ASIA School of Business

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ASB Working Paper Series 03/2025
Center of Technology, Strategy and Sustainability

Malaysia's Declining Innovation: Triple Helix and Regional Perspective

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November 2025

ABSTRACT

Malaysia, a middle-income country aiming for high-income status, has been experiencing a troubling decline in domestic patent output since 2014. This trend remains largely unnoticed and unexplained. Malaysia's persistent middle-income trap is associated with weak innovation capacity and declining patent activity suggests that the country is unable to transform itself into a knowledge-based economy. To uncover the patent trend in Malaysia and the variance of patenting activities, this study uses patent data from the Intellectual Property Corporation of Malaysia (MyIPO) as a proxy for domestic inventive activity in the country. The Triple Helix model and a regional perspective contributes to the explanation of our spatial and statistical descriptions of Triple Helix actors (government, industry, and academia) in Malaysia's domestic patenting applications. Our findings reveal a geographic divergence: while patenting in the country's largest agglomeration, Klang Valley, have dropped by 16.2% from 2018 to 2023, other more urban states like Penang and Johor have seen patent applications increase by 67.6% and 44.4%, respectively in the same time frame. This geographic heterogeneity highlights the growing role of regional innovation systems and the potential impact of regional-level policies. Our analysis of patents reveals two main trends. The first is geographic divergence of patenting activity - one that moves away from the Klang Valley. The second is changes in the patenting trend in universities and government-affiliated institutions. Our results suggest that while public sector research appears to act as a catalyst for increased industry patenting activity, Malaysia's experience in the 2010s indicates that efforts to stimulate industry research through investments and incentives were insufficient to effectively prime industrial innovation, which subsequently declined as policy support and investment in public sector research were reduced.

Keywords: Innovation, Patenting, Knowledge-based Economy, Triple Helix, Regional Innovation, Malaysia

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Attribution – Please cite the work as follows:

Juhari, Rasyid., Stek, Pieter E. (2025). *Malaysia's Declining Innovation: Triple Helix and Regional Perspective*. ASB Center of Technology, Strategy and Sustainability Working Paper Series 03/2025, Kuala Lumpur: Asia School of Business.

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1. Introduction

Malaysia, a middle-income country aspiring to achieve high-income status, is experiencing a concerning decline in patent output since 2014, a trend that remains largely unnoticed and unexplained, and could undermine Malaysia's long term development goals. Interestingly, the decline shows regional divergence: patenting has slowly decreased in the Klang Valley while rising in the urban centers of Penang and Johor. In the context of Malaysia, the transition towards a knowledge-based economy forms a central pillar in national policy ambitions under the New Industrial Master Plan 2030 (NIMP), which aims to raise national research expenditure from around 1% to 3.5% and to develop a high-income, skilled workforce that drives innovation (MITI, 2023). Malaysia's industrialization was driven historically by growth in primary sectors (rubber, palm oil, tin) with strong government support for research in these areas (Lim, 1967; Jomo, 1990). Malaysia has successfully transformed from an agricultural-based economy to one that is manufacturing-driven. Yet declining patent filings expose a persistent innovation gap.

We explore this development from two perspectives: Triple Helix and regional innovation systems, in order to understand potential causes of these developments. The Triple Helix model promotes a balanced and interactive innovation system where government, industry, and academia collaborate equally to prevent domination by any single sector and curate synergy, knowledge exchange, and effective commercialization (Leydersdoff & Etzkowitz, 1995) which has been applied to patenting by numerous empirical studies (Guerrero & Urbano, 2017; Jaksic et al., 2015 Park & Leydesdorff, 2010; Etzkowitz et. al, 2000). The Regional Innovation Systems (RIS) Theory positions regions as critical arenas for innovation (Cooke et al., 1997). Aligned with the Triple Helix Framework, RIS explains how innovation emerges from the dynamic interactions among firms, research institutions, government bodies, and other organisations within a specific region. RIS highlights the importance of localized networks in increasing productivity – which serves as a theoretical baseline of evaluating changing regional patent applications.

We aim to answer the following questions: (1) What is the current patent trend in Malaysia? (2) How do patenting activities vary across Malaysian states, and what are the emerging patterns? (3) How do the interactions among universities, industry, and government (the Triple Helix actors) influence regional disparities in patenting activity across Malaysian states?

The paper is organized as follows. Section 2 outlines the existing literature on innovation, providing a framework to explain factors contributing to the decline in innovation and research productivity. Section 3 describes the data used in this study along with the methodology employed. Sections 4 present the patterns of patent applications with examinations on regional variations and Triple Helix innovation actor types. Section 5 provides a discussion of the findings and policy implications. The final section concludes.

2. Literature Review

This section provides an overview of the relevant literature on innovation, economic growth, and Malaysia's position in the middle-income trap. It outlines key economic theories linking innovation to development, reviews Malaysia's National Innovation System and the Triple Helix framework and discusses trends and challenges in patenting and commercialization within Malaysia.

The link between innovation and sustained economic growth has a long tradition in empirical economics (Schumpeter, 1939; Solow 1956; Romer 1990). Shifting from a commodity-based economy to one that is knowledge-driven is a crucial component behind transitioning from a middle-income state to being classified as a high-income economy (Paus E., 2012). The need to transform towards a knowledge-based economy has fundamentally altered the role and perception of intellectual property (IP) systems (Romer, 1990). Globalization and technological advancements have changed social and economic structures, making the creation, protection, and commercialization of intellectual property essential for competitiveness and innovation (Harris et al., 1998).

Middle-Income Trap and the Malaysian Innovation System

The widely used definition of the middle income trap refers to a situation whereby a middle-income country is failing in its transition to a high-income economy due to rising costs and declining competitiveness (Griffith, 2011). Breaking away from the middle income trap can be relatively difficult due to the necessary overhauling of the economic growth model which once has provided immense growth to emerging economies (Puasa et. al, 2015). Innovation-driven growth remains central in escaping the middle income trap. The nexus of innovation literature often emphasise the short-lived nature of foreign technology reliance – and if countries do not opt to switch from an investment-based strategy to one that is innovation centred, they may find themself stuck in a trap (Gerschenkron, 1962; Acemoglu et. al, 2006; World Bank and the Development Research Center of the State Council, 2013; Cherif & Hasanov, 2015).

Malaysia is one case of a country in a Middle-Income Trap. In the field of Political Economy, Malaysia's persistent middle-income trap and income concentration are partly rooted in entrenched state-business relations which have prioritized patronage and rent-seeking (Gomez et al., 2021). The pursuit of sustained growth in Malaysia is then dominated by a reliance on Foreign Direct Investments (FDI), which political scientists have argued can impede Malaysia's industrial upgrading (Gomez 2012; Gurkov et al., 2019; Sjoholm, 2021). Political incentives and institutional inertia have limited meaningful reforms aimed towards diversifying the economy or enhancing innovation-driven growth, thus reinforcing the structural barriers to Malaysia's transition to a high-income, innovation-led economy (Doner & Schneider, 2016; Gomez et al., 2017). Malaysia however, has worked to grow IP output through targeted policies and programs with clear numerical goals for patent filings and innovation commercialization – which is explored throughout this paper.

Historically, the Malaysian Innovation System is framed by the concept of the National Innovation Systems (NIS). The National Innovation Systems (NIS) framework conceptualizes innovation as arising from interactive systems of firms and supporting institutions within a

national economy (Lundvall, 1985; Freeman, 1987; Nelson, 1985; Dosi, 1984). Malaysia's NIS potential depends on developing effective institutional coordination among firms and supporting organizations like educational institutions, funding agencies, transport, and regulatory systems (Rasiah, 1994). Firms actively generate most innovations, and predominantly do so through incremental changes – often, agents and institutions stimulate and facilitate innovation (Best, 1990; Rosenberg, 1982). Effective government policies and investments harness innovation by addressing market failures and coordinating R&D activities, but government involvement in direct R&D is generally small (Nelson, 1993). In Malaysia, local SMEs face challenges such as lack of entrepreneurial skills, insufficient pressure to improve efficiency, and weak linkages to transnational corporations, though some pockets like Penang show stronger linkages (Diez & Kiese, 2006; Rasiah, 1994). Contrary to the NIS perspective, it seems that the stronger linkages proposed by Rasiah (1994) are potential mechanisms which drive rising domestic patent counts in states like Johor and Penang.

Agglomeration Theory and Dimensions of Proximity

As elucidated by the Triple Helix (TH) framework, innovation thrives in spaces where universities, industries and governments closely interact – conditions which are most found in urban areas. Urban areas dominate innovation outputs due to their concentration of talent, investment, and resources, leading to higher patent quantity and quality compared to rural regions (Bataineh et al., 2024; Fischer et al., 2009). The literature commonly attributes the concentration of innovation in large metropolitan regions to agglomeration economies, where diverse and dense urban areas create knowledge spillovers that enhance innovation potential (Carlino & Kerr, 2015; Duranton & Puga, 2004, 2010; Bettencourt et al., 2008; Gilbert, McDougall & Audretsch, 2008). This urban bias is evident globally, including in China and Sweden, where patenting activity clusters in metropolitan centers (Jiang et al., 2024; Lv et al., 2021; Zhao et al., 2022; Taalbi & Martynovich, 2024). Malaysia exhibits a similar pattern, though recent trends show divergence among its key urban regions.

Though patent outputs are undeniably concentrated in urban cores, the dimensions of Proximity demonstrate that innovation cannot be fully understood solely through urban-centric frameworks. Proximity has become a central concept in understanding innovation collaboration and knowledge flows within the geography of innovation. (Boschma, 2005). Geographical proximity facilitates tacit knowledge exchange through face-to-face contact and is especially valuable in sectors requiring a more focused and interactive learning processes (Audretsch & Feldman, 1996; Delgadillo et al., 2021). The literature on proximity notes that innovation is not solely a localized phenomenon – as access to geographically distant but cognitively proximate partners can spur novel innovation and breakthroughs (Binz & Truffer, 2017; Velenturf, 2016).

Triple Helix and Malaysia

The literature on the Triple Helix (TH) cooperation in Malaysia is limited – and available literature is focused on comprehending the analytical framework of TH in the Malaysian context. Munshi et. al (2018) claimed that the Universities' seek revenue through IP rights (IPR), funding and employment opportunities for its' students. Complementing this was the Industries' motivation for technological problem solutions, profit and access to university labs

and expertise . However, the gap in the coverage of industry and government roles within Malaysia is relatively limited and less explored. The Malaysian government introduced the TH dynamic in the Eight Malaysian Plan (8MP) with the ambition of yielding increased research, development and innovation – which includes partnerships and cooperation among the 3 helices (Krishnan et. al, 2025; Afzal et. al, 2018). The main policies include the First National Science and Technology Policy (1986–1989), the Industrial Technology Development National Action Plan (1990–2001), the Second National Science and Technology Policy (2002–2010), and the National Policy on Science, Technology and Innovation (2013–2020) – yet existing literature forms a consensus on weak institutional collaboration, proving the relevance of improving the triple helix framework (Narayanan & Yew-Wah, 2018; Chandran et. al, 2014; Zeufack & Lim, 2013).

Regional Innovation System (RIS)

RIS posits that strong, well-coordinated institutions are important in building momentum of productivity (Cooke, 2005; Cooke, 1997). If these institutions become less effective – possible mechanisms can be attributed to underfunding, policy changes or loss of autonomy – the support system for innovation and patenting weakens (Chung & Park, 2014). This framework allows us to look at different policies as possible mechanisms of the variations in policy count.

Malaysian Patenting Landscape

Like many developing economies, Malaysia has made strides at improving patent activity. Malaysian academic patenting involves universities generating, protecting, and commercializing inventions from research (Sarjidan et. al, 2023). The Ministry of Higher Education (MoHE) has provided various types of support in the form of funding, facilities, technology or capacity building to research universities (Azmi, 2014). However, the decline in academic patenting can be partly attributed to the relative difficulty of obtaining patents compared to publishing journal articles (Sarjidan et al., 2023; Cherif & Hasanov, 2015; Azmi et al., 2014; Looy et al 2006). Institutional priorities have shifted to favor journal publications, which are easier to produce and heavily weighted in performance metrics like the Malaysian Research Assessment Instrument (MyRA). There is however a major gap in the literature describing the factors of declining patent activity beyond academic sectors in Malaysia.

Malaysian firms do not consistently pursue patent protection in neighboring countries, despite those jurisdictions offering more lenient procedural requirements and streamlined international mechanisms such as the Patent Cooperation Treaty (PCT). Recent WIPO reports indicate that regional neighbors like Indonesia and Thailand account for only a minor share of foreign filings by Malaysians, while Singapore and Brunei together make up less than 5.2% – suggesting that proximity and regulatory differences alone do not drive outward patenting from Malaysia (WIPO, 2024; WIPO, 2023).

Commercialization of Intellectual Property

Economists argue that intellectual property extends beyond legal protection, and includes the factor of human capital and competition (Romer, 1990; Grandstand, 1999; Bader, 2006; Cowan & Harrison, 2001). Its value emerges only when used in the market, not just when legally defended (Sveiby, 1997; Van Caenegem, 2002). This incentivises intellectual assets to

be utilised in a way where they are granted a competitive edge (Al-Ali, 2003). This inclusion of competitive elements is relevant to the interaction of Triple Helix (TH) actors. Commercialization is essential to convert patented ideas into products with market impact. In principle, firms would choose to innovate for monopoly rents of innovation to be captured via the patenting system. Firms and universities across the globe strategically manage patents by evaluating not only technological merit but also market demand, commercialization feasibility, and economic potential; employing multi-tier evaluation systems and commercialization plans supported by policy incentives (Rouse, 2025). Management of patents are also established as clear variables to the incumbent commercial value from those patents (Ernst et. al, 2016).

Patent counts alone often do not explain the value of the patenters accurately – with empirical studies finding weak or modest positive relations between firms' patenting activity levels (Narin et al., 1987; Griliches et al., 1991; Ernst, 2001). Levitas and Chi (2010) highlights the ambiguity in patenting-performance relationship and in his paper recommended focusing on managerial capability and processes that help firms create real commercial value from patents. Therefore, defining 'quality' is imperative. The quality of a patent can be measured from four aspects: quality for invention, quality for application document, quality under examination, and quality for commercialization (Hefa & Zhenxing, 2014). MyIPO requirements hold strenuous pride in novelty (MyIPO, n.d.) – yet what is often forgotten in the chase of quantity is the commercialisation value of each patent application. Neuhäusler et al. (2011) show that patent portfolio characteristics (such as family size and citations) are better predictors of firm market value and ROI than raw patent counts, indicating patent quality and management matter. In line with these academic literatures – the value of patent commercialisations are a better metric of innovation capacity rather than patent counts.

In developing economies like Malaysia, the commercialization rate of university patents are still seen as generally low (Gu, 2023). Despite growing interest in university research commercialization, no established framework or guidelines exist to facilitate startups or side-companies from universities, as most Malaysian literature focuses predominantly on institutional and external factors influencing technology transfer (Shahidan et. al, 2019; Khademi et. al 2015 as cited by Habidin & Yahaya, 2024). The process of commercialization by the Malaysian Universities is adequately covered in academic literature. These universities generally initiate the patent commercialization process through the disclosure of scientific inventions to technology transfer offices (TTOs), where inventions undergo evaluation for patentability, market potential, and strategic value (Ismail et. al, 2011). Decision-making on patent filings varies by institution, ranging from highly selective procedures grounded in thorough market analysis to broader filings driven by inventor motivation. Commercialization pathways typically involve licensing to established firms or the formation of spin-off companies, with active inventor engagement and strategic networking with industry and investors playing critical roles in successfully translating patented technologies into market-ready products (Ismail et. al, 2011). Malaysia's universities lag in commercializing research and transferring technology due to inconsistent funding, ineffective incentives skewed towards publications, and cultural gaps with industry expectations (World Bank, 2021).

3. Methodology

This study uses patent data from the Intellectual Property Corporation of Malaysia (MyIPO) as

a proxy for domestic inventive activity in the country. As Malaysia's national patent office, MyIPO has the world's largest collection of Malaysia-invented patents, with 24,561 patent applications from 1987 to 2023, making it the most suitable database to study Malaysian domestic patenting activity. It is important to note that Malaysian-invented patents also frequently appear in the USPTO database, however these patents tend to be owned by foreign corporations.

In total, 214,045 patent records are downloaded from the database, of which 24,561 are identified as having at least one Malaysian inventor. The other patents are typically held by foreign corporations who seek patent protection in Malaysia under the Patent Cooperation Treaty (PCT), to which Malaysia is also a signatory.

The geographic origin of patents is identified by searching the inventor addresses or applicant addresses of the patent application data. For example, to identify patents from the Klang Valley, patents which include "Kuala Lumpur", "Selangor" or "Putrajaya" are counted.

To identify corporate, university and government-owned patents, specific keywords are used. For corporate: *berhad* and *limited* (and their short forms, *bhd* and *ltd*). For universities: *universiti*, *university*, *kolej*, *sekolah*, *politeknik*, and *collaborative research in engineering*, which refers to a research center led by Universiti Sains Malaysia (USM) in Penang. For government: *jabatan*, *ministry*, *government* and *mimos*, which refers to the Malaysian Institute of Microelectronic Systems (MIMOS), a government agency for applied research.

These keywords are identified inductively by observing applicants listed on various patent applications. Note that there is sometimes overlap in identification, for example a state-owned enterprise such as *MIMOS Berhad* or a private university such as *Swinburne Innovation Malaysia Sdn Bhd*, can be identified as corporate. Therefore identification as a university or government agency supersedes identification as a corporate organization. The keyword list can be further refined.

As we observe that Penang and Johor's patent counts are not falling – a mini case study using the Triple Helix framework was conducted and we further examined policies which may explain why. We further reviewed patent activity across periods of 2010-2014 and 2019-2022, alongside classifying the contributions by university, industry, and government actors on a state-level using the Triple Helix framework.

Adapting from simple metrics of maintenance rate from Schankerman & Pakes (1987), we analyzed patent retention and rejection rates as proxies for commercial value and initial quality to capture the impact of patents from universities and government agencies. We calculated the ratio of lapsed and definitely lapsed patents to the total patents filed each year, distinguishing between corporate, university, and government applicants. A higher lapse ratio implies a lower commercial value or reduced willingness to maintain patents.

4. Findings

Innovation indicators – particularly patent applications reveal Malaysia's underperformance in innovation output. Malaysia is experiencing a decline in patent applications by local inventors since 2014. While patent applications do not capture the full image of innovation outputs that contribute to productivity growth, Malaysia's lagging patent activity suggests either a deficiency in converting innovative efforts into tangible products or a shortfall in innovation activities. The trend in patent counts was different prior to 2014. From the late 1980s through the early 2000s, Malaysian inventors steadily increased their patent applications. As shown in Figure 1, Malaysian patent applications increased from 522 in 2005 to 1,275 in 2010. Academic and government institutions drove this surge – with the state-owned Malaysian Institute of Microelectronic Systems (MIMOS) alone filing 464 patents between 2005 and 2010 (MyIPO, n.d.). Key factors which may explain the progressive increase included the Ninth Malaysia Plan (2006–2010), which prioritised R&D funding and introduced fiscal incentives such as double tax deductions for R&D expenditures, pioneer status, and investment tax allowances up to 100% for qualifying activities (Prime Ministers Office, 2016). Promotion of commercialisation such as the National Biotechnology Policy (2005) and National Intellectual Property (IP) Policy may also influence the rising activity of patenting within the aforementioned timeframe. We observe that policy changes and government initiatives often coincide with shifts in patent counts, but it will require further quantitative methods of assessment to properly evaluate and isolate policy effects from other factors such as industrial development or global economic trends.

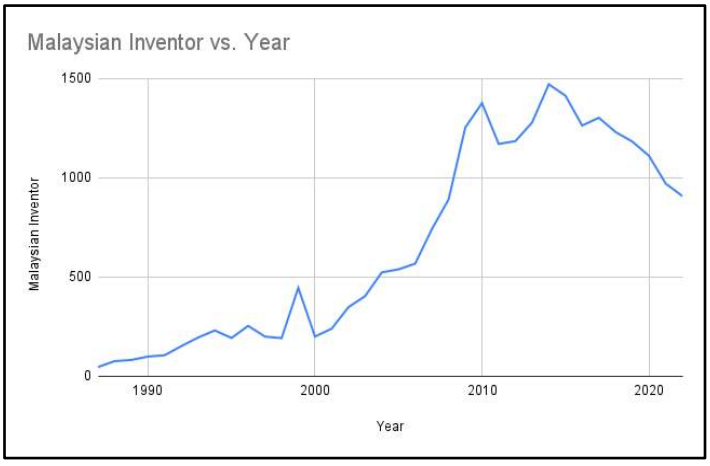

Figure 1: Overall Malaysian Patent Applications, 1987-2023 (data source: MyIPO)

Urban centers are concentrated with patent output, as studies demonstrate. (Bettencourt et al., 2007; Broekel et al., 2023; Feldman, 1994; Feldman & Kogler, 2010; Glaeser, 2011; Lobo et al., 2013). This has led many scholars to describe cities as powerful hubs of innovation, with some arguing that innovation not only occurs in urban areas but is fundamentally dependent on them (Florida et al., 2017). This pattern is observed across cities like Seoul, Boston, Beijing, Tokyo and Munich leading in the number of patent applications worldwide (Taalbi &

Martynovich, 2024; Jiang et al., 2023; Carlino et al., 2006). Malaysia as it stands, is an interesting case. We observed in Figure 4 that while patent filings have declined in Malaysia's largest urban area, the Klang Valley (-16.2% from 2018-2023), they are steadily increasing in alternative cores, including Penang (+67.6%), and Johor (+44.4%).

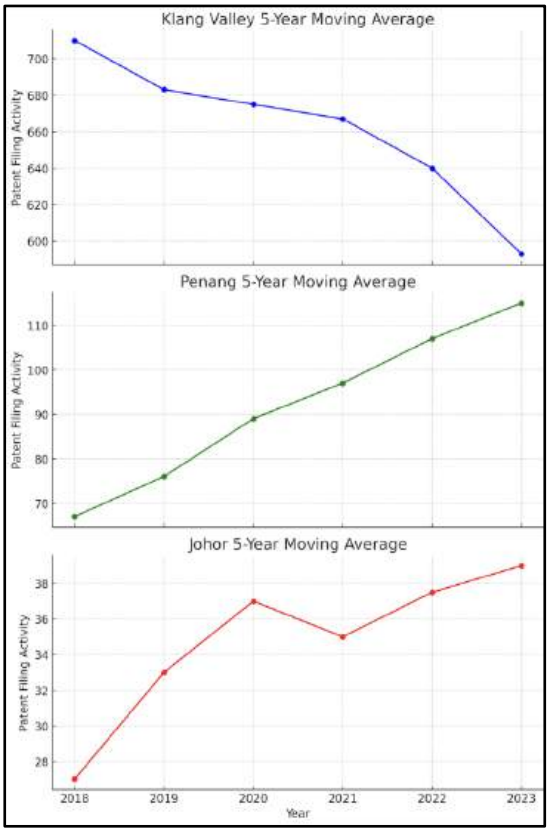

Figure 2: 5-year Moving Average of Patent Applications in Klang Valley, Penang and Johor, 2018-2023 (data source: MyIPO)

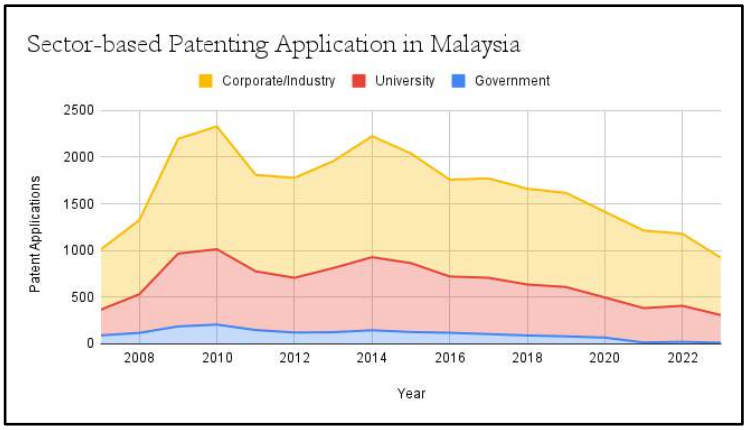

Figure 3: Institutional (Industrial, University, Government Agencies) Patent Application (data source: MyIPO)

Malaysia's productivity growth as compared to Singapore and Indonesia lagged by a significant margin. From 1991 to 2024, Malaysia's labor productivity rose by only 9%, falling behind Singapore's 28% and Indonesia's 49%, the latter boosted by shifting labor from agriculture to manufacturing; this slower growth raises concerns about Malaysia's ability to

sustain economic growth and improve citizens' well-being (DOSM, 2024; CEIC, 2024).

Triple Helix Evaluation of Malaysian Patenting

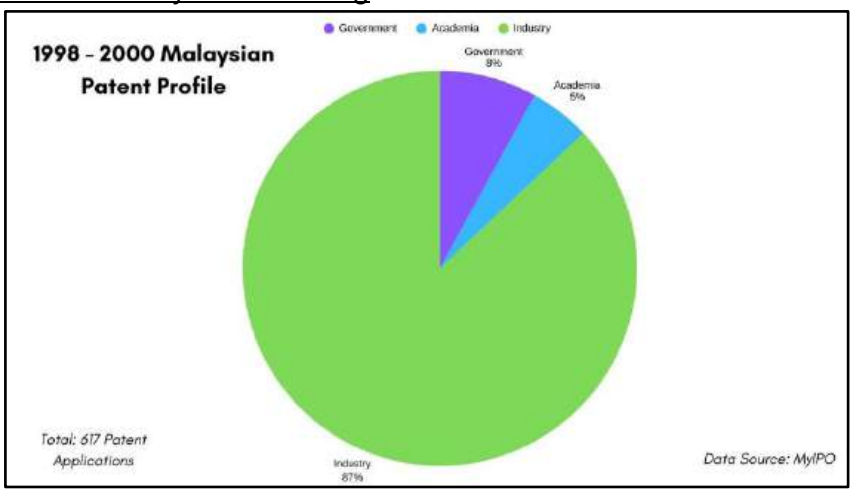

Figure 4: 1998-2000 Malaysian Patent Profile (data source: MyIPO)

1999-2001 – saw the private sector's innovative engagement (via patent application) as the most active, with moderate government and government-affiliated institutions (Palm Oil Research Development, Ministries, Petronas, Sirim, TNB, Lembaga Getah, among others) are observed. However, what is most surprising is the little patent participation from Academia, which consists of only 5% of patent count in these 3 years. We chose to analyze this time frame because these three years are considered a hallmark of innovation in Malaysia. Initiatives during this period included direct R&D funding, tax incentives, and grants such as the Industrial R&D Grant Scheme and Techno Fund. Industry-science collaborations increased, supported by public-private partnerships, research universities, and innovation-focused organizations like MIGHT and MTDC. The Multimedia Super Corridor (MSC) and science parks were established to catalyze high-tech growth.

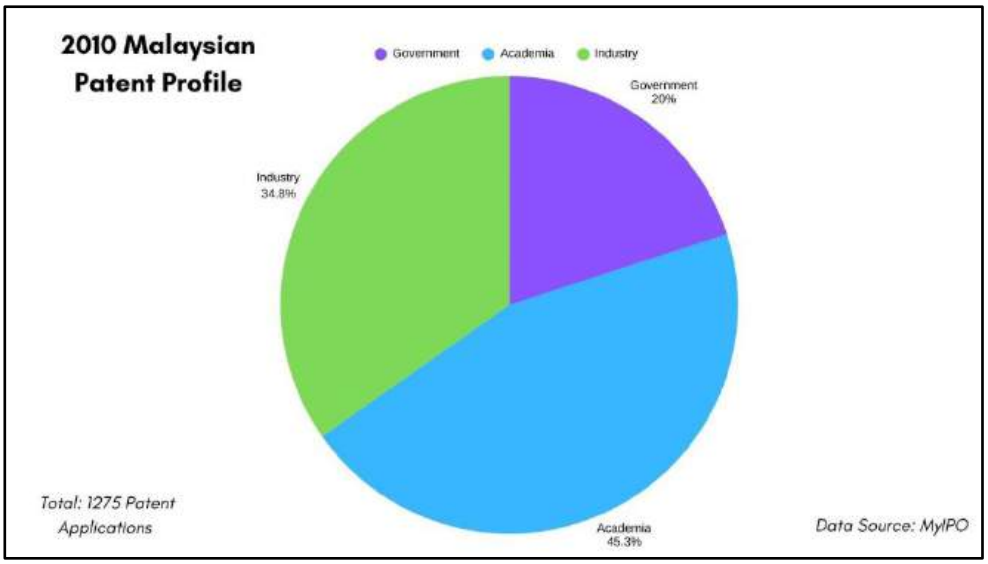

Figure 5: 2010 Malaysian Patent Profile (data source: MyIPO)

2010 – Government-driven incentives between 2005–2010 shifted the patenting profile towards academia, which reached 45% of total filings. However, industry's relatively stagnant patent output, despite expanded grants, highlights a structural imbalance in Malaysia's Triple Helix system: policy support successfully mobilized universities but failed to engage private firms. There exists a gap in literature which could potentially explain why the policy push failed to move the industrial players forward.

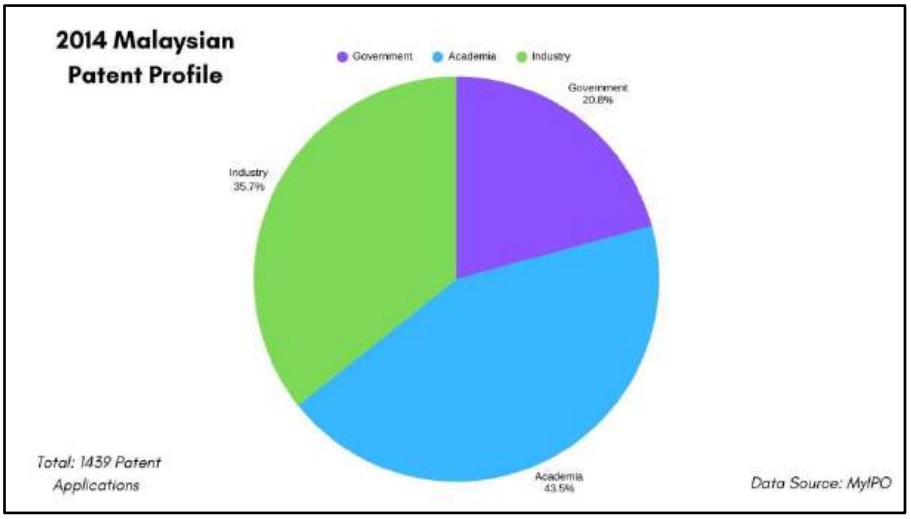

Figure 6: 2014 Malaysian Patent Profile (data source: MyIPO)

2014 – Malaysia recorded its highest level of domestic patent filings in 2014. This picture is most similar to 2010. Malaysia's Gross Expenditure on Research & Development (GERD) was 1.3% of GDP in 2014 (MASTIC, n.d.), which was the highest ever recorded up until that time. The R&D spending is split between business enterprises (45.7%), government research institutes (8.2%), and institutions of higher learning (46.1%).

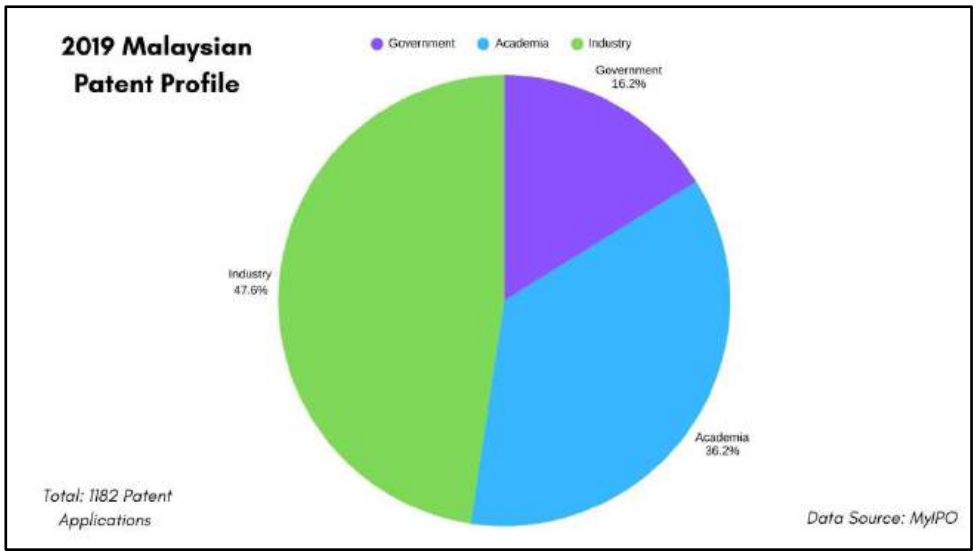

Figure 7: 2019 Malaysian Patent Profile (data source: MyIPO)

2019 - Shortly before the COVID-19 Pandemic, the patent profile reshaped. In this time period, we found that Academic Patenting has decreased to representing below 40% while patents from the private sector make up for 47.8% of the patent applications in the year 2019 – a stark difference from the year 2010 and 2014.

Triple Helix Overview in Penang and Johor

We examined patent activity in Klang Valley, Penang, and Johor between 2010 and 2022 which reveals notable temporal and regional variation. In the later years of the period (2019–2022), universities in the outlier states (Johor and Penang) emerged as significant contributors to overall patent output. For the purpose of this study, we define an *outlier state* as one state in which patenting activity diverges from the national trend of declining patent counts, exhibiting either growth or relative stability during the same period. In particular, academic institutions from these outlier states; Universiti Sains Malaysia (USM) and Universiti Teknologi Malaysia (UTM) – accounted for a substantial share of filings in Penang and Johor, respectively. Concurrently, industrial actors, especially those located within established industrial parks, also played a central role in sustaining patenting activity in these outlier states. In 2022, USM alone was responsible for approximately 35 percent of all patents originating from Penang.

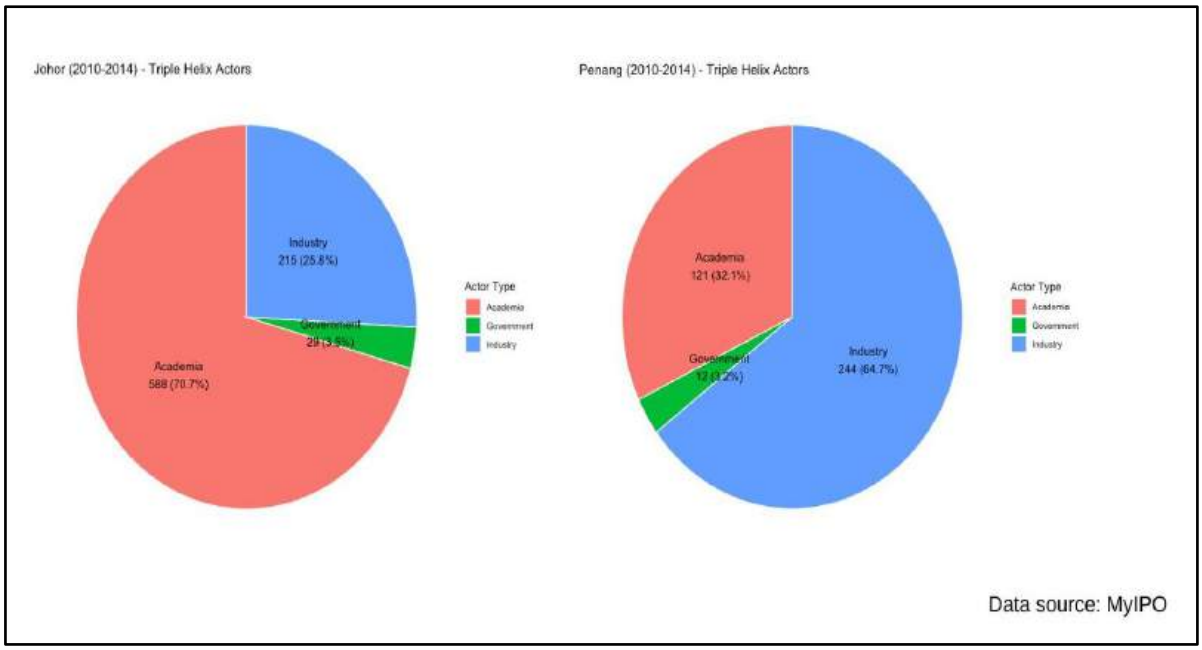

Figure 8: 2010-2014 Johor and Penang Patent Profile – Triple Helix

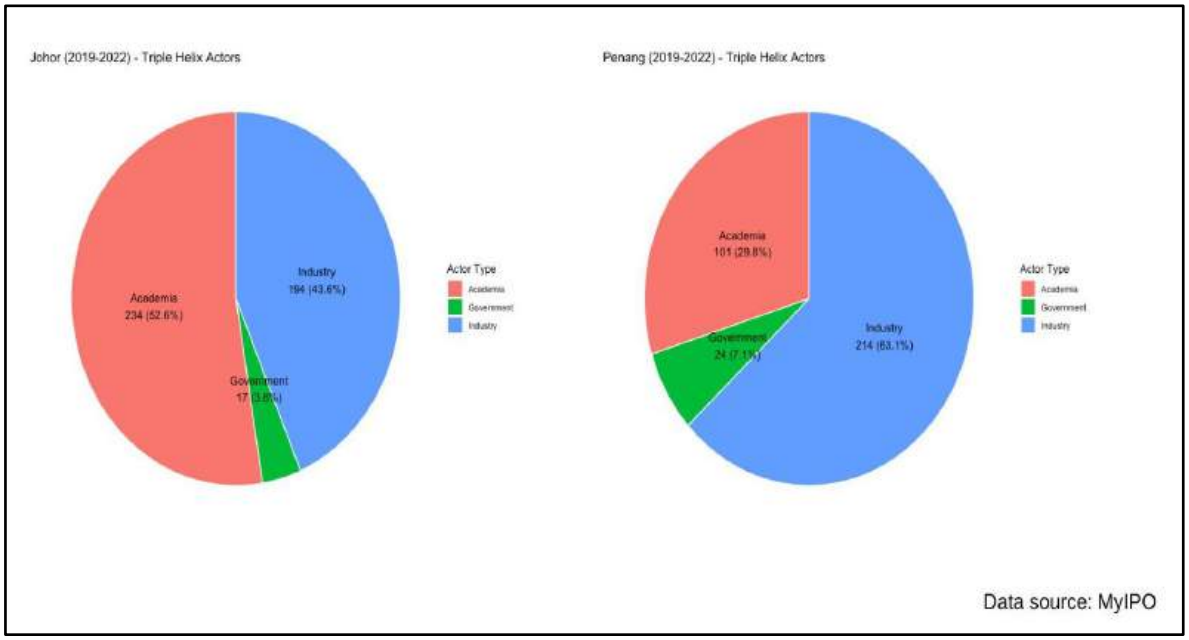

Figure 9: 2019 - 2022 Johor and Penang Patent Profile – Triple Helix

To capture recent spatial shifts in patenting, we analyzed 2019–2022 patent data (Figure 9) as we focus on the increasing role of industrial hubs in Penang and Johor. Industrial clustering appears to explain Penang and Johor's divergence from the national decline. Patent activity in these states rose alongside the expansion of Bayan Lepas and Iskandar Puteri industrial parks, suggesting localized RIS dynamics where foreign-linked firms and proximate universities (USM, UTM) reinforce innovation ecosystems. This supports the RIS argument that regional institutions, not just federal policy, drive patenting trajectories (Cooke, 1997).

While Penang and Johor are strengthening as innovation hubs, the patenting gap with Klang

Valley remains substantial, and Klang Valley still leads by a wide margin. However, the performance trend for Penang and Johor corresponds with significant investment inflows and investment-based policies which resulted in – Johor attracted RM43 billion in 2022 (The Edge, 2024), including RM21.5 billion from foreign investors in Singapore, China, and South Korea. Penang maintained robust investment, recording RM76.2 billion in manufacturing investments in 2021 (MIDA, 2024), largely driven by foreign reinvestment.

Nationwide – we could observe the falling of academic institutions as lead patenters (Figure 9). However, Academia still very much plays a central role in domestic patent counts at Johor within recent years (Figure 8 and 9). This however, is expected as UTM accounts for the highest university participation in the patent count ever since academia saw a distinct increase of patent output from 2006 onwards (Table 2).

Our analysis on patent quality indicates that university and government patents have higher lapse ratios than corporate patents post-2014, suggesting challenges in patent commercialization or changing incentives. Additionally, rejection ratios for university patents appear elevated compared to corporate filings, highlighting prospect gaps in invention quality or support during the application process. These metrics underscore the need to complement patent quantity data with quality-focused indicators to better inform Malaysian innovation policy.

5. Discussion and Policy Implication

This paper is the first to identify spatial divergence in Malaysia's patenting activity and systematically link government R&D expenditure, innovation policy, and commercialization metrics to explain patent counts and regional patent trends, setting the agenda for further research on domestic innovation mechanisms. Government R&D expenditure does not consistently correspond with rises in patent activity. Figure 10 illustrates that government R&D expenditure positively correlated with patent applications until 2014, after which the link weakens. Despite R&D expenditure as a percentage of GDP peaking in 2016, analysis of absolute R&D spending reveals a more balanced and nuanced picture of Malaysia's innovation landscape. While the GERD/GDP ratio increased, the actual absolute amounts of R&D funding plateaued or even declined after 2016 due to slower GDP growth or contraction, especially in 2020. This illustrates that a higher R&D share of GDP does not always translate to continuous growth in overall investment or innovation outputs like patents. In absolute numbers, national commitment to research remained substantive but did not accelerate after 2016, resulting in a decline in patenting rather than exponential growth of patenting activity. National spending has improved research outputs, patents, and industry collaboration, with R&D expenditure reaching 1.44% of GDP in 2016 but both GDP and count has declined since.

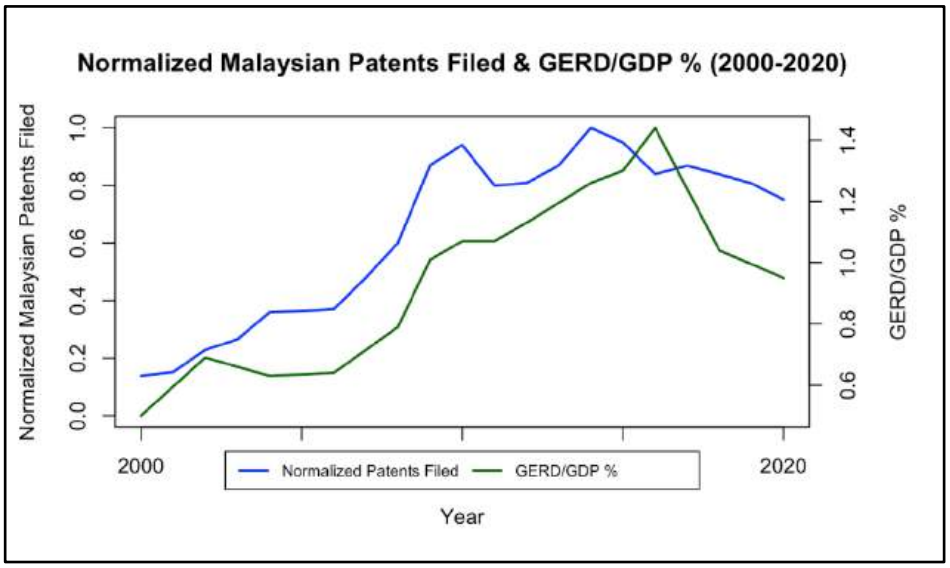

Figure 10: Normalized Malaysian Patents & Expenditure on R&D/GDP – Data source: MASTIC

	GDP (USD billion)	GERD/ GDP %	GERD (USD billion, approx.)
	94	0.50	0.47
	105	0.69	0.72
	123	0.63	0.77
	153	0.64	0.98
	221	0.79	1.75
	207	1.01	2.09
	238	1.07	2.55
	279	1.07	2.99
	314	1.13	3.55
	340	1.26	4.28
	296	1.30	3.85

	302	1.44	4.35
	358	1.04	3.72
	337	0.95	3.20

Table 3: Malaysia R&D Expenditure and Patent Activity, 2000–2020 – Absolute GERD and Application Trends, Data source: MASTIC and World Bank

Our analysis confirms that university and government actors principally drive patenting in Malaysia, reflecting strong policy support. However, the private sector has lagged behind, failing to respond fully to the push. The decline of university and government patenting is also a concern, as it appears that it has dragged down industry patenting with it. This suggests that industry patenting in Malaysia relies a lot on public sector research. The data shown in Figure 10 and Table 3 suggests that Malaysia's current R&D trajectory is insufficient to support the achievement of its NIMP 2030 policy ambitions.

Penang and Johor stand out as outliers. In Penang, private firms lead patent activity, though USM continues to contribute a substantial share of academic patents. In Johor, the share carries differently: UTM predominates and remains a key academic contributor despite the relative decline of patent output from previous years, with the private sector marching closely. Our finding challenges the assumption of innovation concentration only in the largest metropolitan centers, also showing diffusion toward secondary hubs. This divergence highlights how secondary urban cores can sustain industrial patenting when aligned with local RIS institutions (Combes et al., 2005; Maria & Costa-Campi, 1997). Agglomeration can move, as factors such as infrastructure investments and targeted policies can redirect economic concentration.

The Regional Innovation System (RIS) concept explains differences among these regions by emphasizing localized institutions, industries, and governance structures (Bekhet & Latif, 2018). For instance, InvestPenang and Johor's Strategic Innovation Institute embody RIS principles distinct from the federal National Innovation System, taking advantage of universities' entrepreneurial roles in knowledge co-creation and commercialization (Theeranattapong et al., 2021; Cooke et al., 1997). Economic corridors, such as the Northern Corridor Economic Region (NCER), illustrate practical implementations of RIS and Triple Helix cooperation by linking infrastructure, trade, and innovation networks (Athukorala & Narayanan, 2017). Penang's strong business ecosystems and logistics capabilities complement these

corridors, while Johor benefits from its proximity to Singapore and cross-border initiatives like the Johor–Singapore SEZ, alongside their emphasis on innovation from UTM.

Meanwhile, Klang Valley is evolving into a services-based economy, as highlighted by the Greater Klang Valley National Key Economic Area (NKEA) initiative (MIDA, 2024). Services-driven innovation, often focused on business processes, organizational improvements, and digital transformation, typically generates fewer patent filings compared to manufacturing innovation (Morikawa, 2019). Consequently, Klang Valley's transition toward services explains, in part, the recent decline in patent activity within the region. These regional variations suggest that Penang and Johor offer valuable lessons on enhancing Malaysia's overall patenting performance, highlighting the need to better engage industry alongside universities and government.

6. Conclusion

This study provides a regional and Triple Helix stakeholder analysis of contemporary Malaysian patenting. The study suggests that Malaysia has been unable to develop a strong national innovation system, despite significant public sector investment during the 2010s. The subsequent reduction of public R&D spending has correlated to a decline in industry patenting, which suggests that public R&D expenditure, especially at universities, did play a role in supporting patenting by local firms – even though the effectiveness of such spending, and a perceived lack of university-industry linkages has been noted in the literature.

A second finding of the study is the rise in patent output in Penang and Johor, two secondary urban centers that are both home to large and well-established public universities. The growth of patent output in these regions, both by their respective anchor universities, USM and UTM, and by Malaysian industry, suggests a strong regional innovation system dynamic has developed. While the regional innovation system of Penang has been extensively studied in the literature, the development of Johor is a more recent phenomenon. It is also unclear if the Johor regional innovation system is closely connected to neighboring Singapore, or if it has developed more independently.

The emergence of dynamic and growing regional innovation systems outside the Klang Valley suggests that Malaysia's innovation policies could benefit from having a stronger regional focus. As these regional innovation systems seek to position themselves within global value chains, state governments could be empowered by having greater autonomy over research funding and taking a greater role in developing local and international research linkages. Such a decentralized approach may be more effective in encouraging innovation and technological upgrading among Malaysian firms.

Bibliography

Afzal, M. N. I., Sulong, R. S., & Dutta, S. (n.d.). *An Investigation on Triple Helix Model and National Innovation Systems: The Case of Malaysia*.

Akoum, I. (2016). Research, Development and Innovation in Malaysia: Elements of an Effective Growth Model. *Asian Economic and Financial Review*, *6*(7), 390–403. https://doi.org/10.18488/journal.aefr/2016.6.7/102.7.390.40

Asid, R., Kogid, M., Mulok, D., & Lily, J. (2012). *Intellectual property rights protection, foreign direct investment and economic growth in Malaysia: An ARDL bound test approach.* Asian Journal of Empirical Research, 2(2), 9–19.

Ashikin & Zaharul (2024). The Triple Helix of Innovation: A Case Study of the Role and Social Relations of Universities, Industry and Government. (2024a). *Akademika*, *94*(03). https://doi.org/10.17576/akad-2024-9403-16

Azmi, I. M. (2014). Intellectual property policy and academic patenting in Malaysia: Challenges and prospects. Pertanika Journal of Social Science and Humanities, 1–20.

Al-Ali, N. (2003). *Comprehensive Intellectual Capital Management: Step-by-Step*. John Wiley & Sons.

Bader, M. (2006). Intellectual Property Management in R&D Collaborations. The Case of the Service Industry Sector. Physica-Verlag, Heidelberg

Broekel, T., & Boschma, R. (2023). The geography of innovation: A critical review. *Regional Studies, 57*(1), 1–14. https://doi.org/10.1080/00343404.2023.2001234

Bettencourt, L.M.A., Lobo, J., & Strumsky, D. (2007). Invention in the city: Increasing returns to patenting as a scaling function of metropolitan size. *Research Policy, 36*(1), 107–120. https://doi.org/10.1016/j.respol.2006.09.026

Carlino, G. A., Chatterjee, S., & Hunt, R. M. (2007). Urban density and the rate of invention. *Journal of Urban Economics*, *61*(3), 389–419. https://www.sciencedirect.com/science/article/abs/pii/S0094119006000817

CEIC Data. (2025). Singapore labour productivity growth (1986–2024) [Quarterly data]. CEIC Data. Retrieved June 9, 2025, from https://www.ceicdata.com/en/indicator/singapore/labour-productivity-growth

Chung, C. J., & Park, H. W. (2014). Mapping triple helix innovation in developing and transitional economies: Webometrics, scientometrics, and informetrics. Scientometrics, 99(1), 1–4. doi:10.1007/s11192-0131105-6

Cherif R. & Hasanov F., (2015). *The Leap of the Tiger: How Malaysia Can Escape the Middle-Income Trap* (IMF Working Paper No. 15/131). International Monetary Fund

Cowan R. & Harison, E. (2001). Intellectual Property Rights in a Knowledge-Based Economy. MERIT, University of Maastricht.

Combes, P. P., Duranton, G., & Overman, H. G. (2005). Agglomeration and the adjustment of the spatial economy. *Papers in Regional Science*, *84*(3), 311–349. https://doi.org/10.1111/j.1435-5957.2005.00038.x

Cooke, P. (2002). Regional innovation systems: General findings and some new evidence from biotechnology clusters. The Journal of Technology Transfer, 27(1), 133–145. doi:10.1023/A:1013160923450

Cooke, P., Gomez Uranga, M., & Etxebarria, G. (1997). Regional innovation systems: Institutional and organisational dimensions. *Research Policy*, *26*(4–5), 475–491. https://doi.org/10.1016/S0048-7333(97)00025-5

Cooke, P. (2005). Regionally asymmetric knowledge capabilities and open innovation. Research Policy, 34(8), 1128–1149. doi:10.1016/j.respol.2004.12.005

Cooke, P., Uranga, M. G., & Etxebarria, G. (1997). Regional innovation systems: Institutional and organisational dimensions. Research Policy, 26(4–5), 475–491. doi:10.1016/S0048-7333(97)00025-5

Department of Statistics Malaysia. (2024). *Labour Productivity Fourth Quarter 2024*. https://storage.dosm.gov.my/technotes/productivity.pdf

De Keyser, B., & Vandenbempt, K. (2025). Persisting under pressure: How organizations coordinate their response to disruptive innovation. *Research Policy*, *54*(8), 105275. https://doi.org/10.1016/j.respol.2025.105275

Etzkowitz, H., & Leydesdorff, L. (1995). The Triple Helix---University-Industry-Government Relations: A Laboratory for Knowledge-Based Economic Development. *EASST Review 14*, 14-19.

Etzkowitz, H., & Leydesdorff, L. (1998). The Endless Transition: A “Triple Helix” of University-Industry-Government Relations, Introduction to a Theme Issue. *Minerva, 36*, 203-208.

Feldman, M.P. (1994). The geography of innovation. *Geography of Innovation*, 1–18. Springer, Dordrecht. https://doi.org/10.1007/978-94-011-1184-1_1

Feldman, M.P., & Kogler, D.F. (2010). Stylized facts in the geography of innovation. *The Handbook of Evolutionary Economic Geography*, 381–398. Edward Elgar Publishing. https://doi.org/10.4337/9781849807124.00030

Grandstand, O. (1999). The Economics and Management of Intellectual Property. Edward Elgar.

Northampton, MA.

Guerrero, M., & Urbano, D. (2017). The impact of Triple Helix agents on entrepreneurial innovations' performance: An inside look at enterprises located in an emerging economy. *Technological Forecasting and Social Change, 119*, 294–309. https://doi.org/10.1016/j.techfore.2016.06.015

Glaeser, E.L. (2011). Triumph of the city: How our greatest invention makes us richer, smarter, greener, healthier, and happier. Penguin Press. ISBN: 9781101475676

Gordon, I. R., & McCann, P. (n.d.). *Clusters, Innovation and Regional Development*.

Gomez, E. T., Cheong, K. C., & Wong, C.-Y. (2021). Regime changes, state-business ties and remaining in the middle-income trap: The case of Malaysia. *Journal of Contemporary Asia, 52*(5), 707–728. https://doi.org/10.1080/00472336.2021.1933138

Gurkov, I., Kokorina, A., Saidov, Z., & Balaeva, O. (2019). Foreign Direct Investment in a Stagnant Economy: Recent Experience of FDI in Manufacturing Facilities in Russia. Journal of East-West Business, 26(2), 109–130. https://doi.org/10.1080/10669868.2019.1689219

Griffith, B. (2011). Middle-income trap. In R. Nallari, S. Yusuf, R. Bhattacharya (Eds.), Frontiers in Development Policy: A Primer on Emerging Issues (pp. 39-43). World Bank.

Harris, M., Harris, P. & Hannah, S. (1998). Into the Future: The Foundations of Library and Information Services in the Post-Industrial Era. Ablex Publishing Corporation, Greenwich, CT

Ismail, K., Wan Omar, W. Z., & Abdul Majid, I. (2011). The commercialisation process of patents by universities. *African Journal of Business Management, 5*(17), 7198–7208. https://doi.org/10.5897/AJBM09.255

Jiang, R., Hu, S., Su, Z., Huang, Y., & Zhang, H. (2025). Spatial and Temporal Evolution of Urban Patent Quality: Evidence From China Prefectural Cities. SAGE Open, 15(1). https://doi.org/10.1177/21582440251319925

Kim, J., & Lee, K. (2022). Local–global interface as a key factor in the catching up of regional innovation systems: Fast versus slow catching up among Taipei, Shenzhen, and Penang in Asia. *Technological Forecasting and Social Change*, *174*, 121271. https://doi.org/10.1016/j.techfore.2021.121271

Kiss, E., Varga, G., & Kuttor, D. (2023). Triple helix in the age of the fourth industrial revolution and the spatial pattern of Hungarian industry. *Erdkunde*, *77*(1), 53–69. https://doi.org/10.3112/erdkunde.2023.01.04

Leydesdorff, L. (1996.). *The Triple Helix of University-Industry-Government Relations*.

Levi Jaksić, M. L., Jovanović, M., & Petković, J. (2015). Technology entrepreneurship in the changing business environment – A Triple Helix performance model. *Amfiteatru Economic, 17*(38), 422–440.

Levitas, E., & Chi, T. (2010). A look at the value creation effects of patenting and capital investment through a real options lens: The moderating role of uncertainty. *Strategic Entrepreneurship Journal, 4*(3), 212-233.

Lobo, J., Strumsky, D., Muro, M., & Rothwell, J. (2013). Patenting prosperity: Invention and economic performance in the United States and its metropolitan areas. *The Brookings Institution*. https://www.brookings.edu/research/patenting-prosperity-invention-and-economic-performance-in-the-united-states-and-its-metropolitan-areas/

Li, P. (2025). Cluster-based routines and paradigm-bound innovation. *Research Policy*, *54*(3), 105192. https://doi.org/10.1016/j.respol.2025.105192

MIDA (2024, February 28). Greater Klang Valley to drive economic boom with anticipated introduction this year — MB. *MIDA*. https://www.mida.gov.my/mida-news/greater-klang-valley-to-drive-economic-boom-with-anticipated-introduction-this-year-mb

Motohashi, K., Ikeuchi, K., & Kwon, S. (2025). Impact of national university patenting on innovation: Researcher analysis in Japan. *Technology in Society*, *81*, 102806. https://doi.org/10.1016/j.techsoc.2024.102806

Morikawa, M. (2019). Innovation in the service sector and the role of patents and trade secrets: Evidence from Japanese firms. *Journal of the Japanese and International Economies, 51,* 43–51. https://doi.org/10.1016/j.jjie.2018.10.003

MyIPO. (n.d.). *Statistic application & registration: Application and granted patents and utility innovations from 1986 - 2024*. Intellectual Property Corporation of Malaysia. Retrieved June 12, 2025, from https://www.myipo.gov.my/statistic-application-registration/

Ouellette, L. L., & Tutt, A. (2020). How do patent incentives affect university researchers? *International Review of Law and Economics, 61,* 105883. https://doi.org/10.1016/j.irle.2020.105883

Van Looy, B., Callaert, J., & Debackere, K. (2006). Publication and patent behavior of academic researchers: Conflicting, reinforcing or merely co-existing? *Research Policy*, *35*(4), 596–608. https://www.sciencedirect.com/science/article/abs/pii/S0048733306000394

Paradigm Shift to Quadruple Helix Model of Innovation in Malaysia. (2025). *Journal of Quality Measurement and Analysis*, *21*(1). https://doi.org/10.17576/jqma.2101.2025.06

Pino, R. M., & Ortega, A. M. (2018). Regional innovation systems: Systematic literature review and recommendations for future research. *Cogent Business & Management*, *5*(1), 1463606. https://doi.org/10.1080/23311975.2018.1463606

Park, H. W., & Leydesdorff, L. (2010). Longitudinal trends in networks of university–industry–government relations in South Korea: The role of programmatic incentives. *Research Policy, 39*(5), 640–649. https://doi.org/10.1016/j.respol.2010.02.009

Paus, E. (2017). *Escaping the middle-income trap: Innovate or perish* (ADBI Working Paper No. 685). Asian Development Bank Institute. https://www.adb.org/publications/escaping-middle-income-trap-innovate-or-perish

Puasa, A. F., Abdul Rashid, Z., & Omar, Z. (2015, September 8–9). *Malaysia and Middle-Income Trap*. Paper presented at the Malaysian Institute of Economic Research (MIER) Conference, Pullman Putrajaya Hotel, Kuala Lumpur, Malaysia.

Rasiah, R., Crinis, V., & Lee, H.-A. (2015). Industrialization and labour in Malaysia. Journal of the Asia Pacific Economy, 20 (1), 77–99. https://doi.org/10.1080/13547860.2014.974327

Rasiah, R. (1996). *Malaysia's national innovation system* (IKMAS Working Paper No. 4). IKMAS.

Romer, P. M. (1990). Endogenous Technological Change. *Journal of Political Economy*, *98*(5), S71–S102. http://www.jstor.org/stable/2937632

Sarjidan, M. A. M., Abu Bakar, A., Ismail, N. H., Syed Omar, S. N. S., & Nordine, N. (2023). Practices Malaysian Research Universities: Patent Profile in The Lens Database. *Journal of Information and Knowledge Management (JIKM), 13*(1), 75-90

Schumpeter, J. A. (1939). *Business cycles: A theoretical, historical, and statistical analysis of the capitalist process*. McGraw-Hill.

Sveiby, K. E. (1997). *The New Organizational Wealth: Managing & Measuring Knowledge-based Assets*. Berrett-Koehler Publishers.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics, 70*(1), 65–94. http://www.jstor.org/stable/188451

Sjöholm, F. (2021). *Industrial policy and foreign direct investment*. In M. Andersson, E. Deiaco, & J. Eklund (Eds.), *Swedish Economic Forum Report 2021: Swedish Perspectives on Industrial Policy – The Washington Consensus and Beyond* (Chapter 7, pp. 131–151). Entreprenörskapsforum.

Hefang, S., & Zhenxing, L. (2014). Patent quality and the measuring indicator system: Comparison among Chinese provinces and key countries. *Science Research Management, 35*(11), 68-76

Taalbi, J., & Martynovich, M. (2024). On the urban bias of patents and the scaling of innovation. *Papers in Evolutionary Economic Geography*. http://econ.geo.uu.nl/peeg/peeg2422.pdf

Tang, H. H. (2022). The strategic role of world-class universities in regional innovation system: China's Greater Bay Area and Hong Kong's academic profession. *Asian Education and Development Studies*, *11*(1), 7–22. https://doi.org/10.1108/AEDS-10-2019-0163

Theeranattapong, T., Pickernell, D., & Simms, C. (2021). Systematic literature review paper: The regional innovation system-university-science park nexus. *The Journal of Technology Transfer*, *46*(6), 2017–2050. https://doi.org/10.1007/s10961-020-09837-y

The Edge Malaysia. (2024). *Johor – Ready for the Big Leap* [Special issue]. The Edge Malaysia.

United Nations, 2012. Fostering innovative entrepreneurship: challenges and policy options/United Nations Economic Commission for Europe. Geneva: New York and Geneva

Van Caenegem, W. (2002). "Intellectual property and intellectual capital." *Intellectual Property Forum*, (48), 10–26.

World Bank. (2021). *Assessing the Effectiveness of Public Research Institutions*. World Bank, Kuala Lumpur. https://doi.org/10.1596/34612