L Yao, X Shi, P Andrews-Speed, 2018. Conceptualization of energy security in resource-poor economies: The role of the nature of economy. *Energy Policy* 114, 394-402.

Conceptualization of energy security in resource-poor economies: the role of the nature of economy

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Abstract:

This paper studies how energy security is conceptualized in four resource-poor, advanced island economies: Singapore, South Korea, Japan, and Taiwan. It is found that the energy security conceptualization of the four economies in effect returns to the very original and conventional one: stable and reliable energy supply. However, these economies are different in the level of stability and reliability demanded. Why are they similar in energy security conceptualization whereas different in the level of stability and reliability demanded? Adopting documentation analysis, comparative study, and the varieties of capitalism theory, we find that the nature of economy constitutes the decisive factor that shapes energy security conceptualization. The coordinated market economies (CMEs) are more concerned about energy supply disruption than the liberalized market economies (LMEs). The paper demonstrates that despite numerous energy security concepts in the literature, resource-poor economies still adopt the original and conventional one in practice. The findings suggest that security of supply is the top measure for resource poor economies to improve their energy security and creating a joint petroleum and LNG market would be desirable for the four economies in this study.

Key worlds: energy security; varieties of capitalism; coordinated market economies; liberalized market economies; Japan; Korea;

1. Introduction

The concept of energy security has long been studied since WWII. The traditional and/or conventional concept would be a condition in which a country has access to adequate, stable and reliable energy supplies (Yergin 1988; Bielecki 2002; Clingendael International Energy

Programme 2004; Chang and Lee 2008). During the past two decades, a series of articles has been written in an attempt to conceptualize energy security in a new and comprehensive way, making energy security a more holistic concept. New facets and new dimensions have been added to fit the changing international situation. These new dimensions include factors such as environment, technology, regulation, international relation, military security, and so on (Kruyt et al. 2009; Vivoda 2010; Sovacool and Mukherjee 2011; Yao and Chang 2014).[1]

Based on the traditional energy security concept and the new dimensions, a new framework that has been established recently is a three-dimension framework including vulnerability, efficiency and sustainability, which is applied to a case study of four island economies (Japan, Korea, Taiwan and Singapore) [2]. Unlike large countries, these economies have little indigenous energy resources and thus almost entirely dependent on imported energy. Furthermore, as small economies, they do not have domestic flexibility in demand and supply. This serves the vulnerability dimension; due to vulnerability to energy supply disruption, these economies attach great importance to demand side management measures, particularly energy efficiency and thus justifies the efficiency dimension; as developed economies, they have committed to using safer and cleaner energy resources and greener methods of energy production and consumption to maintain sustainability. A more detailed discussion is presented in Li, Shi and Yao (2016).

[1] For more discussion on energy security concept, please refer to section 3.

[2] In this study we do not include Hong Kong, a city that has many similarities to Singapore, on the understanding that as far as energy is concerned, Hong Kong has the mainland China as a reliable energy supplier and thus its concept of energy security would be quite different.

Using an energy security concept framework, this paper analyzes energy security conceptualization of resource-poor yet economically advanced island economies in East Asia — Singapore, South Korea,[3] Japan, and Taiwan. This group of economies has common unique characteristics in economy, society, and especially in their energy import dependence and lack of indigenous energy resources (Li, Shi and Yao 2016). The paper addresses the research question 'how is energy security conceptualized by resource-poor, advanced island economies'. It shows that these economies, despite their common characteristics as 'resource-poor yet economically advanced island economies', possess both commonalities and differences in the way they conceptualize energy security. The paper argues that, despite the current trend towards a holistic concept of energy security, the energy security concept of these four resource-poor economies in effect returns to the very original and conventional one: stable and reliable energy supply.

The contribution of this paper is three-fold. First, it reveals the conceptualization of the energy security of resource-poor, advanced island economies. Second, it constructs an analytical framework to explain why these resource-poor economies have such an energy security conceptualization. The framework can explain the interaction between the nature of economies and the liberalization of an energy market and is deeply indebted to the 'varieties of capitalism' theory , which has not been introduced into energy -analyzing framework before. Third, it gives suggestions as to how the resource-poor economies can improve energy security.

The paper is structured as such: Section 2 presents the methodology, including an analytical framework. Section 3 analyzes the commonality and distinction of the energy security concept of

[3] South Korea is considered an island country as North Korea physically blocks over-land connections between South Korea and other countries.

these resource-poor island economies through a literature survey. Applying the analytical framework, Section 4 discusses the role of the nature of the economy of these resource-poor islands and their energy markets in determining their energy security concept. Section 5 concludes the paper with implications and recommendations.

2. Methodology

The methods employed include documentation analysis, comparative study, and the varieties of capitalism theory. The paper evaluates the concept of energy security of these economies through documentation analysis. With a cross-country comparative study of these national energy policies, the paper identifies the common characteristics and the distinction, which help explain energy security conceptualization. After the review, using the varieties of capitalism theory, the paper explains why these economies, all being market economies, have different degrees of liberalization in the energy sector, and how the interaction between liberalization and the type of economy determines the concept of energy security .

The nature of national energy economy is identified as a key factor that has deeply affected the energy sector of these economies. The paper constructs a framework for understanding the interaction between the nature of economies and the liberalization of an energy market, with the aim of explaining why these four economies are different in the level of their pursuit for stable energy supply. Based on the 'varieties of capitalism' theory (for more details, see Hall and Soskice (2001)) and following the core distinction drawn to compare national political economies, our study categorizes these four economies into two types of economies: liberal market economies (LMEs) and coordinated market economies (CMEs). The dichotomy is set out

by Hall and Soskice (2001) in their introduction to the widely cited collection of essays under the title *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*.

The LMEs and CMEs are distinguished primarily by the way through which firms coordinate their activities with each other and other actors. In LMEs, firms coordinate their endeavors and construct their core competencies by way of competitive market mechanisms; while in CMEs, the coordination relies more on non-market forms of interaction. Five spheres are selected, in which firms must develop relationships with others. They are: industrial relations, vocational training and education, corporate governance, inter-firm relations, and relations with employees. Table 1 illustrates these five spheres which lay the foundation to distinguish LMEs and CMEs.

[Insert Table 1]

While the behavior of firms have an important role in determining the energy security concept, their behaviors, however, are affected by the market structure, or the level of liberalization in the energy market, due to regulations and competition that constrain their behavior. For example, coordination among firms could lead to violation of the anti-trust laws in some markets. However, in the case of highly concentrated markets, competition is not a significant concern as the government often regulates energy prices and thus there is little room for further manipulation. The energy market liberalization in turn, is affected by the nature of economy.

In this paper, our framework has four quadrants to categorize these four economies as presented in figure 1. The horizontal axis of the quadrant shows the degree of energy market liberalization

and the vertical axis represents the types of economy.The matrix illustrates how the types of economy affect energy market liberalization and how their interaction affects energy security concept. The illustration of the relationship between the types of economies and liberalization of energy markets explores why there is big difference in these economies' pursuit of energy supply. A detailed discussion is presented in section 4.

[Insert Figure 1]

3. Commonality and distinction of energy security concept of the four economies

This section provides a detailed literature review to address the questions: how energy security is conceptualized by the resource-poor island economies, and what are the commonality and distinction? The conceptualization of energy security has been captured on the basis of their national energy policies,[4] where the objectives and principles have been clearly stated. Identification of the commonality and distinction is based on a framework that evaluates energy security of the resource-poor economies (Li, Shi and Yao 2016). The framework covers three dimensions of energy security: vulnerability, efficiency, and sustainability.

3.1. Vulnerability

Given that the four economies are resource-poor, securing supply of energy is a straightforward and top priority. However, the methods to secure energy supply are different among these

[4] Specifically, these national energy policies include governments' official policy statements and papers that discuss the policy targets/objectives, as well as the policy instruments.

economies. The Singapore government has put great efforts in the diversification of energy supplies to hedge against price fluctuation and other threats to the reliability of energy supply, particularly supply disruption (MTI 2007, 4). This indicates that as a small island without indigenous fossil fuel resources, Singapore's energy security concept focuses on 'energy supply diversification'. In November 2007, the Singapore government launched its first comprehensive 'National Energy Policy Report' (NEPR) titled 'Energy for Growth', which clearly specifies that "[d]iversification is the best way to ensure energy security" (MTI 2007, 29). With this guidance, the Singapore government has started to import LNG from various sources of the world, in addition to its pipeline imports from Indonesia and Malaysia, and thus enhances its energy security.

Korea's traditional energy policies are designed to ensure stable and reliable energy supply at low prices to keep their industrial competitiveness. Energy independence and self-reliance is the most important policy goal in the 1st National Energy Basic Plan (1st Plan hereafter) that was issued in 2008. The 2nd National Energy Basic Plan (2nd Plan hereafter), approved in early 2014, also emphasizes that "[a] stable energy supply basis must be maintained in preparation for energy crises" (KEEI 2015). The 1st Plan highlights the pursuit of the 'nation's controllable energy resources' and stable energy supply to fuel economic growth; it also specifies to increase the ratio of the nation's 'controllable' energy resources, including self-developed fossil fuels, new and renewable energies, and nuclear power, to 65 per cent by 2030 from 27.5 per cent in 2007 (OECD/IEA 2012, 24). Under these policy targets, Korea's oil stocks have been maintained at above 160 days of net oil imports since 2009, far more than the IEA 90-day requirement. Further, the country promotes long-term oil and LNG contracts as a mean to secure supply. It has

planned to raise the share of long-term oil contracts out of total oil imports from 62 per cent in 2007 to 85 per cent by 2030 (OECD/IEA 2012, 24).

Since 2003, the importance of 'self-sufficiency' and 'self-controllable energy resources' has also been frequently highlighted in the four Japanese Basic Energy Plans (BEPs). The New National Energy Strategy[5], published in 2006, sets several targets by 2030. Those that are noteworthy include: oil dependence reduced to 40 per cent of TPES; nuclear power increased to 30-40 per cent of total electricity supply; and Japanese-developed oil increased to 40 per cent of Japan's total oil imports (METI 2006). The 3rd Basic Energy Plan released in June 2010 sets an ambitious target of the Plan: to double Japan's energy self-sufficiency ratio to about 40 per cent by 2030 from 18 per cent in 2010 (Duffield and Woodall 2011, 3743). In early 2014, the Japanese 4th BEP confirms that nuclear will be an important base-load power source on the premise of ensuring its safety (METI 2014).

Taiwanese energy policies are basically reflected in the energy conferences and energy plans at the national level. The First National Energy Conference, held in 1998, placed on the priority of policy agenda the following targets: accelerate privatization of the petroleum power industry, re-plan industrial structuring, set target of energy savings of 16 per cent by 2010, and stipulate CO_2 reductions to the 2000 level by 2020. After the Kyoto Protocol came into effect on 16 February 2005, the Taiwanese government held the Second National Energy Conference to adapt to the new situation through the advancement of renewable energy: renewable energy would account for 4-6 per cent of all energy by 2020 and 5-7 per cent by 2025 (Liou 2010, 1770). In 2008, the

[5] The New National Energy Strategy is normally regarded as the second Basic Energy Plan.

government proposed a ‘Framework for Taiwan’s Sustainable Energy Policy’, which aims to achieve an ‘energy, environmental protection and economy triple win’ through the development of energy efficiency and clean energy. The renewable energy development target was increased to 8 per cent of all power generated by 2025 (Ministry of Economic Affairs 2008). In response to the Fukushima disaster in March 2011, the Taiwanese government announced the New Energy Policy of Taiwan in November 2011. Three major principles of the Policy are: no power rationing, reasonable power prices, and carbon emissions reduction (Office of the President 2015).

Although the governments show differences in their pursuit of reliable and stable energy supply, their efforts in achieving energy efficiency and environmental sustainability are much the same.

3.2. Efficiency

Although each economy has its own strength and weakness in conserving energy and improving efficiency, policies in these economies are very much the same. They have implemented energy efficiency policies in various sectors. Several policy instruments such as tax concession and subsidies have been adopted.

However, the major difference lies in the timeframe that some of these specific policies were implemented. Japan has been the leader in many energy efficiency policies, with its policies followed and/or learnt by other economies. Three factors are found particularly helpful for Japan’s energy efficiency improvement. The first factor is the effort from industries. To cut cost and rationalize energy consumption, the Japanese industries have made substantial efforts to improve their energy efficiencies. The second factor is public awareness of the energy costs. The

third factor is the various government policies that have both direct and indirect effects in increasing energy efficiency (Tanabe 2011). A noteworthy measure is the Top Runner Program, which is an epoch-making one that has turned out to be a great success in saving energy, and thus became a role model for many other countries, including Korea. [6]

In Korea, curbing fossil fuel consumption via efficiency improvement is an important policy of both its 1st and 2nd National Energy Basic Plan. Several measures targeting various sectors have been implemented in the economy. Particularly, in 2012, the government introduced the 'Energy Frontier Program', which is similar to Japan's Top Runner program, to promote the manufacturers' technological innovations in reducing energy consumption (KEI 2013).
Singapore has implemented several energy efficiency and conservation measures in each of the sectors of energy use, including but not limited to a switch from oil-fired power plants to gas-fired plants, mandatory fuel economy labeling, promotion of public transportation, fuel-efficient and green vehicles, development of energy-efficient buildings, and mandatory energy labeling for appliance and smart metering (MTI 2007, 44-47).
Taiwan's major energy efficiency policies and programs cover all the sectors, however Taiwan's major problem is that its electricity price is too low to provide any effective incentive for consumers to increase their energy efficiency.

It is very important that society as a whole needs to become energy conservation-oriented from the bottom up and lifestyles need to be changed. Beyond mandatory obligations, more voluntary

[6] Manufacturers have been motivated to develop more energy-efficient technologies as they have to compete in the market under the Program. As a result, Japan is highly respected as one of the most energy efficient countries in the world.

energy conservation is needed, and more needs to be done to promote changes in consumer behavior. This is exactly what the other three economies need to learn from Japan. Further, cost-reflective pricing is essential to improve energy efficiency. Taiwan and Korea are lagging behind in making their energy pricing correct.

3.3. Sustainability[7]

Basically all these economies have similar demands for sustainability, and have all expressed their resolutions and taken actions in mitigating climate change. Major measures focus on development of new and renewable energy resources. The countries without favorable conditions to develop renewable energy have attempted to make their countries renewable energy research and innovation hubs as well as build up a renewable energy technology export industry. Intended Nationally Determined Contribution (INDC) commitment has also been made seriously.

Even Taiwan which is not recognized as a country, and is forbidden to submit its INDC, Taiwan still made its INDC commitment in 2015 to reduce GHG emissions by 50 % lower than the BAU scenario by 2030 (W.-h. Chen 2015). Although Taiwan is not a signatory party to the Kyoto Protocol, GHG reduction has always been a priority on its policy agenda to promote clean development. The Taiwanese government has made the reduction of emissions an important task of the nation since the 2000s. In the fourth National Energy Conference in 2015, the government declared that it would implement United Nations Framework Convention on Climate Change (UNFCCC) so as to put Taiwan on the path towards a low-carbon future (National Energy Conference 2015). For this purpose, the government has implemented a number of economic incentive policies, some of which include various subsidies, tax reductions or tariff remittance, to

[7] In line with the established framework, sustainability here refers to reducing carbon emissions from fossil fuels.

make their commitments meet up to the level of international practice (Chen, Kim and Yamaguchi 2014).

Despite its limited impact on the global conditions, Singapore is still actively carrying out its emissions mitigation as part of a concerted global effort. Singapore ratified the UNFCCC in 1997, and acceded to the Kyoto Protocol in 2006 (MTI 2007). At the COP21 in Paris in the end of 2015, Singapore made the commitment to reduce GHG emissions intensity by 36 per cent from the 2005 levels by 2030 and stabilize its emissions with the aim of peaking around 2030. Given that Singapore does not have renewable energy potential, with the exception of solar, this pledge is ambitious (UNFCCC 2015; NCCS 2016). Therefore, Singapore's pursuit of new and renewable energy mainly focuses on technology research and innovation rather than resource development. To this end, in 2007 the government established in a 'clean energy fund' for R&D, test-bedding and piloting clean energy projects so as to make Singapore a global clean energy hub (Chua 2011). Singapore is also planning to introduce carbon tax on large direct emitters of GHGs such as power stations from 2019 (Kotwani 2017).

Over the past decade, the Korean government has been taking strong steps to reduce emissions. Following the launch of 'Low Carbon, Green Growth' in 2008, in 2009 the government pledged to reduce its emissions by 30 per cent below BAU levels by 2020 (OECD/IEA 2012, 29). In the 2nd Plan the government is determined to construct an environment-friendly economy. The major measures are development and distribution of new and renewable energy technologies, which is not only for power generation, but for exports as well. For this purpose, it targets to increase its

share of the global solar manufacturing market to 20 per cent by 2030 from 5 per cent in 2008 in order to become a major renewable products manufacturer (IEA 2016).

Japan has also revised its commitment in reducing its GHG emissions several times to contribute more to the mitigation of climate change since 1997. The Japanese INDC pledges to reduce GHG emissions by 26 per cent by 2030 compared to the 2013 level. Both renewable and nuclear energy are expected to account for 20 to 22 per cent of Japan's power generation by 2030 respectively (World Nuclear News 2015). It is clear that Japan will re-utilize nuclear for power generation with its safety confirmed.

3.4. Conceptualization of energy security

The four economies' overall concept of energy security is the same. They all regard stable and reliable energy supply as the top priority on their policy agenda. All have tried to diversify energy resources, develop new types of energy, and expand the capacity of the existing energies. Policies on energy efficiency and sustainability are basically much the same across the four economies.

What constitutes the major difference is the degree in which the four economies pursue stable and reliable energy supply and how they have pursued it. Japan and Korea have frequently mentioned in their official documents that they would seek to be energy self-reliant as much as possible and to achieve self-controllable energy resources as many as possible. 'Stable energy supply', 'energy crises', and 'energy supply disruption' are always the top concerns of the Korean government. Furthermore, the Korean government frequently emphasizes the terms such as 'self-reliance' and 'self-developed fossil fuels' in its national energy plans. Similar to Korea,

the Japanese government also seeks to procure more ‘self-controllable’ energy resources and be more energy ‘independent’. In contrast, the Singaporean government perceives the key in ensuring the country’s energy security is diversification of supply. It has however never mentioned in its official documents that the nation wants to seek energy self-sufficiency or self-controllable energy resources, nor has it endeavored to do so. Similarly, the Taiwanese government also regards stable and diversified energy supply as of utmost importance, yet it has not sought energy self-sufficiency. Furthermore, Korea and Taiwan highlight the need of low prices in order to project their export-oriented economies.

Overall, it is shown that the energy security conceptualization of the four resource-poor economies in effect returns to the very original and conventional one: stable and reliable energy supply; however, these economies are different in the level of demanding stability and reliability and pursuing low energy prices. A brief summary of the policies on energy security is listed in Table 2.

[Insert Table 2]

Why do these four economies, similarly being resource-poor islands, have such difference in pursuing energy supply and conceptualizing energy security? Applying the varieties of capitalism theory and the proposed analytic framework, the next section explains the reasons.

4. Nature of economy and energy security concept

In general, as liberalized market economies (LMEs) rely more on competitive market mechanisms, while coordinated market economies (CMEs) rely more on non-market forms of interaction, LMEs are relatively more market-led while CMEs tend to be government-led. Therefore, LMEs tend to rely on market forces for energy supply while CMEs have a relatively stronger demand for energy independence and self-controllable energy resources. This shows that CMEs have less of a sense of energy security than LMEs. In this section, we explain the market economics and energy market of the four economies, followed by analysis and discussion.

4.1. Nature of the economy of the four resource-poor islands

Applying the scope of the 'varieties of capitalism' theory, this section distinguishes the market economies among the four islands. It is found that Japan and South Korea are CMEs while Singapore, which has been hailed as one of the most open economies in the world (T. Doshi 1991), is an LME. Taiwan also has the tendencies to be an LME.[8]

The institutional structures in Japan and South Korea, as stated by Hall and Soskice (2001)'s view, foster group-based coordination. The most important business networks in Japan have been built on *keiretsu*, which are families of companies with dense interconnections cutting across sectors. Korea's *chaebol* are similar to the Japanese *keiretsu* in terms of size, range of activities, and importance to the nation's economy. Basically Japan and Korea's firms are respectively the *keiretsu* and *chaebol* linked enterprises, and can be categorized in the group of CMEs (Hall and Soskice 2001).

[8] As Asian's economies are at various stages of transition, it may be controversial to fit an economy into the dichotomy of CME and LME. Yet the institutional structure in the Taiwanese economy, as analyzed in this section, shows more LME features and less CME features; the same with Singapore.

Taiwan's economy is dominated by a large number of small- and medium-sized enterprises (SMEs) compared to Korea and Japan's economies that are dominated by the *keiretsu* and *chaebol* respectively. Therefore, Taiwan is distinctive in the sense that its business groups have relatively loose interconnections within them and thus the markets are competitive. Despite bearing the marks of a traditional Chinese family system, the family based small- and medium-sized firms in Taiwan operate largely according to market exchange principles (Lee 2008). Consequently, business groups in Taiwan's SMEs-dominated economic structure have "a relatively lower capacity than their Japanese and Korean counterparts to influence government decisions" (Thurbon 2007, 109). It seems that in general, the Taiwanese economy tends to have more characteristics of a LME rather than a CME. This is also confirmed by Dodgson (2009) when he compared the national innovation systems between Korea and Taiwan, and concludes that Taiwan's network-based innovation strategy resembles a feature of LME.

Taiwan is a special case in our study. Despite the LME features that the Taiwanese economy has, Taiwan's economic bureaucracy has not totally dismantled its governance model, i.e., the (e)conomic "governance in Taiwan by and large maintains a state-led but market-friendly approach" (Chu and Lee 2004, 50). This state-led approach is especially obvious as far as the energy sector is concerned. Therefore, a liberalized market economy does not necessarily have a liberalized energy market.

Similar to Korea, Taiwan also has a strong export-oriented development strategy. However, in comparison to the Korean economy dominated by *chaebols*, the export boom in Taiwan has been

led by private firms, particularly SMEs. Yet at the same time, large SOEs played a very important role at the beginning of the export-oriented period. The role of these SOEs was not to directly export, but to exploit economies of scale in producing inputs for the private export sector (Kokko 2002). These inputs are basically raw materials, including energy. Therefore, although Taiwan is a relatively liberalized market economy dominated by many private SMEs, the energy sector has still been monopolized by large SOEs, e.g. the China Petroleum Corporation in the oil and gas sector, and the Taiwan Power Company in the electricity sector. The energy prices are still kept low to maintain the competitiveness of the Taiwanese products in the international market.

Singapore has the most liberalized economy of the four economies, and the belief in a liberal economy has been reflected in the energy sector. In the early period after it was founded, Singapore adopted a concerted export-oriented industrialization strategy. Guided by this strategy, the government has a long history and good reputation for attracting large multinational corporations that possess the requisite technological and marketing capabilities to invest in Singapore. This practice has built up the foundation for Singapore to be one of the most open economies in the world with a consistent and liberal policy regime.[9] Its energy market is also the most liberalized among the four economies. Singapore and Japan' energy markets are more liberalized than Taiwan and Korea. The major reason is that, although Japan and Korea are both CMEs, Korea's national economy is dominated by several large privately-owned enterprises (*Chaebols*); while in Japan, large enterprises and SMEs have been developed together.

[9] This study does not deny that state leadership plays a role in Singapore's economy. Chen (1983) argues that Singapore's success is due to a mixture of both markets and government policies, which are in effective interaction.

4.2. Energy market structure of the four economies

The nature of a national economy has deeply affected the energy sector of these four countries. Different from Singapore, both Korea and Taiwan were largely rural economies with a few modern factories at the end of WWII. Japan had a better industrial base, as industrial groups had dominated the Japanese economy since the Meiji revolution. Nevertheless, governments of the three economies pursued an export-led economic development strategy, making it necessary to create basic heavy industries and search for energy resources to power economic growth (Lombardi 2011). Against this background, medium- and large-sized oil and gas companies as well as power companies have been established to facilitate export-led economic growth and the energy market has been under government control over a long time. Korea's energy sector has been to a large extent, monopolized by a small number of large *Chaebols*. They are Korea Gas (KOGAS) and Korea Electric Power Corporation (KEPCO), and respectively, they monopolize the gas and electricity sectors. While in Japan, oil, gas, and electricity sectors have an oligopolistic structure, and each sector is dominated by a number of large and medium sized enterprises. Consequently, compared to Korea, Japan has more market competition in the energy sector, and has proposed to liberalize the energy market much earlier. Although Korea's oil sector is not monopolized as it has several private oil companies competing with Korea National Oil Company (KNOC), it is still less competitive compared to Japan as the competitors are much fewer in Korea than in Japan. Only in 2014 did the Korean government mention in its official document to liberalize its energy market in a gradual way. Although both are CMEs, Japan has greater energy market liberalization than Korea. In the following subsection, we explain energy market structure by economies.

4.2.1. Singapore

Although the Singapore government has played a crucial role in the nation's economic success, the city-state's export-oriented growth financed by foreign capital means that a vibrant free-market economy is the key factor that has supported the country's success. Singapore's oil refining industry boomed along with Singapore's economic rise. As stated by Ng (2012), "Singapore could not have achieved its current standard of living without the powerful growth impetus and multiplier effects provided by the refineries in its start-up years". In the 1970s, Singapore safely survived the oil crisis as the export-oriented refineries enabled the city-state to quickly pass on the effects of high oil prices to the importers (Ng 2012). This case serves a typical example of how Singapore, an economy highly dependent on energy imports, is cushioned from the energy supply risk with its export-oriented refineries. After the Asian financial crisis in 1997, the Singapore government adopted an increased degree of neo-liberal economic policies that are even more market-friendly (Siddiqui 2010).

Along this line of thinking, the Singapore government believes that a liberalized competitive energy market is the cornerstone of their energy policy, and their "framework of competitive markets is fundamentally sound" (MTI 2007, 16). Now, Singapore has one of the most open energy markets in the world. As reflected in the NEPR, the government believes that the competitive energy market will support economic competitiveness and raise growth potential. Therefore, the Singapore government does not prescribe fuel mix with a top-down target. Instead they leave the private sector to decide what technologies they would invest in and what fuels they prefer to use, as it is believed that the market is in better position for fuel allocation. It is also highlighted in the NEPR that "[c]ompetitive markets are the best way to ensure the optimal

allocation of resources and cost competitiveness" (MTI 2007, 33). The government is also in the position to make sure that the "regulations are open and flexible enough to allow diversification to take place" (MTI 2007, 30), indicating that the government tries to minimize its role when ensuring energy supply diversification. Therefore, Singapore's electricity, oil and gas sectors are all liberalized, except 25 per cent of the retail electricity market that is comprised mainly of households (MTI 2007, 23).

The Singapore government restructured and liberalized the electricity sector in 2001. Currently, with the exception of small businesses and households, other electricity consumers can choose to buy electricity from the open retail electricity market or from the wholesale electricity market (EMA 2015). The Energy Market Authority (EMA) is working towards full retail competition by 2018 (Doshi 2015). Further, the advancement of Singapore's refinery and petrochemical industries have made the country a leader in oil-trading and refining in Asia. The geographical location of Singapore and the scarcity of energy resources have placed the country in the market position of Asia's oil hub. The government is committed in maintaining its position in the oil-trading and refining sectors.[10]

Utilizing the experiences in oil-trading, the government aims to extend the trading to other types of energy as well (MTI 2007, 25). Natural gas market is also under further liberalization. In October 2005, a Gas Network Code was introduced to "provide common terms and conditions for players to access the gas pipeline network in a fair and open manner" (Chua 2011, 296).

[10] It is specifically stated in the NEPR that widening Singapore's lead in the oil industry is 'one key priority'.

4.2.2. Korea

Korea's energy-intensive economic structure that has been framed by its targeting of heavy and chemical industries (HCIs) has produced not only rapid economic growth but also huge conglomerates that dominate the key sectors of the national economy, helping Korea maintain its fast growth during the 1970s even through the two oil crises. In the 1980s, Korea's economy was given a further boost by favorable external conditions such as the low energy prices (Harvie and Pahlavani 2006). The increasingly stronger manufacturing sector is the main driver for the growth of not only Korea's economy but also its energy consumption (Kim, Shin and Chung 2011).

Basically, in order for Korea to meet huge energy demands and to maintain stable energy supplies to fuel the economy, the nation has been relying on central planning rather than a liberalized energy market as a major function of its energy policies. Central planning is not difficult to achieve because the big industrial conglomerates (*Chaebols*) constitute a large share of the economy, and the decisions concluded by the *Chaebols* are normally the final resolution. For example, the state-owned KOGAS and KEPCO monopolize the gas and electricity markets respectively in Korea.[11] The government intensively invested in these industries, and the coordination among them is simple. Different from Japan, Korea's refining facilities hold relatively larger scales, as the government tries to keep the refineries a competitive export industry (Takeishi 2014).

[11] The Korean government has been trying to introduce competition into the gas market by admitting fair third-party access and allowing for more import/wholesale companies enter into the natural gas import sector, but KOGAS still holds the nationwide monopoly position in the domestic natural gas market.

Over the last decade, the Korean government has been pushing forward policies to promote market development and privatization. It encourages more competitive markets and market-value pricing in energy industries. For this purpose, the government is going to restructure energy industries, inclusive of those of electricity, gas, and district heating, to establish a fair market competition system (KEEI 2015).

It is noteworthy that, although the Korean government is determined to liberalize the energy industry, it has been very cautious with the process. The 2nd Plan has on numerous occasions stated that liberalization should be carried out in steps with gradual de-regulations, and the influence on the national economy must be taken into consideration (KEEI 2015). Such caution is especially reflected in the electricity sector. South Korea's electricity sector is dominated by KEPCO, a state-owned power company that owns 94 per cent of generating capacity. In the generation sector, six state-owned power generating companies have been established, but they are in effect KEPCO's subsidiary companies. The competition among power producers is quite limited and superficial (OECD/IEA 2012). Currently, although KEPCO has been divided into generation, transmission, and distribution components (KEPCO 2016), it still maintains a near-monopoly position in transmission, distribution, and retail. Effective competition has yet been introduced into the electricity sector and there is still a long way to go for KEPCO to be cultivated into a world-level energy corporation.

4.2.3. Japan

With a strong domestic market, Japan has less pressure than Korea to artificially maintain low energy prices in a bid to be internationally competitive. Although both are CMEs, Japan has a higher degree of energy market liberalization relative to Korea. The dominant market player in

upstream oil sector, the state-owned Japan National Oil Corporation (JNOC), was restructured in 2004 into three new companies to introduce more competition[12] (Koike, Mogi and Albedaiwi 2008). The downstream oil sector in Japan is full of private companies, making the sector relatively competitive. With the easing of regulatory restrictions on foreign companies, the degree of competition in the downstream oil-refining sector has been increased over the past several years (EIA 2015).

In the gas industry, the government began to deregulate the city gas sector in 1995, when the government put an end to the regulations governing market entry and gas tariffs for users consuming a large annual-contracted volume. The scope of liberalization was extended further in the later years to include medium-scale gas consumers. The reforms opened the industry to greater competition with the incoming of a number of new private companies (EIA 2015). The government has been planning to fully deregulate the downstream gas sector in 2017, when regional monopolies are to be ended, and households can freely select their gas suppliers (Matsuo 2015).

Japan's electricity industry is dominated by 10 privately-owned and vertically-integrated regional monopolies that also control the country's regional transmission and distribution infrastructure. Liberalization of the electricity industry started in the wholesale market in 1995 (The Japan Times 2015). However, the government is very careful and concerned about the result of any step in the process of electricity market liberalization. The 'Electricity Business Act' had been amended several times to introduce competition into the electricity sector in a stepwise

[12] Two of the largest Japanese upstream oil companies are JAPEX and INPEX Holdings (Koike, Mogi and Albedaiwi 2008).

approach, and in an incremental way (IEA 2008), until the Fukushima accident in 2011 kicked off the acceleration of electricity sector reform. From 1 April 2016, the retail sector was liberalized. Before then, the independent or wholesale power producers could only sell electricity to the monopolized regional distributors. Table 3 shows the milestones in electricity market liberalization in Japan.

[Insert Table 3]

4.2.4. Taiwan

Taiwanese economic development was boosted by the development of Small and Medium Enterprises (SMEs), and to fuel the export-oriented industries, the government has been highly controlling the energy sector to keep the energy prices artificially low. The SMEs are "the backbones of Taiwanese economic development and foreign trade" (Hsiao and Hsiao 2015, 20). Supported by the growth of SMEs and an already export-oriented economy, the Taiwanese government adopted an export-promotion policy in the mid-1960s, and this helped push the Taiwanese economic development in a great way to success. In the 1980s, more and more SMEs in labor-intensive industries began to transform and upgrade themselves. A new type of SMEs in technology-intensive industries emerged and the importance of the SMEs to the economy continued to increase. Since the 1990s, the SMEs have been "more knowledge-intensive, technology-intensive and innovation-intensive" so as to keep the international competitiveness of their exports (MEA 2015). The artificially low energy prices make privatization and energy market liberalization a political obstacle.

The oil market in Taiwan has been liberalized incrementally since 1987, starting from the downstream retail sector, and then progressing to the upstream refinery industry. Finally the import of petroleum products was liberalized in 2001 (BOE 2016). However, Taiwan's oil sector is still dominated by the state-owned petroleum and natural gas monopoly, China Petroleum Corporation (CPC)[13]. The government has been trying to privatize CPC, yet progress has always been falling behind schedule (Chen 2014). The government indicates that the privatization shall be incremental and cannot be implemented until the privatization plan is reported to the Legislative Yuan (Taiwan's legislature), and get its consent (State-owned Enterprise Commission 2014). In the gas market, the production and import of gas are also controlled by CPC. The Natural Gas Enterprise Law stipulates that "the utilities should supply gas by district in the municipalities, and by township (town, city or district) in the counties (cities), and they shouldn't supply natural gas out of the coverage area without the permission from the central authority" (J.-Y. Chen 2014, 149).

The government has also tried to introduce competition into the electricity sector. From 1995 until 2006, the government incrementally opened the market to Independent Power Producers (IPPs). Foreign investors were also permitted to own up to 100 per cent of an IPP (Huang and Wu 2009, 633). Despite the competition in the power generation sector, in general the progress of electricity market liberalization is very slow. Taiwan's electricity market is still dominated by state-owned monopoly Taiwan Power Company (Taipower). In July 2015, one decade after the liberalization in the power generation sector, the Taiwanese Executive Yuan (Taiwan's top executive body) passed the amendments to the Electricity Act to divide Taipower into two parts

[13] CPC is the only company that imports LNG for Taiwan.

− a power company and a grid company, which are under separate management (Chao 2015). The fourth National Energy Conference in 2015 announced that electricity pricing shall be decided according to actual costs. Liberalization of the electricity sector will be conducted in an incremental way (National Energy Conference 2015). The result remains yet to be seen.

4.3. Nature of the economy and energy security concept

Despite being a relatively liberalized market economy, Taiwan has a low level of energy market liberalization. In this sense it is similar to South Korea. While Japan, as a CME, has an energy market more liberalized. The reason lies in the fact that although export is also an important pillar, Japan's economy is more reliant on its domestic market as compared to Korea and Taiwan, which have relied primarily on exports to drive economic growth. Therefore, Korea and Taiwan to a certain extent have a lesser degree of energy market liberalization as they have tried to keep energy prices relatively low to maintain the competitiveness of their products in the international markets. With the exception of Singapore, the most liberalized economy with the most liberalized energy market, the other three have all been very slow in energy market liberalization, and have emphasized that the liberalization must be incremental. In terms of energy security conceptualization, Korea and Japan highlight self-reliance and controllable resources. They also stress the need for low energy prices in order to protect their export-oriented economies.

Singapore is the most liberalized economy in our study and it has the most liberalized energy market. It has the highest sense of energy security among the four economies. With a relatively liberalized energy market, Singapore has never pursued or highlighted in their official documents 'energy self-reliance' or 'self-controllable energy resources'. The reason lies in its special status as an energy trading hub. Despite the absence of fossil fuels and other energy resources,

Singapore is endowed with another natural advantage — its location. Situated at the southern tip of the Malay Peninsula and possessing a superb deep-water harbor, Singapore has logically developed into a full-fledged port city and a regional entrepôt, particularly a distribution center for petroleum. This advantage has been maintained by the government's continuous investments in the country's infrastructure, including the seaport, the airport, and the telecommunications network (T. Doshi 1991).

These characteristics make Singapore a distribution center for petroleum, which also explains why Singapore is not so concerned about its energy security problem as the other three economies, in particular Japan and Korea. Petroleum constitutes one of the largest commodities in Singapore's foreign trade, and refineries constitute the heart of the country's petroleum industry. As Singapore's domestic demand only accounts for a small volume of the total output of refineries, most petroleum products are exported. Therefore, as a distribution center for petroleum, "Singapore has been effectively cushioned from supply shocks owing to the presence of the large refining industry" (T. Doshi 1991, 197-198). The relativity of large refinery capacity to energy consumption makes the energy supply security not as urgent an issue as compared to the other three economies. Therefore, the Singapore government does not highlight the wording such as 'self-controllable energy' in their official documents.

Different from Singapore, the other three economies always have fears of a serious disruption in energy supplies. This is because most of the energy imports by Japan, South Korea, and Taiwan lean towards supporting the energy-intensive sectors as compared to the refineries that will be exported as by Singapore. In other words, energy imports by the three economies have been

absorbed by the national economies to fuel the energy-intensive manufacturing industries such as steel, cement, petrochemicals, and shipbuilding industries. In contrast, energy imports by Singapore, particularly crude oil imports by Singapore, have been used in the refineries and petrochemical plants, and a large share of the petroleum products have been exported to other countries and regions. For example, Singapore imported 45.7 million tons of crude oil and 125.7 million tons of oil products in 2015, while it exported 88.7 million tons of oil products in the same year. Also in 2015, Japan imported 167.8 million tons of crude oil and 46.7 million tons of oil products, yet it only exported 17.4 million tons of oil products.[14] Singapore is akin to a holding and transfer station, and a large part of the crude they import is essentially exported in the form of oil products rather than being absorbed in by the nation's manufacturing industries as in Japan. Therefore, the energy supply security issue in Singapore is not as urgent as compared to the other three economies.

5. Conclusion and implications

Regardless of difference in the degree of pursuing reliable and stable energy supply, the conception of energy security of these resource-poor island economies is very conventional: energy security for them means sufficient, stable and reliable energy supply. Although in the past two decades researchers have added new dimensions into the concept of energy security, such as the environmental dimension, technology dimension, and so on, for these resource-poor yet economically advanced island economies, energy security means stable and reliable energy supply. That is to say, in any sense, securing a stable and reliable supply of energy is of vital national interests for these four resource-poor economies.

[14] Data are sourced from BP Statistical Review of World Energy, 2016.

This traditional concept of energy security explains why these economies, except Singapore, have all been slow in liberalizing their energy sectors. This can be seen in their official documents as far as energy sector liberalization and privatization is concerned. Korea, Japan, and Taiwan have all mentioned that the liberalization and privatization of some parts of their energy sectors (e.g. electricity sector) should be carried out in an incremental way. Being a small open economy, Singapore is special as compared to the other three, because on one hand, it has a liberalized energy market relative to other three economies; while on the other hand, the position of it being an entrepôt safely cushions it from energy supply risk.

Employing the varieties of capitalism theory, we, to be the first, find that the nature of economy is the decisive factor that directly constrains energy security conceptualization and indirectly determines energy security concretization through energy market structure. The *chaebol* and *keiretsu*-dominated coordinated market economies (CMEs) are more concerned about energy supply disruption than the more liberalized market economies (LMEs). This is because the less liberalized market economies such as Japan and Korea are more vulnerable to an energy supply disruption than the more liberalized economies such as Taiwan and Singapore. Hence both Japan and Korea have highlighted ‘self-controllable’ and ‘self-reliance’ of energy in their policy documents. Singapore, as a small open liberalized market economy, can only guarantee its energy security by vibrant economic development and a liberalized market, which are exactly what the official documents have highlighted. Therefore, of these resource-poor islands, Singapore has the most liberalized energy market.

Since all the four economies prioritize stable and reliable energy supply, establishing a regional emergency-sharing system and enhancing regional cooperation to exchange information will improve energy security for all. South Korea, Japan, and Taiwan are geographically close, their levels of economic development are roughly equivalent, and their energy mix is very similar. This condition is favorable for the establishment of a common energy market. Since these three economies are not connected by any power grid or pipelines, a joint oil products and LNG market might be a good option. First, a combined oil products market can enable the three economies to prepare for emergency by sharing reserves and redirecting cargoes in transportation, as well as streamlining in their refinery and petrochemical industries. Further, a combined common petroleum market can bring in economies of scale in the transportation system for petroleum products. For example, if Japan supplies petroleum products to north Taiwan or to the southern part of Korea, the transportation costs can be greatly reduced. The economic benefits can be harvested with a slight reduction of self-reliance. The impact on energy security in Taiwan and Korea, however, will be much less than the change of self-reliance indicates, as economic benefits and efficiency improvement from transport are positively contributing to energy security.

Second, cooperation in LNG market development should be promoted among these four economies. All the four economies are LNG importers and together they account for half of the total internationally traded LNG, and thus changes in LNG market are critical for their energy security. In the current restructuring of the natural gas market, gas and LNG pricing is undergoing transition from oil indexation to hub pricing, which needs the regional cooperation for a benchmark hub, likely in the form of a LNG hub for these four economies. A fresh example

is that Korea Gas, Japan's JERA --a joint-venture between the Tokyo Electric Power Group and the Chubu Electric Power Group and the world's largest LNG buyer, and China National Offshore Oil Corporation signed a memorandum of understanding in March 2017 to secure more flexible supply contracts (Chung, Obayashi and Vukmanovic 2017). Gas swapping has been discussed within ASEAN, and the idea should be ready to be extended beyond the regional level of ASEAN. Such cooperation among these four economies will generate maximum liquidity for such a hub, and will increase its chances to be accepted as the benchmark hub.

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