Analyzing the Spillover Effects from Parental Markets to Cross-listed IPOs on Mean returns and Price Volatility

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Abstract: *The phenomenon of synchronization of financial market dynamics and the transmission of price variability among markets has been analyzed using the mean returns and the volatility spillover between markets. However, an unanswered question is how those market dynamics are transmitted from parental markets to cross-listed IPOs. This paper addresses that question. In this study, we selected 74 cross-listed firms registered on Alternative Investment Markets (AIM). Initially those companies were incorporated on the Australian Stock Exchange, the Toronto Stock Exchange, the Tel Aviv Stock Exchange, the Irish Stock Exchange, and NASDAQ. We used weekly data to analyze the transmission of market dynamics during the period from January 2001 to April, 2018. The findings show that only mean spillover effects from US and Australian markets and volatility spillover effects from US, Canada, Australia and Irish markets transmit to their counterpart cross-listed IPOs on the AIM. In addition, we report that the US market has a strong linkage effect in these markets as well as on their cross-listed firms. These findings suggest that prospective investors can develop and diversify their portfolio in the AIM.*

Keywords: Mean and volatility spillover, AIM, cross-listed firms, markov switching model, GARCH.

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Introduction

It has been shown that integration of capital markets induces synchronization of financial dynamics and transmits price volatility from global markets to regional markets (Y.-H. Lee, 2013). As a result, debate focused on convergence theory-catch up effects have analyzed co-movement of exchanges. See Meric, Kimb, Gong, and Meric (2012); Meric, Prober, Gong, and Meric (2011); Patel (2016) integration of regional market with global market (Chen, Chen, & Lee, 2014; Epaulard & Pommeret, 2016) and cross-over & spillover effects of financial integration (Al-Deehani & Moosa, 2006; Joshi, 2011). This research was not limited to co-movement of exchanges and spillover effects in the domain of stock markets. It also studied the effects of foreign exchanges (Panda & Deo, 2014; Rajhans & Jain, 2015),

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oil prices (Kumar & Maheswaran, 2013) and currency on domestic markets and financial institutions (Elyasiani, Kalotychou, Staikouras, & Zhao, 2015).

The emergence of Alternative Investment Markets (AIMs) allows and encourages cross- or off-shore listing (Sarkissian & Schill, 2016). The AIMs allow domestic firm to list securities for trading around the world with far fewer regulatory inhibitions. The AIM listings make it easier for the firm to attract investors. In addition, the AIM listings make it easier for firms to control operations in their home countries (Alhaj-Yaseen, Lam, & Barkoulas, 2014). Listing on AIMS enables firms across the globe to have the advantages of cross-listing in the international markets. An implication is that if the firm issues an IPO in an alternative market located in another country, the alternative listing can transmit financial synergies and volatility to host market.

Although the existing body of literature is replete with the concept of spillover effects on established stock markets, there remain two fundamental questions; (a) what is the strength of the spillover effects from the parental markets to the AIM? and (b) Does the spillover have a significant effect on the returns and risks of cross-listed IPOs on AIM? This paper addresses the two questions by examining spillover effect(s) of the mean returns and the volatility of returns transmitted from the firms cross-listed on alternative markets using two stage GARCH -in mean (GARCH-M) applied by Bhar and Nikolova (2007); Y. A. Liu and Pan (1997).

Literature Review

In 1960, Clark Kerr presented an idea about the convergence theory. The introduction of this theory opened up various avenues of thought and debate in academia and among practitioners relating to co-movement growth, uniformity and interdependency among nations. The idea behind this theory is based on the proposition that even polar opposite nations in terms of ideology and strategic positioning like US and the Russian federation tend to converge towards homogeneous narrative, that is, self-interest and growth under the umbrella of larger international forum . This idea was thought to be the main spirit and soul of capitalism (Boucekkine & Huang, 2016). It introduced the concept of "catch-up effect" (Kolodko, 2002). In an early phase, industrial and technological countries obtained benefits of convergence which allows them to "catch up" with well-established and technological advanced nations.

The validity of the theory of convergence is based on the assumption that advanced economies will invest in underdeveloped economies. If capital is not invested in these countries, no catch-up can occur (Kolodko, 2002). The less integrated country is then classified to have diverged rather than converged (Lorentzen & Waadeland, 2008). With the evaluation of network economies and technological advancement in 1990, the then developed and technological advanced countries introduced a concept of globalization which is generally based on the (a) integration, (b) convergence and (c) cohesiveness. This provided a strong argument to understand convergence theory. It brought into being various drastic changes and reforms which consist of multi-dimensional outcomes i.e. economic, political, religious, ideological (knowledge economy), environmental and cultural globalization (Steger

& Globlization, 2003). On the other hand, opponents of globalization highlighted disadvantages of financial integration such as higher level of dependency which causes high levels of risk, fewer options for risk diversification (Ahmad, Deisting, Sehgal, et al., 2012), inhibited growth of local exchanges (Natarajan, Singh, & Priya, 2014; Yavas & Rezayat, 2016), high mutual dependency of markets magnifying the likelihood of financial crises (Meric et al., 2011) and domino effects whereby collapses in highly volatile and risky markets may induce concomitant declines in stable and emerging markets (Meric et al., 2012).

This narrative acquired a constituency after the financial crisis in 2007-08. That economic decline shifted market dynamics and refocused the interest of financial analysts towards the regional connectivity, alliance and integration (Y.-H. Lee, 2013). Financial integration of capital markets is conducive to synchronization of price dynamics and transmission of financial instability from global markets to regional markets(Y. H. Lee, 2013) and vis-a-vis. As a result, research on the validity of convergence theory-catch up effects has been focused on co-movement of securities exchanges. See Meric et al. (2011, 2012); Patel (2016), integration of regional market with global market (Chen et al., 2014; Epaulard & Pommeret, 2016) and cross-over & spillover effects of financial integration (Al-Deehani & Moosa, 2006; Joshi, 2011). The research was not only limited to co-movement of exchanges and spillover effects in the domain of stock market. It expanded to include spillover effects of foreign exchange market (Panda & Deo, 2014; Rajhans & Jain, 2015), spillover effects of oil prices on markets (Kumar & Maheswaran, 2013) and currency spillover effects on domestic financial institution and markets (Elyasiani et al., 2015).

Financial globalization generally means integration of stock exchanges, which further fuels synchronization of financial synergies (Kalemli-Ozcan, Papaioannou, & Peydro, 2013), transmission of risk and vulnerabilities (Majumder & Nag, 2018), co-movement of exchanges (Patel, 2016) and mean and volatility spillover (Natarajan et al., 2014) among exchanges across the globe. This paradigm shift creates a high level of mutual dependency among exchanges. That mutual dependency is manifested as unidirectional movement of securities markets and integration of other financial instrument and products with exchanges movements and performance (Chen et al., 2014).

The extensive literature addresses every aspect of exchange integration and movement. This literature survey is divided into three major concerns of financial integration: (a) synchronization of relevant financial synergies, (b) transmission of risks and instability, and (c) dynamics of financial integration before and after financial crisis during 2007-08. To address the synchronization of financial dynamics and transmission of financial instabilities, we consider approaches in the literature ranging from various markets and time periods. Various attempts have been made to identify the interconnection and synchronization of financial corns. Yavas and Rezayat (2016) analyzed the equity exchange traded funds (ETF) returns and mean & volatility spillover from USA, Europe to emerging stock markets during the period of February 3, 2012-February 28, 2014. They applied multi-variate auto-regressive moving-averages (MARMA) to find the transmission of returns from developed markets to emerging markets. They applied generalized auto-regressive conditional heteroscedasticity (GARCH) modeling to test the existence of mean and volatility among sample exchanges. They found the existence of co-movement of returns among all country ETFs. Those co-movements were evidence of synchronization in market returns of highly

volatile domestic markets. They also adduced evidence to suggest that no ETF volatility is transmitted from the emerging markets to the USA markets, South African markets, Brazil markets and Chinese stock markets. Conversely, those markets transmitted volatilities to emerging markets. They found that US market volatility is transferred to markets in India, Russia, Mexico and Turkey. Likewise, European volatility spills over to Mexico and South Korea. These finding are important findings for investors; they imply that whereas financial market synchronization moves in bilateral directions volatility and risks are transmitted only from developed markets to regional markets. Majumder and Nag (2018) investigated shock and volatility transmission in various sectors listed on National Stock Exchange (NSE) of India during the period of 2004 to 2014.They applied the autoregressive asymmetric BEKK-GARCH model. They found bidirectional mean and volatility spills over between Finance and IT and unidirectional from Fast-moving consumer goods (FMCG) to those sectors.

Similarly, Alikhanov (2013) examined the role of mean and volatility spillover effects of U.S, EU stock markets and oil price market on stock markets of eight European countries using GARCH technique. He reported that volatility spillover effects from the US-global, EU-regional and oil market towards the domestic regional exchanges. He also found mean spillover effects attributable only to US-global markets on regional exchanges. Stock prices of these regional exchanges are mostly influenced by mean and volatility spillover effects of US-global and EU-regional markets. Although, EU-regional markets transmit volatility into regional markets, they do not transmit return spillover. This result suggests before dominating effect of the U.S markets to transmit mean and volatility spillover.

Gunasinghe (2005) examined the integration and volatility spillover transmission among exchanges of Pakistan, Indian, and Sri-Lanka. He found that after 1990, emergence of the liberalization of economies enhanced linkage among these regional exchanges for the period 1997-2002 compared to 1992-96. He also rejected the proposition of long-run association of regional exchanges. In addition, he explored the volatility spillover effect of Indian exchanges on capital markets of Sri-lanka and Pakistan,the research of (Gunasinghe, 2005). Taneja examine the short-term and long-term association between major world financial markets and Indian stock exchanges during the period 1999 to 2010. He applied the Granger Causality test and the Co-integration test. He found short-run and long-run relationships between Indian and world exchanges. He also found that Indian stock exchanges display unidirectional Granger causality in the US markets. These findings also suggest the dominance of US markets. The findings also suggest that the price dynamics of Indian markets are converging towards those of US markets.

Y. Liu and Ouyang (2014) added information transfer and coherent movement factors to explain mean and volatility spillover effects between US and Chinese markets under common external circumstances. They reported evidence of mean and volatility spillover effects and dynamic conditional correlation which also confirm that bad and good news in US markets has similar effects on regional markets. Another attempt to measure transmission of financial vulnerabilities and risks by Hwang (2014) has addressed the issue of transmission of financial crisis effects from US markets to the markets in Hong Kong, Korea, Singapore and Taiwan. They inferred no mean spillover effects exist but they found volatility spillover effects between the US markets and the Asian markets identified above.

To provide a more empirically-based theoretical model to this concept of transmission of volatility or risk, (S. J. Lee, 2009) conducted research on volatility transmission between regional market that are Japan, Singapore, Taiwan, India, Hong Kong, and South Korea. The findings of that study are consistent with all previous studies: there are mean and volatility spillover effects from global and more influential market as well as regional exchanges.

Adding to the evidence of the synchronization of mean and volatility among regional exchanges, the research of Taşdemir and Yalama (2014) analyzed the mean and volatility spillover in inter-regional exchanges among the Sao Paulo Stock Exchange and Istanbul Stock Exchange. They found significant and strong evidence of volatility spillover effects among these exchanges which provide strong support to the concept of market integration and co-movement.

Technological innovations in information transmission and globalization of product and service markets provided the foundation for the integration of financial and capital markets. The effect of that integration has been to fuel synchronization of financial markets resulting in transmission of inter-market volatility. This paradigm shift created interest among researchers and academicians to test the concept of co-integration, co-movement and return and volatility spillover effects. In last three decades, various attempts have been made to test the co-movement and mean & volatility spillover effects in different region. The debate covers all aspects of synchronization of financial synergies and transmission of financial risks and price volatility.

Data and Methodology

To measure the mean and volatility spillover effects from parental market to alternative markets and cross-listed firms, we selected all cross-listed firms from various countries of incorporation during the period from 2001 to 2018. That procedure resulted in a sample size of 270 firms. The firms in the sample were segregated into small firms and large-sized firms defined by their market capitalization. We selected only large-sized firms for our analysis. Our sample size reduced to 74 firms from 100 firms. Large-sized exchanges include: (a) Australian Stock Exchange, (b) Toronto Stock Exchange, (c) Tel Aviv Stock Exchange,(d) Irish Stock Exchange, and (e) NASDAQ with market capitalization $1.982 trillion, $2.2841 trillion, $412 billion, EUR150 billion and $10 trillion respectively. The data for both share prices and market index are weekly data from January 2001 to April 2018.

The convergence theory-catch up effect to be tested states that if capital is not invested in undeveloped markets, or does not emerge in these undeveloped countries, no catch-up effect can occur (Kolodko, 2002). These effects can be observed in large-sized firms and forums (Kolodko, 2002). The statistical parameters we employed to measure the market trends and behavior, are the means, the medians and the standard deviations of returns.

The main engine of inference is Markov-switching regression. Markov-switching regression is applied to identify the lowest level and the highest level of market returns which are categorized as Bull and Bear regimes. This Markov-switching technique can be applied

using following equation:

$$r_t = \mu_{St} + \epsilon_t, where \ \epsilon \sim i.i.d/(O, \sigma_{st}^2) \tag{1}$$

In this equation, μ_{st} and σ_{St}^2 represent the regime specific mean and variance respectively. The regime in the sample is binary. We differentiate between a bull regime and a bear regime by assigning a dichotomous value to the symbol s_t:

$$s_t = \begin{pmatrix} 0 \ bear \ regime \\ 1 \ bull \ regime \end{pmatrix}$$

This is the same bifurcated variable applied in the paper by Leon Li*, William Lin, and Hsiu-hua (2005). The returns of market at time t are symbolized by r_t. The transition probability in two-state Markov process can be obtained using following equation and matrix:

$$P(S_t = j \mid S_{t-1} = i) = P_{ij}t \tag{2}$$

Because it is assumed that these probabilities are time-invariant (t) restriction is not needed. The Markov matrix is defined as:

$$P = \begin{pmatrix} p^{00} & p^{01} \\ p^{10} & p^{11} \end{pmatrix} \tag{3}$$

Where,

$$p^{00} = P(S_t = 0 \mid S_{t-1} = 0);$$

$$p^{11} = P(S_t = 1 \mid S_{t-1} = 0);$$

$$p^{01} = 1 - P^{11};$$

$$p^{10} = 1 - P^{00};$$

After the bifurcated sample space for bull and bear are defined, the filtered probabilities for bull and bear are calculated. This matrix displays the probability of bull and bear to transition from one regime to another regime in specific time. The frequency of the temporal dimension may be weekly or monthly: The symbol θ_{jt} is defined as:

$$\theta_{jt} = P(S_t = j \mid \phi_{t-1}), j = (0, 1)$$

Initially, this technique was developed and tested by Hamilton (1989). The issue of nonlinearity arises in this technique because it is based on discrete shifts in the mean, between high-and low-growth states. These discrete shifts can be explained through following equation:

$$r_t - \mu_{st} = \phi_1(r_{t-1} - \mu_{st-1}) + \phi_2(r_{t-2} - \mu_{st-2}) + \phi_3(r_{t-3} - \mu_{st-3}) + \phi_4(r_{t-4} - \mu_{st-4}) + \sigma\epsilon_3 \tag{4}$$

where $\sigma\epsilon \sim N\ (0,1)$

Various techniques have been used to test the mean and volatility spillover effects from market to market such as GARCH and EGARCH model (Ke, Wang, & Murray, 2010; Narula, 2016; Panda & Deo, 2014), VAR-ABEKK and VAR-DCC-AGARCH (Singh & Singh, 2017), GARCH-BEKK Model (Alotaibi & Mishra, 2015; Caporale, Pittis, & Spagnolo, 2006; Joshi, 2011), GARCH (Abou-Zaid, 2011; Dedi & Yavas, 2016; Moon & Yu, 2010), random walk test (Wagner & Szimayer, 2004) and co-integration and granger causality (Patel, 2016; Singh & Singh, 2017).

Two stage GARCH -in mean (GARCH-M) applied by Bhar and Nikolova (2007); Y. A. Liu and Pan (1997) has been used in this study because it provides information on volatility spillover without the need to select any explanatory variable. The measurement of the strengths as well as the direction of the relationship makes the utility of this technique far better as compared with other techniques. In the first step, we calculate the market return as well as share return through following formula:

$$r_t = log\left(\frac{P_1}{P_0}\right) \tag{5}$$

This technique is based on two steps to test the mean and volatility spillover effects. In the first step, we auto-regress the relevant parental market index returns series through an ARMA (1, 1)-GARCH (1, 1)-M method as shown below:

$$r_{p,t} = \delta_o + \delta_1 r_{p,t-1} + \delta_2 V_{p,t} + \delta_3 \mu_{p,t-1} + \mu_{p,t}, \mu_{p.t} - N(O, V_{p,t}) \tag{6}$$

$$V_{p,t} = \tau_o + \tau_1 V_{p,t-1} + \tau_2 \mu_{p,t-1}^2 \tag{7}$$

$r_{p,t}$= Weekly returns of Index 'p' signifies parental market index at time t

$\mu_{p,t}$= Residual/error term (unexpected return). It is assumed to be normally distributed with mean zero and with time conditional volatility (variance i.e.$V_{p,t}$). ARMA or MA is included in the model to adjust possible series correlation.

In the second step, the mean and volatility spillover effects across the cross-listed firms are calculated by obtaining the standardized residual (standardized error term) and by taking its square in the first step i.e. equation/process of parental market and including these values/calculation in the second step process i.e. mean and volatility equation of cross-listed firms as shown below:

$$r_{c,t} = \delta_o + \delta_1 r_{c,t-1} + \delta_2 V_{c,t} + \delta_3 \mu_{c,t-1} + \eta_c \mu_{c,t} + \mu_{c,t}, \mu_{c.t} - N(O, V_{c,t}) \tag{8}$$

$$V_{c,t} = \tau_o + \tau_1 V_{c,t-1} + \tau_2 \mu_{c,t-1}^2 + \sigma_c t_{p,t}^2 \tag{9}$$

where, $l_{p,t} = =$ Standardized residual series for parental market index and is capturing mean spillover effects from parental markets.

To examine the volatility spillover, the exogenous variable $l_{c,t}^2$ - square of standardized residual series is included in the conditional variance i.e. volatility equation and this volatility is calculated as:

$$l_{p,t} = \frac{\mu_{p,t}}{\sqrt{V_{p,t}}}$$

Findings and Discussion

Dynamics of Market Transitions

The descriptive statistics displayed on Table 1 indicate that Canadian average market return is 0.9% as shown in table 1. It is higher than all other parental and alternative markets. On average, alternative markets yield the lowest mean market return, which is 0.003%. The findings of market stability and persistency conditioned on bull and bear regimes shows that all of the sample market are very mature market and persistent. This phenomenon indicates the maturity, persistency and perfection of these markets.

Table 1
Descriptive Statistics

	US	Israel	Ireland	Canada	Australia	AIM
Mean	0.001	0.001	0.000	0.000	0.000	0.000
Median	0.003	0.002	0.000	0.003	0.002	0.002
Maximum	0.103	0.113	0.044	0.128	0.091	0.060
Minimum	-0.175	-0.126	-0.105	-0.170	-0.175	-0.145
Std. Dev.	0.028	0.024	0.010	0.022	0.020	0.019
Skewness	-0.730	-0.381	-1.641	-1.085	-0.985	-1.536
Kurtosis	7.003	6.234	17.551	12.287	9.449	9.311
Jarque-Bera	671.87	408.60	8233.49	3366.09	1682.90	1823.35
Bull (return)	0.001	0.001	0.000	0.000	0.000	0.000
Bear (return)	0.001	0.001	0.000	0.000	0.000	-0.001
Probability						
Bull	0.548	0.534	0.492	0.533	0.534	0.575
Bear	0.504	0.504	0.490	0.504	0.504	0.475
Duration						
B Bull	2.213	2.146	1.970	2.144	2.146	2.354
Bear	2.016	2.016	1.960	2.016	2.016	1.904

Data used in this analysis is weekly stock index returns during the period of January 2001 to May 2018. Probability indicate the probability of sustainability (p^{00} or p^{01}) of specific market condition and duration exhibits the duration of that specific market condition.

Table 2 presents switching coefficient in all markets with regards to alternative market. However, only the Australian market (coefficient = 0.491 at p < 0.01) is penetrating positively in alternative market to sustain in bull market conditions. The US markets have a positive role in the sustainability of bull market condition (coefficient = 0.120, 0.667, and 2.311 at p < 0.001) in Australian, Canadian, and Israeli market respectively except negative role in Irish market (coefficient = -0.472 at p < 0.001). Likewise, US markets play a positive role in bear market condition (coefficient = 0.198, 0.346, and 0.106 at p < 0.001) in Australian, Canadian, and Israeli markets respectively except Irish market (coefficient

= 0.00 at p > 0.001).This finding implies that the US markets attain a prominent position over all other exchanges.

Similarly, the Australian market has a significant role in defining bull and bear market conditions of the AIM, the Canadian markets and the Irish market. These findings support the convergence theory that small and full-fledged local exchanges are converging and are influenced by global markets (Wang & Shih, 2013). Different studies have documented evidence in the support of our findings that the statistical characteristics of local markets are converging toward those of global markets. The convergence can be observed in the parameters of the mean and volatility spillover effects between Chinese markets and US markets (Moon & Yu, 2010), trickle down effects of financial crisis on regional exchanges (Rajhans & Jain, 2015), co-movement between regional market as well as global market (Singh & Singh, 2017).

Table 2
Markov-switching coefficient

		AIM	Australian	Canada	Israel	Ireland	U.S
State1	Australian	0.491		0.785	-0.087	-2.126	0.089
		(3.380)**		(7.770)**	-0.240	(5.210)**	-1.420
	Canadian	-0.015	0.612		-1.205	1.383	1.034
		-0.120	(13.37)**		(1.970)*	(7.100)**	(13.63)**
	Israeli	-0.219	0.240	-0.433		0.692	0.126
		-1.810	(6.190)**	(5.120)**		(5.120)**	(3.040)**
	Irish	0.264	0.034	0.026	2.475		-0.096
		-1.610	-0.510	-0.260	(8.030)**		-1.220
	American	-0.125	0.120	0.667	2.311	-0.472	
		-1.560	(2.990)**	(6.720)**	(8.840)**	(2.590)**	
	_cons	-0.043	-0.001	-0.004	0.013	-0.036	0.000
		(14.99)**	-1.430	-1.460	-1.520	(9.340)**	-0.020
State2	Australian	0.018		0.321	0.313	0.006	0.528
		-0.460		(10.390)**	(6.760)**	-0.290	(3.780)**
	Canadian	0.007	0.111		0.087	-0.014	0.171
		-0.160	-1.310		-1.740	-0.590	-1.410
	Israeli	0.010	-0.017	0.058		-0.009	0.148
		-0.300	-0.390	(2.580)**		-0.600	-1.730
	Irish	0.008	-0.125	0.023	-0.130		0.143
		-0.140	-1.390	-0.520	(2.080)*		-0.870
	American	-0.014	0.198	0.346	0.106	0.000	
		-0.44	(3.250)**	(16.90)**	(2.980)**	-0.020	
	_cons	0.003	0.002	0.000	0.001	0.001	0.002
		(5.900)**	(2.020)*	-0.900	-1.710	(2.640)**	-1.420
Lnsigma	_cons	-4.230	-4.375	-4.449	-3.962	-4.680	-4.090
		(154.65)**	(153.16)**	(174.76)**	(158.56)**	(183.91)**	(152.29)**
p11	_cons	-0.414	-1.158	-0.479	1.712	0.836	-1.931
		-1.390	(2.830)**	-1.020	-1.450	-1.140	(4.020)**
State1	Aim		0.051	0.752	-1.693	0.418	0.078
			-1.300	(4.090)**	(3.810)**	(2.740)**	-1.630
State1	Aim		-0.054	-0.040	0.007	-0.018	-0.240
			-0.720	-1.780	-0.220	-1.050	(2.610)**
p21	_cons	3.344	0.468	3.733	3.730	4.573	0.894
		(14.23)**	-0.840	(7.010)**	(9.880)**	(9.650)**	-1.560

Data used in this analysis is weekly stock index returns during the period of January 2001 to May 2018. State 1 if it is greater than state 2 then it is categorized as bull or otherwise for respective exchange and state 2 if it is lesser than 1 then it is categorized as bear or otherwise for respective exchange. Similarly, P^{11} and P^{21} indicates probability to sustain in bull and bear respectively. Whereas *, ** indicates p<0.05; p<0.01 respectively.

Figure 1
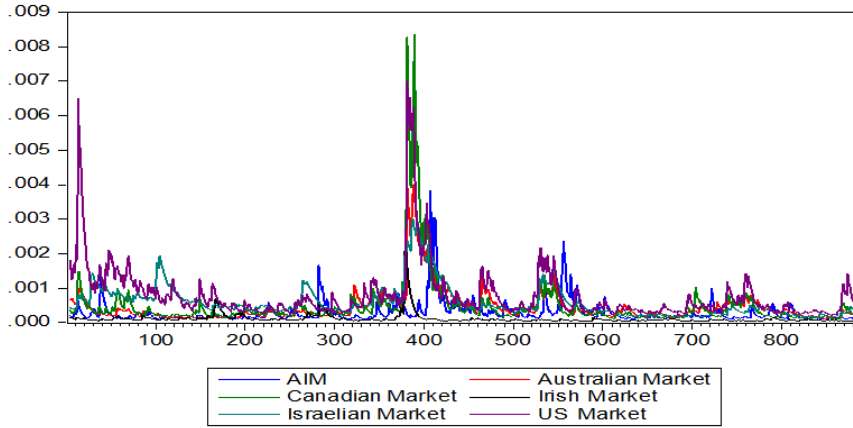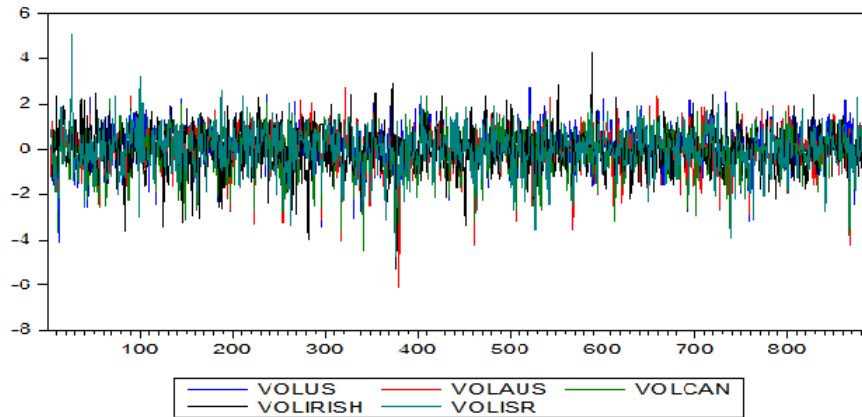Position of stock market returns during 2001 to 2018.

Figure 2
Volatility of sample exchanges during 2001 to 2018.

## Mean and Volatility Spillover between Parental and Alterative Markets

To test the mean and volatility spillover, we used the GARCH (1,1) variance equation. The result of GARCH τ_1 in table 3 for US, alternative market, Australian, Canadian, Israeli and Irish markets($\tau_1 = 0.796$, 0.680, 0.871, 0.795, 0.917 and 0.787 at $p < 0.05$) respectively indicates that all markets are volatile and the values of GARCH in almost all market which are near to 0.90 which shows the persistency of market conditions.

Figure 3

Mean of sample exchanges during 2001 to 2018.
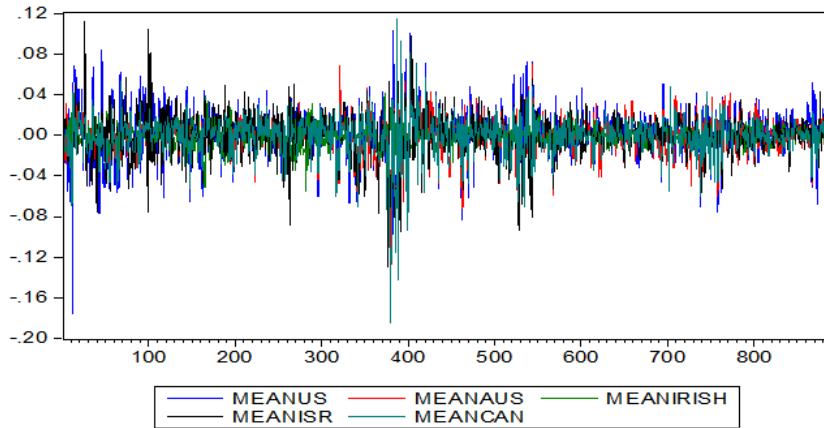
Alternatively, value of η (mean spillover) for US, Australian, Canadian, Israeli and Irish markets (η = -0.013, -0.007, 0.004, -0.0004 and 0.064 at p > 0.05 respectively) indicates there is no mean spillover effects from all parental to alterative markets. This result is consistent with previous studies (Bouri & Azzi, 2014; Hwang, 2014; Natarajan et al., 2014). In the most of the studies mean spillover effects were not found between international markets and regional and local markets. On other hand, value of σ from US, Australian and Irish markets (σ = -0.0002, 0.0006 and 0.0001 at p < 0.01 respectively) indicates volatility spillover effects from US, Australian and Irish market to AIM. US market volatility is penetrating negatively. Likewise, there is no volatility spillover effects (σ = -0.0002 and 0.0001 at p > 0.05) from Canadian and Israeli markets. This result is consistent with other studies (Baele, 2005; Hashmi & Tay, 2012; Y. Liu & Ouyang, 2014) where US market has prominent position and influence on other world markets. In general, other markets have a positive effect on the AIM.

Mean and Volatility Spillover between Parental Markets and Cross-listed IPOs

The result of mean and volatility spillover between parental markets and their respective cross-listed IPOs in table 4 shows that value of (η) in US and Australian market ((η) = 4.656 and 0.483at p < 0.001) respectively indicate mean spillover effects from US and Australian market to their respective cross-listed IPOs on AIM. This indicates that return of cross-listed IPOs are influenced by the AIM as well as their respective parental market (Alikhanov, 2013) in US and Australian IPOs.

On the other hand, mean spillover effects from Canadian, Irish and Israel's market (η = 0.411, 0.145 and 0.004 at p > 0.05 respectively) have not been observed in their respective cross-listed IPOs on alternative markets. This result supports the catch-up effects of convergence theory indicating that highly technological integrated and sound in

Table 3
Mean and Volatility Spillover between Primary Exchanges and AIM

	US Vs. AIM		Australian Vs. AIM		Canadian Vs AIM		Israel's market Vs AIM		Irish Vs AIM	
	NASDAQ	AIM	S&P/ASX 200	AIM	S&P/TSX	AIM	TA-125	AIM	ISEQ 20	AIM
$\delta_0(c)$	0.002	0.0007	0.001	0.0007	0.0005	0.0007	0.003	0.0007	0.0008	0.0007
	-0.003	-0.0008	-0.002	-0.0008	-0.001	-0.0008	-0.001	-0.0008	-0.0006	-0.0008
$\delta_1(r\text{-}1)$	0.729	0.528	-0.454	0.528	0.585	0.528	-4.639	0.528	-0.557	0.528
	(1.240_	-0.073	-2.301	-0.073	-1.195	-0.073	-1.932	-0.073	-0.578	-0.073
$\delta_2(G)$	1.493	0.682	1.585	0.682	0.662	0.682	14.026	0.682	1.260	0.682
	-2.101	-3.266	-4.112	-3.266	-3.751	-3.266	-5.540	-3.266	-5.518	-3.266
$\delta_3(ut\text{-}1)$	-0.758	-0.025	0.439	-0.025	-0.614	-0.025	4.630	-0.025	0.622	-0.025
	-1.247	-0.079	-2.309	-0.079	-1.200	-0.079	-1.936	-0.079	-0.579	-0.079
η	-0.013		-0.007		0.004			-0.0004		0.064
	-0.027		-0.019		-0.019			-0.018		-0.052
$\tau_0(c)$	0.003	0.0002	0.0009	0.0002	0.001	0.0002	0.0005	0.0002	0.0007	0.0002
	-0.001	-0.0005	-0.0003	-0.0005	-0.004	-0.0005	-0.0002	-0.0005	-0.0001	-0.0005
$\tau_1(G\text{-}1)$	0.796**	0.680**	0.871**	0.680**	0.795**	0.680**	0.917**	0.680**	0.787**	0.680**
	-0.036	-0.042	-0.020	-0.042	-0.027	-0.042	-0.013	-0.042	-0.038	-0.042
$\tau_2(Res)$	0.156**	0.219**	0.109**	0.219**	0.161**	0.219**	0.073**	0.219**	0.142**	0.219**
	-0.026	-0.033	-0.017	-0.033	-0.023	-0.033	-0.012	-0.033	-0.025	-0.033
σ_c	-0.0002**		-0.0006**			-0.0002		0.0001		0.0001**
	-0.0006		-0.0001			-0.0002		-0.0002		0.0004
Residual Diagnostics										
Q(24)	0.231	0.260	0.234	0.284	0.251	0.278	0.265	0.284	0.278	0.258
Q(24) Sq	0.816	0.781	0.891	0.846	0.913	0.931	0.781	0.936	0.871	0.849

Data used in this analysis is weekly stock index returns during the period of January 2001 to May 2018. The figures/numeric in parentheses under the actual estimates is standard errors. The value of Q (24) statistic indicates the Portmanteau statistic with the assumption of no residual serial correlations measured at 24 lag. Similarly, the value of Q(24) Sq exhibits the square of same test. Whereas *, ** indicates p<0.05; p<0.01 respectively.

Table 4
Mean and Volatility Spillover between parental market and Cross-listed IPOs

	US Market to Cross-listed IPOs		Canadian Market to Cross-listed IPOs		Australian Market to Cross-listed IPOs		Irish Market to Cross-listed IPOs		Israelian Market to Cross-listed firm	
	US	US-Firms	Canadian	Canadian IPOs	Australian	Australian IPOs	Irish	Irish IPOs	Israelian	Israelian IPOs
$\delta_0(c)$	0.0005	3.265	-0.023	0.241	-0.005	-0.003	-0.001	0.004	0.366	-0.0003
	-0.003	-1.745	-0.004	-0.313	-0.046	-0.016	-0.0003	-0.008	-0.0001	-0.002
$\delta_1(r\text{-}1)$	1.38	-4.796	-0.336	0.0219	-0.075	-0.698	0.215	-3.656	49.473	0.112
	-1.457	-48.874	-0.111	-1.110	-1.050	-0.474	-0.128	-1.814	-1.306	-1.824
$\delta_2(G)$	-0.081	-0.473	-0.002	0.059	0.127	-0.0001	19.929	-0.034	0.053	-0.0001
	-1.12	-0.221	-0.0005	-0.104	-1.394	-0.003	-3.654	-0.068	-0.0001	-0.003
$\delta_3(ut\text{-}1)$	-1.369	5.474	0.546	-0.056	0.061	0.708	-0.094	3.666	-49.729	-0.0481
	-1.457	-48.311	-0.099	-1.124	-1.052	-0.475	-0.132	-1.815	-1.310	-1.817
η		4.656**	0.411			0.483**		0.145	-0.004	
		-1.853	-1.033			-0.101		-0.321	-0.126	
$\tau_0(c)$	0.001	-2.869	0.0001	0.017	0.0002	0.002	0.0001	0.008	0.001	0.0003
	-0.001	-8.721	-0.0001	-0.007	-0.0001	-0.0001	-0.0003	-0.001	-0.0001	-0.0001
$\tau_1(G\text{-}1)$	0.597*	0.902**	0.212**	0.150	0.786**	0.480**	0.794	0.560**	0.163**	0.685**
	-0.339	-0.021	-0.024	-0.111	-0.171	-0.010	-0.008	-0.083	-0.007	-0.006
$\tau_2(Res)$	-0.002	0.784	1.517	0.600	-0.003**	0.224**	0.187	-0.002**	0.163	0.145
	-0.0003	-0.566	-0.118	-0.162	-0.0001	-0.010	-0.010	-0.0007	-0.003	-0.009
σ_c		-0.528**		0.0001**		0.003**		-0.0004**		0.0029
		-0.066		0.0006		-0.0001		-0.0001		-0.0001
Residual Diagnostics										
Q(24)	0.268	0.271	0.212	0.599	0.289	0.570	0.281	0.251	0.312	0.267
Q(24) Sq	0.998	0.671	0.954	1.000	0.891	0.672	0.761	0.791	0.991	0.671

Data used in this analysis is weekly stock index returns and stock return during the period of January 2001 to May 2018. The figures/numeric in parentheses under the actual estimates is standard errors. The value of Q (24) statistic indicates the Portmanteau statistic with the assumption of no residual serial correlations measured at 24 lag. Similarly, the value of Q(24) Sq exhibits the square of same test. Whereas *, ** indicates $p<0.05$; $p<0.01$ respectively.

term of market capitalization markets and firm synchronizes their synergies among their relative markets and firms (Kolodko, 2002).

Volatility spillover effects from US, Canada, Australia and Irish (σ= -0.528, 0.0001, 0.003 and -0.0004 at p<0.05 respectively) indicates the strong penetration of volatility of these market on the risk of their respective cross-listed IPOs except Israel's market (σ= 0.0029 at p>0.05). The volatility spillover effects of US and Irish markets is negative, which indicates any substantial changes in these markets have strong negative effects on their respective IPOs in AIM. This result supports the catch-up effects of convergence theory. These findings imply that mean and volatility of parental markets can be considered as a major determinant of risk and return measurement and movement of cross-listed firm on alternative markets.

Conclusion

The primary objective of this study is to determine the mean return and return volatility spillovers, if any, from parental markets to alternative markets and cross-listed firms. This study applied two stage GARCH -in mean (GARCH-M). We selected 74 cross-listed firms listed on these markets include incorporated in Australian Stock exchange, Toronto Stock Exchange, Tel Aviv Stock Exchange, Irish Stock Exchange, and NASDAQ.

We found that mean spillover effects from US and Australian markets affect their cross-listed firms. In addition, we analyzed volatility spillover effects from US, Canada, Australia and Irish markets to their respective cross-listed IPOs on alternative markets. It is important to consider that the US markets have a strong influence on these markets and cross-listed firms. The importance of US markets towards other markets supports the theory of catch-up effects of convergence theory.

Our results enhance the understanding of the dynamic interaction between parental and alternative markets on the returns of, cross-listed firms. This suggests that investors in an alternative market utilize the information of cross-listed firm's parental market dynamics and US market as well. To the extent that this is true, investors will have improved their ability to predict the expected risk and returns in parental market as well as an alternative market. That improvement will then improve their ability to make informed investment decisions. This study will also benefit the cross-listed firms contemplating issuance of their shares in an alternative market.

The findings of our research can be used to help policy makers as show how trickledown effects of cross-listing may be mitigated through diversification of markets related risk and returns. This might also help to formulate policy guidelines for the emerging markets that are contemplating the establishment of alternative markets and investment fora.

Potential and prospective investors will also get benefit in terms of firm's size, market returns and liquidity. If they invest in cross-listed firms which have been incorporated into large- and small-sized markets, it may be possible for investors to earn abnormal excess returns while trading on those markets.

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