-listing premium? What are the important determinants of the specific industry and firm characteristics affecting financial integration? This paper provides empirical answers to these questions and clarifies some interesting aspects relating to possible arbitrage opportunities.

We extend the existing literature to establish 14 hypotheses (see Section 3). In the empirical analyses, first, we measure the cross-listing premium between Japanese A.D.R.s and their underlying stocks. Second, following Yeyati, Schmukler, and Horen (2009), we employ traditional autogressive (A.R.) models to calculate the convergence speed of a shock to the cross market premium as (inverse) measures of the degree of international financial integration (i.e., half-life). In addition, we interpret both the band-width and the convergence speed as (inverse) measures of integration by non-linear threshold autoregressive (T.A.R.) models to implicitly characterise a compensating premium for typical transaction costs such as brokerage fees, as well as to estimate no-arbitrage bands (i.e., zones where deviations between A.D.R. and stock prices are not arbitraged away) and convergence speeds outside the band (Yeyati et al., 2009). Third, by way of the non-linear Band-threshold autoregressive (Band-T.A.R.) results, we focus on the asymmetric adjustment and no-arbitrage bands, and identify the firms' specific characteristics, corporate governance, industry, and A.D.R. features that determine the convergence speed of financial integration and no-arbitrage band.

The work that comes closest to our study is Yeyati et al. (2009). We augment their study and contribute to the existing literature in two aspects. First, we consider that the study of the firm level of the Japanese case is critical, because most of the related studies probe at regional level, such as Asian economies (Caceres & Unsal, 2013). Japan has a well-developed market in which the government controls of cross-country capital movement are fewer compared with controls of emerging markets, such as government restrictions on capital flow,

government corruption. Therefore, most of the explicit barriers can be on the whole ruled out. In this study, we expect that the degree of integration between A.D.R. and its underlying Japanese stock returns is diverse from different firm features. Also, inferences referring to average sector effects may not necessarily hold at the firm level (Manjón-Antolín, 2010). Which firm, A.D.R. features, and industry affect arbitrage opportunity? Taking Japanese firms as examples, we examine whether cross-listing premiums exist within a highly developed market.

Second, most of the international financial integration literature examines limited firm features. For example, Yeyati et al. (2009) find that liquid A.D.R.s and their parent stock prices' deviations across markets are rapidly arbitraged away and no-arbitrage bands are narrow. Lucey and Zhang (2011) uncover that corporate leverage is negatively related to integration. This study probes more inclusive features of firms that influence the phenomena of international financial integration. In this way, we can address several important questions at once, instead of discussing only a firm's capital size or an individual leverage variable. Few studies explore the relationship between financial integration and firm-specific attributes and industry that result in possible arbitrage opportunities. Hence, this study sheds light on some debates on how firm-level factors affect firms' international financial integration, allowing investors and analysts to exploit investment opportunities and to diversify investment portfolios.

Following Aslanidis, Osborn, and Sensier's (2010) study on co-movement in monthly stock returns, we investigate the monthly cross-listing premiums from 10/2001 to 9/2010 for 33 stocks in Japan with A.D.R. listings. Our analysis shows that firms characterised by a larger size, sales growth, turnover, better firm performance, institutional holdings, merger activity, overseas subsidiaries, industrial or consumer goods industries, Level 2 or 3 A.D.R., a longer history of A.D.R. listing, or listed in the N.Y.S.E. or Nasdaq market are able to integrate well (i.e., smaller absolute cross-listing premium, shorter half-life, narrower no-arbitrage band); we believe this is because the informativeness of firm-specific characteristics largely decreases investor information asymmetry. On the other hand, the cross-listing premium for firms with more large shareholders and a larger extent of earnings management converges more slowly, and has larger half-lives and wider no-arbitrage bands. Moreover, most of the variables remain a significant determinant of the half-lives and threshold regimes, but firm leverage does not. Furthermore, the metals and mining industry converges more slowly than other industries, indicating arbitrage is still possible.

2. Literature review

Financial integration may be affected directly or indirectly by factors related to the nature of the firm and its industry (Wiwattanakantang, 2001). Yeyati et al. (2009) find that liquid A.D.R.s and their parent stock prices' deviations across markets are rapidly arbitraged away. Lucey and Zhang (2011) uncover that corporate leverage is negatively related to integration. Yeyati et al. (2009) offer evidence that large firms are fully integrated with the international financial system. Phylaktis and Xia (2006) report that the increasing industry effects on international financial integration are not confined to the Technology, Media and Telecommunications sectors, and thus are not considered a temporary phenomenon. Faias and Ferreira (2017) pinpoint the important linkage between international stock return co-movements and institutional ownership. Karolyi (2004) reveals that negative spillovers

are associated with smaller A.D.R.s, with less-liquid O.T.C. listing and Rule 144a, compared with large ones listing on the N.Y.S.E. and Nasdaq markets.

Previous studies investigating factors influencing international financial integration suggest firm characteristics, corporate governance, industry features and A.D.R. features could play important roles. Many studies identify that size (Hong, Torous, & Valkanov, 2007; Yeyati et al., 2009), sales growth (Roosenboom & van Dijk, 2009; Bekaert et al., 2007; Chan & Lakonishok, 2004; Lakonishok, Shleifer, & Vishny, 1992), volume turnover (Grammig, Melvin, & Schlag, 2005; Koumkwa & Susmel, 2008; Yeyati et al., 2009), firm performance (Jegadeesh & Livant, 2006; Lee, Shleifer, & Thaler, 1991; Lee & Zumwalt, 1981), and corporate leverage(Lucey & Zhang, 2011; Smith & Watts, 1992) are the crucial firm characteristics that are most likely to affect international financial integration.

Some studies evaluate the effect of corporate governance such as the presence of large shareholders (Admati, Pfleiderer, & Zechner, 1994; Jian, Tingting, & Shengchao, 2011; La Porta, Lopez-DeSilanes, & Shleifer, 1999; Wiwattanakantang, 2001), level of institutional shareholders (Faias & Ferreira, 2017; Gillan & Starks, 2003; Chidambaran & John, 2000), and earnings management (Barron, Standard, & Yu, 2009; Sun, 2009) on international financial integration. Other studies justify the impact of industry features such as merger activity (Baker & Savasoglu, 2002; Moeller, Schlingemann, & Stulz, 2005), overseas subsidiaries (Dhawan, 1997; Owhoso, Gleason, Mathur, & Malgwi, 2002), and specific industries (Doidge, Karolyi, & Stulze, 2006; Espinoza & Kwon, 2009; Moerman, 2008) on international financial integration. Much research emphasises the potential effect of A.D.R. features such as levels of A.D.R. Level 2 or 3 A.D.R.s, A.D.R. size, and history on international financial integration (Hales & Mollick, 2014; Karolyi, 2004; Lee, Chang, & Chen, 2015). The aforementioned literature provides a solid foundation to probe more inclusive features of firms that may influence the phenomenon of international financial integration. Next, we discuss and develop the hypotheses for the linkages between financial integration and firm characteristics, corporate governance, industry, and A.D.R. characteristics.

3. Hypotheses development

3.1. Firm characteristics

Hypotheses 1–5 are associated with five selected firm characteristics measured by size (log of the year-end equity), sales growth (the percentage of change in sales), volume turnover, return on equity (R.O.E.), and leverage. These five hypotheses are derived from previous studies such as Lucey and Zhang (2011), Yeyati et al. (2009), Roosenboom and van Dijk (2009), Koumkwa and Susmel (2008), Bekaert et al. (2007), Hong et al. (2007), Jegadeesh and Livant (2006), Grammig et al. (2005), Chan and Lakonishok (2004), Lakonishok et al. (1992), Smith and Watts (1992), Lee et al. (1991), and Lee and Zumwalt (1981), and are shown below:

Hypothesis 1: The degree of financial integration is positively associated with firm size.

Hypothesis 2: The degree of financial integration is positively associated with firm growth.

Hypothesis 3: The degree of financial integration is positively associated with turnover.

Hypothesis 4: The degree of financial integration is positively associated with firm performance.

Hypothesis 5: The degree of financial integration is negatively associated with corporate leverage.

3.2. Corporate governance

Hypotheses 6–8 are related to three selected corporate governance variables: the presence of large shareholders, level of institutional shareholders, and earnings management. These hypotheses are generated from previous studies, such as Faias and Ferreira (2017), Jian et al. (2011), Barron et al. (2009), Sun (2009), Gillan and Starks (2003), Wiwattanakantang (2001), Chidambaran and John (2000), La Porta et al. (1999), and Admati et al. (1994), and are shown below:

Hypothesis 6: The presence of large shareholders has no effect on financial integration.

Hypothesis 7: Higher levels of financial integration are associated with a higher level of institutional shareholders.

Hypothesis 8: Higher levels of financial integration are associated with a lower level of earnings management.

3.3. Industry features

Hypotheses 9–11 are based on three selected industry variables: merger activity, overseas subsidiaries, and specific industries. These hypotheses are proposed based on previous studies such as Espinoza and Kwon (2009), Moerman (2008), Doidge et al. (2006), Moeller et al. (2005), Baker and Savasoglu (2002), Owhoso et al. (2002), and Dhawan (1997), and are listed as follows:

Hypothesis 9: The presence of merger activity is no impact on the degree of financial integration.

Hypothesis 10: The degree of financial integration is positively associated with overseas subsidiaries.

Hypothesis 11: The degree of financial integration is negatively associated with the specific industries.

3.4. A.D.R. characteristics

Hypotheses 12–14 are associated with three selected A.D.R. characteristics: Level 2 or 3 A.D.R.s, A.D.R. size, and history. These hypotheses are derived from previous studies, such as Lee et al. (2015), Hales and Mollick (2014), and Karolyi (2004), and are listed below:

Hypothesis 12: The degree of financial integration is positively associated with Levels 2 or 3 ADRs.

Hypothesis 13: The degree of financial integration is positively associated with NYSE- and NASDAQ-listed ADRs compared with those that are OTC-listed.

Hypothesis 14: The degree of financial integration is positively associated with the history of ADR listing.

4. Data and the cross-listing premium

4.1. Sample selection and descriptive statistics

The data used in this study are obtained from *DataStream* and *Compustat* databases. The cross-listing premium and half-lives were calculated during the period from October 2001 to September 2010. Monthly data are used in this study because this allows us to neglect the issue of non-contemporaneous trading days and non-overlapping trading hours. When focusing on firm-level data by half-lives, we selected Japanese A.D.R. samples for our investigation because not only do they have relative merits for economic significance, but they could also isolate possible government intervention. In addition, Japanese A.D.R. samples rule out the limitations of international presence. As our samples come from a single stock market (i.e., Japan), the exchange rate influence, that is not the focus of this study, is neglected. Firms must satisfy the following three criteria for inclusion in our study samples. First, Japanese public firms with Level 1, 2 and 3 A.D.R.s listed before 2003 are used for investigation. Since we are interested in different A.D.R. types resulting in different extents of integration, Level 1 A.D.R.s traded in O.T.C. are also included in our analysis. Rule 144a issues trading only among qualified institutional buyers on the P.O.R.T.A.L. system are discarded. Second, stocks that present irregular patterns in the time series, for example, displaying large unexplained shifts in trading volume, are excluded. In addition, we further impose a minimum number of observations to estimate reliably the A.R. and Band-T.A.R. models; that is, stocks that have at least 90 months of observations for A.R. and Band-T.A.R. analyses. Third, this study gathers A.D.R.s which have price, stock price, exchange rate, and A.D.R.-related data in the *DataStream* database. There are also underlying stock data in the *Compustat* database, such as stock capital, sales, turnover, R.O.E., leverage, large shareholder percentage, institutional holding percentage, earnings management, merger, overseas and industry data. After eliminating firms for which required data are missing, the final sample for our analysis contains 33 firms.

For each firm, we collect four categories of firm-level data, that is, five financial features (size, sale growth, turnover, R.O.E., and leverage), three corporate governance features (large shareholder percentage, institutional holding percentage, and earnings management), three industry features (merger activity, overseas subsidiary, and industry classification), and three A.D.R. features (A.D.R. type, market listing, and A.D.R. effective day). The operational definitions of these variables are as follows: firm size is scales by average equity in thousand. Growth is the percentage of change in sales. Turnover is the value of total shares traded divided by market capitalisation. R.O.E. is the return on equity defined as the amount of net income returned as a percentage of shareholders equity. Leverage is calculated as total debt divided by total equity. Large shareholder is the percentage of stock holdings by large shareholders. Institutional holding is the percentage of stock holdings by institutions. Earnings management is the discretionary accruals divided by total assets. We set the merger dummy variable as equal to one if firms engaged in merger activity, and zero otherwise. The overseas dummy is equal to one if firms have overseas subsidiaries. Three industry dummies are used to classify four industries (i.e., industrial, consumer goods, metals and mining industries). We set Level 2 and 3 A.D.R. type dummy equal to 1, Level 1 zero. The A.D.R. market exchange is a dummy variable that is equal to one if the A.D.R.s are listed in N.Y.S.E. or Nasdaq and zero for the O.T.C. exchange. A.D.R.s are split into A.D.R. effective dates in the 1970s, 1990s are equal to one, and others are zero in order to capture the impact

Table 1. Summary of empirical data for ADRs.

Firm No.	DR Issue	ADR Type	Exchange	Industry	ADR Effective Date
1	Advantest	2	NYSE	Tech. hardware and equipment	17/09/2001
2	All Nippon Airways	1	OTC	Travel and leisure	28/11/2000
3	Belluna	1	OTC	General retailers	20/12/2001
4	Canon	3	NYSE	Tech. hardware and equipment	01/01/1979
5	Eisai	1	OTC	Pharmacy and biotechnology	1/12/1995
6	Hitachi	3	NYSE	Electronic and electric equipment	11/03/1982
7	Honda	3	NYSE	Automobiles and parts	01/01/1977
8	Kawasaki	1	OTC	Industrial engineer	6/11/1997
9	Kewpie	1	OTC	Food producers	18/02/1998
10	Kobe Steel	1	OTC	Industry metals and mining	01/10/1992
11	Konami	3	NYSE	Leisure goods	30/09/2002
12	Kubota	3	NYSE	Industrial engineer	01/01/1976
13	Kyocera	3	NYSE	Electronic and electric equipment	13/05/1980
14	Makita	3	NASDAQ	Household goods	01/04/1991
15	Minebea	1	OTC	Electronic and electric equipment	11/04/1997
16	Mitsubishi	2	NYSE	Support services	01/07/1994
17	Mitsubishi UFJ Fin.	2	NYSE	Banks	02/04/2001
18	Mitsui	3	NASDAQ	Support services	01/12/1970
19	Nidec	2	NYSE	Electronic and electric equipment	27/09/2001
20	Nippon	3	NYSE	Fixed line telecom	01/09/1994
21	Nomura	3	NYSE	Financial services	17/12/2001
22	Ntt Docomo	2	NYSE	Mobile telecommunication	01/03/2002
23	Olympus	1	OTC	Leisure goods	01/06/1993
24	Orix	3	NYSE	Financial services	16/09/1998
25	Panasonic	3	NYSE	Leisure goods	01/01/1970
26	Ricoh	1	OTC	Tech. hardware and equipment	01/04/1991
27	Sekisui House	1	OTC	Household goods	28/03/2001
28	Shiseido	1	OTC	Personal goods	01/07/1992
29	Sony	3	NYSE	Leisure goods	01/01/1970
30	Sumitomo Metal	1	OTC	Metals and mining	01/07/1993
31	SumitomoTrust	1	OTC	Banks	30/04/1998
32	Toyota	3	NYSE	Automobiles and parts	28/09/1999
33	Wacoal	3	NASDAQ	Personal goods	01/12/1997

Source: DataStream database.

of A.D.R. listing history on financial integration. We also account for the effects of financial integration by controlling all regressions for indicators of A.D.R. size (the amount of total A.D.R. share) and A.D.R. liquidity (i.e., A.D.R. turnover, which is calculated by A.D.R. price times A.D.R. traded share). Table 1 provides information about the list of 33 firms in our sample. Table 2 shows the descriptive statistics of firm characteristics.

4.2. The cross-listing premium

The cross-listing premium (or discount) reflects the deviation between the market price of the parent stock and its price in the U.S. It is computed by converting the local currency price of the underlying stock into U.S. dollar prices, multiplying this by the number of underlying shares that one A.D.R. represents, and then dividing the value by the A.D.R. price. When financial assets can be transferred freely between the parent market and the

Table 2. Summary statistics of firm characteristics.[a]

Variable	Mean	Median	Minimum	Maximum	Std. Dev.
Size	90,596.227	18,546.758	1003.967	1,350,000	236,000
Growth (%)	10.224	7.329	−1.376	24.518	22.351
Turnover (%)	3.616	1.474	0.324	341.701	62.219
R.O.E. (%)	10.445	3.412	−2.147	17.293	36.228
Leverage (%)	105.736	64.267	22.935	203.156	55.881
Large shareholders (%)	40.157	32.136	2.472	89.213	41.725
Institutional holding (%)	17.329	7.239	3.162	32.587	24.127
Earnings management (%)	32.4	12.4	2.1	88.4	24.561

[a]Firm size is scales by average equity in thousand. Growth is the percentage of change in sales. Turnover is the value of total shares traded divided by market capitalisation. Leverage is calculated as total debt divided by total equity. Large shareholder is the percentage of stock holdings by large shareholders. Institutional holding is the percentage of stock holdings by institutions. Earnings management is the discretionary accruals divided by total assets.
Source: Authors calculation.

Table 3. Summary statistics - each company's cross-listing premium.[a]

No	Firm	Mean	Median	Std. Dev.	Skewness	Kurtosis	Obs.
1	Advantest	−0.252	−0.144	1.437	0.456	3.900	109
2	All Nippon Airways	−0.413	−0.339	4.967	−0.168	7.637	121
3	Belluna	−0.051	0.269	1.653	−1.119	6.525	102
4	Canon	0.013	−0.070	1.249	1.514	8.143	121
5	Eisai	−0.491	−0.497	5.117	9.514	4.325	121
6	Hitachi	0.062	−0.059	1.074	−0.053	4.911	121
7	Honda	−0.080	−0.132	1.363	−0.389	5.743	121
8	Kawasaki	1.515	0.905	8.315	2.017	15.241	121
9	Kewpie	1.577	0.452	11.124	8.353	14.835	121
10	Kobe Steel	4.019	4.025	11.338	2.263	29.300	121
11	Konami	−0.400	−0.352	1.361	−0.328	3.767	96
12	Kubota	0.232	−0.050	1.385	−0.165	3.612	121
13	Kyocera	0.236	−0.432	1.075	0.246	4.188	121
14	Makita	0.689	0.610	1.885	3.843	9.738	121
15	Minebea	1.615	0.430	10.234	9.514	10.961	121
16	Mitsubishi	1.992	2.991	4.828	−0.250	4.992	121
17	Mitsubishi UFJ Fin.	−0.174	−0.169	1.534	−0.198	6.589	114
18	Mitsui	0.217	−0.030	2.113	2.280	11.910	121
19	Nidec	−0.107	−0.284	1.466	0.775	6.905	109
20	Nippon	−0.502	−0.501	0.687	−3.048	12.992	121
21	Nomura	0.455	−0.292	3.900	6.261	17.330	121
22	Ntt Docomo	0.340	−0.108	3.575	6.214	6.254	121
23	Olympus	−0.912	−0.901	0.836	−0.347	12.892	121
24	Orix	−0.123	−0.173	1.290	0.326	8.211	121
25	Panasonic	−0.131	−0.100	1.258	−1.877	13.828	121
26	Ricoh	1.013	0.805	9.629	0.907	7.656	121
27	Sekisui House	−0.211	0.025	4.933	−1.889	8.672	121
28	Shiseido	−0.793	−0.798	2.267	3.457	15.943	121
29	Sony	0.245	0.022	1.824	2.284	15.536	121
30	Sumitomo Metal	4.014	3.993	9.859	3.857	28.086	121
31	Sumitomo Trust	0.816	0.405	4.833	1.241	10.969	121
32	Toyota	−0.034	−0.089	1.149	0.441	7.160	121
33	Wacoal	0.552	0.494	1.899	0.822	7.824	121
All stocks		0.383	−0.154	1.299	2.191	6.271	3918

[a]The table shows summary statistics for the cross-listing premiums (%), defined as the percentage difference between the dollar price of the stock in the domestic market and the price of the corresponding D.R. in the U.S. 'All stocks' denotes the simple average of all the stocks in the sample.
Source: Authors calculation.

U.S. market, transaction costs are negligible, and the two markets close at the same time, then the cross-listing premium should be close to zero, if the market is fully integrated (Yeyati et al., 2009). Table 3 presents the summary statistics of the cross-listing premium

of the sample firms. Due to space limitations, we do not interpret these statistics in detail. Nevertheless, the interpretation of these statistics is available upon request to the authors.

4.3. Unit-Root tests

If the cross-listing premium data are I(1), then the standard statistical inference may suffer from the spurious regression-type critique (Granger & Newbold, 1974) and the half-life of the deviations would be too long to allow for any meaningful discussion in terms of financial integration. Therefore, various unit root tests (such as D.F.-G.L.S. and N.P. tests) confirm that the cross-listing premium series follow a I(0)/stationary process. Because of limited space, we do not report these results. Nevertheless, the results for these tests are available upon request to the authors.

5. Models and methodology

5.1. Linear regressions

The linear regression model estimated by the generalised least squares technique is used to gauge the effects of firm characteristics, corporate governance, industry, and A.D.R. characteristics on international financial integration(measured by firm *i*'s estimated half-life) in order to validate our proposed hypotheses (described in Section 3). Therefore, the independent variables include firm characteristics, corporate governance, industry, and A.D.R. characteristics described in Section 4.1, and the dependent is the firm *i*'s half-life generated by the A.R. and Band-T.A.R. models. We now introduce both A.R. and Band-T.A.R. models.

5.2. AR model

Financial integration through the law of one price (L.O.O.P.) can be measured using two models. The first consists of a traditional linear A.R. model. Following Yeyati et al. (2009), higher convergence speeds reflect a quicker convergence to the L.O.O.P. and hence strong financial integration. We estimate the persistence of stocks applying the Augmented Dickey–Fuller model, with one autoregressive component and another lagged difference – that is, we estimate the following model:

$$\Delta X_t = \alpha X_{t-1} + \sum_{i=1}^{k} \psi_i \Delta X_{t-i} + \varepsilon_t,$$

$$\sigma_t^2 = \beta_0 + \sum_{i=1}^{p} \beta_i \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \varphi_i \sigma_{t-i}^2, \tag{1}$$

where α measures the change in the premium to differences between the price of the underlying stock and the price of the A.D.R. Put differently, α offers a measure of the speed of convergence of the premium back to its equilibrium value. Here, σ_t^2 is the variance of the process. The model includes Generalised Autoregressive Conditional Heteroskedasticity (G.A.R.C.H.(p,q)) effects to account for heteroskedasticity prevalent in the data. Lags

are included so that no serial correlation or heteroskedasticity is present in the residuals. Specifically, in each A.R. model the number of lags and G.A.R.C.H. terms vary such that there is no serial correlation and heteroskedasticity left in the residuals. The half-life measures the time it takes for a deviation from the premium to dissipate by 50% and is calculated by $\ln(0.5)/\ln(1+\alpha)$ (Ha & Fan, 2004). This expression assumes a monotonic rate of decay, which does not necessarily occur in higher-order A.R. models.

5.3. Band-T.A.R. model

The second type of model we utilise is the non-linear Band-T.A.R. model. The Band-T.A.R. model was first proposed by Tong (1978) and further developed by Tong and Lim (1980). The non-linear models are well supported by theoretical arguments based on international transaction costs or sunk costs of international arbitrage (Sercu, Uppal, & van Hulle, 1995). The existence of transaction costs implies the existence of two different regimes, an arbitrage and a no-arbitrage regime. If the difference between the two prices is smaller than the transaction costs, then an arbitrage will not take place and the difference can persistently exist. However, when a shock in either of the two markets results in a difference between the two prices that exceeds the transaction costs (i.e., the premium is outside the no-arbitrage band), then it triggers profitable arbitrage trades that elicit a strong pressure on the premium to go back inside the band. In other words, theoretically there will be a no-arbitrage regime when the persistence is high, and an arbitrage regime when there exists pressure on the price to converge. To the extent that high transaction costs, and hence a broader band of a no-arbitrage regime, are associated with a lower degree of financial integration, the estimated width of the no-arbitrage bands provides a measure of effective integration. Following Yeyati et al. (2009), the Band-T.A.R. specification we estimate is the following:

$$\Delta X_t = (C_{in})\beta_{in} X_{t-1} + (C_{out})\beta_{out}\Theta(X_{t-1}, V) + \sum_{i=1}^{k} \varphi_i \Delta X_{t-i} + \varepsilon_t$$

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \eta_i \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \lambda_i \sigma_{t-i}^2,$$

Where

$$\begin{aligned}
&\Theta\left(X_{t-1}, V^{up}\right) = X_{t-1} - V^{up} \text{ if } X_{t-1} > V^{up},\\
&\Theta\left(X_{t-1}, V^{low}\right) = X_{t-1} - V^{low} \text{ if } X_{t-1} > V^{low},\\
&C_{in} = 1 \text{ if } V^{low} < X_{t-1} < V^{up};\ \textit{zero otherwise}.\\
&C_{out} = 1 \text{ if } X_{t-1} > V^{up} \text{ or }; X_{t-1} < V^{low};\ \textit{zero otherwise},\\
&V^{up} > 0 \text{ and } V^{low} < 0.
\end{aligned} \tag{2}$$

This model is known as the Band-T.A.R.(k, 2, de), where k is the augmented lag length, 2 is the number of thresholds, and de is the delay parameter. We assume that the thresholds are symmetric and that the dynamics of the process outside the threshold are the same regardless of whether there exists a premium or a discount. Moreover, we set de equal to one, β_{in} and

β_{out} represent the convergence speed in the no-arbitrage and arbitrage regimes, respectively, V^{up} is the upper threshold, and V^{low} is the lower threshold. We assume that constants in both regimes are zero. For each firm, we estimate a different model, where k, p, and q are set such that the residuals do not contain any serial correlation or heteroskedasticity (p is the number of A.R.C.H. terms and q is the number of G.A.R.C.H. terms).

The model is estimated following the procedure described in Obstfeld and Taylor (1997). The estimation proceeds via a grid search on the threshold, which maximises the log likelihood ratio (L.L.R.). As the threshold is not defined under the null, the standard inference is invalid and L.L.R. does not follow the usual χ^2 distribution. To derive the critical values of the L.L.R. test, we follow Obstfeld and Taylor (1997) and use Monte Carlo simulations. The empirical distribution of the L.L.R. can then be calculated from the 1000 simulations, and this is used as the basis for the inference in judging the alternative Band-T.A.R. model against the A.R. null.

6. Empirical results

6.1. Estimated half-lives and threshold regimes

We examine the extent of financial market integration through the L.O.O.P. by conducting A.R. and Band-T.A.R. models for each firm, and the results of implied half-lives for A.R. and T.A.R. as well as the estimated T.A.R. thresholds are reported in Table 4. As indicated in Table 4, we find that the average half-lives (from the A.R. models) range from 0.014 in Kubota to 2.743 in Sumitomo Metal. The average half-lives tend to be lower than 1 in the majority of A.D.R.s. A similar pattern is observed in the case of the T.A.R. estimates. Kubota and Kobe, both belonging to the steel and metal industry, appear the two largest A.R. and Band-T.A.R. half-lives, signifying that specific-industry arbitrage opportunity exists. In contrast, cross-listing premiums for Kubota (industrial engineer industry) and Honda (automobiles) are the quickest to converge to zero in both A.R. and Band-A.R. half-lives. The faster the convergence is for premiums, the more efficient the pricing is in the A.D.R. and underlying markets, implying fewer arbitrage opportunities. Note that for 11 out of 33 firms, when using the non-linear model it takes less than 0.1 months for the A.D.R. price premium to be reduced by half. From the non-linear estimation, we find faster adjustments for all the firms. For the non-linear models, the estimated average half-life is 0.486 months, which is smaller than that of the linear model at 0.614 months. By allowing non-linear adjustments, the average half-life is reduced by approximately 21% compared with the standard linear model, indicating non-linear Band-T.A.R. models fit well across all firms.

In Table 4, a positive correlation between A.R. half-life and the threshold width signifies that slowly reverting industries tend to have larger thresholds. The no-arbitrage bands range from 0.023% in Honda to 1.444% in Sumitomo Metal. This means that the cross-listing premium in Sumitomo Metal can move between –1.444% and 1.444% without arbitrage taking place in the market. Once outside the inaction-band, arbitrage happens very quickly, with a typical half-life less than a month. It is important to note that these results might not just imply that Honda is more integrated with U.S. market than Sumitomo Metal. As explored in the next section, deviations from the L.O.O.P. might be affected by the above-mentioned stock, A.D.R., and industry specific factors. Thus, to study the relative integration of different A.D.R.s one has to compare A.D.R.s with different characteristics. Yeyati et al. (2009) note that if non-linearities are present in the evolution of the cross-listing premium, then convergence speeds should be slower when estimated by the A.R. models

Table 4. Results for Half-Lives of the linear model (A.R.), non-linear model (Band-T.A.R.), and estimated thresholds.

Firm	A.R.Half-life	Estimated Band-T.A.R.Threshold (%)	Band-T.A.R.Half-life
Advantest	0.452	0.212	0.321
All NipponAirways	0.054	0.053	0.034
Belluna	0.673	0.514	0.474
Canon	0.150	0.126	0.158
Eisai	0.075	0.069	0.054
Hitachi	0.074	0.071	0.059
Honda	0.044	0.023	0.022
Kawasaki	0.666	0.267	0.347
Kewpie	1.053	0.563	0.742
Kobe Steel	2.473	1.319	1.753
Konami	1.541	0.617	1.396
Kubota	0.014	0.026	0.010
Kyocera	0.056	0.033	0.044
Makita	0.994	0.391	0.937
Minebea	1.234	0.414	1.201
Mitsubishi	0.290	0.167	0.260
Mitsubishi UFJ Fin.	0.185	0.105	0.171
Mitsui	0.434	0.243	0.427
Nidec	0.084	0.038	0.074
Nippon	0.529	0.246	0.424
Nomura	0.797	0.292	0.684
Ntt Docomo	0.785	0.351	0.706
Olympus	0.893	0.294	0.681
Orix	0.056	0.051	0.044
Panasonic	0.047	0.027	0.033
Ricoh	0.318	0.163	0.284
Sekisui House	1.030	0.514	0.680
Shiseido	1.447	0.572	1.328
Sony	0.067	0.041	0.057
Sumitomo Metal	2.743	1.444	1.784
Sumitomo Trust	0.587	0.252	0.498
Toyota	0.078	0.028	0.064
Wacoal	0.351	0.293	0.273
All stocks	0.614	0.212	0.486

Source: Authors calculation.

than by the Band-T.A.R models. The phenomenon is the same in our findings. Furthermore, the wider the band-width is, the higher the persistence estimated by the A.R. That is, the results offer further evidence of how the presence of non-linearities influences the results from a linear estimation.

6.2. Convergence speeds of integration and firm-specific characteristics

This part of the analysis investigates the dependence of the conditional persistence of the cross-listing premium (that is, convergence speeds or half-lives). In Table 5, the persistence of the premium outside of the thresholds co-varies notably negatively with firm size, growth rate, turnover, performance, and its interaction variables, except for leverage. As to the corporate governance variables, large shareholders and earnings management are positively significant in explaining the persistence of the premium outside of the thresholds, while institutional holdings are negatively significantly related to the persistence of the premium, indicating that institutional holdings increase integration, while large shareholders and earnings management decrease integration. The premiums for firms with a larger size, growth, turnover, better performance, and more institutional holdings take a shorter time

Table 5. Results for A.R. half-life regressions in monthly data.[a]

	Model (1)		Model (2)		Model (3)		Model (4)	
	Firm characteristics		Firm characteristics + Corporate governance		Dummies variables only		Firm characteristics + Corporate governance + Dummies variables	
Firm characteristics	Coeff	S.E.	Coeff	S.E.	Coeff	S.E.	Coeff	S.E.
Size	−0.064**	(0.022)	−0.082**	(0.029)			−0.077**	(0.026)
Growth	−0.056**	(0.025)	−0.061**	(0.028)			−0.082**	(0.031)
Turnover	−0.217**	(0.093)	−0.283**	(0.101)			−0.352**	(0.119)
Size*Growth	−0.072**	(0.025)	−0.081**	(0.031)			−0.113**	(0.039)
Size*Turnover	−0.084**	(0.041)	−0.093**	(0.044)			−0.091**	(0.045)
Growth*Turnover	−0.049**	(0.021)	−0.056**	(0.027)			−0.072*	(0.041)
Size*Growth* Turnover	−0.017*	(0.011)	−0.026*	(0.015)			−0.032*	(0.018)
R.O.E.	−0.105**	(0.043)	−0.113**	(0.047)			−0.097**	(0.041)
Leverage	0.134	(0.112)	0.179	(0.121)			0.206	(0.128)
Corporate governance								
Large shareholders			0.229*	(0.132)			0.241*	(0.139)
Institutional holdings			−0.117**	(0.053)			−0.132**	(0.059)
Earnings management			0.265**	(0.112)			0.307**	(0.116)
Dummies								
Merger dummy					−0.092*	(0.056)	−0.102*	(0.059)
Overseas dummy					−0.122**	(0.044)	−0.141**	(0.051)
Industry dummy-Industrials					−0.224**	(0.103)	−0.237**	(0.107)
Industry dummy-Consumer goods					−0.169*	(0.092)	−0.151*	(0.085)
Industry dummy-Metals and mining					1.913**	(0.229)	2.017**	(0.233)
A.D.R. Features								
A.D.R. type dummy					−0.047*	(0.026)	−0.053*	(0.031)
Market dummy					−0.325**	(0.144)	−0.402**	(0.149)
Year dummy-effective in 1970s					−0.147*	(0.081)	−0.165*	(0.088)
Year dummy-effective in 1990s					0.137	(0.92)	0.144	(0.960)
Control variables								
A.D.R. size	−0.036*	(0.021)	−0.042*	(0.024)	−0.037*	(0.022)	−0.067**	(0.031)
A.D.R. liquidity	−0.119**	(0.053)	−0.184**	(0.067)	−0.126**	(0.057)	−0.205**	(0.072)
Constant	−0.332**	(0.117)	−0.514**	(0.212)	−0.447**	(0.179)	−0.661**	(0.227)
Adj. R^2	0.227		0.263		0.204		0.319	

[a]The standard errors are reported in parentheses.
** and * represent significance at the 5% and 10% levels, respectively.
Source: Authors calculation.

to converge to the no-adjustment bound. The premiums for firms with larger shareholders and earnings management take longer to converge to the no-adjustment bound.

As to the dummy variables, the convergence speed co-varies significantly negatively with merger activity, overseas subsidiaries, Level 2 or 3 A.D.R.s, N.Y.S.E. or Nasdaq market exchange, and an A.D.R. effective date in the 1970s, at less than the 10% significance level. Only younger A.D.R. listings have an insignificant influence on the persistence of the premium outside of the thresholds. Regarding the industry classifications' impact on financial integration, industrial and consumer goods industries are more financially integrated than other industries. The metals and mining industry is significant with a positive sign,

suggesting that this industry with a higher degree of premiums has longer half-lives. The metals and mining industry has a lowest level of financial integration. Fernandez (2009) notes that the mining industry is a complicated industry affected by political instability and energy industries. Hong et al. (2007) address that the metals and mining industry can forecast the market up to two months, because certain investors receive information originating from metals and mining only with a lag. Thus, we believe that the salient negative effect from the metals and mining industry is more likely to go from a risk and information asymmetry to a cross-listing premium. These results are robust to including A.D.R. size and A.D.R. liquidity as additional control variables.

Table 6 reports the results from the dependent variable of the estimated half-life in the Band-T.A.R. models, confirming the importance of firm-specific characteristics and corporate governance variables. The results highlight the need to account for firm-specific characteristics in explaining a persistent premium. Firm size, growth, turnover, performance, institutional holdings, merger activity, overseas subsidiaries, Level 2 or 3 A.D.R., N.Y.S.E. or Nasdaq listing, and a longer A.D.R. listing history are significantly negatively related to half-lives, while large shareholders and earnings management converge more slowly to the half-lives. Except for leverage and younger A.D.R. listing, all variables are significant explanatory variables. The results from the Band-T.A.R. model not only confirm the results from A.R., but also suggest that the above results remain robust to the full model shown in Model (4) of Table 6. The additional control variables allow us to make inferences about the possibility impact from A.D.R. size and A.D.R. liquidity on financial integration. We find the larger the A.D.R. size and liquidity, the larger the degree of financial integration.

6.3. Determinants of thresholds

In this section, we test whether firm-specific characteristics, corporate governance, and A.D.R. features can explain threshold regimes. As shown in Model (1) of Table 7, only leverage cannot explain the threshold regime for firm-specific characteristics. That is, size, growth, turnover, R.O.E., and the interaction terms are significantly negative in explaining the threshold regime. Other things being constant, larger size firms have a narrower threshold of no-arbitrage. An increase in the size decreases the threshold by 4.6% points in Model (4). Similarly, firms with larger growth, larger turnover, and larger R.O.E. have a narrower threshold of no-arbitrage. We believe the results are due to informativeness. In Model (4) of Table 7, the corporate governance variables in determining no-arbitrage bands remain highly significant after controlling for the firm-specific characteristics. An increase in larger shareholders increases the no-arbitrage threshold by 12.7% points, and an increase in earnings management increases the no-arbitrage threshold by 21.5% points, indicating larger shareholders and earnings management have wider thresholds of no-arbitrage. On the other hand, institutional holdings are significantly negatively related to the size of the thresholds by –17.7% points. Consistent with Gillan and Starks (2003), corporate monitoring by institutional holders enhances monitoring, decreases the no-arbitrage threshold, and increases the liquidity of the markets and price informativeness of the markets.

Merger activity and overseas subsidiaries dummies are also important in explaining threshold regimes. Merger activity increases the informativeness of a firm and thus decreases the no-arbitrage bands. Overseas subsidiaries dummies increase the reputation effect of the firm, thus decreasing the no-arbitrage band. As to the industry dummy in Model (3), the

Table 6. Results for band-T.A.R. half-life regressions in monthly data.[a]

	Model (1)		Model (2)		Model (3)		Model (4)	
	Firm characteristics		Firm characteristics + Corporate governance		Dummies variables only		Firm characteristics + Corporate governance + Dummies variables	
Firm characteristics	Coeff	S.E.	Coeff	S.E.	Coeff	S.E.	Coeff	S.E.
Size	−0.052**	(0.023)	−0.064**	(0.025)			−0.076**	(0.029)
Growth	−0.041**	(0.019)	−0.057**	(0.021)			−0.059**	(0.027)
Turnover	−0.223**	(0.096)	−0.241**	(0.094)			−0.229**	(0.090)
Size*Growth	−0.064**	(0.029)	−0.075**	(0.028)			−0.069**	(0.025)
Size*Turnover	−0.077**	(0.031)	−0.082**	(0.033)			−0.112**	(0.039)
Growth*Turnover	−0.042**	(0.019)	−0.049**	(0.017)			−0.039*	(0.023)
Size*Growth* Turnover	−0.022*	(0.013)	−0.027*	(0.015)			−0.031*	(0.019)
R.O.E.	−0.097**	(0.036)	−0.112**	(0.038)			−0.105**	(0.035)
Leverage	0.104	(0.096)	0.101	(0.093)			0.096	(0.092)
Corporate governance								
Large shareholders			0.192*	(0.103)			0.200*	(0.109)
Institutional holdings			−0.105**	(0.049)			−0.124**	(0.046)
Earnings management			0.176**	(0.062)			0.228**	(0.081)
Dummies								
Merger dummy					−0.082*	(0.047)	−0.094*	(0.051)
Overseas dummy					−0.091**	(0.043)	−0.103**	(0.049)
Industry dummy-Industrials					−0.142**	(0.056)	−0.167**	(0.059)
Industry dummy-Consumer goods					−0.132**	(0.051)	−0.124**	(0.053)
Industry dummy-Metals and mining					1.667**	(0.241)	1.796**	(0.249)
A.D.R. Features								
A.D.R. type dummy					−0.032*	(0.018)	−0.041*	(0.023)
Market dummy					−0.221**	(0.101)	−0.214**	(0.104)
Year dummy-effective in 1970s					−0.162*	(0.091)	−0.178*	(0.096)
Year dummy-effective in 1990s					0.124	(0.086)	0.135	(0.089)
Control variables								
A.D.R. size	−0.027*	(0.015)	−0.034*	(0.019)	−0.029*	(0.016)	−0.041*	(0.023)
A.D.R. liquidity	−0.092**	(0.032)	−0.104**	(0.035)	−0.101**	(0.039)	−0.126**	(0.041)
Constant	−0.327**	(0.145)	−0.421**	(0.147)	−0.335**	(0.148)	−0.471**	(0.151)
Adj. R^2	0.234		0.317		0.211		0.347	

[a]The standard errors are reported in parentheses.
** and * mean significance at the 5% and 10% levels, respectively.
Source: Authors calculation.

industrial and consumer goods industry is significantly negative in determining no-arbitrage bands, while the metals and mining industry increases the no-arbitrage threshold by 122.4% points. This is likely due to information asymmetry and risk being popular in the metals and mining industry.

Regarding the A.D.R. features, A.D.R. type, market exchange, and effective date, three kinds of dummy variables are used. In determining no-arbitrage bands, Level 2 or 3 A.D.R.s are significantly negative in explaining thresholds. The market exchange is also important in explaining thresholds – that is, N.Y.S.E. or Nasdaq exchange A.D.R.s show significantly

Table 7. Thresholds and determinants in monthly data.[a]

Firm characteristics	Model (1)		Model (2)		Model (3)		Model (4)	
	Firm characteristics		Firm characteristics + Corporate governance		Dummies variables only		Firm characteristics + Corporate governance + Dummies variables	
	Coeff	S.E.	Coeff	S.E.	Coeff	S.E.	Coeff	S.E.
Size	−0.037**	(0.017)	−0.041**	(0.019)			−0.046**	(0.021)
Growth	−0.031**	(0.015)	−0.039**	(0.016)			−0.057**	(0.023)
Turnover	−0.132**	(0.053)	−0.144**	(0.057)			−0.157**	(0.061)
Size*Growth	−0.041**	(0.021)	−0.047**	(0.023)			−0.052**	(0.025)
Size*Turnover	−0.057**	(0.022)	−0.066**	(0.026)			−0.063**	(0.021)
Growth*Turnover	−0.036**	(0.015)	−0.031**	(0.011)			−0.047**	(0.018)
Size*Growth* Turnover	−0.022*	(0.014)	−0.036*	(0.019)			−0.039*	(0.021)
R.O.E.	−0.088**	(0.041)	−0.094**	(0.044)			−0.087**	(0.040)
Leverage	0.102	(0.074)	0.114	(0.077)			0.117	(0.079)
Corporate governance								
Large shareholders			0.122*	(0.068)			0.127*	(0.071)
Institutional holdings			−0.152**	(0.066)			−0.177**	(0.069)
Earnings management			0.204**	(0.088)			0.215**	(0.085)
Dummies								
Merger dummy					−0.027*	(0.015)	−0.033*	(0.018)
Overseas dummy					−0.084**	(0.036)	−0.095**	(0.039)
Industry dummy-Industrials					−0.061**	(0.029)	−0.072**	(0.031)
Industry dummy-Consumer goods					−0.105**	(0.044)	−0.113**	(0.049)
Industry dummy-Metals and mining					1.224**	(0.121)	1.216**	(0.127)
A.D.R. Features								
A.D.R. type dummy					−0.037*	(0.020)	−0.031*	(0.017)
Market dummy					−0.226**	(0.096)	−0.234**	(0.099)
Year dummy-effective in 1970s					−0.142*	(0.077)	−0.157*	(0.081)
Year dummy-effective in 1990s					0.122	(0.089)	0.134	(0.091)
Control variables								
A.D.R. size	−0.043*	(0.025)	−0.049*	(0.027)	−0.052*	(0.029)	−0.066*	(0.036)
A.D.R. liquidity	−0.137**	(0.050)	−0.144**	(0.052)	−0.147**	(0.053)	−0.152**	(0.057)
Constant	−0.367**	(0.122)	−0.448**	(0.131)	−0.406**	(0.133)	−0.492**	(0.139)
Adj. R^2	0.226		0.277		0.215		0.349	

[a]The standard errors are reported in parentheses.
** and * mean significance at the 5% and 10% levels, respectively.
Source: Authors calculation.

lower thresholds, compared with A.D.R.s in the O.T.C. market. The effective date dummy shows that a long history of A.D.R. listings since the 1970s (i.e., Canon, Honda, and Sony) decrease no-arbitrage bands, while A.D.R. listings since the 1990s do not show any significant relation with thresholds. Closer scrutiny suggests that all of the variables have the same results as in the full model and Model (1). Interestingly, the control variables (A.D.R. size and A.D.R. liquidity) have significant impact on financial integration, implying that A.D.R. features are as critical as firm-specific characteristics in explaining arbitrage opportunity.

6.4. Robustness checks

Weekly data were used to check the extent to which our empirical findings are robust. The results generated from the weekly data are not different from monthly data. Due to space limitations, we do not report the results of robustness checks. Nevertheless, the results for these tests are available from the authors on request.

6.5. Discussion

In sum, we employ the A.R. and T.A.R. models to calculate the convergence speed of a shock to the cross market premium as (inverse) measures of the degree of international financial integration (i.e., half-life) as well as threshold for the non-arbitrage band, signifying the cross-listing premium in A.D.R. can move between the negative and positive thresholds without any arbitrage taking place in the market. Thus, the negative coefficients of the variables represent an increase of the degree of international financial integration in Tables 5 and 6, and the negative coefficients of the variables in regression models represent a decrease of the threshold of no-arbitrage in Table 7. Our threshold, and half-life A.R. and Band-T.A.R. regression results present evidence that the larger the extent of earnings management is, and with more large shareholders, the larger the half-lives and no-arbitrage bands are. Specifically, earnings management and large shareholders increase the boundary of the no-arbitrage band, causing the premium to be, on average, positive. The higher the R.O.E. is and the larger are the size, turnover, and growth of the firms, the lower the deviations from the L.O.O.P. and the smaller the no-arbitrage band will appear to be (integration appears to be stronger). In other words, a worse performance adds to transaction costs and weakens financial integration. Only the leverage ratio of all firm-specific characteristics seems to be insignificant.

Our empirical results significantly support Hypothesis 1 (the degree of financial integration is positively associated with firm size), Hypothesis 2 (the degree of financial integration is positively associated with firm growth), Hypothesis 3 (the degree of financial integration is positively associated with turnover), Hypothesis 4 (the degree of financial integration is positively associated with firm performance), Hypothesis 6 (the degree of financial integration is positively associated with large shareholder), Hypothesis 7 (Higher levels of financial integration are associated with a higher level of institutional shareholder), and Hypothesis 8 (Higher levels of financial integration are associated with a lower level of earnings management), but not Hypothesis 5 (The degree of financial integration is negatively associated with corporate leverage). The results also indicate that the matter for Hypothesis 11 (The degree of financial integration is negatively associated with the specific industries) of the association of financial integration can be demonstrated for specific industries, so do merger activities (Hypothesis 9: The degree of financial integration is positively associated with the presence of merger activity) and overseas subsidiaries (Hypothesis 10: the degree of financial integration is positively associated with overseas subsidiaries). Finally, we find support for the hypotheses that Levels 2 and 3 A.D.R.s (Hypothesis 12: The degree of financial integration is positively associated with Levels 2 or 3 A.D.R.s), N.Y.S.E. and Nasdaq listing A.D.R. (Hypothesis 13: The degree of financial integration is positively associated with N.Y.S.E.- and Nasdaq-listed A.D.R.s compared with those that are O.T.C.-listed), and longer history of A.D.R. (Hypothesis 14: The degree of financial integration is positively

associated with the history of ADR listing) integrate financially well, implying more liquid and longer history firms' A.D.R.s have fewer arbitrage opportunities. Thus, the empirical results are not anomalous.

Our empirical evidence suggests the presence of the specific firm, corporate governance, industry, and A.D.R. impacts on the international financial integration between Japanese A.D.R. and their underlying firms. The findings are consistent for monthly and weekly as well as linear and non-linear empirical results. The evidence presented in this study suggests that Japanese stock-A.D.R. arbitrage can be characterised by the metals and mining industry, the presences of large shareholders and larger earnings management.

7. Summary and conclusion

The purpose of this study is to test for the linkages between financial integration and various firm-specific variables (such as firm characteristics, corporate governance, industry features, and A.D.R. characteristics), using 33 Japanese public firms that have A.D.R.s from October 2001 to September 2010. Our empirical results not only confirm the relationship between financial integration and various firm-specific variables, but also provide important implications for diversification.

First, our firm-level evidence shows that industry effects are important in explaining the variation of firm-level cross-listing premiums. For example, the converge speeds in cross-listing premium and no-arbitrage bands of the metals and mining industry is considerably higher than other industries. The premiums of the metals and mining industry are saliently higher than its A.D.R. prices in our 9-year sample periods, contrary to the premiums of mobile and fixed-line telephone industry stocks. Second, in composing portfolios and selecting individual equities, consideration should be given to the firm-specific characteristics and A.D.R. features, such as their level of global business, proportions of large shareholders, sales growth, turnover, performance, institutional holdings, and A.D.R. listing status. Finally, this study also has strong implications as firms especially seeking to list A.D.R.s to lower cost of capital could adjust their firm features and fuel their financial performance before globalised financial markets. Then, increased international financial integration promotes financial development and enhances economic performance in the countries, while decreasing arbitrage opportunities. Future research exploring factors influencing financial integration of cross-listing will guide the decisions of financial managers, stock exchanges, and investors.

Disclosure statement

No potential conflict of interest was reported by the authors.

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