Nguyen, Trang, Chaiechi, Taha, Eagle, Lynne, and Low, David (2020) ***Dynamic impacts of SME stock market development and innovation on macroeconomic indicators: a post-Keynesian approach.*** **Economic Analysis and Policy, 68 pp. 327-347.**

https://doi.org/10.1016/j.eap.2020.10.002

Dynamic impacts of SME stock market development and innovation on macroeconomic indicators: A Post-Keynesian approach

Trang Nguyen, Taha Chaiechi, Lynne Eagle, David Low

PII: S0313-5926(20)30430-6
DOI: https://doi.org/10.1016/j.eap.2020.10.002
Reference: EAP 426

To appear in: *Economic Analysis and Policy*

Received date : 3 September 2019
Revised date : 5 October 2020
Accepted date : 10 October 2020

Dynamic Impacts of SME Stock Market Development and Innovation on Macroeconomic Indicators: A Post-Keynesian Approach

Corresponding author:

Trang Nguyen
PhD in Economics
College of Business, Law and Governance
James Cook University, Australia
Email address: thiminhtrang.nguyen2@jcu.edu.au
Postal address: 14-88 McGregor Road, Smithfield, Cairns, Queensland, Australia, 4878

Co-authors:

Dr Taha Chaiechi
Head of Economics and Marketing Group
College of Business, Law and Governance
James Cook University, Australia
Email address: taha.chaiechi@jcu.edu.au
Postal address: 14-88 McGregor Road, Smithfield, Cairns, Queensland, Australia, 4878

Professor Lynne Eagle
Associate Dean
College of Business, Law and Governance
James Cook University, Australia
Email address: lynne.eagle@jcu.edu.au
Postal address: 1 James Cook Drive, Douglas, Townsville, Queensland, Australia, 4811

Professor David Low
Dean
College of Business and Law
Charles Darwin University, Australia
Email address: david.low@cdu.edu.au
Postal address: Ellengowan Dr, Casuarina, Northern Territory, Australia, 0810

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Dynamic Impacts of SME Stock Market Development and Innovation on Macroeconomic Indicators: A Post-Keynesian Approach

Abstract

This study is grounded on the propositions of Kaleckian-Post-Keynesian macroeconomic framework to explore the dynamic impacts of SME (Small and Medium Enterprise) stock market development and innovation on key macroeconomic variables in Hong Kong, Singapore, Thailand, and Malaysia. For the reported empirical analysis, a Structural Vector Error Correction (SVEC) model and an impulse response function (IRF) were adopted. The evidence shows that SME stock market development and/or innovation have small but positive impacts on short-run economic stimulation. The SME stock market development promotes economic growth through the combination of the following channels: private investment, savings and productivity in Hong Kong, Singapore, and Thailand. Innovation, on the other hand, fosters growth through the combination of these channels and the employment channel in all four countries.

Keywords: SME stock market; Innovation; Post-Keynesian economics; Structural VEC; Impulse response analysis

JEL codes: E44, O16, O31, O43

1. Introduction

Established in many different parts of the world since the 1990s, SME stock markets have expanded reaching a total of 51 markets in 2016, of which almost a quarter are located in Asia (World Federation of Exchanges, 2015). During 2000-2014, US$185 billion was raised through the Initial Public Offerings (IPOs) and the Seasoned Equity Offering (SEO) on the SME stock exchanges worldwide (Organisation for Economic Cooperation and Development - OECD, 2015). This equates to a remarkable 5.8% of the global credit gap for SMEs that is equivalent to 30% of the total outstanding balance of SME lending (International Finance Corporation - IFC, 2013). There is also evidence suggesting that a successful SME stock market could elevate the contribution of SMEs to the host country's overall GDP by 0.1-0.2% each year (Peterhoff et al., 2014).

As such, SME stock markets have grown to become an important source of funding for SMEs as these organisations frequently struggle to obtain traditional funding for innovation. By definition, innovation can be viewed as a process that involves research and development (R&D) activities and the acquisition of necessary resources to develop and deliver the firms' core value propositions (Grossman & Helpman, 1994). Accordingly, more inflow of capital into innovation potentially leads to an increase in the number of patents and trademarks filed by SMEs (Pradhan, Arvin, Nair, Bennett, Bahmani, &

Hall, 2018) which consequently stimulates demand and economic growth. Therefore, the growth of SME stock markets can be seen as a key catalyst for innovation. And the more innovation, the more fuels for higher economic growth.

Given that SME stock markets play a pivotal role in filling the credit gaps for SMEs and are key catalyst for innovation, the development of SME stock markets and innovation could potentially have joint impacts on various channels of economic development. Nonetheless, such joint impacts have yet to be explored in the literature on either the finance-growth nexus or the innovation-growth nexus. In the two bodies of literature, empirical studies are voluminous but merely focus on the main stock markets and each nexus separately and their findings remain inconclusive across different countries, indicating a call for further examinations. More importantly, in terms of the methodological approach, a great deal of existing studies fail to test these relationships in a structural macroeconomic framework.

On the other hand, the Kaleckian-Post-Keynesian model of growth and distribution is renowned as an integrated system of behavioural functions of macroeconomics (Chaiechi, 2012). The model effectively demonstrates the functional interrelationship among private investment, savings, income distribution, productivity growth, net export, and employment. While the model has been augmented by Chaiechi (2012), taking into account the effect of indicators of financial development, the specific roles of SME stock markets and innovation in the financial systems have yet to be explored. This knowledge gap motivates the modelling approach in this study, along with some of the theoretical assumptions to further improve the specification of the Kaleckian macroeconomic model.

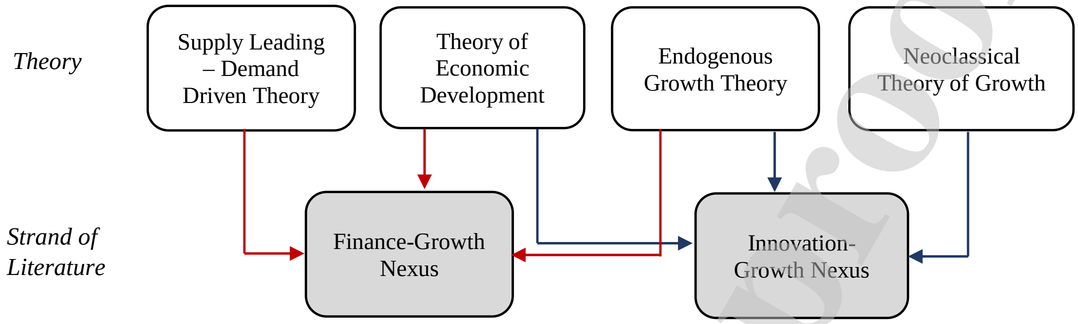
This study, therefore, contributes to the current body of knowledge by offering a thorough investigation into the joint impacts of second-tier stock market development and innovation on major macroeconomic indicators, adopting a Kaleckian-Post-Keynesian framework. This study is distinctive in its way of offering both theoretical and empirical contributions by extending a Kaleckian-Post-Keynesian model of growth and distribution. Specifically, the indicators of SME stock market development and innovation have been incorporated into the behavioural functions of private investment, domestic savings, productivity growth and employment. The theoretical framework of Kaleckian-Post-Keynesian economics is thus further expanded to better elucidate the interactions between various financial and economic indicators in an open economy. This study uses economic and financial data from Hong Kong, Singapore, Thailand and Malaysia, as case studies. The selection of these four case studies is based on their institutional characteristics and the significant role their second-tier stock markets play in financing SMEs (extensively discussed in Section 3).

The results exhibit a practical improvement in model specification. Also, the findings from this study could be replicated in different setups to assist regulators in proposing new and innovative policies that foster the development of second-tier stock markets.

2. Literature review

To elucidate the investigation of dynamic effects of SME stock market and innovation on economic growth, two strands of literature on finance-growth nexus and innovation-growth nexus are discussed in this section. The corresponding theoretical bases are demonstrated in Figure 1 as below.

Figure 1: Theoretical bases of finance-growth nexus and innovation-growth nexus



The theoretical framework of finance-growth nexus can be traced back to the theory of economic development of Schumpeter (1912), who placed emphasis on the importance of financial institutions in determining productive investments. Later, McKinnon (1973) and Shaw (1973) proposed the supply-leading theory, stating that financial assets aggregation enhances economic growth. Thus financial market development positively affects growth. On the other hand, Friedman and Schwartz (1963) introduced the demand-driven hypothesis in which economic growth leads to the establishment and development of the financial market. The finance-growth nexus is further explained by endogenous growth theory, which was introduced by Lucas (1988) and Romer (1990). Accordingly, financial development endogenously boosts growth through capital accumulation, which can be invested in innovation and technology and, consequently, fosters productivity and growth.

Since the financial sector is complex and multi-layered, it becomes extremely challenging to measure its growth using a single indicator, thus several studies have focused on the nexus between one specific segment of financial market and economic development. Stock market is such a segment that has captivated wide academic interests. Greenwood and Jovanovic (1990) and Jbili, Enders, and Treichel (1997) initially described the role of stock market as being to mobilise savings, distribute resources, and promote long-term economic stimulation. They included the role of stock market in endogenous growth model to establish the interrelation between stock markets and economic growth. Endogenous growth literature has later been enriched by several models incorporating channels through which stock markets influence economic growth. Stock markets endogenously drive growth through the process of efficient resource allocation. The allocation of funds is enhanced thanks to stock market liquidity that helps mitigate the risk of losing all capital invested in projects that can not be profitable in the short run

(Bencivenga, Smith, & Starr, 1996). Investment projects that are less risky and can be easily liquidated through stock markets will be prioritised over those that are more productive but financially illiquid.

Endogenous growth models place emphasis on productivity growth as the most likely channel through which stock markets can affect economic growth. King and Levine (1993a) introduced a model in which innovation acts as a powerhouse of economic growth since successful innovations can improve productivity growth rate. Stock markets then appraise the potential innovative projects and allocate capital to the most profitable ones and monitor the implementation of investments. Demetriades and Hussein (1996) contended that an economy with well-functioning stock markets will experience a higher productivity growth rate. Holmström and Tirole (1993) proposed a model that underlined the function of stock markets as a measure of managerial performance since managerial performance is captured in stock price and cannot be extracted from the company's data. The performance information that is incorporated in stock price is critical to managerial incentives program so as to improve a company productivity and thus stimulate growth. Pagano (1993) also laid stress on saving mobilisation function of stock markets as they can attract more savings into productive investments and prevent the premature withdrawal of capital invested in long-term projects, thus, foster long-term growth.

A large body of empirical studies on the nexus between stock market and economic development has emerged since the proposition of endogenous growth theory. The findings, however, remain contradictory across different countries and different periods. Several studies reported a positive relationship in the short- and long-run between stock market and growth for the countries where the stock markets are well-established such as Canada, Finland, France, Germany, Australia, Hong Kong, Singapore, Thailand, and Malaysia (for examples, see Arestis, Chortareas, and Magkonis (2015), Cojocaru, Falaris, Hoffman, and Miller (2016), Durusu-Ciftci, Ispir, and Yetkiner (2017), Pradhan, Arvin, Bahmani, Hall, and Norman (2017), Hoque and Yakob (2017), Ho (2018), and Samsi, Cheok, and Yusof (2019)). Meanwhile, many studies investigated nonlinearities and showed negative results for the countries where the financial sectors are dominated by banks or the stock markets are relatively young such as Ecuador, Jordan, Peru, Saudi Arabia, Nigeria and Bangladesh (for examples, see Mishra and Narayan (2015), Sahay, Čihák, N'Diaye, and Barajas (2015), Samargandi, Fidrmuc, and Ghosh (2015), Prettner (2016), Owusu (2016), Banerjee, Ahmed, and Hossain (2017), Prochniak and Wasiak (2017), and Rehman (2018)). Other studies showed the weakening or varnishing effect of stock market on growth during financial crisis episodes such as Denmark, Germany, France, Poland, Hungary and Turkey (for examples, see Haiss, Juvan, and Mahlberg (2016) and Naceur, Blotevogel, Fischer, and Shi (2017)). Although the existing studies have covered both developed and emerging economies, they have just examined the main stock markets mainly because the main markets are larger in term of capitalisation and liquidity compared to the second-tier markets. In addition, most of these studies tested the relationship using various choices of stock market and growth indicators and common econometric techniques rather than examining the relationship within a theoretical framework.

The focus is now on the literature on the interrelation between innovation and economic growth. In his theory of economic development, Schumpeter (1912) considered innovation as one of the endogenous drivers to growth. He argued that institutions, entrepreneurs, and technological changes are the foundations of economic growth and are often influenced by government policy. According to the neoclassical theory of growth proposed by Solow (1956), technology improvements tend to increase capital productivity and thus promote further investments. Solow concluded that capital formation should be viewed as growth initiator. Romer (1986, 1990) emphasised that industrial innovation is the main drivers of economic development due to their direct impacts on the production process. In line with Schumpeter and Solow, Kirchhoff (1994) and Wennekers and Thurik (1999) further hypothesized that innovation promotes productivity and inspire establishment of new businesses, which in turn boosts employment levels, output levels, and economic growth. Moreover, Grossman and Helpman (1994) emphasized on the indispensable role of innovation and technological advances in generating a rapid and endogenous growth process specially when challenged with depletable natural resources.

The empirical works on the innovation-growth nexus, however, exhibit mixed results, which can be synthesised into the following four hypotheses. First, the supply-leading hypothesis posits that innovation upholds marginal productivity and output, thus Granger causes economic growth. Second, the demand-following hypothesis, which is the reverse of the first hypothesis, economic growth Granger causes innovation. Third, the feedback hypothesis implies a bidirectional causality between innovation and growth, such that innovation leads to higher growth, which in turn induces further innovation. And fourth, the neutrality hypothesis refers to the case that innovation and economic growth are not causative factors of each other. Although the innovation-growth nexus has been widely examined in the literature (for examples, see Table 1), it has yet been examined within an integrated system of macroeconomic functions. The current studies just simply applied prevail econometric models (VAR/VECM) on individual indicators of innovation and growth.

Table 1: Empirical studies supporting four hypotheses of innovation-growth nexus

No.	Hypothesis	Empirical studies
1	Supply-leading hypothesis	Kirchhoff, Newbert, Hasan, and Armington (2007), Hasan and Tucci (2010), Agénor and Neanidis (2015), and Pradhan, Arvin, Hall, and Nair (2016), Pradhan et al. (2018)
2	Demand-following hypothesis	Howells (2005), Sinha (2007), and Sadraoui, Ali, and Deguachi (2014)
3	Feedback hypothesis	Guloglu and Tekin (2012), Cetin (2013), Galindo and Méndez (2014), and Maradana, Pradhan, Dash, Gaurav, Jayakumar, and Chatterjee (2017)
4	Neutrality hypothesis	Cetin (2013)

In summary, two major knowledge gaps have been identified from the current bodies of literature. First, despite the importance of second-tier stock markets in SMEs financing and their growing presence worldwide, an intensive body of literature on finance-growth nexus fails to examine the dynamic interaction between the development of second-tier stock markets and macroeconomic growth process. There should be a potential contribution of second-tier stock markets to different channels of economic growth. Second, there is a paucity of research on the relationship between innovation and economic growth within a theoretical macroeconomic framework. Such an examination could provide further understanding of the impact of innovation on an integrated system of macroeconomic indicators. This study is, therefore, intended to explore the dynamic impacts of second-tier stock market development and innovation on different channels of economic growth within a theoretical macro-economic framework, which is discussed in Section 4 – Extended Kaleckian model of growth and distribution.

3. Stylised facts

This study employed Hong Kong, Singapore, Thailand, and Malaysia as case studies. While Hong Kong and Singapore are recognised as Asian Tigers, Thailand and Malaysia are referred to as Tiger Cub Economies. By the 21st century, Hong Kong and Singapore have developed into advanced economies, specialising in areas of competitive advantages such as international finance, trade and transportation. Thailand and Malaysia, unsurprisingly, have been replicating the similar export-driven model of economic development pursued by the Asian Tigers. The four countries are also the top trading partners of each other; considerably, in 2018, their international trades recorded 1.2–3.7 times the corresponding GDP. Moreover, according to the World Intellectual Property Organisation - WIPO (2019), the Global Innovation Index (GII) of Singapore and Hong Kong ranked the first and the third, respectively, in South East Asia, East Asia, and Oceania. Meanwhile, the GII of Malaysia and Thailand held the second and the fourth positions, respectively, among the upper-middle income economies.

Stock markets in the four economies have been appreciated as a main sources of capital for Asia and a key growth driver of the region (Ong & Lipinsky, 2014). The SME stock markets in the four countries, namely Growth Enterprise Market (GEM), CATALIST Market, Market for Alternative Investment (MAI), and Access, Certainty, and Efficiency Market (ACE), correspondingly, are also remarkable. Capital mobilised from these markets between 1999 and 2016 was US$28.1 billion, which effectively filled 75.8% of SMEs credit gap in the four economies, or 43.1% of this gap in Southeast Asia. Consequently, the GEM, CATALIST, MAI, and ACE, given their substantial contributions to closing the credit gap for SMEs in Southeast Asia, arguably, can be a major source of funding for SMEs in the region. The markets are characterised by innovativeness, small capitalisation, and high investment risk.

Table 2: Facts and figures (2016)

	Hong Kong	Singapore	Thailand	Malaysia
SME stock market	GEM	CATALIST	MAI	ACE
Established by	Hong Kong Stock Exchange (HKEX)	Singapore Exchange (SGX)	Stock Exchange of Thailand (SET)	Bursa Malaysia (BM)
Market opened	1999	2007	2001	2009
No. of listed firms	260	185	134	113
Market capitalisation [a]	40.1	6.4	11.9	2.3
Percentage of GDP (%)	12.6%	2.3%	3.0%	0.8%
Traded value [a]	19.0	4.9	15.5	3.2
Percentage of GDP (%)	6.0%	1.7%	3.9%	1.2%
Innovation				
No. of patent applications [b]	14,092	10,980	7,820	7,236
Percentage of labour force	0.4%	0.3%	0.02%	0.05%
No. of trademark applications [b]	36,181	22,740	51,613	39,107
Percentage of labour force	0.9%	0.6%	0.1%	0.3%
High-technology exports [a]	0.4	120.7	34.2	52.1
Percentage of GDP (%)	0.1%	42.5%	8.5%	18.8%

Source: Exchange factbooks and National Statistics Departments' publications. Notes: (a) in US$ billion; (b) data include residents and non-residents.

4. Extended Kaleckian macroeconomic model

The Kaleckian model of growth and distribution, which was first introduced by Marglin and Bhaduri (1990) and later augmented by Onaran and Stockhammer (2006), demonstrates the interaction between the goods market and the labour market. In this model, economic growth is driven by capitalists' profit and labours' remuneration which represented by an integrated system of behavioural functions of private investment, savings, net export, income distribution, labour productivity and employment. This study further extended the model by including exogenous variables of SME stock market and innovation into the functions of accumulation, savings, productivity growth, and employment to examine their simultaneous impacts on the integrated real sectors. The extended system of equations is presented as follows:

Accumulation
$$g_t^i \equiv \frac{I_t}{K_t} = \alpha_0 + \alpha_1 z_{t-1} + \alpha_2 \pi_{t-1} - \alpha_3 r_t + \alpha_4 g x_{t-1} + \boldsymbol{\alpha_5 smd_t} + \boldsymbol{\alpha_6 inn_t} \quad (1)$$

Savings
$$g_t^s \equiv \frac{S_t}{K_t} = \beta_1 z_t + \beta_2 \pi_t + \beta_3 smd_t + \boldsymbol{\beta_4 inn_t} \quad (2)$$

Income distribution
$$\pi_t = \gamma_0 + \gamma_1 z_t + \gamma_2 u_t + \gamma_3 g x_t \quad (3)$$

Productivity growth
$$g x_t = \tau_0 + \tau_1 g_t^i + \tau_2 z_t + \boldsymbol{\tau_3 smd_t} + \boldsymbol{\tau_4 inn_t} \quad (4)$$

Net export
$$n x_t = -\delta_1 z_t + \delta_2 \pi_t \quad (5)$$

Unemployment
$$u_t = \lambda_0 - \lambda_1 g_t^i - \lambda_2 \Delta z_t - \lambda_3 \pi_t + \lambda_4 u_{t-1} + \lambda_5 g x_t - \boldsymbol{\lambda_6 inn_t} \quad (6)$$

Market equilibrium
$$g_t^i = g_t^{stotal} = g_t^s - n x_t \quad (7)$$

where I_t denotes private investment, K_t denotes physical capital stock, g_t^s is savings (normalised by physical capital stock), z_t is capacity utilization, π_t is income distribution, nx_t is net export (normalised by GDP), u_t is the rate of unemployment, gx_t is the rate of productivity growth, r_t is the rate of interest, smd_t is SME stock market development, and inn_t is innovation indicator.

Equation (1) defines the growth of capital accumulation as a result of investment decisions of firms. Investment decisions are affected positively by the expected rate of profit, which is decomposed into the profit share and capacity utilisation, and negatively by interest rate (Kalecki, 1968; Hein, 2004). Kalecki (1968) gave emphasis to the importance of technological progress for investment, thus this factor is reflected in the investment function by a term for productivity growth. Interest rate has a strong influence on investment through its effect on mobilising internally generated funds and external sources of funds. The demand effect of investment arouses further investments while the lagged capacity effect stifles investment decisions. In addition, investment can produce sufficient savings by means of redistribution or by changing the level of capacity utilisation.

Equation (2) demonstrates private domestic savings function which is positively influenced by the two important components of profit rate, i.e. profit share and capacity utilisation. This is a plain Cambridge savings function, supposing that capitalists have a higher marginal propensity to save than workers, whose wages are all consumed for necessities. This supposition is the cornerstone of Post-Keynesian open economy theory, such that savings are conditional on saving behaviour of workers and capitalists (Marglin, 1984; Lavoie, 1992).

Equation (3) presents the supply-side of the model, delineating income distribution function which is positively affected by capacity utilisation rate, unemployment rate, and productivity growth. The first element is derived from the supposition that firms establish prices based on a mark-up over unit labour cost, which is positively correlated with capacity utilisation rate. The second element signifies the Marxian reserve army effect. The third element is inserted because the distributional struggle may be more about the division of productivity gains than about the output itself.

Equation (4) postulates that the growth of labour productivity is driven by capital accumulation and capacity utilisation. Technological advancements need to be implemented through the production of new machinery and equipment, thus resulting in physical capital accumulation. This in turn increases the ratio of capital over labour. Furthermore, measuring labour productivity relies on the extent to which the existing machinery and equipment are placed in service, thus relating to the rate of capacity utilisation.

Equation (5) shows the proposition that net export is a positive function of profit share and a negative function of capacity utilisation. Domestic demand for import can lead to negative impact of capacity utilisation on net export. In other words, a decline in domestic labour costs can be interpreted as an improvement in profit share, which can induce a decrease in export prices and hence boost export volume. Therefore, the impact of international competitiveness on net export can be captured by a positive function of profit share.

Equation (6) depicts the labour market where unemployment rate is identified as a function of the growth of capital stock, the change of capacity utilisation, profit share, unemployment persistence, and the growth of labour productivity. The first two elements are the goods market variables, also known as standard Keynesian variables. Kalecki (1968) posits that employment is subject to demand for output. Employment relies on capacity utilisation which is treated as endogenous in the function of capital accumulation. The third element is considered as a non-Keynesian effect, such that if demand for labour hinges on remuneration, the impacts of remuneration per labour and productivity can be captured by profit share. As for the last element, technological progress may cause unemployment if it is not matching with a rise in aggregate demand for output. This is a natural consequence of any macro-economic model with demand restriction and it is reflected in the effect of labour productivity growth.

Equation (7) describes the goods market equilibrium in the long run in which investment and growth can be improved only if savings is increased or the real wage rate is decreased.

The incorporation of SME stock market and innovation into Equations (1), (2), (4) and (6) are theoretically justified as below:

Heterodox economists contend that capital can influence final demand for output through the investment of enterprises and consumption of households. Capital may also affect manufacturing firms through the acquisition of materials and recruitment of workers. Stock markets can satisfy the capital requirement for investment and production (Duménil & Lévy, 1989). Therefore, stock markets can be acknowledged as an important mechanism in fostering investment according to the fundamentals of Keynesian economics. Given the significance of SME stock markets for investment and production activities of SMEs, they were included in the capital accumulation function (Equation 1).

According to endogenous growth theory, stock market development can influence the proportion of saving deposits that are converted into profitable projects, therefore it may alter deposit interest rates (Pagano, 1993). Stock markets can mobilise savings from individuals, firms, and government by offering additional financial instruments that possibly meet their risk appetites and capital requirements. The availability of various channels for investment may lead to the rise of savings interest rate (Levine & Zervos, 1998). In addition, stock markets connect net savers (household, individuals) and net investors (firms), thereby reducing the transaction costs related to saving mobilisation and making the savings highly liquid. Therefore, the SME stock market development were included in the domestic savings function (Equation 2).

Greenwood and Jovanovic (1990) placed emphasis on the functions of stock markets in improving productivity and fostering growth in the endogenous growth model. Stock markets use public offering requirements to analyse and select prospective firms and allocate funds to the most profitable projects. King and Levine (1993b) asserted that stock market development effectively allocates capital into profitable projects and diversifying project risks, thereby inducing long-term economic stimulation. As pointed out by Rioja and Valev (2004), stock market development enhances the global economic growth by way of improving productivity for industrial economies and intensifying capital accumulation for developing economies. Accordingly, the equation of productivity growth (Equation 4) was also augmented with the development of SME stock market.

As stated by Aghion and Howitt (1998), innovation and capital accumulation should be acknowledged as two aspects of the growth process rather than distinct causal elements. Technological innovation brings in new economic opportunities for investment in physical and human capital. Meanwhile, physical and human capital are indispensable inputs for R&D activities and the implementation of new technologies, which are invented from innovation. Zeng (2003) later asserted that long-term economic growth is attributable to innovative technologies and physical and human capital accumulation. Therefore, theoretically, it is essential to incorporate innovation into the equation of capital accumulation (Equation 1).

Aghion, Comin, Howitt, and Tecu (2016) proposed a theory of endogenous domestic savings and growth in an open economy, stating that innovation-led economy can take on advanced technology without difficulty. For economies that are unable to keep up with advanced technology, a collaboration between foreign partners who are experts in the technology and the local firms who are acquainted with local conditions is needed. In such situation, domestic savings allow local enterprises to possess equity stakes in the collaboration, thus domestic savings are essential for innovation and growth. This helps moderate the agency problem that would otherwise discourages foreign partners from involvement in the collaboration. Innovation, in turn, stimulates the domestic savings for further technological collaboration that will spur long-term growth. For those countries which are close to the frontier, domestic firms have no problem of adopting the technology and thus no foreign cooperation is needed. According to the theory, innovation were therefore incorporated into the domestic savings functions (Equation 2).

Innovation results in the invention of new technologies, systems, and procedures that enhance efficiency and productivity in the economy. Huergo and Jaumandreu (2004) analysed the effect of process innovation[1] on productivity over various phases of firm development and came up with a number of the following conclusions. First, process innovation results in extra productivity growth throughout the process. Second, productivity growth rate tends to be higher in the early stage and then gradually converge to a normal average growth rate over time. And third, in the case where innovation is halted, additional productivity growth tends to continue for a number of years before the halt, however, it exhibits a below-average growth rate. Therefore, inclusion of innovation in the productivity growth function (Equation 4) is desirable.

Theoretically, technological advance may eliminate jobs in the short run. However, a positive impact of technology can be expected in the long run because the compensation mechanism will induce higher demand for labour. In the long run, technological innovation ultimately creates new economic opportunities for investment in human capital, thus creating more jobs and employment. Furthermore, as posited by Ugur, Churchill, and Solomon (2018), the impact of technological innovation on employment is attributable to several factors such as labour market flexibility, product market competition, types of innovation, national innovation systems, and international trade.

5. Structural VEC (SVEC) model identification

To examine the dynamic effects of SME stock market development and innovation on the integrated system of macroeconomic functions, an SVEC model was used. In the model, only short-run restrictions were imposed while long-run restrictions were not due to the problem of finite time series data (Faust & Leeper, 1997) and weak-instrumental problem[2] (Gospodinov, 2010).

To impose short-run restrictions on structural errors of the system, a lower triangular Cholesky decomposition, which orthogonalises the reduced form errors, was applied. The above-diagonal components are constrained to be zero and the lower diagonal components are ordered in a recursive structure Wold-causal chain. In such a recursive structure, the first variable is assumed to be the most endogenous and contemporaneously independent of all other variables, while the last variable should be the least endogenous and contemporaneously dependent on all other variables. The ordering of variables is essential for identifying the structural form errors, which allows the orthogonal shocks to be imposed in the impulse response function (IRF). According to the Kaleckian theory of growth and distribution, private investment is presumed to be the powerhouse for effective growth in domestic savings, income distribution, productivity, net export and employment. Thus, investment is placed first in the Cholesky ordering. Since the labour market is determined endogenously by other real sectors, unemployment is therefore placed last.

[1] Process innovation refers to the implementation of a new or significantly improved manufacturing or logistic methods.
[2] Weak-instrumental problem refers to the situation that IRF is not consistently estimable for an I(0) time series that is parameterised as local to unity.

Having determined the order of key macroeconomic variables, the focus moves on to exploring the dynamic responses of key macroeconomic variables to orthogonal shocks imposed on the SME stock market development and innovation variables. The SME stock market development variable is followed by innovation variable because the SME stock market acts as a platform for SMEs to raise funds for R&D activities. Initially, a set of indicators of SME stock market and innovation was introduced into the SVEC model and block exogeneity Wald test was carried out. If the indicators are found to be exogenous, they will be excluded from SVEC modelling and will not be imposed shocks to examine the IRF.

The following vector presents the order of variables that is used for the subsequent analysis.

$$Y_t = (INV_t, SAV_t, AW_t, GX_t, NX_t, UN_t, SMD_t, INN_t) = (MED_t, SMD_t, INN_t) \tag{8}$$

where INV_t is private investment, SAV_t is domestic savings, AW_t is income distribution, GX_t is productivity growth, NX_t is net export, UN_t is unemployment, MED_t is macroeconomic development $MED_t = (INV_t, SAV_t, AW_t, GX_t, NX_t, UN_t)$, SMD_t is SME stock market development, and INN_t is innovation.

The vector is written in the following SVEC representation:

$$\Delta Y_t = \Pi Y_{t-1} + \Gamma_1 \Delta Y_{t-1} + \cdots + \Gamma_{p-1} \Delta Y_{t-p+1} + B\varepsilon_t \tag{9}$$

To exploit the information on the underlying structural shocks, the Beveridge-Nelson moving average representation of the vector Y_t is used and written as

$$Y_t = \Xi \sum_{i=1}^{t} u_i + \sum_{j=0}^{\infty} \Xi_j^* u_{t-j} + Y_0^* \tag{10}$$

where the first term on the right-hand side is the common trends of the system Y_t, the second term is zero order of integration and Ξ_j^* converge to 0 as $j \to \infty$, the last term is the initial values. In modelling an SVEC, the common trends are the key driver of the system Y_t since they capture the long-term effects of shocks. The matrix Ξ is of reduced rank $K - r$ and is defined as

$$\Xi = \beta_\perp \left[\alpha_\perp^\top \left(I_k - \sum_{i=1}^{p-1} \Gamma_i \right) \beta_\perp \right]^{-1} \alpha_\perp^\top \tag{11}$$

The contemporaneous effects of the structural innovations are determined by the matrix B whereas the long-run effects of the structural errors are captured by the matrix ΞB. For the SVEC model identification, a number of $K(K-1)/2$ restrictions are required wherein at least a number of $r(r-1)/2$ restrictions must be imposed on the short-run matrix B.

6. Data and variables definition

Data employed in this research are a set of indicators representing the development of macroeconomics, SME stock market, and innovation. The data were retrieved from National Statistics, International Financial Statistics, World Bank Database and Bloomberg Database during 2009:M7 and 2016:M12 for Hong Kong, Singapore, Thailand, and Malaysia. All data have been adjusted for seasonality and frequency conversion technique (sum or average) was applied where appropriate to generate monthly series for data that are only available in quarterly or annually. Table 3 presents the list of variables used and their definitions.

Table 3: Definition of Variables

Variable	Notation	Definition
Macroeconomic indicator	INV	Private Investment = [stock of physical capital + (1 – the rate of capital depreciation) x net fixed capital formation] / stock of physical capital
	SAV	*Saving rate* is normalised by physical capital stock
	AW	Income distribution = [1 – (wage rate x labour force / GDP)] * indicator of capacity utilisation
	GX	Productivity growth= growth rate of (nominal GDP / labour force)
	NX	Net Export is normalised by nominal GDP
	UN	The rate of unemployment
SME stock market indicator	SCAP	SME stock market capitalisation is normalised by nominal GDP.
	STRA	SME stock market traded value is normalised by nominal GDP.
	STUR	SME stock market turnover ratio = market traded value / market capitalisation
Innovation Indicator	PTA	Number of (residents and non-resident) patent applications Patent applications per thousand labours
	TMA	Number of (residents and non-resident) trademark applications per thousand labours
	HTE	The volume of high-technology export normalised by nominal GDP

7. Empirical results

This section presents the empirical estimation of an SVEC model and an impulse response analysis based on the assumptions of short-run restrictions and the outcomes of cointegration and block exogeneity tests for the selected economies: Hong Kong, Singapore, Thailand, and Malaysia.

7.1 *Stationarity*

To avoid fallacies which allow shocks in the system of equations to accumulate over time, leading to permanent effects, all variables were tested for stationarity before fitting into an SVEC model. Unit root tests such as Augmented Dickey and Fuller (1981), Phillips and Perron (1988), and Ng and Perron (2001) were performed in both orders of integration I(0) and I(1). The results show that the null hypothesis of a unit root (non-stationarity) cannot be rejected for most of variables at I(0), but it can be easily rejected for all variables at I(1) for all cases (see Appendices A and B). This indicates that all variables were integrated at first difference and their first order of integration should be applied in succeeding analysis.

7.2 *Lag length*

Selection of appropriate lag order is an essential part of the analysis of VAR/VEC models because it eliminates any serial correlation from the residuals and avoid over-parameterisation in the system which leads to losing an important degree of freedom for estimation purposes. A symmetric lag order or a similar lag order is set up for all variables in all equations of the model. Table 4 shows that 3 out of 5 criteria (LR, FPE, and AIC) consistently selected lag 4 for the cases of Hong Kong, Singapore, and Thailand and lag 3 for the case of Malaysia. Therefore, a VAR/VEC model with lag 4 was established for Hong Kong, Singapore, and Thailand and that with lag 3 for Malaysia.

Table 4: Lag order selection criteria

Lag	Hong Kong	Singapore	Thailand	Malaysia
0	SC	SC	SC, HQ	SC
1	HQ	-	-	HQ
2	-	-	-	-
3	-	HQ	-	LR, FPE, AIC
4	LR, FPE, AIC	LR, FPE, AIC	LR, FPE, AIC	-

Notes: LR is sequentially modified likelihood ratio test statistic (each test at 5% level); FPE is Final Prediction Error; AIC is Akaike Information Criterion; SC is Schwarz Information Criterion; HQ is Hannan-Quinn Information Criterion. Numerical statistics are reported in Appendix C.

7.3 *Cointegration analysis*

Since all macroeconomic and financial variables for four cases were stationary at I(1), cointegration relationships may exist between the variables. Cointegration relationship can be interpreted as a long-run equilibrium relationship in which variables are likely to exhibit co-movement in the long run. To test for this relationship, Johansen (1991, 1995) cointegration rank test was performed. The method was developed to identify the number of cointegrating vectors and cointegration ranks based on maximum likelihood estimation for the coefficient matrix of a VAR model. The test also included various deterministic trend assumptions of variables (i.e. linear and quadratic). The test results are reported in Table 5, showing the presence of cointegration relationships among the variables for all four cases. Thus, a VEC model that incorporates an error correction term is a good fit for the cointegrated variables. The results, as expected, confirmed our theoretical model specification which is described in Section 5.

Table 5: Identification of Johansen Cointegrating Equations

	Hong Kong		Singapore		Thailand		Malaysia	
Statistic	Trace	Max-Eigen	Trace	Max-Eigen	Trace	Max-Eigen	Trace	Max-Eigen
No. of Cointegrating Equation(s)	5	4	4	3	4	4	4	3

Notes: Trace statistic and Max-eigenvalue statistic indicate the number of cointegrating equations at the 5% level of significance. Numerical statistics are displayed in Appendix D.

7.4 *Block exogeneity and multicollinearity issue*

Exogeneity issue may cause SVEC model to become too restrictive and that may distort the true relationships between the variables in the system (Huh, 2005). To test for the presence of this issue, the Block Exogeneity Wald test was conducted. As shown in Table 6, the exogeneity assumption was rejected for all macroeconomic indicators and most of the indicators of SME stock market development and innovation across the four countries. While market capitalisation, traded value, turnover ratio are endogenous variables in the cases of Hong Kong, Singapore, and Thailand, only the last two variables are endogenous in the case of Malaysia. Regarding innovation indicators, patent applications (in Singapore and Malaysia), trademark applications (in Hong Kong, Thailand, and Malaysia), and high-technology exports (in Hong Kong) are valid to be included in the system. These variables are eligible for shock imposition to analyse the impulse response function.

Table 6: Block Exogeneity Wald test

		Hong Kong	Singapore	Thailand	Malaysia
Variable	Notation	Chi-sq (df = 4)	Chi-sq (df = 5)	Chi-sq (df = 5)	Chi-sq (df = 5)
Private investment	INV	68.27**	97.39*	104.77*	41.78*
Domestic savings	SAV	75.26*	182.00*	94.02*	58.80*
Income distribution	AW	61.20**	199.95*	113.68*	81.45*
Productivity growth	GX	70.27*	161.44*	88.13*	88.81*
Net exports	NXY	60.95**	90.49*	155.94*	44.37*
Unemployment	UN	106.44*	128.38*	121.89*	39.51**
SME stock market capitalisation	SCAP	106.54*	120.51*	178.35*	23.32
SME stock market traded value	STRA	87.30*	152.00*	91.25*	30.97***
SME stock market turnover ratio	STUR	86.05*	149.90*	97.82*	31.33***
No. of patent applications	PTA	48.48	170.52*	42.73	53.55*
No. of trademark applications	TMA	65.69**	40.76	130.14*	60.46*
High-technology exports	HTE	59.66***	49.70	75.17	33.38

Notes: *, **, *** represent 1%, 5%, and 10% level of significance, respectively

Multicollinearity is also an issue that needs to be tested when modelling an SVEC model because it may reduce the statistical power of the analysis. While moderate multicollinearity may not raise a concern, serious multicollinearity really does as it can increase the variance of the coefficient estimates and cause the coefficient estimates to switch signs. The resulting estimates thus become very sensitive to small changes in the model and difficult to interpret. The Variance Inflation Factors (VIF) was conducted to test whether introducing the endogenous indicators of SME stock market and innovation into the model leads to multicollinearity issue.

The general rule of assessment is that a VIF of 1 means no correlation among independent variables, a VIF of greater than 4 requires further investigation, and a VIF of greater than 10 signals serious multicollinearity which requires correction. As reported in Appendix E, the VIFs for all endogenous indicators of macroeconomics, SME stock market development and innovation across the four countries were lower than 2. This indicates no serious multicollinearity issues in the modelling and all of the endogenous variables are valid for further analysis.

7.5 *Residuals diagnosis and model stability*

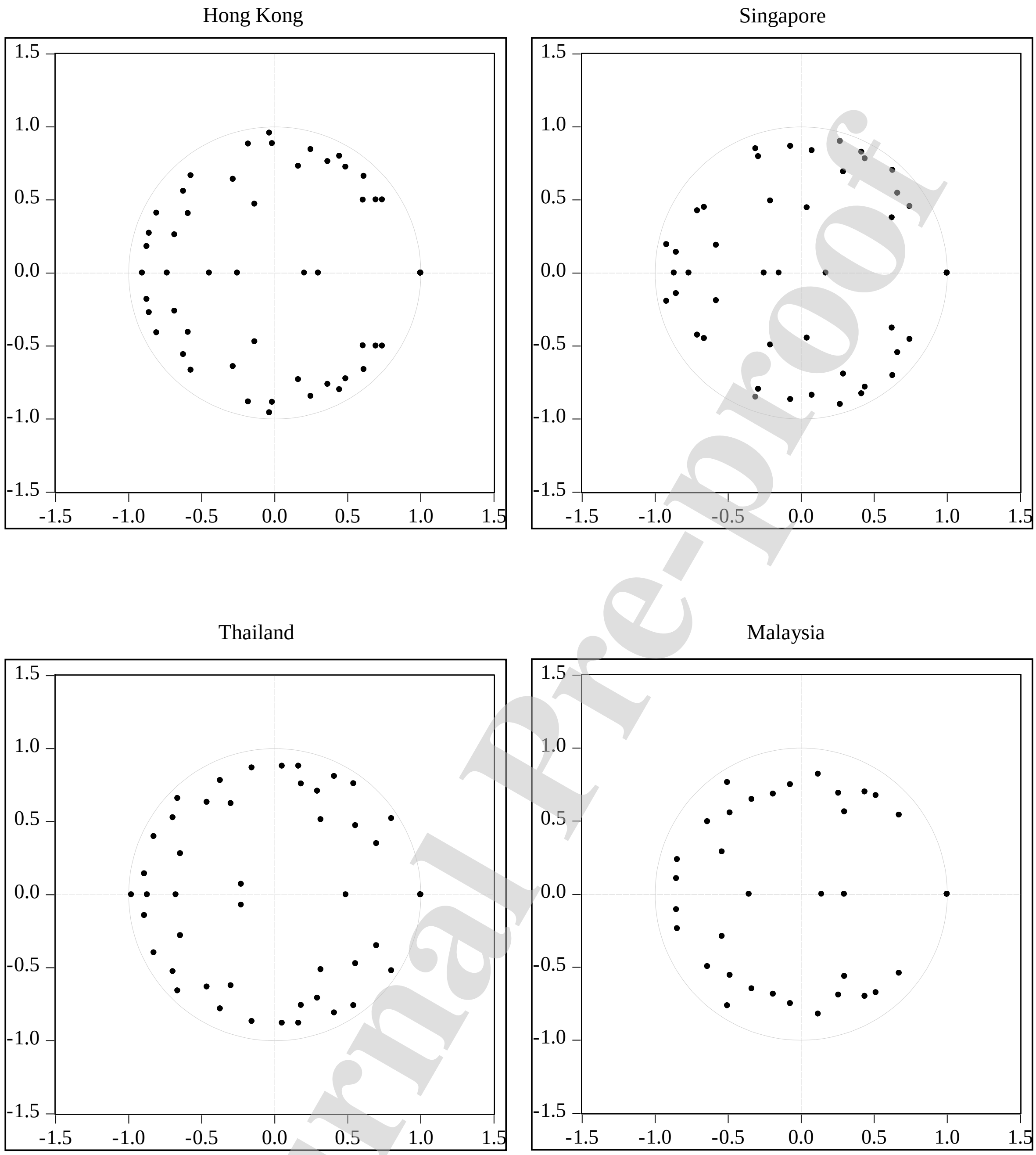
Following the results of cointegration analysis, lag order selection, and block exogeneity test, VEC models were established for a set of identified endogenous variables for each of the selected countries. The presences of serial correlation, non-normality, and heteroscedasticity in the residuals are indications of serious model misspecification. Therefore, model residuals diagnosis were conducted and reported in Table 7. The results of serial correlation Lagrange Multipliers test reveal that all models have zero autocorrelation in residuals up to lag 12. The results of normality joint test and heteroscedasticity joint test show that residuals of all models are normally distributed, homoscedastic and independent with the regressors. Accordingly, given the satisfaction of the three conditions on residuals, the models used in each country are well-specified.

Table 7: VEC residual diagnostics

	Hong Kong		Singapore		Thailand		Malaysia	
VEC Residual Serial Correlation Lagrange Multipliers Tests								
Lag	Rao F-stat	P-value	Rao F-stat	P-value	Rao F-stat	P-value	Rao F-stat	P-value
2	0.866	0.790	1.049	0.409	0.875	0.740	76.638	0.960
4	0.879	0.764	0.955	0.589	0.935	0.627	102.049	0.424
6	0.976	0.553	1.056	0.398	0.924	0.650	91.009	0.729
8	0.861	0.798	0.785	0.881	1.226	0.169	81.492	0.912
10	0.880	0.763	1.064	0.383	0.835	0.806	101.253	0.446
12	1.176	0.180	1.054	0.400	0.933	0.632	102.396	0.415
VEC Residual Normality Tests								
Joint test:	Jarque-Bera	P-value	Jarque-Bera	P-value	Jarque-Bera	P-value	Jarque-Bera	P-value
	28.522	0.159	14.950	0.779	23.711	0.255	13.621	0.849
VEC Residual White Heteroscedasticity Tests (Levels and Squares)								
Joint test:	Chi-sq	P-value	Chi-sq	P-value	Chi-sq	P-value	Chi-sq	P-value
	4,920.86	0.352	3,642.56	0.438	3,731.34	0.537	3,796.55	0.255

The model stability was also examined using the inverse roots of autoregressive characteristic polynomial. The stability condition holds when all inverse roots of the VEC models stay in or on the circle rather than outside. As depicted in Figure 2, this condition was not violated in all four cases, indicating that our VEC models are covariance-stationary.

Figure 2: VEC stability condition – Inverse roots of AR characteristic polynomial



7.6 *SVEC matrices estimation*

Since the VEC models satisfied all conditions for white noise residuals and covariance stationarity (Section 7.5), SVEC models were estimated using a lower triangular Cholesky factorisation approach. Following the Cholesky ordering of variables (Section 5) and the results of block exogeneity tests (Section 7.4), SVEC matrices were identified for each case study wherein only endogenous variables were included in the matrices. Accordingly, the structure of the matrices appear as follows:

Hong Kong: $\Delta Y_t = (MED_t, SCAP_t, STRA_t, STUR_t, TMA_t, HTE_t)$ (12)

Singapore: $\Delta Y_t = (MED_t, SCAP_t, STRA_t, STUR_t, PTA_t)$ (13)

Thailand: $\Delta Y_t = (MED_t, SCAP_t, STRA_t, STUR_t, TMA_t)$ (14)

Malaysia: $\Delta Y_t = (MED_t, STRA_t, STUR_t, PTA_t, TMA_t)$ (15)

where $MED_t = (INV_t, SAV_t, AW_t, GX_t, NX_t, UN_t)$. All other variables were defined in Table 3.

The results (reported in Appendix F) appear to confirm the theoretical model (extensively discussed in Section 4), showing that investment effectively promotes productivity growth and net export in Hong Kong, Singapore and Thailand. Domestic savings is positively affected by investment in all four countries as the theory predicts, such that productive investments essentially foster the mobilisation of savings. Investment and unemployment are negatively related in Singapore as investment creates more job opportunities. Positive effect of investment on profit share or income distribution in Hong Kong and Singapore indicates a profit-led system of capital accumulation in the two economies.

Savings affect income distribution through the marginal propensity to save, which is higher for capitalists and lower for workers. It is observed that Hong Kong shows a positive effect while Thailand and Malaysia experience a negative effect, suggesting that the marginal propensity to save of developed/ developing economies increases/decreases with the level of savings. Productivity positively correlates with the level of savings in Hong Kong and Singapore since the technology improvements in the countries were effectively funded by savings. In Malaysia, it seems that technological progress does not keep up with growing demand for output, thereby instigating unemployment. The last four rows of the estimated matrices indicate contemporaneous relationships among SME stock market development, innovation, and key macroeconomic variables in all four countries.

7.7 *SVEC impulse response analysis*

In the impulse response analysis of SVEC system, Cholesky one standard deviation shocks were only imposed on endogenous indicators of macroeconomic, SME stock market and innovation (as identified in Section 7.4). The responses of private investment, savings, productivity and unemployment to shocks on SME stock market and innovation are the main areas of interest since these functions were theoretically extended with the two new variables (discussed in Section 4). Figures 3 to 6 display the impulse response functions for the selected economies during 30 months ahead. The response is statistically significant at a specified level if the confidence interval does not contain zero. In the graphs, the grey lines signify the response of the variable to the imposition of Cholesky one standard deviation, while the red lines represent the bootstrapped 95% confidence interval of error bands.

Regarding the case of Hong Kong, shocks in the GEM market capitalisation and trademark applications have investment and savings increased in the first quarter. The response of productivity growth to shocks in the GEM market turnover and trademark applications is significant and positive for over a quarter before the impact is fully absorbed by the system. However, productivity growth shows a lag of 4 months before begins to react to the external shock imposed on the GEM market traded value and high-technology export. The results indicate that the eventual response lingers for about a quarter before it becomes statistically insignificant. Shocks imposed on trademark applications, leads to decline in unemployment rate for a short time, but it bounces back rather quickly to pre-shock levels. These findings are in line with Nguyen et al. (2020) that finds innovation effectively impacts the main drivers of economic growth.

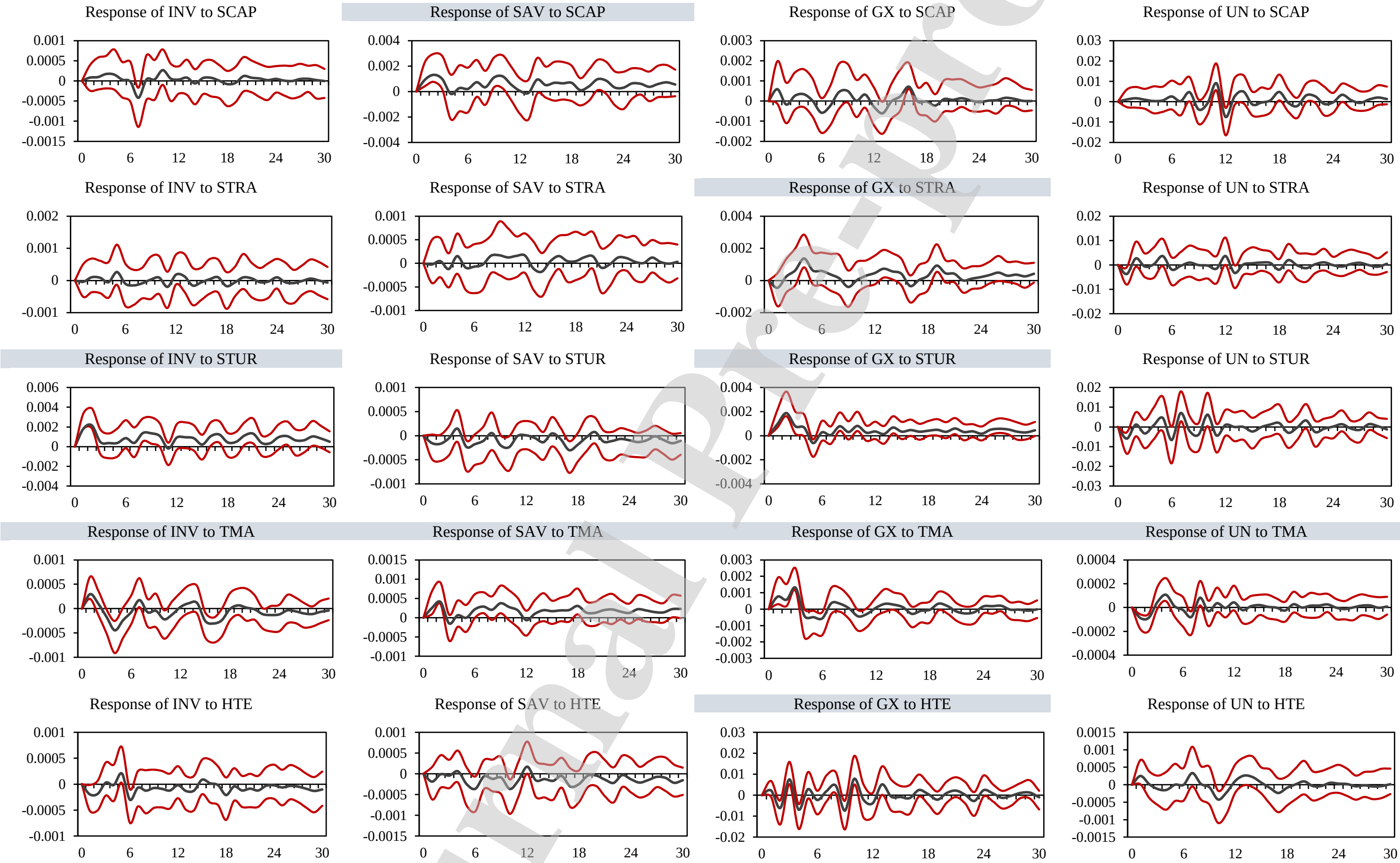
In the case of Singapore, investment is likely to react instantly to a shock in the CATALIST market traded value for 2 months ahead while its reaction to a shock in patent applications only begins after 3 months and lasts for around 3 months. Savings also exhibit positive feedback for 2-3 months after the shocks in the market turnover ratio and patent applications. Productivity growth instantly responds to a shock in the market capitalisation up to 4 months but does not respond to a shock in the market turnover ratio until the 5^{th} month and lasts for about a quarter. The impact of a shock in patent applications on productivity growth is satisfying with an increase without any delay. As expected, a growing number of patent applications negatively affects the unemployment rate as more patent applications are filed, more job opportunities become available, thus bringing unemployment down.

As for the case of Thailand, investment appears to react instantly to a shock in the MAI market turnover ratio and trademark applications within the first 2 quarters. Savings react to shocks in the market capitalisation and trademark applications up to just couple of months. The impacts of shocks in the market capitalisation and trademark applications on productivity growth are immediate rises as no surprise. In response to a shock in trademark applications, unemployment is likely to show some significant up- and down-trends within a quarter. Unlike the previous cases, all considered macro-economic functions in Malaysia (i.e. investment, savings, productivity growth, and employment) seem to have insignificant reactions to shocks in the ACE market development indicators (i.e. market capitalisation, traded value, and turnover ratio). Nonetheless, they significantly react to a shock in trademark applications, such that after the shock, investment and savings show instant increases and unemployment shows an instant decline while productivity growth exhibits some delays in response.

Overall, the results show that at 5% level of significance, shocks to SME stock market development and/or innovation indicators induce small but positive feedbacks in various sources of economic growth in Hong Kong, Singapore, Thailand, and Malaysia. As such, shocks to indicators of SME stock market development trigger responses of private investment, domestic savings, and productivity growth functions in Hong Kong, Singapore, and Thailand. On the other hand, shocks to innovation indicators initiate reactions of these functions plus employment functions in all four countries. The positive responses appear to be statistically significant in the short run only.

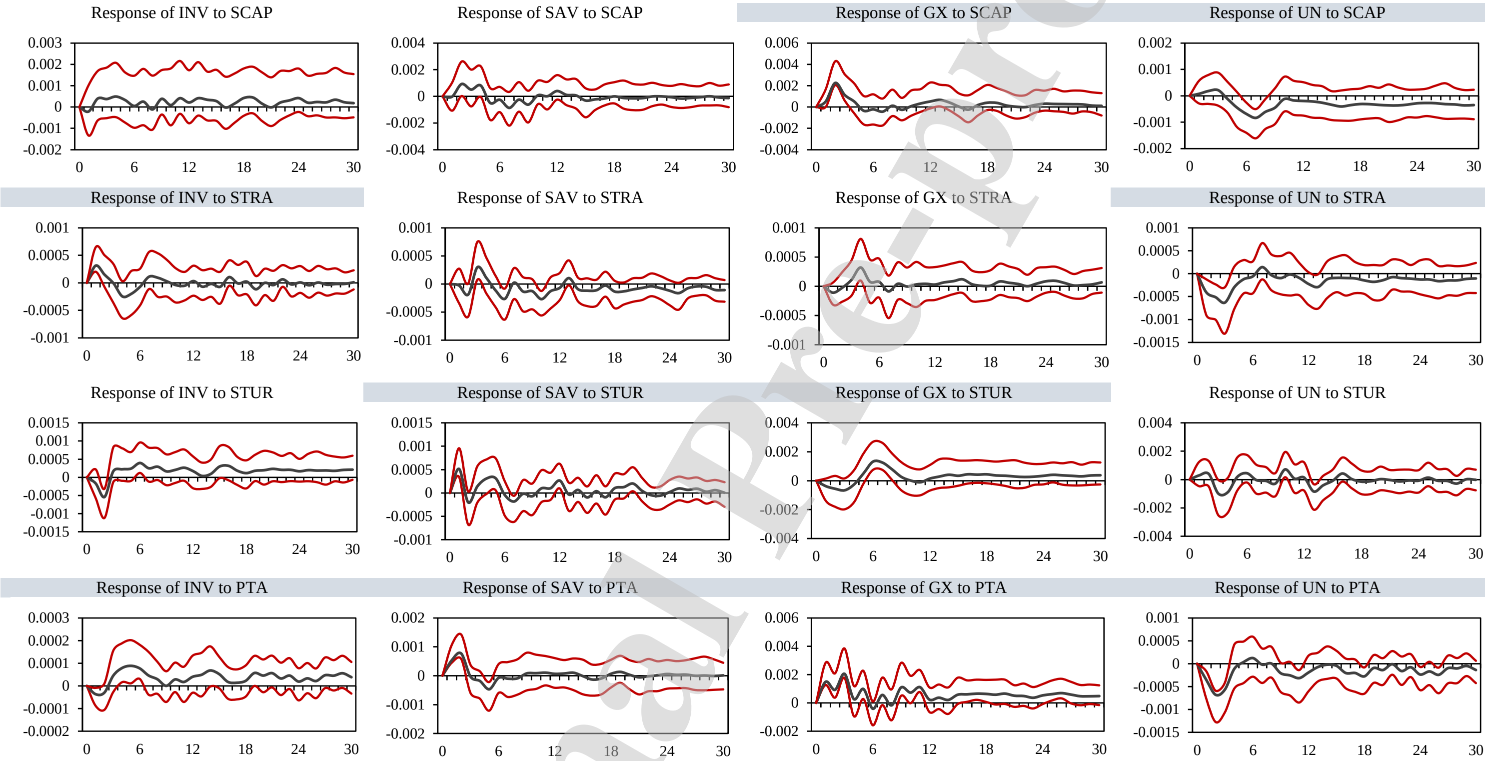
The small contribution of the SME stock markets to economic development is perhaps due to the fact that these stock markets are still at an early stage of development. As reported in Table 1, the market capitalisation and traded value exhibit a modest range of the proportion of GDP: 2.3%-12.6% and 1.7%-6.0%, respectively. In terms of innovation, the number of patent applications and trademark applications currently account for a very small portion of the labour forces from 0.02% to 0.9%. Regarding high-technology exports' contribution to GDP, Singapore is leading the pace with 42.5%, followed by Malaysia (18.8%), Thailand (8.5%), and Hong Kong (0.1%). Nevertheless, this indicator was treated endogenously in the model for the case of Hong Kong only. Therefore, innovation just shows a small impact on various macroeconomic channels.

Figure 3: Impulse response analysis for orthogonal shocks to SME stock market development and innovation in Hong Kong



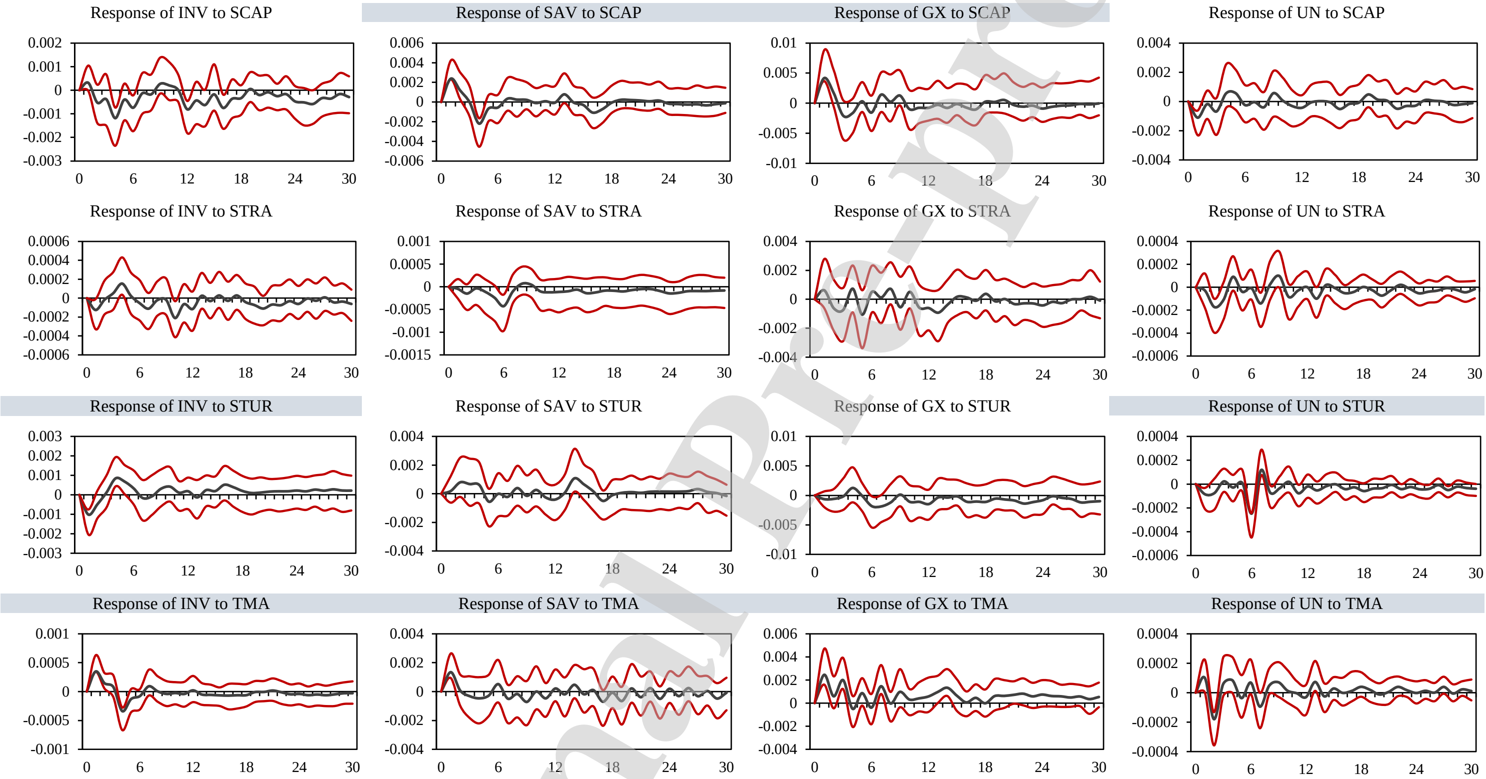
Notes: Grey highlights indicate the IRFs are significant at 5%, INV is investment, SAV is savings, GX is productivity growth, UN is unemployment, SCAP is SME stock market capitalization, STRA is SME stock market traded value, STUR is SME stock market turnover, TMA is the number of trademark applications, and HTE is high-technology exports.

Figure 4: IRF for orthogonal shocks to SME stock market development and innovation in Singapore



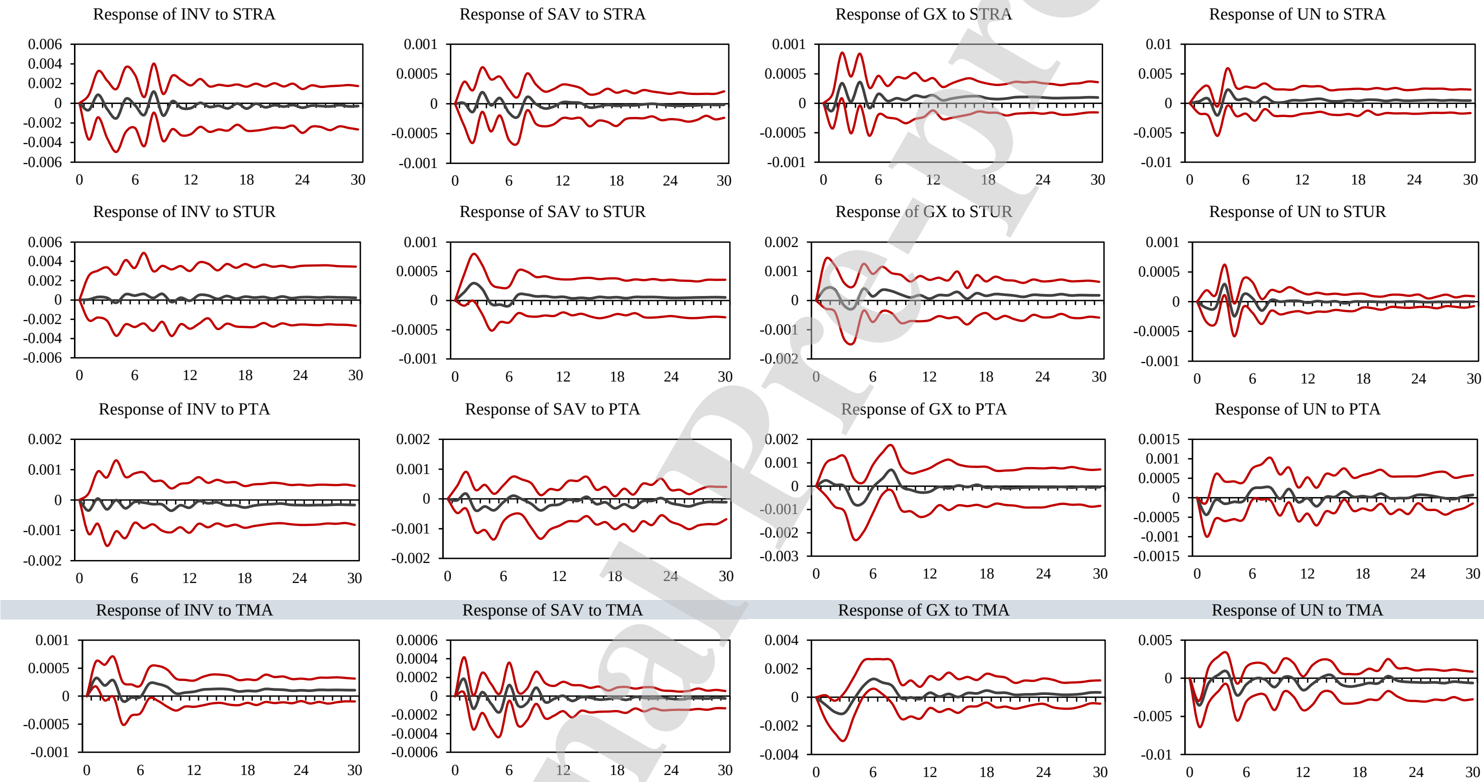
Notes: Grey highlights indicate the IRFs are significant at 5%, INV is investment, SAV is savings, AW is income distribution, GX is productivity growth, NXY is net export, UN is unemployment, SCAP is SME stock market capitalization, STRA is SME stock market traded value, STUR is SME stock market turnover, and PTA is the number of patents applications.

Figure 5: IRF for orthogonal shocks to SME stock market development and innovation in Thailand



Notes: Grey highlights indicate the IRFs are significant at 5%, INV is investment, SAV is savings, GX is productivity growth, UN is unemployment, SCAP is SME stock market capitalization, STRA is SME stock market traded value, STUR is SME stock market turnover, and TMA is the number of trademark applications.

Figure 6: IRF for orthogonal shocks to SME stock market development and innovation in Malaysia



Notes: Grey highlights indicate the IRFs are significant at 5%, INV is investment, SAV is savings, GX is productivity growth, UN is unemployment, STRA is SME stock market traded value, STUR is SME stock market turnover, PTA is the number of patents applications, and TMA is the number of trademark applications.

8. Conclusions and potential future research

This paper extended the Kaleckian-Post-Keynesian theoretical model of growth and distribution in an open economy to investigate the dynamic effects of SME stock market development and innovation on different channels of growth. Accordingly, the indicators of SME stock market development and innovation were integrated into the functions of private investment, domestic savings, productivity growth and employment. Hong Kong, Singapore, Thailand, and Malaysia, which are recognised as Asian Tigers and Tiger Cubs, were selected for empirical study. For the analysis of the simultaneous interactions among the variables, an SVEC model and an impulse response function were used based on the assumptions of short-run restrictions only.

The results determined that various indicators of SME stock market development and/or innovation have small but positive contributions to economic stimulation in the short run in the four countries. The development of SME stock market influences growth process in Hong Kong, Singapore, and Thailand through the combination of following channels: private investment, domestic savings, and productivity growth. Meanwhile, innovation affects growth through the combination of those channels and employment channel in all four economies. Consequently, if the governments provide specific policies that promote the development of SME stock markets and/or innovation, they could potentially induce effective circles of growth in private investment, savings, productivity and employment. Firms would thus find it relatively trouble-free to gain access to capital and technological innovation in order to capture and satisfy an increase in aggregate demand. Additionally, with respect to theoretical and methodological grounds, inclusion of SME stock market development and innovation into the Kaleckian model of growth and distribution not only enhances the model specification but also broaden the theoretical framework of Kaleckian-Post-Keynesian economics.

And finally, governments can facilitate the development process of SME stock markets and innovation possibly by sustaining full employment and real wage rate. As such, when employment and real wage rate are secured, the liquidity preferences of firms and individuals are stabilised. This, consequently, affects income distribution and increases the level of savings, which can then be mobilised into productive investments in the SME stock market and innovation. Therefore, for future research, it is worthwhile to explore the impact of government support on the contribution of SME stock market and innovation to the process of economic development.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A: Stationarity tests for Hong Kong and Singapore

Variables	INV	SAV	AW	GX	NXY	UN	SCAP	STRA	STUR	PTA	TMA	HTE	INV	SAV	AW	GX	NXY	UN	SCAP	STRA	STUR	PTA	TMA	HTE
	Level 0 [$I(0)$]												Level 1 [$I(1)$]											
	Hong Kong																							
ADF																								
C	-2.0	-1.7	-1.7	-2.2	-2.2	-3.5**	-0.9	-2.8***	-2.4	-1.1	-1.9	-1.0	-3.9*	-3.6*	-4.5*	-3.9*	-12.5*	-6.2*	-7.3*	-7.6*	-7.4*	-5.7*	-5.5**	-4.1*
C&T	-2.0	-1.0	-1.1	-1.8	-2.1	-2.5	-1.6	-2.8	-2.5	-1.1	1.0	-2.2	-3.9**	-3.9**	-4.7*	-3.6**	-12.5*	-7.2*	-7.3*	-7.6*	-7.4*	-5.8*	-5.6*	-5.6*
PP																								
C	-2.6	-1.1	-1.6	-5.0*	-5.8*	-4.1*	-1.0	-3.2**	-2.6***	-1.0	-2.6	-0.8	-4.3*	-14.9*	-4.4*	-5.1*	-21.4*	-11.3*	-15.3*	-7.6*	-10.5*	-5.9*	-3.2**	-5.7*
C&T	-2.6	-1.5	-1.0	-4.9*	-5.6*	-3.2***	-1.7	-3.2	-2.8	-1.0	1.0	-2.2	-4.3*	-18.7*	-4.6*	-5.0*	-21.4*	-8.1*	-15.6*	-7.5*	-10.4*	-6.0*	-5.6*	-5.7*
NP - C																								
MZ_α^d	-4.8	-1.9	-0.5	-2.5	-4.0	-1.3	-1.4	-15.6*	-3.6	-1.4	-1.2	0.4	-52.2*	-33.1*	-30.8*	-21.5*	-25.2*	-23.0*	-35.4*	-41.1*	-19.8*	-36.9*	-7.8**	-27.9*
MZ_t^d	-1.5	-1.0	-0.3	-1.0	-1.4	-0.7	-0.5	-2.8*	-1.2	-0.4	-0.7	0.3	-4.9*	-4.1*	-3.4*	-3.2*	-3.5*	-3.1*	-4.2*	-4.5*	-3.1*	-4.2*	-1.7**	-3.7*
MSB^d	0.3	0.5	0.6	0.4	0.4	0.5	0.4	0.2**	0.3	0.3	0.6	0.8	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.2*	0.1*	0.2**	0.1*
MP_T^d	5.2	12.7	24.3	9.0	6.1	16.1	11.8	1.6*	6.8	9.5	19.2	43.5	0.9*	0.8*	2.2**	1.5*	1.0*	2.2**	0.7*	0.6*	1.2*	0.9*	4.0**	0.9*
NP - C&T																								
MZ_α^d	-5.3	-3.1	-13.3	-12.3	-6.1	-1.1	-5.6	-16.1***	-7.7	-4.2	-7.0	-9.0	-39.6*	-34.5*	-29.7*	-31.7*	-29.4*	-36.2*	-36.8*	-41.5*	-43.6*	-40.0*	-34.7*	-34.3*
MZ_t^d	-1.6	-1.2	-2.4	-2.5	-1.6	-0.5	-1.6	-2.8***	-2.0	-1.2	-1.6	-2.1	-4.4*	-4.2*	-3.5*	-3.8*	-3.8*	-4.2*	-4.3*	-4.6*	-4.7*	-4.5*	-4.1*	-4.1*
MSB^d	0.3	0.4	0.2	0.2	0.3	0.5	0.3	0.2***	0.3	0.3	0.2	0.2	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*
MP_T^d	17.0	28.3	8.0	7.4	14.9	47.2	16.2	5.7***	11.8	19.9	13.4	10.3	2.6*	2.6*	4.9**	3.8**	3.1*	3.1*	2.5*	2.2*	2.1*	2.4*	2.7*	2.7*
	Singapore																							
ADF																								
C	-0.8	0.3	0.6	-3.0**	-2.1	-1.8	-1.6	-2.0	-2.0	-1.4	-0.6	-1.2	-3.2**	-3.8*	-3.9*	-3.8*	-5.8*	-5.2*	-10.2*	-9.8*	-9.7*	-7.6*	-10.3*	-4.7*
C&T	-0.8	-0.1	-4.4	-2.3	-2.1	-1.0	-1.8	-1.8	-2.0	-1.4	-2.3	-2.0	-5.2*	-5.8*	-4.3*	-4.9*	-5.9*	-5.6*	-10.1*	-9.7*	-9.7*	-7.7*	-10.5*	-6.6*
PP																								
C	-1.6	-2.1	-0.7	-2.0	-2.5	-8.0*	-1.6	-2.5	-3.6*	-1.6	-2.0	-0.6	-7.3*	-5.6*	-5.2*	-4.6*	-5.9*	-6.2*	-10.2*	-9.8*	-12.6*	-4.0*	-5.1*	-5.8*
C&T	-2.3	-1.6	-3.1	-2.6	-2.4	-5.4*	-1.8	-2.5	-3.6**	-1.8	-3.2	-2.0	-10.2*	-6.3*	-5.3*	-4.5*	-6.0*	-5.7*	-10.1*	-9.7*	-12.5*	-3.9**	-5.0*	-5.8*
NP - C																								
MZ_α^d	-3.3	-1.7	-0.9	-3.0	-1.5	-0.2	-2.6	-5.5	-4.5	-3.5	1.1	-0.5	-16.2*	-26.6*	-13.4**	-13.2*	-10.2**	-27.2*	-21.8*	-29.3*	-42.2*	-35.5*	-10.5**	-19.8*
MZ_t^d	-1.2	-0.9	-0.5	-1.2	-0.9	-0.2	-1.1	-1.6	-1.4	-1.3	0.8	-0.2	-2.8*	-3.4*	-2.5**	-2.5*	-2.2**	-3.6*	-3.2*	-3.8*	-4.6*	-4.2*	-2.3**	-3.0*
MSB^d	0.4	0.5	0.5	0.4	0.6	1.1	0.4	0.3	0.3	0.4	0.8	0.4	0.2*	0.1*	0.2**	0.2*	0.2**	0.1*	0.1*	0.1*	0.1*	0.1*	0.2**	0.2*
MP_T^d	7.4	13.4	16.2	8.2	16.0	60.3	9.3	4.5	5.6	7.1	44.2	13.9	1.7*	1.7*	2.3**	2.1*	2.8**	1.0*	1.3*	0.9*	0.6*	0.7*	2.3**	1.7*
NP - C&T																								
MZ_α^d	-4.8	-2.1	-2.6	-4.9	-1.7	-0.7	-7.2	-5.7	-6.1	-3.8	-7.9	-7.2	-76.3*	-33.8*	-32.5*	-31.2*	-36.7*	-33.9*	-34.1*	-38.3*	-68.5*	-58.2*	-20.5**	-29.4*
MZ_t^d	-1.5	-0.6	-1.0	-1.5	-0.7	-0.4	-1.8	-1.7	-1.7	-1.4	-2.0	-1.8	-6.2*	-4.0*	-4.0*	-3.9*	-4.2*	-4.1*	-4.1*	-4.4*	-5.9*	-5.4*	-3.1**	-3.8*
MSB^d	0.3	0.3	0.4	0.3	0.4	0.5	0.3	0.3	0.3	0.4	0.3	0.3	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.2**	0.1*
MP_T^d	18.5	25.1	32.7	18.2	40.1	57.8	12.9	15.9	15.0	24.1	11.6	12.7	1.3*	3.5*	2.9*	3.3*	2.8*	2.7*	2.7*	2.4*	1.3	1.6*	5.0**	3.2*

Notes: *, **, *** represent 1%, 5%, and 10% level of significance, respectively; INV is investment, SAV is savings, AW is income distribution, GX is productivity growth, NXY is net export, UN is unemployment, SCAP is SME stock market capitalization, STRA is SME stock market traded value, STUR is SME stock market turnover, PTA is the number of patents applications, TMA is the number of trademark applications, HTE is high-technology exports; C represents constant; C&T represents constant and trend; $MZ_\alpha^d, MZ_t^d, MSB^d$ and MP_T^d represent the four test statistics of the Ng-Perron unit root test.

Appendix B: Stationarity tests for Thailand and Malaysia

Variables	INV	SAV	AW	GX	NXY	UN	SCAP	STRA	STUR	PTA	TMA	HTE	INV	SAV	AW	GX	NXY	UN	SCAP	STRA	STUR	PTA	TMA	HTE
	Level 0 [I(0)]												Level 1 [I(1)]											
Thailand																								
ADF																								
C	-2.5	0.6	-1.4	-3.1**	-1.6	-2.3	-0.2	-2.1	-3.5*	-1.9	-1.3	-1.8	-5.6*	-4.7*	-8.2*	-7.3*	-3.7*	-10.2*	-8.0*	-13.4*	-13.2*	-5.5*	-9.7*	-7.1*
C&T	-2.5	-0.9	-3.0	-3.1	-2.5	-2.2	-1.8	-2.4	-3.6**	-1.6	-1.6	-1.5	-5.6*	-7.2*	-8.3*	-7.3*	-3.7**	-8.5*	-7.9*	-13.3*	-13.2*	-5.5*	-9.7*	-7.2*
PP																								
C	-2.5	0.2	-1.8	-3.4**	-1.5	-3.3**	-0.4	-2.4	-4.4*	-0.8	-1.3	-1.8	-4.0*	-6.4*	-6.2*	-7.0*	-5.9*	-18.0*	-8.0*	-14.8*	-12.9*	-5.6*	-9.7*	-6.2*
C&T	-2.5	-1.4	-3.1	-3.4***	-2.1	-3.2***	-2.0	-2.9	-4.4*	-2.1	-1.6	-1.7	-3.9**	-6.6*	-6.2*	-6.9*	-6.1*	-33.2*	-7.9*	-14.7*	-13.0*	-5.6**	-9.7*	-6.2*
NP - C																								
MZ_{α}^{d}	-2.5	0.9	0.9	-5.2	-3.5	-3.3	0.9	6.3	-2.7	-2.6	0.5	-0.4	-12.1**	-36.3*	-28.9**	-17.6*	-40.0*	-37.2*	-41.4*	-23.6*	-35.4*	-10.8**	-39.5*	-32.5*
MZ_{t}^{d}	-0.8	0.4	1.0	-1.4	-1.3	-1.3	0.7	1.7	-0.6	-1.1	0.5	-0.3	-2.3**	-4.3*	-3.8**	-2.9*	-4.4*	-4.3*	-4.5*	-3.4*	-4.2*	-2.3**	-4.4*	-4.0*
MSB^{d}	0.3	0.5	1.1	0.3	0.4	0.4	0.8	0.3	2.3	0.4	1.0	0.6	0.2**	0.1*	0.1**	0.2*	0.1*	0.1*	0.1*	0.1*	0.1*	0.2**	0.1*	0.1*
MP_{T}^{d}	8.4	20.9	75.9	5.2	7.1	7.3	45.4	5.0	6.5	9.3	67.2	24.1	2.5**	0.7*	0.9**	1.7*	0.7*	0.7*	0.7*	1.1*	0.7*	2.4**	0.7*	0.8*
NP - C&T																								
MZ_{α}^{d}	-8.2	-3.0	-1.9	-11.2	-4.5	-3.4	-7.0	-11.4	-11.5	-7.0	-7.4	-4.6	-23.5**	-39.2*	-35.8*	-22.5**	-39.2*	-36.9*	-41.6*	-38.7*	-37.7*	-21.3**	-42.9*	-35.0*
MZ_{t}^{d}	-2.0	-1.0	-0.9	-2.3	-1.5	-1.2	-1.9	-2.4	-1.3	-1.8	-1.7	-1.5	-3.2**	-4.4*	-4.2*	-3.2**	-4.4*	-4.3*	-4.5*	-4.4*	-4.3*	-3.2**	-4.6*	-4.2*
MSB^{d}	0.2	0.4	0.4	0.2	0.3	0.3	0.3	0.2	1.2	0.3	0.2	0.3	0.1*	0.1*	0.1*	0.1**	0.1*	0.1*	0.1*	0.1*	0.1*	0.2**	0.1*	0.1*
MP_{T}^{d}	11.3	26.4	40.0	8.2	20.4	24.7	13.1	8.0	7.2	13.1	12.6	19.5	5.2**	2.3*	2.6*	5.0**	2.5*	2.5*	2.3*	2.4*	2.4*	4.4**	2.1*	2.6*
Malaysia																								
ADF																								
C	-1.5	-0.1	-2.3	-4.4*	-2.2	-2.1	-1.5	-1.4	-1.9	-0.6	-0.5	-2.3	-4.1*	-7.8*	-6.3*	-4.5*	-5.0*	-15.1*	-6.3*	-10.8*	-11.3*	-3.5**	-3.6*	-5.0*
C&T	-2.2	-3.0	-2.2	-4.3*	-3.1	-2.0	-1.9	-1.1	-1.7	-1.0	-2.4	-2.6	-4.1*	-7.9*	-6.2*	-4.5*	-5.0*	-15.2*	-6.3*	-10.7*	-11.3*	-3.6**	-3.7**	-3.9**
PP																								
C	-2.2	-0.3	-2.4	-4.2*	-2.3	-3.7*	-2.1	-1.8	-2.5	-0.5	-0.3	-2.4	-4.8*	-7.8*	-6.4*	-7.7*	-5.1*	-17.1*	-9.4*	-10.8*	-15.5*	-10.5*	-11.0*	-5.0*
C&T	-2.5	-2.4	-2.4	-4.2*	-2.7	-3.6**	-2.5	-2.0	-2.9	-1.3	-1.6	-2.2	-4.7*	-7.9*	-6.3*	-7.4*	-5.1*	-17.6*	-9.4*	-10.7*	-16.9*	-10.9*	-11.0*	-4.9*
NP - C																								
MZ_{α}^{d}	0.7	0.3	1.6	-0.1	0.2	-2.7	-4.4	-3.7	-4.5	-2.2	1.1	-1.6	-17.6*	-15.5*	-22.0*	-22.9*	-23.9*	-38.9*	-44.0*	-22.7*	-13.8*	-31.9*	-39.6*	-19.7*
MZ_{t}^{d}	0.7	0.2	1.4	-0.1	0.1	-1.2	-1.5	-1.3	-1.5	-0.8	0.5	-0.7	-2.9*	-2.8*	-3.2*	-3.4*	-3.4*	-4.4*	-4.7*	-3.4*	-2.6*	-4.0*	-4.4*	-3.1*
MSB^{d}	0.9	0.6	0.9	0.7	0.8	0.4	0.3	0.4	0.3	0.3	0.5	0.4	0.2*	0.2**	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.2**	0.1*	0.1*	0.2*
MP_{T}^{d}	58.6	26.4	59.1	29.6	40.7	9.2	5.5	6.6	5.1	9.1	22.0	11.4	1.5*	1.6*	1.6*	1.1*	1.1*	0.6*	0.6*	1.1*	1.8**	0.9*	0.6*	1.2*
NP - C&T																								
MZ_{α}^{d}	-6.1	-5.2	-1.3	-2.5	-7.0	-3.8	-12.4	-4.3	-7.2	-2.4	-7.2	-13.1	-31.7*	-38.4*	-28.4*	-33.1*	-30.9*	-36.8*	-39.8*	-33.9*	-26.7*	-40.8*	-41.5*	-28.4*
MZ_{t}^{d}	-1.7	-1.6	-0.7	-1.1	-1.8	-1.3	-2.3	-1.3	-1.8	-0.7	-1.8	-2.6	-3.9*	-4.3*	-3.5*	-4.0*	-3.9*	-4.3*	-4.5*	-4.1*	-3.6*	-4.5*	-4.5*	-3.7*
MSB^{d}	0.3	0.3	0.6	0.4	0.3	0.3	0.2	0.3	0.3	0.3	0.2	0.2	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*
MP_{T}^{d}	14.9	17.3	62.5	36.7	13.1	22.5	8.1	19.7	12.9	25.2	12.9	7.0	3.1*	2.6*	5.0*	3.0*	3.0*	2.5*	2.3*	2.7*	3.5*	2.2*	2.3*	3.5*

Notes: *, **, *** represent 1%, 5%, and 10% level of significance, respectively; INV is investment, SAV is savings, AW is income distribution, GX is productivity growth, NXY is net export, UN is unemployment, SCAP is SME stock market capitalization, STRA is SME stock market traded value, STUR is SME stock market turnover, PTA is the number of patents applications, TMA is the number of trademark applications, HTE is high-technology exports; C represents constant; C&T represents constant and trend; $MZ_{\alpha}^{d}, MZ_{t}^{d}, MSB^{d}$ and MP_{T}^{d} represent the four test statistics of the Ng-Perron unit root test.

Appendix C: Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
			Hong Kong			
0	1,867.87	NA	3.80E-27	-43.81	-43.64*	-43.74
1	1,935.06	123.31	1.83E-27	-44.54	-43.34	-44.06*
2	1,969.90	59.01	1.90E-27	-44.52	-42.27	-43.61
3	2,033.21	98.32	1.03E-27	-45.16	-41.88	-43.84
4	2,081.83	68.64*	8.15e-28*	-45.45*	-41.14	-43.72
			Singapore			
0	2,023.79	NA	5.50E-29	-48.04	-47.87*	-47.97
1	2,085.97	114.00	2.96E-29	-48.67	-47.45	-48.18
2	2,099.70	23.21	5.09E-29	-48.14	-45.88	-47.23
3	2,234.40	208.46	5.01E-30	-50.49	-47.19	-49.16*
4	2,274.94	56.95*	4.80e-30*	-50.59*	-46.25	-48.85
			Thailand			
0	1,911.60	NA	7.95E-28	-45.37	-45.20*	-45.30*
1	1,960.35	89.38	5.89E-28	-45.67	-44.46	-45.19
2	1,980.77	34.51	8.64E-28	-45.30	-43.05	-44.40
3	2,055.11	115.06	3.58E-28	-46.22	-42.92	-44.89
4	2,104.27	69.05*	2.79e-28*	-46.53*	-42.19	-44.79
			Malaysia			
0	1,977.41	NA	1.66E-28	-46.94	-46.76*	-46.87
1	2,050.80	134.54	6.83E-29	-47.83	-46.61	-47.34*
2	2,078.23	46.38	8.48E-29	-47.62	-45.37	-46.72
3	2,134.54	87.14*	5.41e-29*	-48.11*	-44.81	-46.78

Notes: * indicates lag order selected by the criterion; LogL is log likelihood; LR is sequentially modified likelihood ratio test statistic (each test at 5% level); FPE is Final Prediction Error; AIC is Akaike Information Criterion; SC is Schwarz Information Criterion; HQ is Hannan-Quinn Information Criterion.

Appendix D: Johansen Cointegration Rank test

Hypothesized	Hong Kong		Singapore		Thailand		Malaysia	
No. of Cointegrating Equation(s)	Trace Statistic	Max-Eigen Statistic	Trace Statistic	Max-Eigen Statistic	Trace Statistic	Max-Eigen Statistic	Trace Statistic	Max-Eigen Statistic
None	417.55*	86.98*	438.02*	125.04*	430.93*	144.48*	375.56*	97.86*
At most 1	330.57*	74.33*	312.97*	92.66*	286.45*	78.10*	277.70*	72.50*
At most 2	256.24*	64.14**	220.31*	65.71*	208.35*	57.82*	205.20*	65.68*
At most 3	192.10*	58.75*	154.61*	51.97	150.53*	55.32*	139.53*	44.18
At most 4	133.34**	37.70	102.64	33.21	95.21	35.95	95.35	40.78
At most 5	95.64	34.28	69.43	24.96	59.26	22.39	54.56	21.55
At most 6	61.36	26.80	44.46	18.46	36.87	18.06	33.01	14.70
At most 7	34.56	14.68	26.01	14.55	18.81	14.35	18.31	9.37
At most 8	19.87	14.17	11.46	11.30	4.46	3.77	8.94	5.24
At most 9	5.70	5.52	0.15	0.15	0.68	0.68	3.69	3.69
At most 10	0.18	0.18	-	-	-	-	-	-

Notes: *, ** indicate that the test statistic is significant at 1% and 5%, respectively.

Appendix E: Variance Inflation Factors (VIF)

Independent variable	Dependant variable										
	Hong Kong										
	INV		SAV		AW		GX		NYX		UN
SAV	1.40	INV	1.11	INV	1.14	INV	1.16	INV	1.14	INV	1.05
AW	1.34	AW	1.36	SAV	1.45	SAV	1.25	SAV	1.46	SAV	1.14
GX	1.45	GX	1.24	GX	1.40	AW	1.32	AW	1.35	AW	1.42
NXY	1.03	NXY	1.05	NXY	1.04	NXY	1.05	GX	1.45	GX	1.28
UN	1.35	UN	1.34	UN	1.29	UN	1.36	UN	1.37	NXY	1.44
SCAP	1.93	SCAP	1.90	SCAP	1.76	SCAP	1.98	SCAP	1.89	SCAP	1.94
STRA	1.59	STRA	1.85	STRA	1.79	STRA	1.75	STRA	1.63	STRA	1.67
STUR	1.64	STUR	1.76	STUR	1.16	STUR	1.54	STUR	1.62	STUR	1.66
TMA	1.36	TMA	1.34	TMA	1.28	TMA	1.28	TMA	1.35	TMA	1.26
HTE	1.15	HTE	1.13	HTE	1.14	HTE	1.16	HTE	1.15	HTE	1.12
	Singapore										
	INV		SAV		AW		GX		NYX		UN
SAV	1.84	INV	1.13	INV	1.15	INV	1.11	INV	1.14	INV	1.05
AW	1.52	AW	1.51	SAV	1.87	SAV	1.62	SAV	1.88	SAV	1.66
GX	1.70	GX	1.52	GX	1.44	AW	1.24	AW	1.51	AW	1.39
NXY	1.10	NXY	1.10	NXY	1.10	NXY	1.09	GX	1.74	GX	1.64
UN	1.36	UN	1.31	UN	1.36	UN	1.38	UN	1.44	NXY	1.07
SCAP	1.85	SCAP	1.84	SCAP	1.85	SCAP	1.84	SCAP	1.85	SCAP	1.85
STRA	1.41	STRA	1.39	STRA	1.67	STRA	1.60	STRA	1.44	STRA	1.32
STUR	1.88	STUR	1.86	STUR	1.91	STUR	1.94	STUR	1.96	STUR	1.86
PTA	1.61	PTA	1.17	PTA	1.61	PTA	1.38	PTA	1.59	PTA	1.60
	Thailand										
	INV		SAV		AW		GX		NYX		UN
SAV	1.27	INV	1.26	INV	1.50	INV	1.24	INV	1.27	INV	1.32
AW	1.40	AW	1.51	SAV	1.32	SAV	1.36	SAV	2.36	SAV	1.36
GX	1.57	GX	1.66	GX	1.52	AW	1.17	AW	2.41	AW	1.38
NXY	1.05	NXY	1.08	NXY	1.09	NXY	1.09	GX	1.68	GX	1.68
UN	1.09	UN	1.07	UN	1.07	UN	1.09	UN	1.08	NXY	1.09
SCAP	1.33	SCAP	1.31	SCAP	1.28	SCAP	1.31	SCAP	1.30	SCAP	1.33
STRA	1.53	STRA	1.53	STRA	1.52	STRA	1.52	STRA	3.52	STRA	1.45
STUR	1.09	STUR	1.09	STUR	1.09	STUR	1.08	STUR	3.09	STUR	1.07
TMA	1.27	TMA	1.12	TMA	1.24	TMA	1.24	TMA	1.27	TMA	1.28
	Malaysia										
	INV		SAV		AW		GX		NYX		UN
SAV	1.20	INV	1.15	INV	1.17	INV	1.16	INV	1.08	INV	1.17
AW	1.45	AW	1.80	SAV	1.08	SAV	1.15	SAV	1.19	SAV	1.23
GX	1.89	GX	1.79	GX	1.52	AW	1.62	AW	1.81	AW	1.46
NXY	1.24	NXY	1.30	NXY	1.19	NXY	1.34	GX	1.91	GX	1.92
UN	1.08	UN	1.08	UN	1.08	UN	1.08	UN	1.05	NXY	1.31
STRA	1.81	STRA	1.74	STRA	1.82	STRA	1.74	STRA	1.83	STRA	1.51
STUR	1.82	STUR	1.69	STUR	1.82	STUR	1.70	STUR	1.82	STUR	1.55
TMA	1.20	TMA	1.18	TMA	1.44	TMA	1.21	TMA	1.12	TMA	1.21
PTA	1.82	PTA	1.79	PTA	1.34	PTA	1.52	PTA	1.81	PTA	1.82

Notes: INV is investment, SAV is savings, AW is income distribution, GX is productivity growth, NX is net export, UN is unemployment, SCAP is SME stock market capitalization, STRA is SME stock market traded value, STUR is SME stock market turnover, PTA is the number of patent applications, TMA is the number of trademark applications, HTE is high-technology exports.

Appendix F: SVEC matrices estimation (short-run restrictions)

Hong Kong	INV	SAV	AW	GX	NX	UN	SCAP	STRA	STUR	TMA	HTE
INV	0.0019	0	0	0	0	0	0	0	0	0	0
SAV	0.0015	0.0052	0	0	0	0	0	0	0	0	0
AW	0.0010	0.0006	0.0024	0	0	0	0	0	0	0	0
GX	0.0026	0.0014	0.0023	0.0053	0	0	0	0	0	0	0
NX	0.0097	−0.0041	0.0117	0.0055	0.0188	0	0	0	0	0	0
UN	0.0000	−0.0001	0.0000	0.0000	0.0002	0.0004	0	0	0	0	0
SCAP	0.0102	0.0161	0.0091	−0.0037	0.0076	0.0078	0.0525	0	0	0	0
STRA	0.0047	0.0041	0.0038	0.0002	0.0021	0.0002	0.0113	0.0094	0	0	0
STUR	0.0023	0.0047	−0.0016	0.0000	0.0018	−0.0004	0.0058	0.0098	0.0030	0	0
TMA	0.0000	0.0005	−0.0006	0.0004	0.0012	0.0004	0.0003	0.0014	0.0005	0.0015	0
HTE	0.00002	0.0000	0.00003	0.0000	0.0000	−0.00002	0.00002	0.0000	0.00002	0.0000	0.0001

Singapore	INV	SAV	AW	GX	NX	UN	SCAP	STRA	STUR	PTA
INV	0.0018	0	0	0	0	0	0	0	0	0
SAV	0.0007	0.0023	0	0	0	0	0	0	0	0
AW	0.0009	0.0000	0.0026	0	0	0	0	0	0	0
GX	0.0029	0.0028	0.0006	0.0065	0	0	0	0	0	0
NX	−0.0002	−0.0008	0.0017	−0.0005	0.0060	0	0	0	0	0
UN	−0.0001	0.0000	0.0000	−0.0001	0.0000	0.0002	0	0	0	0
SCAP	0.0041	0.0030	0.0031	0.0008	0.0006	−0.0021	0.0076	0	0	0
STRA	0.0026	−0.0004	0.0018	−0.0005	0.0000	−0.0021	0.0025	0.0044	0	0
STUR	0.0101	−0.0020	0.0089	−0.0024	0.0001	−0.0073	0.0058	0.0186	0.0042	0
PTA	0.0000	0.0002	0.0000	0.0001	−0.0001	−0.0001	0.0000	0.0001	0.0001	0.0003

Thailand	INV	SAV	AW	GX	NX	UN	SCAP	STRA	STUR	TMA
INV	0.0011	0	0	0	0	0	0	0	0	0
SAV	0.0018	0.0026	0	0	0	0	0	0	0	0
AW	0.0027	−0.0027	0.0037	0	0	0	0	0	0	0
GX	0.0060	−0.0011	0.0049	0.0105	0	0	0	0	0	0
NX	0.0017	−0.0013	0.0022	−0.0001	0.0057	0	0	0	0	0
UN	0.0001	0.0001	0.0003	0.0000	0.0001	0.0008	0	0	0	0
SCAP	−0.0013	−0.0002	0.0012	−0.0014	−0.0012	−0.0004	0.0087	0	0	0
STRA	0.0006	−0.0015	0.0001	0.0008	0.0005	−0.0012	0.0118	0.0063	0	0
STUR	0.0062	−0.0080	0.0062	0.0002	0.0108	−0.0092	0.0566	0.0243	0.0214	0
TMA	0.0000	0.0003	0.0001	0.0000	0.0000	−0.0001	0.0000	0.0002	0.0001	0.0010

Malaysia	INV	SAV	AW	GX	NX	UN	STRA	STUR	PTA	TMA
INV	0.0016	0	0	0	0	0	0	0	0	0
SAV	0.0007	0.0025	0	0	0	0	0	0	0	0
AW	0.0006	−0.0014	0.0042	0	0	0	0	0	0	0
GX	−0.0004	−0.0018	0.0036	0.0122	0	0	0	0	0	0
NX	−0.0002	0.0008	0.0018	0.0009	0.0039	0	0	0	0	0
UN	0.0000	−0.0002	0.0000	0.0004	0.0002	0.0012	0	0	0	0
STRA	0.0003	0.0009	0.0005	0.0005	0.0010	−0.0010	0.0040	0	0	0
STUR	0.0041	0.0076	0.0036	0.0011	0.0090	−0.0045	0.0350	0.0096	0	0
PTA	−0.0001	−0.0001	0.0001	0.0003	−0.0001	0.0000	0.0000	0.0001	0.0003	0
TMA	0.0005	−0.0003	0.0005	0.0012	0.0004	0.0002	0.0003	0.0002	0.0013	0.0006

Notes: Grey highlights indicate the parameter is statistically significant at least at 10%; INV is investment, SAV is savings, AW is income distribution, GX is productivity growth, NX is net export, UN is unemployment, SCAP is SME stock market capitalization, STRA is SME stock market traded value, STUR is SME stock market turnover, PTA is the number of patent applications, TMA is the number of trademark applications, HTE is high-technology exports.

References

Agénor, P.-R., & Neanidis, K. (2015). Innovation, public capital, and growth. *Journal of Macroeconomics, 44*(3), 252-275.

Aghion, P., Comin, D., Howitt, P., & Tecu, I. (2016). When does domestic savings matter for economic growth? *IMF Economic Review, 64*(3), 381-407.

Aghion, P., & Howitt, P. (1998). Endogenous growth theory. Cambridge, Massachusetts: MIT Press.

Arestis, P., Chortareas, G., & Magkonis, G. (2015). The financial development and growth nexus: A meta-analysis. *Journal of Economic Surveys, 29*(3), 549-565.

Banerjee, K., Ahmed, N., & Hossain, M. (2017). Bank, stock market and economic growth: Bangladesh perspective. *The Journal of Developing Areas, 51*(2), 17-29. doi:10.1353/jda.2017.0028

Bencivenga, V., Smith, B., & Starr, R. (1996). Equity markets, transactions costs, and capital accumulation: an illustration. *The World Bank Economic Review*, *10*(2), 241-265.

Cetin, M. (2013). The hypothesis of innovation-based economic growth: a causal relationship. *International Journal of Economic and Administrative Studies, 6*(11), 1-16.

Chaiechi, T. (2012). Financial development shocks and contemporaneous feedback effect on key macroeconomic indicators: a post Keynesian time series analysis. *Economic Modelling, 29*(2), 487-501.

Cojocaru, L., Falaris, E., Hoffman, S., & Miller, J. (2016). Financial system development and economic growth in transition economies: New empirical evidence from the CEE and CIS countries. *Emerging Markets Finance and Trade, 52*(1), 223-236.

Demetriades, P., & Hussein, K. (1996). Does financial development cause economic growth? Time-series evidence from 16 countries. *Journal of Development Economics, 51*(2), 387-411.

Dickey, D., & Fuller, W. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica: Journal of the Econometric Society, 49*(4), 1057-1072.

Duménil, G., & Lévy, D. (1989). The real and financial determinants of stability: the law of the tendency toward increasing instability. *Financial Dynamics and Business Cycles: New Perspectives*. New York, United States.

Durusu-Ciftci, D., Ispir, S., & Yetkiner, H. (2017). Financial development and economic growth: Some theory and more evidence. *Journal of Policy Modeling, 39*(2), 290-306.

Faust, J., & Leeper, E. (1997). When do long-run identifying restrictions give reliable results? *Journal of Business & Economic Statistics, 15*(3), 345-353.

Friedman, M., & Schwartz, J. (1963). *A monetary history of the United States*. New Jersey, United States: Princeton University Press.

Galindo, M.-Á., & Méndez, M. T. (2014). Entrepreneurship, economic growth, and innovation: Are feedback effects at work? *Journal of Business Research, 67*(5), 825-829.

Gospodinov, N. (2010). Inference in nearly nonstationary SVAR models with long-run identifying restrictions. *Journal of Business & Economic Statistics, 28*(1), 1-12.

Greenwood, J., & Jovanovic, B. (1990). Financial development, growth, and the distribution of income. *The Journal of Political Economy, 98*(5), 1076-1107.

Grossman, G., & Helpman, E. (1994). Endogenous innovation in the theory of growth. *Journal of Economic Perspectives, 8*(1), 23-44.

Guloglu, B., & Tekin, B. (2012). A panel causality analysis of the relationship among research and development, innovation, and economic growth in high-income OECD countries. *Eurasian Economic Review, 2*(1), 32-47.

Haiss, P., Juvan, H., & Mahlberg, B. (2016). The impact of financial crises on the finance–growth relationship: A European perspective. *Economic Notes: Review of Banking, Finance and Monetary Economics, 45*(3), 423-444.

Hasan, I., & Tucci, C. (2010). The innovation–economic growth nexus: Global evidence. *Research Policy, 39*(10), 1264-1276.

Hein, E. (2004). Money, credit and the interest rate in Marx's economic. On the similarities of Marx's monetary analysis to Post-Keynesian economics. *International Papers in Political Economy, 11*(2), 1-47.

Ho, S.-Y. (2018). Determinants of economic growth in Hong Kong: The role of stock market development. *Cogent Economics & Finance, 6*(1), 1-19.

Ho, S., & Odhiambo, N. (2012). Stock market development and economic growth in Hong Kong: An empirical investigation. *The International Business & Economics Research Journal, 11*(7), 795-808.

Holmström, B., & Tirole, J. (1993). Market liquidity and performance monitoring. *Journal of Political Economy, 101*(4), 678-709.

Hoque, E., & Yakob, A. (2017). Revisiting stock market development and economic growth nexus: The moderating role of foreign capital inflows and exchange rates. *Cogent Economics & Finance, 5*(1), 1-17.

Howells, J. (2005). Innovation and regional economic development: A matter of perspective? *Research policy, 34*(8), 1220-1234.

Huergo, E., & Jaumandreu, J. (2004). Firms' age, process innovation and productivity growth. *International Journal of Industrial Organization, 22*(4), 541-559.

Huh, H.-S. (2005). A simple test of exogeneity for recursively structured VAR models. *Applied Economics, 37*(20), 2307-2313.

International Finance Corporation - IFC. (2013). *Closing the Credit Gap for Formal and Informal Micro, Small, and Medium Enterprises.* Washington D.C. Retrieved from: http://www.ifc.org/wps/wcm/connect/4d6e6400416896c09494b79e78015671/Closing+the+Credit+Gap+Report-FinalLatest.pdf?MOD=AJPERES.

Jbili, A., Enders, K., & Treichel, V. (1997). *Financial Reforms in Algeria, Moro and Tunisia: A Preliminary Assessment. IMF/Working Paper/97/81.* Retrieved from: https://www.imf.org/external/pubs/ft/wp/wp9781.pdf.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica: Journal of the Econometric Society, 59*(6), 1551-1580.

Johansen, S. (1995). *Likelihood-based inference in cointegrated vector autoregressive models*: Oxford University Press.

Kalecki, M. (1968). Trend and business cycles reconsidered. *The Economic Journal, 78*(310), 263-276.

King, R., & Levine, R. (1993a). Finance and growth: Schumpeter might be right. *The Quarterly Journal of Economics, 108*(3), 717-737.

King, R., & Levine, R. (1993b). Finance, entrepreneurship and growth. *Journal of Monetary Economics, 32*(3), 513-542.

Kirchhoff, B. (1994). *Entrepreneurship and dynamic capitalism: The economics of business firm formation and growth*. Westport, United States: Praeger.

Kirchhoff, B., Newbert, S., Hasan, I., & Armington, C. (2007). The influence of university R&D expenditures on new business formations and employment growth. *Entrepreneurship Theory and Practice, 31*(4), 543-559.

Lavoie, M. (1992). *Foundations of post-Keynesian economic analysis*. Aldershot, United Kingdom: Edward Elgar.

Levine, R., & Zervos, S. (1998). Stock markets, banks, and economic growth. *American Economic Review, 88*(3), 537-558.

Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics, 22*(1), 3-42.

Maradana, R., et al. (2017). Does innovation promote economic growth? Evidence from European countries. *Journal of Innovation and Entrepreneurship, 6*(1), 1-23.

Marglin, S. (1984). *Growth, distribution, and prices*. Cambridge, Massachusetts: Harvard University Press.

Marglin, S., & Bhaduri, A. (1990). *Profit squeeze and Keynesian theory. The golden age of capitalism. Reinterpreting the postwar experience*. Oxford: Clarendon Press.

McKinnon, R. (1973). *Money and capital in economic development*. Washington D.C.: Brookings Institution.

Mishra, S., & Narayan, K. (2015). A nonparametric model of financial system and economic growth. *International Review of Economics & Finance, 39*, 175-191.

Naceur, B., Blotevogel, R., Fischer, M., & Shi, H. (2017). Financial development and source of growth: New evidence: International Monetary Fund. Working Paper WP17/143.

Ng, S., & Perron, P. (2001). Lag length selection and the construction of unit root tests with good size and power. *Econometrica, 69*(6), 1519-1554.

Onaran, Ö., & Stockhammer, E. (2006). Do profits affect investment and employment? An empirical test based on the Bhaduri-Marglin model. *Wages, Employment, Distribution and Growth* (pp. 206-222): Springer.

Ong, L., & Lipinsky, F. (2014). *Asia's stock markets: Are there crouching tigers and hidden dragons?* (WP/14/37). Monetary and Capital Markets Department. International Monetary Fund. Retrieved from: https://www.imf.org/external/pubs/ft/wp/2014/wp1437.pdf.

Organisation for Economic Cooperation and Development - OECD. (2015). *Opportunities and constraints of market-based financing for SMEs. OECD Report to G20 Finance Ministers and Central Bank Governors.* OECD Publishing. Retrieved from: https://www.oecd.org/finance/financial-markets/Opportunities-and-Constraints-of-Market-based-Financing-for-SMEs.pdf.

Owusu, E. (2016). Stock market and sustainable economic growth in Nigeria. *Economies, 4*(25), 1-13. doi:10.3390/economies4040025

Pagano, M. (1993). Financial markets and growth: an overview. *European economic review, 37*(2-3), 613-622.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika, 75*(2), 335-346.
Pradhan, R., et al. (2017). Finance and growth: Evidence from the ARF countries. *The Quarterly Review of Economics and Finance, 66*, 136-148.
Pradhan, R., Arvin, M., Hall, J., & Nair, M. (2016). Innovation, financial development and economic growth in Eurozone countries. *Applied Economics Letters, 23*(16), 1141-1144.
Pradhan, R., et al. (2018). Endogenous dynamics between innovation, financial markets, venture capital and economic growth: Evidence from Europe. *Journal of Multinational Financial Management, 45*, 15-34.
Prettner, C. (2016). Nonlinearities and Parameter Instability in the Finance-Growth Nexus: Vienna University of Business and Economics. Working Paper No. 224.
Prochniak, M., & Wasiak, K. (2017). The impact of the financial system on economic growth in the context of the global crisis: empirical evidence for the EU and OECD countries. *Empirica, 44*(2), 295-337.
Rehman, Z. (2018). Banking sector development, stock market development and economic growth: Evidence from Saudi Arabia. *Academy of Accounting and Financial Studies Journal, 22*(4), 1-15.
Rioja, F., & Valev, N. (2004). Finance and the sources of growth at various stages of economic development. *Economic Inquiry, 42*(1), 127-140.
Romer, P. (1986). Increasing returns and long-run growth. *Journal of Political Economy, 94*(5), 1002-1037.
Romer, P. (1990). Endogenous technological change. *Journal of Political Economy, 98*(5, Part 2), 71-102.
Sadraoui, T., Ali, T., & Deguachi, B. (2014). Economic growth and international R&D cooperation: A panel granger causality analysis. *International Journal of Econometrics and Financial Management, 2*(1), 7-21.
Sahay, R., Čihák, M., N'Diaye, P., & Barajas, A. (2015). Rethinking financial deepening: Stability and growth in emerging markets. *Revista de Economía Institucional, 17*(33), 73-107.
Samargandi, N., Fidrmuc, J., & Ghosh, S. (2015). Is the relationship between financial development and economic growth monotonic? Evidence from a sample of middle-income countries. *World development, 68*, 66-81.
Samsi, S., Cheok, C. K., & Yusof, Z. (2019). Financial Crisis, Stock Market and Economic Growth: Evidence from ASEAN-5. *Journal of Southeast Asian Economies, 36*(1), 37-56.
Schumpeter, J. (1912). The theory of economic development. Cambridge, Massachusetts: Harvard University Press.
Shaw, S. (1973). *Financial deepening in economic development*. London, United Kingdom: Oxford University Press.
Sinha, D. (2007). Patents, Innovations and Economic Growth in Japan and South Korea: Evidence from individual country and panel data: MPRA Paper No. 2547.
Solow, R. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics, 70*(1), 65-94.
Ugur, M., Churchill, S., & Solomon, E. (2018). Technological innovation and employment in derived labour demand models: A hierarchical meta regression analysis. *Journal of Economic Surveys, 32*(1), 50-82. doi:10.1111/joes.12187
Wennekers, S., & Thurik, R. (1999). Linking entrepreneurship and economic growth. *Small Business Economics, 13*(1), 27-56.
World Federation of Exchanges. (2015). *WFE Report on SME Exchanges (with inputs from the World Bank Group's Finance and Markets Global Practice).* Retrieved from: https://www.world-exchanges.org/home/index.php/research/wfe-research#sr.
World Intellectual Property Organisation - WIPO. (2019). *Global Innovation Index 2019: Creating Healthy Lives—The Future of Medical Innovation.* Retrieved from: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2019.pdf.
Zeng, J. (2003). Reexamining the interaction between innovation and capital accumulation. *Journal of Macroeconomics, 25*(4), 541-560.