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Taxation, growth and the stock traded nexus in emerging Asian countries: heterogeneous and semi-parametric panel estimates

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ABSTRACT

This study attempts to investigate the impact of economic growth and stock traded on taxation for emerging Asian countries, namely China, India, Indonesia, Republic of Korea, Malaysia and Thailand. To examine the plausible links between these indicators, we used semi-parametric, heterogeneous and panel causality analysis by employing data covering the period 1990–2014. The semi-parametric estimates indicate a *U*-shape effect between growth and taxation, along with elastic opposite direction effects of stock traded on taxation. This suggests that higher growth will have a positive influence on taxation in emerging Asian countries. The findings of the Dumitrescu and Hurlin (DH) heterogeneous Granger causality test revealed that there is a bi-directional causality running between growth and taxation, and a uni-directional causality running from stock traded to taxation,and from growth to stock traded.This confirms the presence of a growth-led taxation nexus in emerging Asian countries.

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1. Introduction

Over the past three decades, several countries in the Asian region witnessed economic turmoil resulting from major economic recessions such as the Asian Financial Crisis (AFC) in 1997 and the Global Financial Crisis in 2008.These events impacted most of the emerging Asian countries through two main avenues, namely, financial and economic stability. In addition, the instability of global energy prices affected both commodity exporters and importers in the region in different ways (United Nations Development Programme, 2011). Furthermore, the threatening risk of climate change and the recent experience of natural disasters also impacted the stability of the Asian economy. A significant lesson from the crisis was that the governments of emerging Asian countries had to be prepared to overcome any

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unanticipated event. Specifically, the financial sectors of the Asian economies urgently need to build up a precise set of institutional incentives and tools to manage risks and operate effectively in a global market economy (Moreno, Pasadilla, & Remolona, 1998). According to Brookfield and Azizan (2006), there is evidence that the financial crisis is related to the role played by market immaturity. Although the economy has begun to pull out from recession and Asian countries have gradually emerged from the downturn, governments cannot remain passive and comfortable with the present achievement. Surprisingly, most of the emerging Asian countries robustly recovered from the global crisis, which is an outstanding achievement. In a recent exercise, the Asian Development Bank (2011) emphasised that policymakers must turn their focus to ensuring strong medium- and long-term growth. Thus, there is a need for policies that develop the region's productive capacity through both accumulation and productivity factors for the sustainability of growth.

The subjects of stock traded, economic growth and tax revenue were first identified in pioneering works by Marty (1973) and Koester and Kormendi (1989). Previous studies focused on the economic policies that improve the growth performance of a country using fundamental growth theories. Based on the neo-classical growth model, savings and population growth rates were highlighted as important determinants of the person's income sustainability and this has been clearly pointed out by Handa (2009), who neglected the role of taxation. In addition, the classical model also assumed deteriorating returns to the capital, where there is a boundary in how capital accumulation can add to the output per capita of a nation (Baier, Dwyer, & Tamura, 2007). It seems that the only way to sustain productivity growth is by increasing the output per worker in the long-run (Edge, Laubach, & Williams, 2007). We also detected diverse theoretical and empirical literature that investigated the important role of the financial system on economic growth, such as Naceur, Ghazouani, and Omran (2007) and Akimov, Wijeweera, and Dollery (2009). These studies support the idea that the development of a strong financial system is crucial for the short- and long-term economic growth rate.

The nexus between taxes and the financial market is widely discussed in theory, but not much study has been devoted to empirically examine such a relationship. Concentrating on investment as the financial variable, Romero-Ávila and Strauch (2008) and Soli, Harvey, and Hagan (2008) empirically examined and proved the existence of this relationship. For example, Romero-Ávila and Strauch (2008) pointed out the existence of a significant impact from aggregate government expenditure and its main sub-category of economic growth, where the size of the public sector and government consumption are negatively affected in long-run economic growth. Chatziantoniou, Duffy, and Filis (2013) supported this argument, revealing that fiscal policy is able to influence stock market sustainability through direct and indirect channels. It is clear that fiscal policy through taxation is an important determinant of the economic growth rate, which is consistent with Levine's (1999) view from earlier studies. Likewise, economic growth is also an important determinant in influencing tax revenue collection. However, the impact might be different depending on the type of fiscal policy and financial market utilised in the analysis.

In the light of the ongoing debate, we found that the fiscal policy formulation is also a fundamental element of the growth process (Barro & Sala-I-Martin, 1992; Lee & Gordon, 2005). Although taxation can accelerate economic growth through the distribution of income for development purposes, it may also obstruct the growth process through the distortion of investment activities (Kesner-Škreb, 2000). Previous studies by Rovčanin and

Grzinić (2008) and Park (2009) revealed that a feasible exogenous fiscal policy is able to lead to positive short- and long-run economic growth in the unique state of competitive equilibrium. Using data from 28 OECD countries over the period 1960–2005, Hossain and Tsigaris (2010) provided evidence of the one-to-one relationship between economic growth and tax revenue, with the exception of a few countries. Those nations with high spending through borrowing will have limited opportunity to raise revenue in the long-run. These regional differences may independently influence growth patterns in individual countries within the framework of an endogenous growth model (Poulson & Kaplan, 2008). In the early stages, Levine (1991) employed the stock markets' accelerated growth model by facilitating the ability to trade ownership of firms without disrupting the production processes occurring within the firm, and allowing investors to hold diversified portfolios. In that particular situation, tax policy reacts as an added indicator which influences growth directly by altering investment incentives, and indirectly by affecting the functioning of financial markets in ways that alter investment incentives.

Afonso and Furceri (2010) explored whether the size and volatility effects of government revenue and spending promote economic growth for OECD and EU countries. The results suggest that both tax revenue and spending are detrimental to economic growth, where indirect taxes, government investment and consumption have a sizeable, negative and statistically significant effect on economic growth. Meanwhile, Wu and Li (2011) examined three competing explanations, past performance, value-growth characteristics and tax-motivated incentives for long-term return reversals in the UK stock markets. The results support the idea that capital gain taxes have a major influence on stock market performance, and hence affect economic growth. In the case of Indonesia, Tobing (2011) investigated the tax effects of a tax reform and investment in public education and long-run economic growth using an annual series of data from 1970 to 1996. The empirical findings show that Indonesian public policies aimed at enhancing physical investment are less conducive to economic growth performance. Additionally, Blackburn, Bose, and Capasso (2012) proposed a model of tax evasion and bank intermediation to study the relationship between the underground economy and financial development. In accordance with empirical observation, the results suggest that the booming development of the country leads to a smaller chance of tax evasion by the taxpayer and helps to reduce the size of the underground economy. Using the Arellano-Bond approach, Hossain (2012) tackled the short-run panel bias and endogeneity problems in Bangladesh. The findings suggest that tax policy reforms may not generate adequate competition and efficiency in the financial sector. Thus, the implication is that tax is not the major determinant of the financial system's performance.

While the preceding discussion makes clear the relationship between growth and taxation, Marques, Fuinhas, and Marques (2013) tried to capture the relationship between the stock market, bank financing and economic growth in Portugal using an annual time series of data covering the entire period from 1993 to 2011. The results suggest the existence of a bi-directional causal relationship between stock markets and economic growth. However, when analysing a similar relationship for Australia, Tang (2013) suggested that there is only a uni-directional causality running from stock prices to economic growth. In the meantime, Hagen and Zhang (2014) developed a tractable two-country overlapping generations model that shows that cross-country differences in financial development can explain three recent empirical patterns of international capital flow. The results show that a country should promote its level of financial development to increase the investment in

the country. Agbloyor, Abor, Adjasi, and Yawson (2014) and Ngare, Nyamongo, and Misati (2014) applied panel estimates and suggested that financial stability plays a pivotal role in determining future growth. Looking at the relationship between taxation and economic growth, Adkisson and Mohammed (2014) suggested that countries should not rush into adjusting the tax structure if the main goal is to enhance the economic growth during economic downturns. This is due to the fact that an economy can recover in a short-term period without any adjustment on fiscal policy. However, this situation depends on the size of the economy. Bauducco and Caprioli (2014) claimed that countries with a small open emerging economy have less opportunity to share risks with their foreign lenders due to limited commitment, which hinders investment opportunity. Looking at the effect of fiscal policy, tax revenue over GDP is less volatile compared to within a developed economy.

The remainder of this article is organised as follows: Section 2 briefly looks at the theoretical development and existing empirical work on the relationship between taxation, financial systems and economic growth. This is followed by a discussion of the results in Section 3. Finally, Section 4 concludes the article.

2. Data description and model specifications

This study investigated six emerging Asian countries over the period 1990–2014 with a balanced panel of series (24 observations for each country). The six emerging Asian countries covered in the study were China, India, Indonesia, Republic of Korea, Malaysia and Thailand. These emerging countries were identified through the Morgan Stanley Capital International (MSCI) emerging market index website. All of the time series data were collected and retrieved from the World Development Indicators database published by the World Bank (2015) and all series were annual data. The basic function of the variables used in this study can be written as follows:

$$Tax_{it} = A\ Stock_{it}^{\varphi}\ Growth_{it}^{\gamma}\ Growth_{it}^{2^{\delta}} \tag{1}$$

where A is the constant value, Tax is the natural log of tax revenue (percentage of GDP); Stock is the natural log of total volume of stock traded (percentage of GDP), Growth and Growth squared is the natural log of per capita income converted from the domestic currencies using the current currency exchange rates in the international currency market. While, φ, γnd δ represent the coefficients for stock traded, growth and growth squared. When dealing with time series panel estimates, we must be aware of robustness and white-noise. To avoid this problem, we need to transform all variables into logarithm formations and the basic function specification of our model can be written as:

$$Tax_{it} = f\begin{pmatrix} - & + & + \\ Stock_{it} & Growth_{it} & Growth_{it}^{2} \end{pmatrix} \tag{2}$$

In this study, we followed the studies of Soli et al. (2008), Romero-Avila and Strauch (2008) and Taha et al. (2013), which previously examined the relationship between tax revenue, economic growth and stock traded using the fundamental growth theory. First, we determined the parametric-based fixed effects estimates and semi-parametric analysis. Secondly, we identified the order of integration. Thirdly, we determined the long-run cointegration

relationship between tax revenue, economic growth and the stock traded. Before we proceeded with the cointegration test, the time series properties of the panel data needed to be examined using the panel unit root tests. Each of the panel unit root tests has its own strength and is becoming popular because of its ability to capture the country-specific effects, and at the same time allow for heterogeneity on the direction as well as the magnitude of the parameters.

As mentioned by Zhu, You, and Zeng (2012) and Yatchew (1998), most of the economic theories have not been able to capture the specific form of relationship between the dependent and independent variables, especially when we are dealing with time series estimation. According to Baltagi and Li (2002), the semi-parametric panel estimation is a suitable and flexible model which is able to avoid misspecification in estimation and is more accurate for panel data usage. The semi-parametric model was established based on equation (1), and we eliminated the unobserved heterogeneity effects of β_i by introducing a first difference of the variables as proposed by Desbordes and Verardi (2012):

$$p^d\left(Growth_{it}\right),\ \left(Growth_{it-1}\right) = \left[p^d\left(Growth_{it}\right) - p^d\left(Growth_{it-1}\right)\right] \tag{3}$$

where, p^d represents the sequence function of the panel series of equation (4) and to illustrate the sequence using graphs, we used the B-spline regression model with $d = 2$. Once the semi-parametric relationship was obtained, the next useful step was illustrated by the fitted partial semi-parametric curve. Desbordes and Verardi (2012) and Zhu et al. (2012) suggest that the partial fitted semi-parametric curve is based on the following equation:

$$\varepsilon_{it} = \hat{\beta}_i - \hat{\beta}_1 Stock_{it}$$

where, ε_{it} is defined as,

$$\varepsilon_{it} = f\left(Growth_{it}\right) + \mu_{it} \tag{4}$$

The next step was determining the long-run cointegration between taxation and control variables. Basically, the Pedroni (1999) cointegration has seven different statistics, such as the panel Augmented Dickey-Fuller (ADF)-statistic, panel Phillips-Perron (PP)-statistic, panel ρ-statistic, panel v-statistic, group ADF statistic, group PP-statistic and group ρ-statistic. The first four statistics are panel statistics and based on the 'within dimensions' approach, while the last three statistics are group panel cointegration statistics and are based on the 'between dimensions' approach. In order to obtain stable cointegration estimation results, we also employed Kao's (1999) cointegration test which used the Engle-Granger two-step procedure. In the meantime, we also adopted the Dynamic Ordinary Least Square (DOLS), proposed by Kao and Chiang (2000) to identify the long-run cointegration relationship. The following equation (5) indicates the DOLS estimates:

$$\beta'_{DOLS} = \sum_{i=1}^{N}\left(\sum_{i-1}^{T} Tax_{it}\ln Tax'_{it}\right)^{-1}\left(\sum_{i-1}^{T} Tax_{it}Stock'_{it}\right)\left(\sum_{i-1}^{T} Tax_{it}Growth'_{it}\right) \tag{5}$$

Next, we used the heterogeneous panel cointegration test based on Westerlund (2007). This test is more accurate with capturing the error correction term by inferring the null

hypothesis of no cointegration with four types of different test statistics. These four different statistical values can be divided into two major groups, which are the panel statistics, represented by P_τ and $P_\alpha$and the mean for group statistics represented by G_τ and G_α

Next, we continued with the Pooled Mean Group (PMG) estimates proposed by Pesaran, Shin, and Smith (1999). As usual, the sign of the lagged error correction term should be negative and significant, implying that the variables return to long-run equilibrium stage from the short-term unstable condition. From equation (6), ect_{t-1} represents the error correction term, while γ_i is the coefficient measuring the speed of adjustment.

$$Tax_{it} = \alpha_1 + \sum_{k=1}^{m-1} \beta_{ik} \Delta Tax_{i,t-k} + \sum_{k=0}^{n-1} \varphi_{ik} \Delta Stock_{i,t-k} + \sum_{k=0}^{p-1} \gamma_{ik} \Delta Growth_{i,t-k} + \sum_{k=0}^{q-1} \sigma_{ik} \Delta_{ik} Growth_{i,t-k} + \mu_i + \varepsilon_{it} \tag{6}$$

As a final step of the analysis, we employed the Dumitrescu and Hurlin (2012) heterogeneous panel Granger causality test to identify the causal relationship between the variables. This approach is more accurate compared to the traditional panel Granger causality test, where the DH causality test is specially designed for mixed $I(0)$ and $I(1)$ variables with nonlinear estimates. In this study, we used balanced heterogeneous panel estimates and this DH model is flexible for asymptotic (T>N) or semi-asymptotic (N>T) distributions as well as in emphasising the simulated critical values from thousands of replications (Akbas, Senturk, & Sancar, 2013). The DH statistic, which has the asymptotic and semi-asymptotic distributions can be written as follows:

$$W_{it}^{DH} = (T - 2K - 1)\left(\frac{\tilde{\delta}_{it}\gamma_{it}\tilde{\varepsilon}_{it}}{\tilde{\delta}_{it}Y_{it}\tilde{\varepsilon}_{it}}\right) \tag{7}$$

$$Z_N^{DH} = \frac{\sqrt{N}\left[W_{it}^{DH} - N^{-1}\sum_{i=1}^{N} E\left(W_{it}\right)\right]}{\sqrt{N^{-1}\sum_{i=1}^{N} Var\left(W_{it}\right)}} \tag{8}$$

3. Empirical results

Our panel data set comprised six emerging Asian countries with cross-country observations. Table 1 reports the basic summary of the statistics of the natural logarithms series of cross-country observations:

Next, we examined the parametric (FE) and semi-parametric estimations as reported in Table 2. The parametric (FE) results indicate that all the series are statistically significant at a 1% significance level with a positive sign. This indicates that, a 1% change in economic performance would lead to a 36.4% change in taxation. This reveals that growth exerts positive significant effects on taxation which is an indication of the growth-led taxation nexus which has been broadly discussed by Atems (2015), Bishnu, Ghate, and Gopalakrishnan (2016), Aghion, Akcigit, Cage, and Kerr (2016); and Choi and Kim (2016). Meanwhile, the positive growth squared coefficient indicates a *U*-shape effect of economic performance on taxation and this proves that growth conditions cause an upward movement of taxation in

Table 1. Summary of statistics.

Variables	Mean	Standard Deviation	Min	Max
Tax_{it}	4.414	0.519	−1.470	3.460
$Stock_{it}$	3.526	1.091	0.316	5.436
$Growth_{it}$	1.704	0.785	−2.562	2.653

Table 2. Estimation results of parametric (FE) and semi-parametric panel estimates.

	Parametric (FE)		Semi-parametric	
Variables	Coefficient	*t*-statistic	Coefficient	*t*-statistic
Constant	1.941			
$Stock_{it}$	−0.141*	3.480	−0.165*	8.685
	(0.040)		(0.019)	
$Growth_{it}$	0.364*	5.353		
	(0.068)			
$Growth^2_{it}$	0.128*	4.001		
	(0.032)			
Year dummies	√		√	
Country dummies	√		√	
R-square	0.810		0.731	

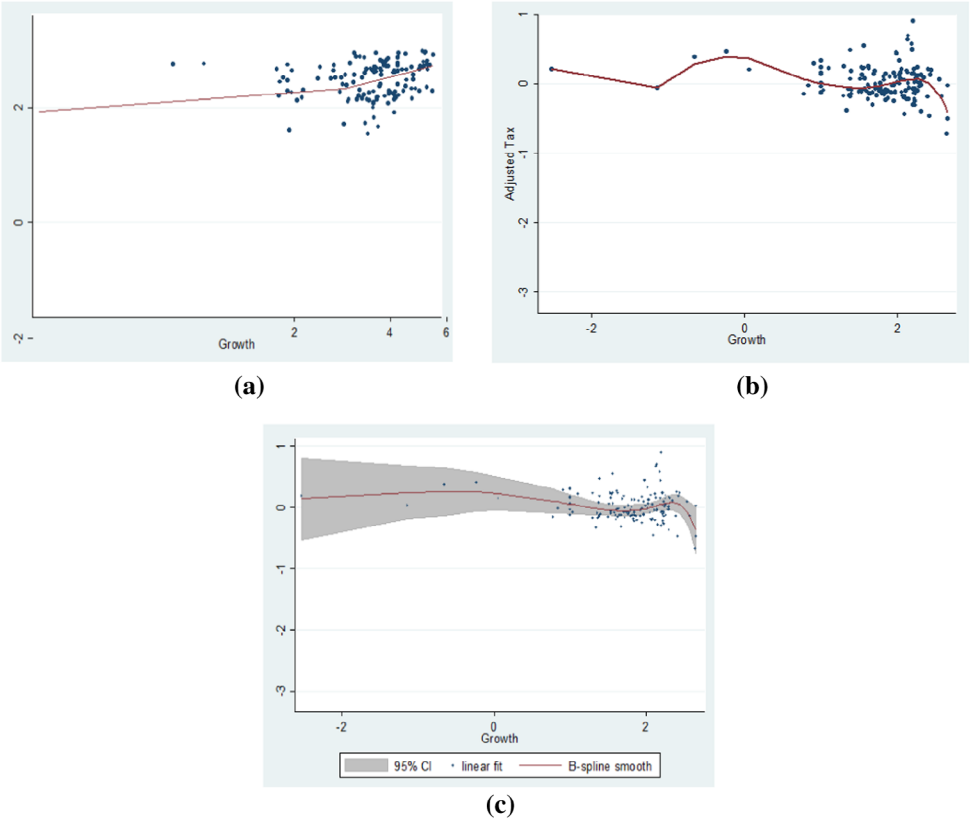
Note: *denotes the rejection of the null hypothesis at 1% level and values in parentheses indicate standard errors.

the longer period. This gives us an indication that the sustainable economic performance of emerging Asian countries will always be in line with the taxation movement with an upward trend. Aghion et al. (2016) also found a similar *U*-shape growth-taxation nexus relationship recently. In contrast, the stock traded coefficient gives us an opposite direction effect on taxation. It suggests that a 1% change in the stock traded would lead to a 14.1% change in taxation in the opposite direction. This shows that financial issues are also quite a reasonable and important aspect to be included when discussing fiscal issues for emerging Asian countries which were plagued by the AFC in the late 1990s.

In conjunction with the semi-parametric estimates, we also attempted to capture the nonlinear effect of growth of taxation using a partial fits graph. First, we illustrate the fitted parametric figure which compresses the taxation and growth (control variable), as shown in Figure 1(a). Each point stated in Figure 1(b) and (c) represents the partial residuals for Tax series in the parametric and semi parametric models, respectively. The shaded area of Figure 1(c) corresponds to 95% confidence intervals. We can see clearly the existence of *U*-shape effects when the growth series reaches 0 to 2 in both Figure 1(b) and (c). Thus, both partial fit lines confirm the *U*-shape effects of growth and taxation for emerging Asian countries.

Next, we reported on the panel unit root test with level and first difference stages in Table 3. In the level form, the null hypotheses cannot be rejected for all unit root methods, except for the stock traded variable which rejects the null hypothesis at level based on the Levin–Lin–Chu (LLC) test, and the growth variable while using the ADF-Fisher test. After taking the first difference, the LLC, Im-Pesaran-Shin (IPS) and ADF-Fisher panel unit root tests are used in this study, which reject the null hypotheses at the 1% significance level. Even though we found $I(0)$ indication of stock traded and growth variables, we conclude that all variables are integrated at order one or $I(1)$ by emphasising the IPS test.

When we assume most of the variables are integrated at $I(1)$, the next issue that arises is the long-run cointegration relationship between the variables. Therefore, we used the Pedroni (1999) and Kao (1999) cointegration tests. Table 4 reports both within and between



(a) (b) (c)

Figure 1. Linear and partial fitted graphs of the relationship between economic growth and taxation.

Table 3. Panel unit root tests results.

	At level		At first difference	
Variables	Statistics	*p*-value	Statistics	*p*-value
LLC test				
Tax_{it}	−1.570	0.058	−7.081*	0.000
$Stock_{it}$	−2.890*	0.001	−6.164*	0.000
$Growth_{it}$	−1.411	0.079	−3.751*	0.000
IPS test				
Tax_{it}	−0.523	0.300	−6.505*	0.000
$Stock_{it}$	−0.868	0.530	−5.563*	0.000
$Growth_{it}$	−0.830	0.544	−6.620*	0.000
ADF-Fisher				
Tax_{it}	13.590	0.327	61.878*	0.000
$Stock_{it}$	12.157	0.467	52.450*	0.000
$Growth_{it}$	28.891*	0.004	58.937*	0.000

Note: *denotes the rejection of the null hypothesis at the 1% level. The optimal lag selection is based on AIC.

dimension panel Pedroni cointegration test statistics with a constant trend, which are based on the average and individual autoregressive coefficients associated with the first order of the unit root test in the panel data sets. Furthermore, we found that, two out of four Pedroni panel cointegration tests reject the null hypothesis of no cointegration at 1% and 5% significance levels, respectively. Meanwhile, the group panel shows that PP-statistics reject the null hypothesis of no cointegration at a 10% significance level. In order to confirm the strong,

Table 4. Pedroni and Kao's panel cointegration test results.

Test type	Panel	Group	Kao
ADF-statistic	−2.175**	−0.810	−3.088*
	(0.014)	(0.208)	(0.000)
PP-statistic	−5.539*	−1.557***	
	(0.000)	(0.059)	
ρ-statistic	−0.445	−0.810	
	(0.327)	(0.208)	
v-statistic	0.891		
	(0.186)		

Note: *, **, ***denote the rejection of the null hypothesis at 1%, 5% and 10% respectively. Values in parentheses indicate *p*-value.

long-run cointegration between the variables, we also employed Kao's (1999) residual based panel cointegration tests. The estimated Kao cointegration tends to reject the null hypotheses of no cointegration at the 1% significance level and this clearly indicates that there is a long-run cointegration between taxation and control variables. Thus, this evidence suggests that a long-run equilibrium relationship exists between tax revenue, economic growth and total stock traded. This finding is also in line with the findings of Bujang, Abd Hakim, and Ahmad (2013), where they found a long-run relationship between taxation and economic sustainability. Bergstresser and Pontiff (2013), in their empirical findings, also proved that taxation and stock traded have a long-run relationship.

Table 5 presents the DOLS long-run cointegration results. This test has reduced the number of degrees of freedom and robust estimates are obtained by including the leads and lags series. The overall panel DOLS estimated coefficients are positive and statistically significant at 5% and 1% levels for economic growth and value of stock traded, respectively. This implies that a 1% change in stock traded increases tax revenue by 16.6%; and 1% change in economic growth will contribute increases in tax revenue by 30.6%. The DOLS estimates also clearly show that India, Indonesia and Malaysia have positive cointegration effects caused by economic growth which fulfil the growth-led taxation nexus. Furthermore, we can see that both China and India have a high elasticity of coefficients of economic growth which is reflected in taxation. The Republic of Korea and Thailand, meanwhile, have a negative relationship and this is due to the fact that these countries faced the economic downturn during the AFC in the late 1990s. At present, they are moving forward to achieve a high-income economy status in the Asian region. We found that Indonesia and Malaysia also have a negative cointegration effect with stock traded because these countries are in the process of recovery from the 1997 AFC with a small range of annual economic growth for the entire period of 2000 to 2014, where both countries have recorded a slow stock traded performance in recent years. Although both countries show similarities during the process of the financial crisis, clear differences in the counter-economic measures are evident where the Indonesian and Malaysian governments opted for independent economic recovery plans based on well-structured fiscal and monetary initiatives in recent years.

Meanwhile, countries with a huge population, such as China and India, have a positive relationship with stock traded as these countries focus more on stock traded issues, mainly manufacturing activities and foreign investment. The governments of both countries also provide grants and subsidies to directly develop export industries which are able to stabilise the balance of payments, and indirectly enhance the growth rate in various sub-sectors of the economy. Therefore, it would enhance the competitive position of Chinese and Indian companies to have greater shares in the global market for its traded sector as a key of economic

Table 5. DOLS estimate results.

Country	Variables	Lag lenght (±)	$Stock_{it}$	$Growth_{it}$	$Growth^2_{it}$
China	Coefficient	1	0.001*	3.943*	−4.972*
	p-value		(0.001)	(0.006)	(0.007)
India	Coefficient	2	0.016**	1.865**	0.894
	p-value		(0.045)	(0.044)	(0.139)
Indonesia	Coefficient	1	−0.359**	0.515*	−1.594*
	p-value		(0.016)	(0.001)	(0.007)
Rep. of Korea	Coefficient	2	0.006	−0.008***	−0.013
	p-value		(0.106)	(0.073)	(0.867)
Malaysia	Coefficient	1	−0.035***	0.270*	0.478*
	p-value		(0.056)	(0.002)	(0.000)
Thailand	Coefficient	1	1.062*	−0.065***	−0.444***
	p-value		(0.000)	(0.088)	(0.058)
$Panel_{DOLS}$	Coefficient	1	0.166**	0.306*	0.049
	p-value		(0.011)	(0.000)	(0.696)

Note: *, **, ***denote the rejection of the null hypothesis at 1%, 5% and 10% respectively. The lead and lag values are based on the AIC lag selection approach.

expansion. These findings are consistent with the findings of Zafar and Bukhari (2015) for Pakistan; and Enisan and Olufisayo (2009) for the Sub-Saharan countries, which clearly indicate the positive effects of stock traded on economic sustainability. The presence of the DOLS estimation also allowed for diminishing returns of scale to the economic growth of taxation, where we found that China, Indonesia and Thailand achieved the inverted *U*-shape effect in the long-run relationship, while Malaysia displayed the *U*-shape effects.

The test results in Table 6 summarise the Westerlund cointegration test. We found that the null hypothesis of no cointegration is rejected at both panel and group stages with a 1% level of significance. This result suggests that long-run cointegration exists at panel and group stages, where economic growth and stock traded have a long-run integrated relationship with tax revenue for emerging Asian countries. This result is consistent with several empirical findings in the literature, such as Lee and Gordon (2005), Romero-Ávila and Strauch (2008), Soli et al. (2008) and Marques et al. (2013).

The next stage of this study was estimating the long- and short-run dynamics. Even though we are able to avoid the mixed stationary problem, the heterogeneous panel cointegration is deemed as the correct approach to capture the long- and short-run dynamics. The panel Autoregressive Distributed Lag (ARDL) (1,3,3,3) estimates show that the long-run coefficient of stock variable is inelastic with a 1% significance level in both the short- and long-run, with a 1% and 10% rejection of the null hypothesis, respectively. It can be observed that the coefficient of economic growth is highly elastic and statistically significant at the 1% level in the long-run. Surprisingly, we could not get any null hypothesis rejection for both economic growth and the squared economic growth in the short-run. More importantly, the estimated speed of adjustment to long-run equilibrium is equal to 43.2%. This finding is in line with recent empirical studies done by Oueslati (2015), Aghion et al. (2016), Bishnu et al. (2016) and Atems (2015):

$$\Delta Tax_{it} = \underset{}{0.536} \underset{(0.0109)^{*}}{-0.114 Stock_{it}} \underset{(0.046)^{*}}{+1.521 Growth_{it}} \underset{(0.020)^{*}}{+0.367 Growth^2_{it}} \underset{(0.034)\ ***}{-0.065 \Delta Stock_{it}} + \underset{(0.848)}{0.219 \Delta Growth_{it}} \underset{(0.179)}{+0.065 Growth^2_{it}} \underset{(0.110)\ *}{-0.432 ect_{t-1}}$$

Note: *, ** and *** denote the rejection of the null hypothesis at 1%, 5% and 10% respectively. Values in parentheses indicate standard errors.

Table 6. Westerlund heterogeneous panel error correction estimate results.

Statistics	Value	*z*-value	*p*-value
G_τ	−3.514*	−3.934	0.000
G_α	−3.428	2.225	0.987
P_τ	−9.268*	−4.912	0.000
P_α	−12.666*	−2.979	0.001

Note: *denotes the rejection of the null hypothesis at 1% and lag length is equal to 1 based on the AIC lag selection approach. G_τ and G_α indicate group estimates, while P_τ and P_α indicate panel estimates.

Table 7. DH heterogeneous panel causality estimate results.

Direction of causality	W^{DH}	Z^{DH}	*p*-value	Decision
$Tax_{it} \rightarrow Growth_{it}$	5.829*	3.200	0.001	Bi-directional
$Tax_{it} \leftarrow Growth_{it}$	19.354*	15.494	0.000	
$Tax_{it} \rightarrow Stock_{it}$	4.287***	1.799	0.071	Uni-directional
$Tax_{it} \leftarrow Stock_{it}$	3.597	1.172	0.241	
$Stock_{it} \rightarrow Growth_{it}$	2.926	0.562	0.573	No causality
$Stock_{it} \leftarrow Growth_{it}$	4.220***	1.315	0.090	

Note: *, **, ***denote the rejection of the null hypothesis at 1%, 5% and 10%, respectively. The lag length of DH Granger causality equals to 1, based on AIC lag selection.

After establishing the existence of the long- and short-run heterogeneous cointegration among the series, we take into account the DH heterogeneous Granger causality test proposed by Dumitrescu and Hurlin (2012). This causality test is able to capture the causal relationship between variables under the conditions of cross-sectional dependence, as shown in Table 7.

Based on the DH causality results, a bi-directional causal relationship was found running between tax revenue and economic growth. This clearly indicates that there is taxation-led growth theory in play in the emerging Asian countries, which is consistent with the findings of Bird and Zolt (2011), Taha et al. (2013) and; Choi and Kim (2016). Meanwhile, a uni-directional causality was found from stock traded to tax revenue, as well as a uni-directional causality effect between economic growth and stock traded. Overall, we would substantiate that tax revenue plays an important role as an engine of economic growth in most of the emerging economies worldwide. Indeed, most of the emerging Asian countries, especially China and India, have a high ability to compete with developing countries because of the sustainable growth along with the revenue being consistently supported by tax collection efficiency from direct and indirect sources.

4. Conclusion

To a certain degree, we can draw a consistent conclusion with other studies that there is a relationship between economic growth and stock traded through the analysis of heterogeneous and semi-parametric approaches. This simply means that the performance of economic growth and stock markets can be used to predict taxation sustainability. Besides this, we also found that economic growth has significant influence on tax revenue for emerging Asian countries. This shows that, most of the Asian countries managed to survive the economic instability throughout the period of the AFC in the late 1990s, as well as the Global Financial Crisis during the period of 2008 until 2009. Even as Brazil, Russia, India, China and South Africa (BRICS) are now reacting as the masters of emerging markets worldwide,

most reputable economists agree that the future of the world economies is in the BRICS emerging markets, and the findings of this study concentrating on India and China concur with that opinion. By looking at the growth trends, it is also believed that Indonesia, Korea, Malaysia and Thailand are moving towards increasing their function in the Asian economy, to be recognised as emerging Asian markets in the future. In the meantime, both India and China are the most valuable trading partners for Asian members, where their relationship could affect the GDP of other countries in the Asian region. The stable growth rate in India and China also reflects that these countries never recorded a negative growth rate during both crises unlike other countries involved in this study.

As we are aware, the stock market plays a pivotal role in the economic development of a country. This relates to fiscal policy where using the tax system as an incentive to promote stock market activities seems to be helpful in insulating a financial system weakened by economic recession. In addition, Asian stock traded gained stronger with the announcement of government stimulus packages, which were aimed at countering the effects of a global slowdown in the economy. Countries in this study are listed in the Association of Southeast Asian Nations (ASEAN) Free Trade Area (AFTA) introduced in 1992, which supports local manufacturing activities in the ASEAN region. One of the benefits for countries under AFTA is that the export and investment sectors will generate higher potential in the long-term due to the price reduction from elimination of tariffs throughout ASEAN, and this helps the governments to increase the tax collection of various economic activities. In addition to the economic situation which deeply impacts tax collection, the political situation also affects the trend of revenue collection. Most foreign investors focus on the political stability of a country before making their investment decision. For instance, countries are known to take advantage of the political instability of neighbouring countries to compete for foreign sector investments.

Understanding the factors which are associated with the realities of an economy appears to be mandatory for a full grasp of the transmission channels from finance to the economy. Among these factors are total investment, GDP trends, economic regime change and sub-prime crisis. In line with current conditions, fiscal restructuring remains challenging; a narrow tax base, weak tax collection efforts and frequent tax amenities are among the systems reflecting low institutional quality and poor budget management. The policy implication of this finding is that it is worthwhile to seek alternative investments such as the bond market, which has the tremendous potential to increase economic growth and which is also reflected in government revenues in recent years in the Asian region. Nevertheless, as there are some homogeneity issues that arises in the panel data, it is obvious that these results should not be generalised to the research on the nexus between tax revenue, economic growth and stock trade among emerging Asian countries.

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