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Technology-Driven Structural Change and the National Science Technology and Innovation Policy in Indonesia: The Problem of Economic Nationalism Discourse

Adiasri Putri Purbantina

Graduate School of Asia-Pacific Studies, Waseda University, Tokyo, Japan
Email: adiasri-p@suou.waseda.jp

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Abstract

As the manufacturing sector is a key driver in achieving higher economic growth at the middle-income stage, scholars have directed their attention toward manufacturing industry's upgrading through Science Technology and Innovation (STI) policy. Under the logic of developmental states, any effective STI policy relies on efficient triple-helix (government-university-industry) coordination. Although an STI policy can provide a big push for national technological change, policy is still a political choice made by policymakers. As such, a discursive institutionalism approach offers a way to examine policymakers' behaviour based on how they frame their policy. Through a qualitative document analysis, this paper argues that the current Indonesian administration uses an economic nationalism discourse to frame the Indonesian national development strategy. This discourse extends to the national STI policy, which prioritizes 'natural resource' protection over national technological upgrading to support indigenous manufacturing sector. As a consequence, this STI policy choice does not offer much support for medium-technology manufacturing subsector growth at a time when Indonesian technological capabilities have already been stuck in a low-technology rut for 23 years.

Keywords**:** *science technology innovation policy, national technological upgrading, structural change, Indonesia*

1. Introduction

Economic growth has always been the central topic in the study of development. Often, a government's biggest challenges have been to escape low-income status and maintain high growth after reaching the middle-income stage. Currently, various developing countries continue to face the problem of middle-income trap (Figure 1). At a middle-income stage, a country can no longer rely on natural resources for their comparative advantage. One of the keys for higher economic growth is structural changes from agriculture to manufacturing and from manufacturing to the service sector, and the manufacturing sector becomes the key driver for higher and faster economic growth at the middle-income stage.

In light of this reality, the United Nations Industrial Development Organization [UNIDO] (2015) highlights the importance of examining the growth of manufacturing subsectors. The report presents that the transitions of developing countries into developed countries within the past 40 years were accompanied by technological upgrading[i] within the manufacturing subsectors. Thus, they propose a technology-driven structural change with a heavy emphasis on a national Science Technology and Innovation (STI) policy. Effective triple-helix (government-university-industry) coordination stands at the centre of providing a big push for a national technological change that supports the manufacturing sector.

Within the age of global production network expansion, Southeast Asia is one of the most dynamic regions hosting multinational companies (MNCs) in the medium-technology manufacturing sector since the 1980s. The Association of Southeast Asian Nations (ASEAN) frames the central idea of the ASEAN Economic Community (AEC) under this light (ASEAN 2008; 2015). In the middle of this global dynamic, most of the middle-income countries in Southeast Asia still find themselves trapped in the middle-income trap (Figure 1). Among them, Indonesia has the weakest manufacture value added growth (Figure 2).

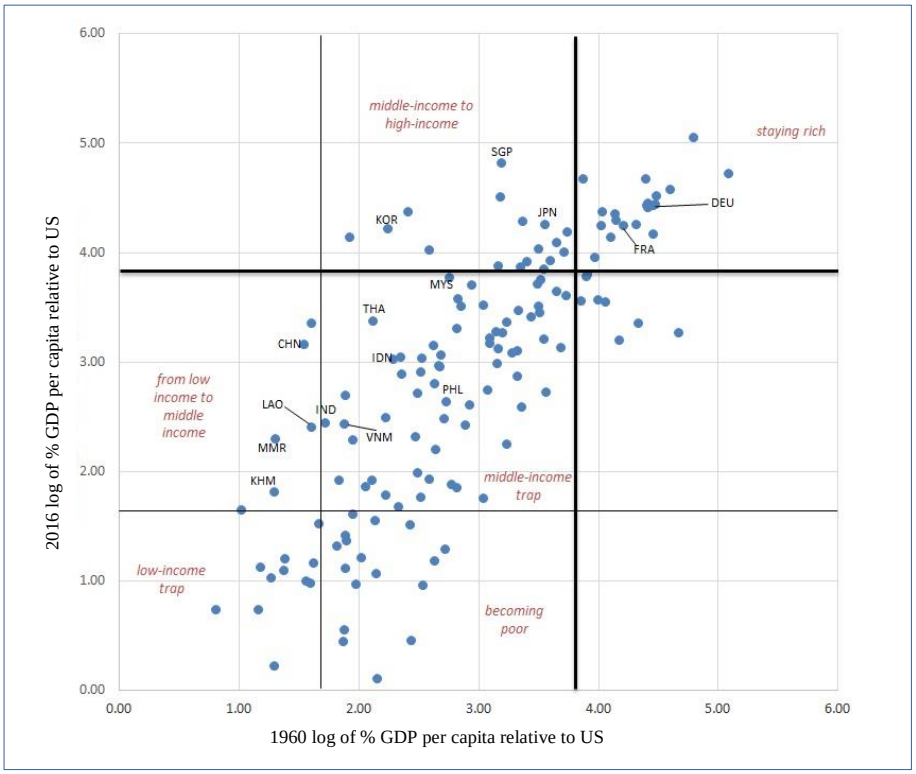

Figure 1 Middle-Income Trap based on Relative Income Calculation
Source: author's calculation based on Agenor, Canuto, and Jelenic (2012). Maddison Project Database version 2018 (Bolt, Inklaar, de Jong, and van Zanden, 2018)

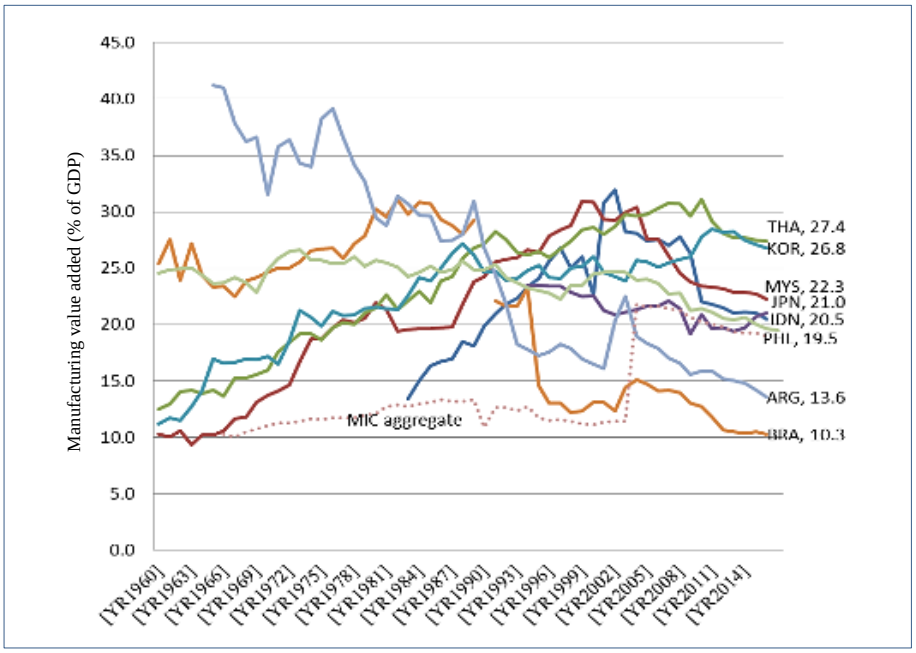

Figure 2 Share of Manufacture Value Added to GDP
Source: World Development Indicators (2018b)

This paper examines the case of STI policy in Indonesia under the technology-driven structural change concept, as one of the latest policy recommendations for middle-income countries. Effective institutions are fundamental to technology-driven structural change concept. Under the new institutionalism approach, this paper does not ask whether, but how an institution matters (March and Olsen, 2008). Instead of using quantitative such as government size or the number of financial regulations to examine the government as an institution (Aiyar, Duval, Puy Wu, & Zhang, 2013). Aiyar et al. (2013) choose a qualitative discursive institutionalism approach to explain how policymakers' behaviour influence policy by highlighting the existing discourse within a certain policy choice. In doing so, this paper hopes to complement various policy reports and indexes on STI development, which already provide a quantitative measurement on institutional capacity to innovate. These measurements include public R&D expenditure, population education level, Science, Technology, Engineering and Mathematics (STEM) data, and other comparative indicators (Cornell University, INSEAD, & WIPO, 2018; OECD, 2016b).

Overall, this paper argues that economic nationalism is one important factor that influence the direction of STI policy in Indonesia. The current President Joko Widodo administration continues the previous administration's emphasis on an agrarian and maritime identity within Indonesia's national development strategy. The STI policy in Indonesia prioritizes 'natural resource' protection over upgrading of manufacturing technology. As a result, low-technology sectors (e.g., agriculture, food) dominate the STI policy programs. Therefore, under the logic of technology-driven structural change, this STI policy choice does not offer much support for medium-technology manufacturing subsector growth at a time when Indonesian technological capabilities have already been stuck in a low-technology rut for 23 years.

2. Technology-Driven Structural Change and Science, Technology, and Innovation Policy

Before going further into the concept of technology-driven structural change itself, this paper first provides a brief history of STI policy study. Lundvall and Borrás (2005) trace it back to a separate origin of science policy, technology policy, and innovation policy. This provides an understanding of why current STI policy can be analysed with different lenses which can also overlap with each other (e.g., natural resource conservation, public health, industrial catch-up). As a whole, however, STI policy gains its momentum when policymakers start to see STI development as an integral part to support national economic growth.

Historically, the origin of science policy stems from the government's interest on using science to improve resource efficiency so as to support welfare distribution. Ministries of education and research often act as main policy agents, alongside some degree of involvement from other ministries (e.g., ministry of health, defence, energy, transport) (Lundvall & Borrás, 2005, p. 7). As science-based technologies (e.g., nuclear power, space technology, computers) begin to play a more significant role to promote economic growth, governments start to pay more attention towards their technology policies. Countries in different developmental stages (high-income advance countries versus catching-up countries) conduct different technology policies. The focus of technology development shifts towards innovation activities as it seeks to improve the capacity to produce the most recent science-based technologies (Lundvall & Borrás, 2005, p. 8). Ministries of economic affairs or ministries of industries tend to be at the centre of innovation policy (national innovation system).

According to Lundvall and Borrás (2005), the current discussion over STI policy centres on a construction of an ideal STI policy that works to boost economic growth. One of the recent policy recommendations for governments in middle-income countries is technology-driven structural change. This is mostly based on the success of East Asian developmental states (e.g., Japan, Taiwan, and South Korea) and the failure of Latin American countries (e.g., Argentina, Brazil). One of the key factors to boost economic growth is structural change or a movement of country's economic activities towards more sustained sectors (from primary sectors into manufacturing sectors). Based on the Prebish-Singer hypothesis, which is based on the case of Latin America, a country cannot overly rely on their primary commodities to boost their economic growth due to the declining relative prices of primary products (Harvey, Kellard, Madsen & Wohar, 2010).

The UNIDO report points out the importance of looking into the growth of manufacturing subsectors, particularly the low-technology and medium-technology sectors (UNIDO, 2015). The transitions of developing countries into developed countries within the past 40 years were accompanied by technological

upgrading within the manufacturing subsectors (p. 3). The report proposes a "technology-driven structural change" to expand the modern formal industrial sector so that it can absorb a "pool of underemployed workers in agriculture" (p. 7). Table 1 below shows a classification of manufacturing subsectors based on their technological level used by the UNIDO report.

Table 1 ISIC REV. 3 Technology Intensity Definition

High-technology industries	**Medium-high-technology industries**
1. Aircraft and spacecraft 2. Pharmaceuticals 3. Office, accounting and computing machinery Radio, TV and communications equipment 4. Medical, precision and optical instruments	1. Electrical machinery and apparatus, n.e.c. 2. Motor vehicles, trailers and semi-trailers Chemicals excluding pharmaceuticals 3. Railroad equipment and transport equipment, n.e.c. 4. Machinery and equipment, n.e.c.
Medium-low-technology industries	**Low-technology industries**
1. Building and repairing of ships and boats 2. Rubber and plastics products 3. Coke, refined petroleum products and nuclear fuel Other non-metallic mineral products 4. Basic metals and fabricated metal products	1. Manufacturing, n.e.c.; Recycling 2. Wood, pulp, paper, paper products, printing and publishing 3. Food products, beverages and tobacco 4. Textiles, textile products, leather and footwear

Source: OECD (2011)

A technology-driven structural change requires governments to assume effective roles and efficient STI policies. Existing studies highlight the success of East Asian developmental states (e.g., Japan, Taiwan, and South Korea) and the failure of Latin America. Gereffi and Wyman (1990) argue that while the East Asian governments used their commitments to boost economic growth through efficient STI policies to provide national security (e.g., in a cold war context), Latin American governments used politically-motivated economic nationalism (against foreign economic powers) to continue to rely on natural resources. Brazil did this to boost income growth until 1978, but then it stagnated in 1995. It bounced back in 2006 only due to a commodities boom (Kharas & Kohli, 2011, p. 283-284).

South Korea and Taiwan, as two examples of successful catching-up countries, rely on the effectiveness of government-funded research institutes (GRIs). The GRIs have disseminated technology to private manufacturing industries since mid-1970s (Lee, 2013; Shin, Kang, & Hong, 2012; Taylor, 2016, p.2010). Fu, Pietrobelli, and Soete (2011) argue that foreign technology would remain as static technology (embedded in imported machineries) if there is no proactive effort to develop indigenous technological capabilities Malaysia, a middle-income country with the highest technological capabilities in Southeast Asia, started a similar strategy in the mid-1980s (OECD, 2016a; Yusuf & Nabeshima, 2009). Therefore, under a technology-driven structural change concept, the national government needs to prioritize indigenous manufacturing subsectors upgrading. As consequences, their STI agents need to prioritize medium-technology development (manufacturing subsectors) above low-technology development (e.g., agriculture sector, resource-based industry).

3. Methodology: Discursive Institutionalism Approach to Policy Analysis

With regards to policy effectiveness, or policy study in general, there is already a growing consensus that institutions matter. This has led to the prevalence of institutional analysis or institutionalism as an approach to explain actors' behaviour within institutions. For example, economic scholars tend to emphasize strategic choice aspects; sociologists tend to focus on the institutionalization aspect; while political scholars tend to be somewhere in the middle (Jackson, 2010, p. 70). However, while institutionalism is now an indispensable element to policy analysis, it is not the sole explanation to particular policy outcomes. The institutionalism approach can only offer one alternative explanation of what influences policymakers' behaviour, which are then reflected in policy outcomes.

In general, the institutionalism approach can be divided into old and new institutionalism. While old intuitionalism looks into the formal structure of institutions (formal institutional constraints), new institutionalism mostly looks beyond the formal structure. Schmidt (2008, 2015) proposes discursive institutionalism to complement the three older new institutionalisms, which are rational choice institutionalism (fixed rationalist preferences), sociological institutionalism (norms and rules), and historical institutionalism (path dependence). According to Schmidt, the three older versions of new institutionalism discuss how external factors influence or constrain policymakers' behaviour. Rational choice institutionalism focuses on rational agents (incentives), sociological institutionalism focuses on norms and social practices, and historical institutionalism on path-dependence nature of system (a self-reinforcing system).

Discursive institutionalism brings attention to what the actors actually say, thereby complementing the three existing approaches. Discursive institutionalism discusses policymakers as sentient agents (who think and speak) to understand what discourse exists and how this discourse influences policy outcomes. It has two important elements: ideas and discourse. Agents think and carry out ideas through discourse (interaction) under the context of ideas (Schmidt, 2008, p. 305). Discursive institutionalism adopts a top-down approach, i.e., "policy elites generate ideas, which political elites then communicate to the public" (p. 311). It works through two channels, i.e., coordinative discourse (interaction among policymakers) and communicative discourse (public persuasion by government).

The paper's choice to place emphasis on discourse also relates to existing studies on STI policy in Indonesia, particularly existing STI reports or indexes by international agencies (Cornell University, INSEAD, and WIPO, 2018; OECD, 2016b) and the work of Amir (2007, 2013); Aspinall (2015) and Patunru, Pangestu and Basri (2018). Existing STI reports already provide a thorough analysis of national STI development in Indonesia by using statistical indicators education level, Science, Technology, Engineering and Mathematics (STEM) data to explain the capacity to innovate. The work of Amir (2007, 2013) provides a comprehensive analysis on STI policy in Indonesia under the New Order era (1966-1999), particularly under the influence of B.J Habibie. His work sheds light on, not only the formal organizational structure, but also the politics behind it. Aspinall (2015) and Patunru et al. (2018) are also two important works on the Indonesian economic policy after the New Order era, particularly under the Susilo Bambang Yudhoyono administration (2004-2014).

The key argument by Amir (2013) is how the New Order regime in Indonesia built their technology policy upon 'technology nationalism', which refers to "a form of ideology to create a shared feeling of national identity and pride through technological artefacts" (Amir, 2007, p. 192). Technology policy, including its system, is not entirely governed by "a pure technical rationality", it also can be politically constructed (e.g., physical calculation and material constraints) (Amir, 2013, p. 160). This means that STI policy analysis needs to also incorporate non-technical aspects to complement technical constraints that determines policy outcomes. Amir's works show how rational choice (political economic incentives) and sociological institutionalism approaches (organizational structure) can be used to examine Indonesian technology policy. Additionally, based on the Indonesia's national development policy documents, the key agents and direction of STI policy in post-New Order Indonesia remain the same. Thus, a use of historical institutionalism approach is redundant as it will only result in conclusion on the self-reinforcing nature of a system (path dependence). Amir's works, however, provide a starting point on the importance of understanding how the Indonesian government perceives STI policy.

One of the latest criticisms of Indonesian economic policy is the strengthening of economic nationalism. Nationalism refers to the existence of a common destiny and common future in a certain geographical territory (Anderson, 1999, p.6). In Southeast Asia, it is often linked to anti-imperialism sentiment (Reid 2010). Aspinall (2015, p.77) argues that the current Indonesian nationalist discourse seems to be "very anachronistic". Patunru et al. (2018) dedicated an entire book to discussing the latest surge of nationalism discourse within the Indonesian economy. Within this book, Aspinall (2018, p.39-40) classifies Indonesian nationalism further into territorial nationalism (territorial integrity against foreign aggression), economic nationalism (protection of domestic producers and national resources against foreign competition), and cultural nationalism (protection of national culture). This book, however, does not discuss STI policy.

Borrowing Aspinall's conception of economic nationalism, this paper uses discursive institutionalism approach to examine how economic nationalism discourse manifests itself within STI policy

in Indonesia under the current President Joko Widodo's administration (2014-2018). This paper places an emphasis on economic nationalism discourse as one approach, among other alternative explanations based on older theories (e.g., political clientelism, populism), to understand STI policy in Indonesia. This paper also aims to complement STI policy reports that already provide statistical information to evaluate country's capacity to innovate. In order to demonstrate the manifestations of economic nationalism discourse within Indonesia's STI policy, first, this paper examines relevant STI policy documents (e.g., policy reports, policy plan books, budget reports) from President Joko Widodo's administration. This provides an overview of the Indonesian government's prioritization of low-technology development (e.g., agro-technology, food sector) over medium-technology development (e.g., electronics, automotive). Second, this paper examines official records (e.g., minutes of meeting, press releases, presidential speeches) as mediums for both coordinative and communicative discourses. Third, this paper also incorporates in-depth interview data to confirm the government's negligence in regard to medium-technology development.

Table 2 List of Documents

Science Technology and Innovation Policy	1. The 2005-2025 Long-Term National Development Plan 2. The 2015-2019 Medium-Term National Development Plan 3. The 2015-2044 National Research Priority Agenda 4. The 2015 Annual Report of Ministry of Research Technology and Higher Education 5. The 2016 Annual Report of Ministry of Research Technology and Higher Education 6. The 2018 Making Indonesia 4.0
Coordinative Discourse	1. The Minutes of Meeting of Commission VII, House of Representative of Republic of Indonesia (January 17, 2017) 2. President Joko Widodo's speech in front of National Innovation Forum 2015 at the Centre for Research, Science and Technology (April 13, 2015) 3. President Joko Widodo's speech in front of the meeting between Echelon I and II officials, the head of universities, and the head of higher education services from the Ministry of Research Technology and Higher Education (October 10, 2018) 4. President Joko Widodo's speech in front of the cabinet plenary session to evaluate the 2015-2019 Medium-Term National Development Plan (December 2, 2018)
Communicative Discourse	1. The Annual Presidential Speech to Commemorate Indonesian Independence Day (televised) from 2015, 2016, and 2017 2. Press Release for the "Four-years Achievement of the President Joko Widodo's administration on Campus Affirmation Policy and Citizen (indigenous) Innovation Growth" by the Minister of Research Technology and Higher Education (October 26, 2018)
Additional Data	In-dept interview with the representative of University-based Centre of Excellence in Automotive Systems and Control, Sepuluh Nopember Institute of Technology, as one out of two University-based Centre of Excellence in medium-technology development (since 2014)

4. Discussion

4.1 The Indonesian Manufacturing Sector and National Technological Capabilities

In regard to structural change, figure 3 shows a simple comparison of sectoral growth between Indonesia, Thailand, Malaysia, and South Korea. Currently, scholars often refer to the speed of structural changes in South Korean industry. Figure 3 shows the average growth of agriculture, manufacture, and service value added share to GDP in over a span of 25 years since the share of manufacturing value added surpass the share of agriculture value added. The figure shows that the structural transformation from agriculture to manufacturing in Indonesia is slower than it is in the other three.

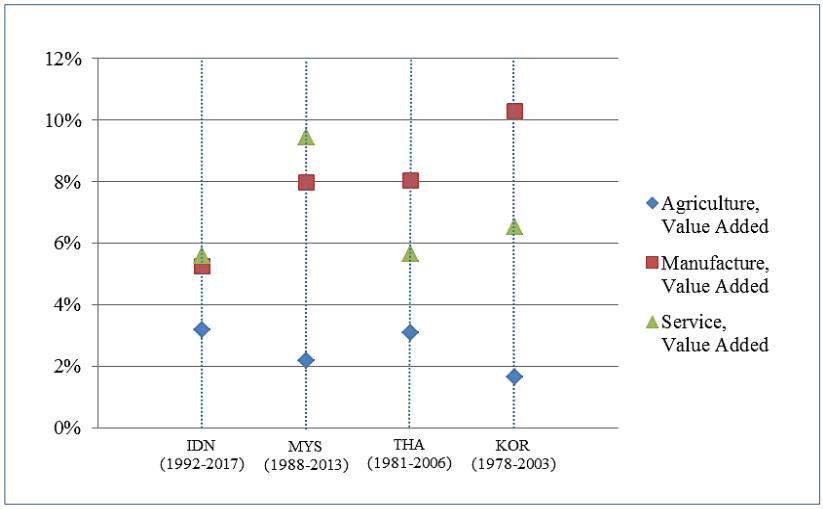

Figure 3 Average Growth of Sectoral Value Added to GDP (percentage)
Source: World Development Indicators (2018a, 2018b, 2018c)

Therefore, it is important to investigate the growth of the Indonesian manufacturing subsectors' share of the GDP to see their diversification into medium-level technology subsectors. Figure 4 shows that from 2000 to 2017, particularly after the 2008 commodity boom, the share of agriculture in GDP increases. Meanwhile, the share of total non-oil and gas manufacturing declines. Furthermore, the low-technology manufacturing subsectors dominate the manufacturing sector, while the medium-technology manufacturing subsectors have not grown significantly within the past 17 years.

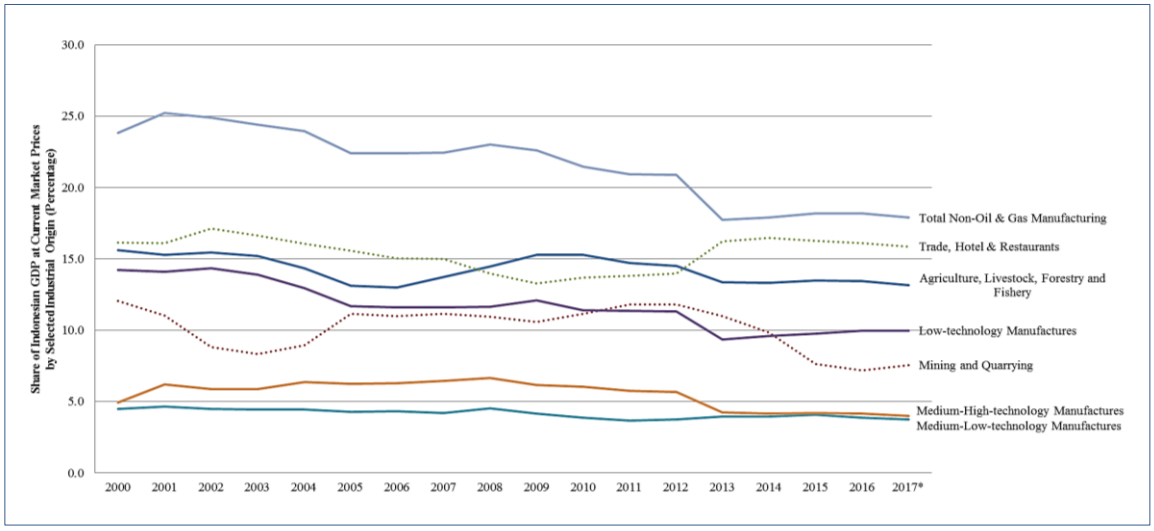

Figure 4 Share of Indonesian GDP at Current Market Prices by Selected Industrial Origin 2000-2017*
Note: The 2017* data is a temporary data. Indonesian manufacturing sub-sectors are categorized into low, medium-low, medium-high technology sub-sectors according to ISIC Rev. 3 Technology Intensity Definition (OECD, 2011).
Source: Bank Indonesia (2018) and Statistics Indonesia (2018)

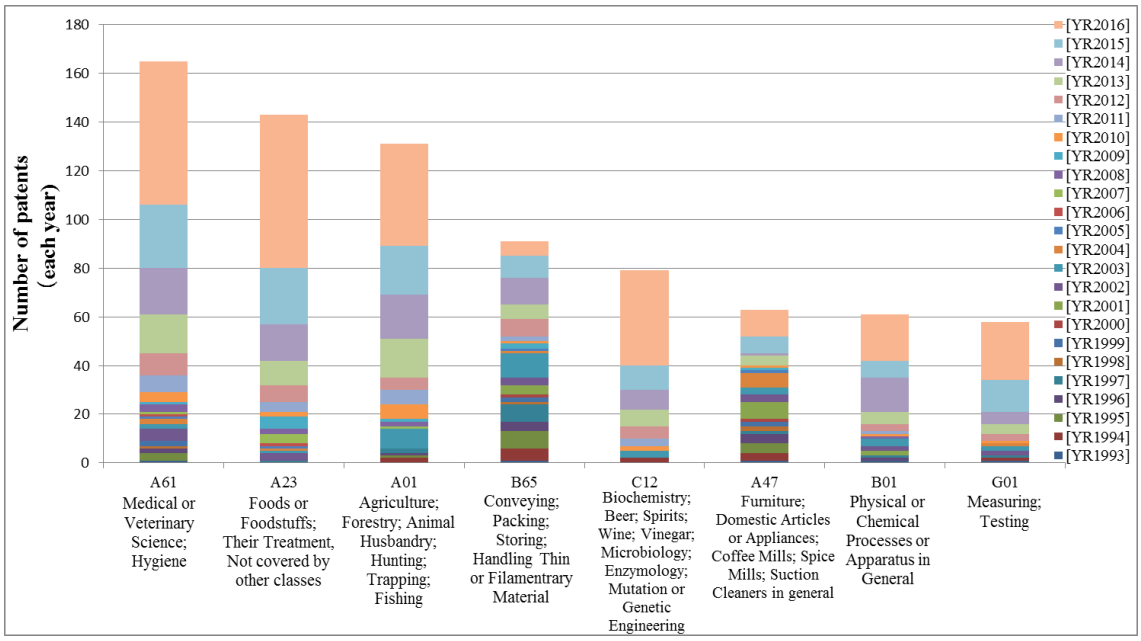

Figure 5 Most Used IPC Codes (3 digits) in Indonesian Patent (Valid & Expired) 1993-2016
Note: Different colour represents different year (from bottom to top: 1993-2016). Each patent can be attached to more than one IPC code. These are the codes used by more than 50 patents from a total of 1394 patent data. This figure only counts patent data under "valid" and "expired' status. The patent data last checked on 07/08/2018.
Source: Indonesian Patent Office (2018)

National patent data is one of the best indicators with which to measure national technological upgrading. Instead of looking into the growth of total patents per year, this paper investigates their (IPC) codes to look for evidence of technological change (Figure 5). Despite the number of patents increasing in the past several years, there is a lack of the technological upgrading needed to proceed to a higher technological level. For the past 23 years (1993- 2016), most Indonesian patents have continued to be issued for agriculture products (A01), including food (A23). Majority of the patents for medical science (A61) were for organic-based medicine or beauty products (108 out of 163). There has been a lack of growth in IPC codes associated with medium-technology manufacturing products, such under code B for automotive patents (e.g., B60, B62), under code F for machinery patents (e.g., F01, F02), or under code H for electrical patents (e.g., H01, H03). Based on the patent titles, some of the patents listed under the B60 code (vehicles, in general) are mostly tires, agricultural machinery (e.g., tractors), and the bodies of cars and motorcycles (instead of the engine components).

4.2 Indonesian Science, Technology, and Innovation (STI) Policy: Assessing Policy Choice from the National Level down to the Local Level

Under a technologically-driven structural change concept, national technological changes or upgrades require an effective national STI policy brought about by triple-helix coordination (government-university-industry). This section argues that instead of economic catching-up, the Indonesian government uses economic nationalism discourse to promote the idea of national resource protection as their national economic strategy. Thus, its extension to the STI policy leads to a prioritization of agricultural and low-technology sector development over medium-technology sector development. The low-technology sectors dominate policy programs. Based on field observations, medium-technology sector development receives less attention, particularly in the technological dissemination stage.

4.2.1 Science, Technology, and Innovation (STI) Policy under President Joko Widodo (2014-present)

One of the latest criticisms of President Joko Widodo involves his 'statist-nationalist' approach, which is a continuation from Susilo Bambang Yudhoyono's administration (Warburton, 2016, 2018). This refers to a promotion over a state-centric resource-based economic planning heavily under narratives such as self-sufficiency in food and rice. Since the New Order regime under Suharto (1966-1998), the Indonesian government put a high prioritization over agricultural sector within their national economic strategy. According to Amir (2013) and Temple (2000) the regime heavily promoted two types of technology: agricultural technology and high technology (e.g., aircraft manufacture). When the regime ended in 1998, which coincided with the 1997/8 Asian Financial Crises, the Indonesian government started to promote more agricultural sector development instead of manufacturing sector.

Figure 6 shows the latest overall structure of STI policy agents in Indonesia. The Ministry of Science, Technology, and Higher Education is the main ministry in charge of STI policy. They receive support from other agencies, including the National Nuclear Energy Agency (BATAN), Nuclear Energy Regulatory Agency (BAPETEN), Indonesian Institute of Sciences (LIPI), National Institute of Aeronautics and Space (LAPAN), Agency for the Assessment and Application of Technology (BPPT), and Geospatial Information Agency (BIG). In addition, universities act as STI policy agents through various government programs under the Ministry of Research Technology and Higher Education. One of the key programs that emerged to boost the involvement of universities in R&D activities was the Centres of Excellence (COEs) program (more on Section 4.2.3). The House of Representative of the Republic of Indonesia, as one of national legislative assemblies in Indonesia, oversees the national budget allocation for policy programs from different sectors. Among a total of eleven commissions, Commission VII of the House of Representative of the Republic of Indonesia is responsible for STI policy. Based on the Minutes of Meeting of Commission VII pertaining to STI policy program coordination, the Ministry of Industry is not involved (more on Section 4.2.2). Historically, the Ministry of Industry has been a minor player within STI policy in Indonesia (see Hill and Pane 2018).

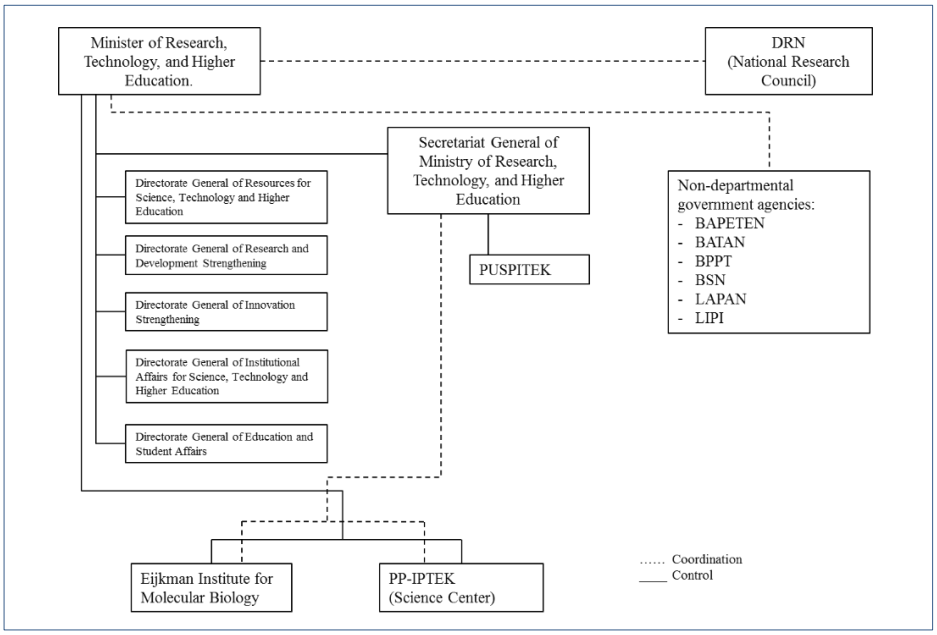

Figure 6 Current STI Policy Agents in Indonesia
Note: This figure only incorporates selected sub-bodies that possess STI development function
Source: Author's construction based on various governmental documents (see Table 2). The author constructs the figure as a modification from Bishry and Hidayat (1998, p. 10) and Amir (2013, p. 67) who provide organizational structure of STI policy agents in Indonesia throughout New Order regime.

Historically, B.J. Habibie was the key figure in the early formation of STI policy under the New Order's regime from the mid-1970s to late-1990s. He became the Minster of State for Research and Technology while holding another position as the chair of BPPT (Agency for the Assessment and Application of Technology), BPIS (Agency for the Management of Strategic Industries), and DRN (National Research Council). Under him, BPPT took control of major technology development while the IPTN (Nusantara Aircraft Industry, now Indonesian Aerospace) developed the Indonesian airplane manufacturing industry (Bishry & Hidayat, 1998). When the New Order regime ended with the 1998 Political Reform, it provided a momentum of anti-New Order sentiment which compromised their project for high technology.

Since the end of the New Order regime, the Indonesian government started placing more emphasis on agricultural development as part of a pro-poor approach. The 2000 National Development Budget Plan, as part of the 1999-2004 Broad Guidelines of State Policy (GBHN), states that the Indonesian national budget allocation for STI dissemination shall be used to develop agriculture-centric and natural resource-based technology. While this might be a natural response as part of democratic transition, a continuation of this approach would need further re-examination in light of current regional economic dynamics and Indonesia's current stage of development as a middle-income country.

The 2005-2025 Long-Term National Development Plan, released under the Susilo Bambang Yudhoyono's administration, claims that the Indonesian national economic strategy is directed to achieve their comparative advantages as maritime and agrarian country. The long-term development plan further states that the Indonesian industrial development prioritizes the national food security issues and national raw material potentials, in which resource-based industrial development is their future interest (Ministry of National Development Planning, 2005, pp. 30-33). When the President Joko Widodo presented his Nawa Cita strategy through the 2015-2019 Medium-Term National Development Plan, he actually offered similar strategy. Among the nine points of Nawa Cita, the sixth and seventh strategies are strategies designed to achieve national economic competitiveness through a set of sectoral priorities, i.e., food sovereignty; energy sovereignty and electric power; maritime and marine; and tourism and industry priorities.

There is a clear policy program prioritization of agro-industry, wood and forestry, fisheries, and mining as part of the national economic strategy to accelerate growth (Ministry of National Development Planning, 2015, pp. 6-113–6-118). As a consequence, STI policy to develop natural resource-based technology is also prioritized (Table 3). The Indonesian government has said that it will start prioritizing manufacturing-based technology in 2025-2030. This is a questionable choice considering AEC's promotion of GVC expansion. Furthermore, the local research and development institution argues that they have the capabilities needed to develop medium-level technology for manufacturing at the present time (more in Section 4.2.3).

Table 3 The 2015-2044 National Research Priority Agenda

Research Area	Priority Rank Based on Development Period					
	2015-2019	2020-2024	2025-2030	2030-2034	2035-2039	2040-2044
Natural resource-based technology	**1**	6	5	4	3	2
Natural resource-based advance technology	2	**1**	6	5	4	3
Applied technology in manufacture	3	2	**1**	6	5	4
Applied technology in services	4	3	2	**1**	6	5
High technology	5	4	3	2	**1**	6
Frontier technology	6	5	4	3	2	**1**

Note: This priority rank refers to government's budget allocation (from first to sixth: 40%, 20%, 15%, 12.5%, 7.5%, and 5%).
Source: National Research Council (2016)

The two latest annual reports of the Ministry of Research Technology and Higher Education (2015, 2016) confirm the prioritization of the agriculture and low-technology sectors through STI policy programs.

This prioritization is also evident in the projects of the National Science and Technology Park (N-STP), Regional Innovation Cluster program (RIC), and Technology Business Incubator program (TBI). N-STP units, under the Ministry of Research, Technology, and Higher Education, focus on natural, resource-based product development (e.g., sago[ii], wood, coffee, fisheries). Innovation clusters under the RIC program are for low-technology products (e.g., brown sugar, bananas, sweet potatoes, fisheries, crafts, and woven products). TBI program outputs aim mostly at increasing production capacities instead of technological capabilities (e.g., seaweed technology, electric stoves for Batik, milk pasteurization, green bean technology, rice technology).

Overall, there is a lack of attention being paid to medium-technology development and its dissemination to indigenous manufacturing industries covered by Indonesian STI policy programs. In addition, when the Indonesian Ministry of Industry (2018) released their "Making Indonesia 4.0", this document did not contain an indigenous technology development program for medium-technology manufacturing. Food and agriculture industry (low-technology) continue to be the main emphasis. The Ministry's strategy for the medium-technology manufacturing subsectors (e.g., the automotive and electronic sectors) only emphasizes the expansion of MNCs (domestic production) without any explanation of the technology transfer mechanism.

4.2.2 Discursive Institutionalism: Economic Nationalism Discourse within STI Policy Making (Coordinative and Communicative Channels)

The previous section presented the choice on the part of Indonesian government to prioritize agriculture and low-technology development within STI policy programs over medium-level technology for the manufacturing industry. The conception of technology-driven structural change demands the national government to support indigenous manufacturing subsectors upgrading through national STI policy. This means that the national government, though their STI agents, needs to focus more at the medium-technology development rather than low-technology. In this regard, the national government needs to put technological upgrading as their main objective for STI policy. However, the current Indonesian government frames their STI policy under economic nationalism discourse, which then takes form of national resource protection.

The discursive intuitionalism approach offers one way to explain this choice through an examination of coordinative (among policymakers) and communicative channels (from policymakers to the public). Economic nationalism discourse very much frames the STI policymaking process in Indonesia under the President Joko Widodo's administration. The best representation of coordinative channel is a Commission VII[iii] open meeting (House of Representative of Republic of Indonesia, 2017). The meeting discussed the 2016 STI policy outputs and the 2017 STI policy plan.

The sentiment "a protection of national resources" often appears in the reasoning from both Members of Parliament and the STI policy agents. First, the meeting confirms the parliament members' demands for a prioritization of R&D in the energy, maritime, and food sectors. They stated repeatedly that the agricultural and fisheries sectors were vulnerable sectors that needed protection. The statements during the meetings show that the motivation for the STI policy programs is not technological changes or upgrades, but national resource protection.

> Therefore, in my opinion, we have spent useless budgets for years, which have not resulted in *technology that solves national problems, both in food and industrial sectors*. […] How far does your ministry protect these technologies so that they will not be sold to foreign interests? One of the examples is fish. Can the public access the technology? [translation by author] (A legislative member from the National Mandate Party)

> We do not have our own ship; please think strategically (…). This is *to protect our sea border, economic value* and transportation value [translation by author] (A legislative member from Great Indonesia Movement Party)

In response to the Member of Parliament, the STI agents (non-elected bureaucrats) emphasized their programs for agricultural sector development. The head of BATAN claimed that BATAN works to increase

the income level of farmers. The head of BPPT promised to reduce the dependency on imported salt. The head of LIPI promoted their programs for food preservation, amphibian rice, and food stimulation for animals. The Minister of Research, Technology, and Higher Education highlighted the Ministry's cooperative program with the Ministry of Marine Affairs and Fisheries and Bogor Institute of Agriculture (IPB) to boost local fishermen's productivity. There was no discussion of indigenous medium-technology development for the manufacturing industry.

> […] BATAN owns one Science and Techno Park (STP) unit located at Pasar Jumat and three units that we refer as Agro Techno Parks because of *their focuses on the agricultural problem*. Therefore, we put focus on training, revitalization, and infrastructures at Pasar Jumat. Subsequently, we also conduct *training on animal feed production at the three Agro Techno Park units*, which are located at Musi Rawas, Klaten, and Polewari Mandar, in addition to the breeding and seed dispersal activities there. [emphases added; translated by author] (Head of BATAN)

> Subsequently, this local canned food […] Therefore, this can become *business in food preservation sector*, particularly during the Haji season; there are a lot of local foods that can be taken there. Next, we have also developed what we call *'amphibian rice,'* which we have not launched yet. Next, we also conduct *food stimulation for animals*, for example, we give cows vitamins [emphases added; translated by author] (Deputy Head of LIPI)

Another examples for coordinative channel are various occasions when President Joko Widodo delivers speeches in front of policymakers, particularly the STI agents. He often emphasizes resource-based development, mainly agriculture technology and innovation (e.g., coffee, palm oil, corn, salt). He framed national technological development and national innovation under resource-based idea instead of technological upgrading to support indigenous manufacturing sector. When President Joko Widodo made a remark on the need for Indonesia to catch-up economically, he did not frame it under technological upgrading context (Widodo, 2018a). Additionally, agricultural sectors also became his points when he discussed on human resource development and overseas training (Widodo, 2018a, 2018b). Below are some of his remarks on the Indonesian technological development.

> In the relations with food sector, or cement, there is a wide price gap (between islands), from IDR 60,000-70,000, it increases to IDR 2,500,000 when it reaches a regency in Papua. These are the problems that need solutions from a good research. […] I saw in Subang (a regency in Java), rice seeds that reach 8-9 tons per hectare. We already tried and confirmed the result. But it was a small-scale research. How (can we) nationalize this? [translated by author] (Widodo, 2015b)

> I am not sure (when), around two or three years ago, I delivered my idea on the need to establish a university level Coffee Study. At that time, some laughed (at me). In my view, a coffee-study (and) palm oil-study are our big industries! And I was being serious […] At the U.S. and Italy, there are coffee institutes, you can search for it yourself. Coffee is learned, researched, taught, from its method of planting and processing, industrialization stage, branding, packaging, and selling. They have these details. This is a multidisciplinary study on a world-class huge economic turnover. [translated by author] (Widodo, 2018a)

> Perhaps, from the Ministry of Agriculture, I am asking for several hundred (people) from our fieldwork program to be sent for overseas training. Furthermore, in my understanding, our Ministry of Agriculture maintains a good relationship with Taiwan, who possesses good agricultural capabilities. [translated by author] (Widodo, 2018b)

Communicative discourse examines the mediums through which policymakers attempt to influence the public. One of the most effective mediums is the annual presidential speeches to commemorate Indonesian Independence Day (Widodo, 2015a, 2016, 2017). Along with the context of an Independence Day commemoration, the President always emphasizes Indonesia's colonial legacy and the protection of national resources as he describes Indonesian technological achievements. During his first speech in 2015 (Widodo, 2015a), he stated that self-sufficiency in food and illegal fishing was the two among four major problems that he wanted to tackle. Instead of promoting the Indonesian indigenous manufacture sector, he connected the challenges of globalization with the government effort to push for self-sufficiency in food (e.g., rice, corn, meat, chillies, and shallots). Economic nationalism discourse framed a national development strategy that resonated with the public sentiment on the anti-colonialism history in Indonesia. Throughout various occasions, President Joko Widodo continue to promote agricultural sector development rather than indigenous technological upgrading for manufacturing sector. This extends to his STI policy.

> We have to be brave to fight against the theft of our marine resources. We have to be brave to sink illegal fishing to protect our fishermen. We have to be brave to protect every inch of earth (*bumi pertiwi*) for the welfare of our people. [translation by author] (President Joko Widodo 2017)

> There is no way we can become a nation who possess food sovereignty if we have a very limited number of dams and irrigation channels across our agricultural land. [translation by author] (President Joko Widodo 2017)

Other than those presidential speeches, another example of a communicative channel is a recent press conference on the "Four-years Achievement of the President Joko Widodo's administration on Campus Affirmation Policy and Citizen (indigenous) Innovation Growth" by Muhammad Nasir, the Minister of Research Technology and Higher Education. On October 26, 2018, The Minister presented some of their achievements on technology and innovation products. On this occasion, the Minister also echoed the President's intention to develop a university-level coffee-study. The minister made a recommendation to the Indonesian universities to open a Coffee Science study, Coffee Economy study, Barista Education study, and other visionary majors needed by the market (Ministry of Research Technology and Higher Education, 2018.

Furthermore, the minister stated that, as an agrarian country, the development of technology and innovation capability in Indonesia needs to support society's welfare. Under this light, the Ministry of Research Technology and Higher Education stated that he aims to push and to escort the higher educational institutions in Indonesia to develop innovation in agriculture and plantation sectors. The Minister pointed out some of the best innovation products, such as a rice innovation from the Bogor Agricultural University and a salt innovation from Agency for the Assessment and Application of Technology (BPPT). Additionally, the minister also made a remark on an innovation on fisherman vessels that can support the local fisherman welfare in a maritime country (Ministry of Research Technology and Higher Education, 2018).

4.2.3 Tracing Medium-Technology Research and Development Activity Down at the Local Level: The University-based Center of Excellence in Automotive Systems and Control Sepuluh Nopember Institute of Technology (PUIPT-SKO ITS)

At the macro level, economic nationalism discourse binds the STI policy-making process to favouring low-technology development and neglecting medium-technology development for manufacturing. Field observations at a university-based Centre of Excellence in Automotive Systems and Control, Sepuluh Nopember Institute of Technology (PUIPT-SKO ITS) confirms this problem. Within Indonesian STI policy, the idea of the triple helix gave birth to the Center of Excellence (CoE) program as central STI agents, which contains both university-based CoEs and non-university-based CoEs. Among a total of 45 COEs established since 2014, there are only two COEs that conduct R&D in medium technology (Ministry of Research Technology and Higher Education, 2015, 2016). One of them is PUI-SKO ITS, which was initiated by a research team led by Mr. M. Nur Yuniarto (current executive director).

> There is no sign [for government support in national automotive industry] in Indonesia. If we wait for the signs, it would not be realized. Deputy Director of PUI-SKO ITS (Wikarta 2018)

Based on the field observations and an interview with Mr. Alief Wikarta, the deputy director of PUI-SKO ITS, PUI-SKO ITS has the capabilities to develop medium technology in parts and components (automotive) but has problems disseminating their results to the industry. The deputy director argues that there is policy discoordination between the Ministry of Research Technology and Higher Education and the Ministry of Industry. According to the deputy, the Ministry of Industry expects the Ministry of Research Technology and Higher Education to be ready with their results first before presenting them to the Ministry of Industry. The Ministry of Industry does not provide facilitation for the networking and dissemination of R&D products for automotive sector (Wikarta, 2018).

There is a lack of support from the government (e.g., tax incentives) for indigenous automotive industries to work with local R&D institutions. They also do not provide a networking facilitation between local R&D institutions and automotive MNCs (subsidiaries). The deputy expresses his scepticism regarding the opportunities presented by the global production network as parts and components suppliers. He argues that since 1980s local suppliers have not been able to keep up with the cost (Wikarta, 2018). Overall, an observation at local level confirms that the government negligence over medium-technology dissemination to indigenous industry.

4.3 Connecting Technology-Driven Structural Change and the Problem of Economic Nationalism within National STI Policy

The discussion above highlights two key problems. The first problem is the influence of economic nationalism discourse on how the government directs STI policy in Indonesia. The economic nationalism discourse binds the Indonesian government to favouring agriculture and low-technology development (e.g., rice, coffee, fisheries, foods). With the growing importance of STI policy as a tool to support technology-driven structural change for middle-income countries, this means that the current STI policy programs in Indonesia do not accord the highest prioritization on the development of manufacturing technology (e.g., automotive, electronics). The growth of the manufacturing subsectors in Indonesia has already stagnated for 17 years, and the national patent data shows that the economy has been stuck at a low-technology level for the last 23 years.

This gives rise to another discussion on the problem of normative policy recommendations. There has been a growing obsession on how to replicate the successful catch-up experiences from East Asian developmental states, particularly as more countries find themselves facing the risk of middle-income trap. Various economic studies offer different policy recommendations with the intention to replicate the success stories, including the technological-driven structural change concept put forward by the UNIDO. There is a large volume of scholarly works echoing the same idea. One of the common problems of these policy recommendations is that they tend to take the government's for granted without looking further into their behaviour.

East Asian countries (e.g., Japan, South Korea, Taiwan) regard STI policy as a tool for their economic growth strategy, which led them to build effective triple-helix cooperation to develop indigenous technological capabilities from foreign technology to support the development of their manufacturing sector. It is important to note that these East Asian countries are countries with limited natural resource endowment. An examination of the existing discourse within STI policy in Indonesia, as an example among natural resource-abundance countries, shows that the national government does not start from "technology development" itself, but rather "resource-based development through technology". With abundant resources, governments in these countries will naturally construct their economic development strategy from natural resource development.

5. Conclusion

A discussion over STI policy can cover various dimensions (e.g., natural resource conservation, public health). Along with the growing importance of the idea of industrial catch-up, scholars start to pay

attention to how governments can manage national STI development to support national economic growth. This includes STI policy recommendations under the technology-driven structural change concept. The case of economic nationalism discourse and STI policy in Indonesia shows how the Indonesian government, with its middle-income level, still continue to frame STI policy under the idea of natural resource protection instead of technological upgrading to support growth in the indigenous manufacturing sector. This suggests a contrast against the STI policy in East Asian developmental states, as the main models for technology-driven structural change concept.

The suitability of STI policy recommendation does not only draw from measurable comparative indicators offered by STI reports or indexes, but also on governments' perception on the policy itself. Discursive institutionalism as an approach offers one way to understand government's perception based on their own words. Along the same lines as Schmidt, this paper offers an alternative explanation that can complement other existing explanation on actors' behaviour (e.g., pollical clientelism, populism). On a final note, this paper concludes it is important to re-visit the origins of a developmental state in order to have a better understanding on whether STI policy recommendation based on the East Asian catch-up experience can be replicated.

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