

The Singaporean natural gas hub: reassembling global production networks and markets in Asia

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Abstract

Recently, economic geographers have sought to account for how regional and national initiatives shape the strategic decisions of actors in global production networks (GPNs). In this article, I intend to discuss the political and institutional dynamics by which GPNs evolve, and the capacity of states to shape emerging organizational and spatial arrangements in dynamic GPNs. Building on assemblage thinking, I conceptualize these political and institutional dynamics as the unbundling of legal, regulatory and institutional components of nation-state authorities that govern GPNs, and the subsequent reassembling of these components through emerging interactions with finance, technology and new forms of private authority. These emerging global assemblages are both partially embedded in global cities and stretch across and within the borders of nation-states. Building on this conceptual framework, this article explains how the exclusive nation-state authorities that traditionally governed liquefied natural gas (LNG) trade and markets are becoming unbundled. The article focuses on the initiatives of public and private actors in Singapore who are attempting to shape evolutionary dynamics in GPNs by establishing a hub for LNG trading and speculative financing in Asia. The article finds that Singapore's capacity to shape LNG production networks is dependent upon the capacity of public and private actors in Singapore to establish cross-border connectivity to markets in Southeast Asia.

Keywords: Global production networks, nation-state authority, liquefied natural gas, assemblage

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1. Introduction

In their editorial for the special issue on 'Global production networks: mapping recent conceptual developments' published in this journal, [Coe and Yeung \(2019\)](#) identify five 'constituent outsides' which, in their opinion, have been productive arenas for global production network (GPN) scholars to engage with literature in other fields. One such constituent outside includes broadening and deepening the understanding of the intersections between states and GPNs, including 'examining the politics of state transformation in order to reveal the more foundational and strategic role of the state in underpinning the activities of global production networks' ([Coe and Yeung, 2019](#), 783). Current discussions on this subject have considered how state transformation has enabled the strategic coupling of national economic actors to GPNs or influenced how states become articulated in geopolitical relationships that shape the construction and restructuring of GPNs ([Smith, 2015](#); [Yeung, 2016](#); [Dawley et al., 2019](#)). However, thus far GPN scholars have centered

their analysis on the powers of the nation-state that are largely extensive to multiscale hierarchies and consequently have yet to grasp how nation-state authorities become reassembled through new alliances with private actors, finance and technology to constitute novel geographies of authority that stretch within, beyond and across given scales and boundaries.

In this article, I intend to investigate the uncertain dynamics by which the emergence of these novel geographies of authority enables the capacity of nation-states to shape spatial and interorganizational dynamics in GPNs. The conceptual framework developed in this article draws upon [Sassen's \(2006\)](#) account of how the global economy is continuously being shaped as traditional nation-state authorities become unbundled, and political arrangements, physical infrastructure, codes and flows that are both located within and cut across national boundaries are subsequently brought together within emergent assemblages that are neither fully national nor global. In addition to Sassen's account of emerging assemblages, I suggest the need to further conceptualize how the capacity of these assemblages to shape GPNs emerges, the temporality and instability of these assemblages, and the uncertain dynamics by which such assemblages are actively reproduced and maintained ([DeLanda, 2006](#); [Anderson et al., 2012](#); [Haarstad and Wanvik, 2017](#)). My analysis of the dynamics by which nation-state authority becomes reworked is framed by the initiatives of financial intermediaries, public authorities and corporations in Singapore to establish a hub for liquefied natural gas (LNG) trading in Asia.

Historically, natural gas markets and the cross-border trading of natural gas have been assumed under the authority of the nation-state and, consequently, international gas trade has been limited. However, since the early 1990s, natural gas trade has been evolving through neoliberal market reform and international market integration through long-distance gas pipelines and the seaborne transportation of LNG. In their analysis, [Bridge and Bradshaw \(2017\)](#) explain that the reconfiguration of spatial and organizational arrangements in LNG production networks is constituting a global market for natural gas. Nevertheless, a key challenge for the globalization of markets is distinctively regional pricing regimes ([Stern, 2016](#)). While the USA and parts of Europe have established marketplaces and pricing benchmarks for natural gas, LNG marketplaces in Asia are immature and LNG is indexed according to the price of oil. The dependence on oil indexation in Asia is considered by industry experts to be a significant hinder for the integration of global gas markets ([Stern, 2014](#); [Haze, 2018](#)).

Evolving spatial and organizational arrangements and the limitations of market development provides a 'window of opportunity' for Singapore to capture value from LNG production networks by establishing a hub for LNG trading. In doing so, Singapore could develop a pricing benchmark in Asia that would further shape the evolutionary dynamics of LNG production networks. In this article, I intend to discuss how Singapore's capacity to shape and capture value from LNG production networks is dependent upon the unbundling of nation-state authorities in LNG production networks and the initiatives of corporate, financial and government actors in Singapore to rework and embed unbundled authorities in the city-state. In my analysis, I find that Singapore's role as a future LNG trading hub is dependent on its capacity to establish and maintain connectivity to regional markets in Southeast Asia. However, this article subsequently finds that this capacity is limited due to challenges surrounding market development and liberalization in neighboring countries.

The remainder of this article is structured as follows: the next sections (2 and 3) introduces recent discussions surrounding the role of states in shaping GPNs and the

contribution that assemblage thinking provides to these discussions. Section 4 outlines the empirical material and methods used in the empirical study of the LNG hub in Singapore. The subsequent sections (4-6) examines the dynamics by which LNG production networks are evolving, the current limitations to further growth, and how public and private actors in Singapore are establishing the basis for new organizational and spatial arrangements in LNG production networks by reworking traditional nation-state authorities over natural gas markets. Section 7, concludes by outlining the key findings and the theoretical contributions of assemblage thinking to current perspectives on state transformation in GPNs.

2. The role of the nation-state in GPNs

Since its inception, the analytical framework of GPNs has recognized that states play a key role in GPNs (Henderson et al., 2002; Coe et al., 2004; Coe and Yeung, 2019). Similar to the global commodity chains approach, GPN scholars sought to push beyond the notion that the central agent in development is the nation-state, in favor of recognizing the role of diverse constellations of economic actors that are interconnected through nodes and links that extend spatially across national boundaries. At the same time, scholars differentiated the GPN framework from the firm- and chain-centered focus of related approaches, such as the global commodity chains, by emphasizing the importance of institutional contexts at different spatial scales (Dicken et al., 2001). Scholars emphasized that GPNs are territorially embedded in the places they are located, meaning that they are partially shaped by the economic, social and political arrangements of these places (Hess, 2004; Hess, 2008). It is through this embeddedness that states have the capacity to exert institutional and regulatory power, both individually and through interstate agencies such as the European Union (EU), which influence the decisions of firms integrated into GPNs (Coe et al., 2008; Smith, 2015).

GPN scholars have also noted that nation-states are continuously engaged in bargaining processes with transnational corporations in GPNs surrounding the location and nature of investments in productive capacities within state territories (Coe et al., 2004; Coe et al., 2008). Coe et al. (2004) have theorized strategic coupling as an active and intentional intervention of both regional and national institutions and multinational corporations to create opportunities for value creation and enhancement in GPNs. In his studies of East-Asian development, Yeung (2014, 2016) points to the need to better understand how the changing role of states in governing markets in a globalizing era underpins the activities of GPNs through strategic coupling mechanisms. Yeung explains that the weakening of state autonomy and the decentering of developmental state institutions in East-Asian economies enabled the disembedding of East Asian firms from state-directed development regimes and their subsequent articulation into the competitive dynamics of GPNs. In his analysis, Yeung draws upon the GPN 2.0 approach that identifies the casual mechanisms by which key competitive dynamics and risk factors drive firm-specific strategies and behavior in GPNs (Coe and Yeung, 2015). In this framework, the extent to which states shape these dynamics is through extra-firm bargaining strategies which is defined as a ‘a contested two-way process of negotiation and accommodation between firms and non-firm actors in order to reach a mutually satisfactory outcome in the creation and capture of value through global production networks’ (Coe and Yeung, 2015, 151). Extra-firm bargaining strategies are presented as a dependent variable, driven by the key competitive dynamics of GPNs, which Yeung and Coe claim is the ‘raison de affair’ of GPNs.

Yeung's approach is useful for avoiding accounts that overemphasize the role of the state in governing development at the expense of considering interorganizational and spatial dynamics in GPNs. However, the notion that firms become disembedded from nation-state and that the role of the nation-state is reduced to responding to the needs of GPNs through strategic coupling is problematic. Specifically, by generalizing the decline of state capacities, the GPN approach may miss the ways in which the authorities of nation-states become re-embedded in novel geographies of authority with the power to shape the emergence and transformation of GPNs. [Neilson et al. \(2018\)](#) suggest that by presenting the main drivers of GPNs as independent causal forces and extra-firm bargaining as dependent variables, the GPN 2.0 perspective underplays the role of the state in underpinning the emergence of GPNs. Similarly, [Mayer and Phillips \(2017\)](#) argue for the need to account for the role of states in facilitating the emergence and spread of global value chains and GPNs. While Mayer and Phillips emphasize the structural power of corporations in the global political economy and their influence on the behavior of states, they also suggest the importance of recognizing the role states play as key architects of GPNs through international trade agreements, the strategic loosening of competition policies, and liberalization and deregulation strategies. Although such arrangements lead to the proliferation of private authority in governing GPNs, Mayer and Phillips argue that this is not necessarily a consequence of the decline of state capacities, but rather a political and ideological project that states themselves have been central to constructing and enabling.

In line with the arguments above, I suggest that there is a need to go beyond notions of nation-states as responsive and facilitative to GPNs, and further conceptualize how nation-states and state transformation may play a key role in actively constituting organizational and spatial arrangements in GPNs. A key limitation of current GPN literature to account for these dynamics is that scholars have primarily emphasized the powers of the nation-state that are extensive to multiscalar institutional hierarchies. At the supra-national level, scholars have focused on how states shape GPNs by engaging in multilateral agreements ([Glassman, 2011](#); [Smith, 2015](#)). At the national level, scholars have focused on how states regulate the access and ownership of resources and infrastructure embedded within territories ([Bridge, 2008](#); [Stephenson and Agnew, 2015](#)). At the regional level, scholars have primarily identified how states play a facilitative role in the strategic coupling process ([Lee et al., 2014](#); [Dawley et al., 2019](#)). While such conceptualizations may be useful in their respective contexts, these framings within well-known multiscalar institutional hierarchies may come at the expense of accounting for, what [Allen and Cochrane \(2007\)](#) term the 'looser, more negotiable sets of political arrangements' that stretch within, across and beyond given scales and boundaries.

In the next section, I discuss three ways in which assemblage thinking can provide a useful analytical framework to conceptualize how the transformation of traditional state authorities over markets does not necessarily entail the retreat of the nation-state to a responsive role in the global economy. Instead these transformations are an opportunity for both public and private actors to reassemble traditional nation-state authorities through novel geographies of authority.

3. Assemblages

The first way assemblage thinking can contribute to current perspectives on state transformation in GPNs is by using the notion of assemblages as a useful heuristic to describe the emergence of novel geographies of authority that extends both within, across and

beyond traditional multiscale institutional hierarchies. In her book, *Territory, Authority, Rights: From Medieval to Global Assemblages*, Sassen (2006) uses the notion of assemblages to explain how novel geographies of authority emerge under the circumstances by which the exclusive authorities of the nation-state become unbundled, and reoriented toward global agendas and systems through new interactions with financial institutions, corporate logics and hypermobile capital flows. Instead of seeing globalization in terms of the decline of nation-state authority, Sassen interprets globalization as enacted through changes within the state itself. In Sassen's account, the dynamics of globalization are embedded in nation-states, as new legal forms necessary for globalization are implemented through state institutions. At the same time, these legal forms deborder traditional nation-state boundaries as they function in operational spaces that are 'no longer national in the strict sense of the term' (Sassen, 2013b). These partially global, partially national assemblages are highly contingent and specialized in scope, emerging from the agencies and initiatives of public and private actors (Allen and Cochrane, 2010). Sassen provides several examples of highly specialized assemblages in which the nation-state provides the necessary instrumentalities together with private actors to enable novel geographies of authority (Sassen, 2006). These include the debordering of anti-trust policy, the privatization of international commercial arbitration, international courts and tribunals, global capital markets, etc. Sassen claims that these assemblages of overlapping public and private authorities play a key role in shaping the global economy.

While Sassen's account of assemblages is useful for heuristic purposes to designate how state transformation leads to new forms of socio-spatial organization that are not reducible to existing multiscale hierarchies, her notion of assemblage is used in its most descriptive sense. Sassen explicitly states that she does not employ the more theoretical usages of the term developed by Deleuze and Guattari (1987). Anderson and McFarlane (2011) suggest that deploying the notion of assemblages as a descriptor comes at the expense of the more explicit theorizations, surrounding the processes by which the higher-level capacities of assemblages to affect socio-spatial outcomes emerge that have been developed by scholars following the Deleuzian tradition of assemblage thinking (Protevi, 2006; Legg, 2009; DeLanda, 2016). Assemblage thinking in the Deleuzian tradition is similar to actor-network theory, which partially constitutes an ontological basis for the notion of 'networks' in GPN theory (see Dicken et al., 2001; Henderson et al., 2002). Both approaches account for the distributed agency by which social actors and material entities are continuously ordered and reordered within networks (Müller and Schurr, 2016). In addition, both assemblages and actor-networks are considered to be provisional unities that have emergent or complex causalities that are irreducible to the social and material entities that compose them (Anderson et al., 2012). However, whereas actor-network theory conceptualizes the agency and identity of social and material entities as solely constituted by their relations with other entities, assemblage thinking characterizes emerging wholes according to the notion of 'relations of exteriority'.

Building upon the notion of relations of exteriority, I suggest that the second way that assemblage thinking can contribute to current perspectives on state transformation in GPN theory is by drawing attention to how the capacity of states to shape GPNs emerges by identifying how different actors and materials become related through such assemblages, and the quality of these relationships. Relations of exteriority entails that while the capacities of social and material entities to affect outcomes are emergent through relationships, the identity and properties of these entities are heterogenous and external to such relationships (DeLanda, 2006; Deleuze and Parnet, 2007). Assemblage thinking can be utilized to account for how the emergent capacity of the partially national, partially global

assemblages described by Sassen to shape GPNs is immanent to the initiatives, practices and materialities by which a diversity of actors (firms, states, intermediaries, etc.) and material entities (recourses, technology, infrastructure, etc.) are arranged. [Dittmer \(2014\)](#) suggests that assemblage thinking can be used to consider how states and political actors produce desired outcomes, by identifying the dynamics by which entities enter relationships, and the processes by which such relationships endure in ways that make desired outcomes possible. For example, by using assemblage thinking, [Bouzarovski et al. \(2015\)](#) demonstrate how an integrated, European gas market is emerging from the erosion of traditional forms of state authority over markets and new political and material practices. As nation-state authority is unbundled, natural gas markets in Europe become reassembled through new assemblages of energy security narratives, cross-border pipeline development, EU commission directives for market deregulation, market exchanges and standardized pricing regimes. [Bouzarovski's et al. \(2015\)](#) research on gas markets in Europe draws similarities to the emergence of markets in Southeast Asia.

The third way assemblage thinking can contribute to current perspectives on state transformation in GPN theory is by conceptualizing the inherent temporality and instability of the partially national, partially global assemblages described by Sassen. Relations of exteriority also entails that while the capacity of any actor to achieve a desired outcome cannot be understood outside the relationships within the assemblage that actor is a part of, these relationships are only contingent achievements ([Deleuze and Guattari, 1984](#)). The actors connected through these relationships may have different and continuously changing priorities and strategies ([Savage, 2019](#)). Assemblage thinking therefore draws attention to the inherent heterogeneity and instability of assemblages, as the component parts of assemblage can be subject to multiple dynamics and interactions resulting in capacities that can either reproduce or destabilize assemblages ([Bonta and Protevi, 2004](#); [DeLanda, 2016](#)). The extent to which assemblages are reproduced and made durable over time occurs through the imposition of institutional arrangements of power that emerge from the variety of political mobilizations that different actors engage with to secure, modify or translate their goals and interests ([Allen, 2011](#)).

Relations of exteriority implies that assemblages are not held together by centers of powers nor totalities, but by the extent to which political mobilizations, alliances and technological mediations work to maintain the overall coherence of emerging assemblages and the extent to which certain dynamics that may contradict this coherence are excluded from the assemblage ([DeLanda, 2016](#)). Therefore, the power of financial, political and corporate actors to shape GPNs is less a question about dominance and holding 'in reserve' a right mix of institutional and financial resources. Rather, power is more a question of the extent to which new alliances among actors, capital, infrastructure and resources result in emerging capacities to establish and sustain connectivity across, within and beyond traditional multiscale institutional hierarchies in order to reproduce and maintain emerging assemblages ([Allen and Cochrane, 2010](#)).

To summarize, I suggest that assemblage thinking can be drawn upon to better understand the political and institutional transformations by which the capacity of the state to shape organizational and spatial arrangements in dynamic GPNs emerges in the following three ways. First, the notion of assemblages can provide a useful heuristic to describe the emergence of highly specialized political arrangements that exist both within, across and between traditional spatial frameworks. Second, assemblage thinking in the Deleuzian tradition can be used to explain the emergent capacities of these assemblages to shape emerging GPNs by identifying how different actors and materials become related through

assemblages, and the quality of these relationships. Third, assemblage thinking can be used to conceptualize the inherent temporality and instability of assemblages, as the capacity of political mobilizations, alliances and technological mediations deployed to maintain the overall coherence of emerging assemblages is not guaranteed.

4. Methods

In the remainder of this article, I continue the theoretical discussions through an empirical study of an initiative by public authorities, financial intermediaries and corporations in Singapore to shape LNG production networks by establishing a hub for LNG trading. The initiative to establish an LNG hub is particularly interesting because of its relative significance for shaping emerging organizational and spatial arrangements in LNG production networks. Furthermore, the initiative demonstrates a conjunctionally specific moment where public and private authorities in Singapore are attempting to capture development opportunities from transformations in LNG production networks by enrolling new sets of actors and technologies into emerging global assemblages.

The empirical evidence for this study draws from [Bridge and Bradshaw's \(2017\)](#) account of LNG production networks, as well as other authors who have written on the subject ([Mehden and Lewis, 2006](#); [Corbeau and Ledesma, 2016](#)). The development of LNG hubs and the role that LNG hubs play for the evolution of markets in Asia is a significant topic of discussion among international energy agencies and independent energy research institutes ([Srnicek, 2007](#); [Ten Kate et al., 2013](#); [Stern, 2014](#); [Corbeau and Ledesma, 2016](#); [Fulwood, 2018](#)). These organizations have published reports that provide hypotheticals on the conditions by which LNG hubs in Asia may develop, usually based on their analysis of how hubs developed in Europe. Singapore is identified by these reports as a possible location for an LNG hub, even though these reports detail several limitations that must be overcome for Singapore to do so. While the reports mentioned above are useful, and provide a basis for the following empirical discussion, I find that they tend to naturalize the evolution of markets in Asia as if these fates are predetermined. Missing from these reports is an account of the political agencies, resources and strategies that are employed by corporations, governments and financial actors to re-assemble markets in Asia. In addition to the reports, the empirical section is based upon multiple visits to Singapore in 2015 and 2016. The primary purpose of these visits was to conduct interviews with managers at LNG-related companies in Singapore. These LNG-related companies included technical advisory agencies, financial consulting groups, commodity-trading groups, shipyard owners and equipment suppliers. The informants held positions with regional oversight and were well aware of the activities related to the Singapore government's effort to establish an LNG trading hub in the region. In total, 21 interviews were conducted. Informants were identified and selected during attendance at conferences and seminars by the author and through snowball sampling.

Before I discuss how public and private authorities in Singapore are attempting to shape LNG production networks by establishing a hub for LNG trading I will provide an account on how nation-state authority and governance over LNG trade and markets has been contingently necessary for the emergence of LNG production networks in Asia and how in the last decade these relationships have been changing in ways that open a 'window of opportunity' for an LNG hub in Singapore.

5. Nation-state authority and LNG production networks

The governance of interfirm relationships in LNG production networks was initially assumed under the authority of nation-states with the financial and regulatory capacity to support utilities and corporations in securing LNG supplies due to the territorial embeddedness of natural gas markets. Unregulated natural gas markets have historically been subject to private sector monopolization as the ownership of capital-intensive and networked infrastructure (e.g. pipelines, refining facilities, compressors) creates high barriers to entry for competitors (Sica, 2018). Therefore, natural gas markets have traditionally been regulated and allocated to government-owned utilities or regulated monopolies. Furthermore, nation-states were strongly present in overseeing, facilitating, creating demand for LNG trade and the regulation of natural gas markets. For example, from the 1980s, the Japanese government played a key initial role in emerging LNG production networks by generating demand for LNG by providing different tax incentives and subsidies to promote fuel switching for power generation and city gas (Mehden and Lewis, 2006). In addition, Japanese corporations were loaned funds with lucrative interest rates by the export–import bank of Japan to invest in upstream LNG production terminals in Indonesia and Malaysia.

According to Bridge and Bradshaw (2017), LNG production networks have traditionally assumed a project character, as the sheer costs of developing LNG terminals (in the tens of billions of dollars) entailed that investment decisions for LNG terminals both in Asia and around the world have been underpinned by guaranteed revenue streams through long-term contracts, around 15–20 years, with take-or-pay clauses. Take-or-pay clauses imply that LNG buyers are bound to pay for a prespecified minimum quantity of LNG whether they import the gas or not (Stern and Koyama, 2016). These contracts impose significant market risk on LNG buyers, who need to pay for agreed upon LNG quantities over a long-term period, despite market swings, recessions, etc. Therefore, final investment decisions (FIDs) on LNG terminals have been based on the creditworthiness of LNG buyers, which have traditionally been government-owned natural gas companies or regulated utilities, with the capacity to pass risks onto consumers due to their regulated monopoly position (Corbeau, 2016b). Furthermore, LNG markets in Asia were typically exclusive to high-income countries like Japan, Taiwan and South Korea, as power utilities in lower income markets were not considered sufficiently creditworthy to guarantee long-term LNG contracts (Corbeau et al., 2014).

While the capacity of LNG production networks to realize value creation may have been emergent from the exclusive authorities of nation-states and their relations within interorganizational relationships, these relations, in line with assemblage thinking, can be characterized by the notion ‘relations of exteriority’, as the continuity of such relationships is threatened by emerging capacities that disrupt the overall coherence of these relationships. This is exemplified as the authority of nation-states, particularly in the USA, Europe and Japan, to oversee and govern LNG trade became unbundled by the liberalization of natural gas markets. These reform initiatives have increased the pressure on traditional utilities to seek more flexible LNG supply contracts to maintain their advantage in competitive markets. Historically, such options were excluded due to long-term LNG contracts, however, surplus capacity in LNG production and slowing demand in high-income markets threaten the traditional organization of LNG production networks. Since the early 2000s, the global LNG industry witnessed a significant expansion in LNG production capacity as LNG producers began to expand and build LNG terminals without fully

dedicating production capacity to specific long-term contracts. Instead, extra-capacity was sold through spot (single-cargo) and short-term trades (4 years or less), which eventually increased from 5% to 28% of global trade between 2000 and 2015 (Corbeau, 2016a). Bridge and Bradshaw (2017) explain that the consequence of these shifts is that LNG production networks are evolving from a:

Relatively simple floating pipeline model of point-to-point, binational flows orchestrated by producing and consuming companies governed by long-term contracts, to a more geographic and organizationally complex production networks that is constitutive of a global gas market. (215)

The growth in spot markets has allowed buyers to reduce take-or-pay obligations by purchasing LNG through spot trades and short-term contracts (Stern, 2014). Before 2014, spot trades and short-term contracts, particularly in Asia, had been priced at much higher premiums, and have therefore been less attractive than long-term contracts (Stern, 2014). Since 2014, however, premiums for spot cargos and short-term contracts have decreased due to the boom in domestic shale gas production in the USA which was historically a significant LNG importer, while LNG demand growth in Japan, Korea and China has been slowing (Bridge and Bradshaw, 2017). With LNG prices at historic lows, LNG producers are dependent upon the significant expansion of LNG markets if they are to maintain their capital gains (Corbeau et al., 2014). As an interviewed management consultant at a global energy advisory firm in Singapore explained:

In the current market situation, you have huge amounts of new supply coming in from the US and Australia. So, there is a huge imbalance in the market between demand and supply, and the LNG needs to go somewhere. First, the spot prices will go down, and second, new demand needs to be created. But demand won't come from large consumers in Japan or Korea; it is probably going to come from smaller demand centers in Indonesia, China, Philippines, and Sri Lanka. So, how do we access that?

The economic consultant further explained how potential LNG buyers in emerging economies are now leveraging purchasing power through low prices on LNG spot markets to reduce take-or-pay commitments. However, despite the growth in demand for LNG in emerging economies, a 2018 outlook by the Shell Corporation, notes that few FIDs on new LNG terminals have been made since 2015 (Shell, 2018). Growth in LNG demand is expected to overtake LNG supply by the mid-2020s, unless new FIDs are taken in the next few years. According to the outlook, the lack of FIDs is a result of a mismatch between increasing demand for flexible LNG contracts, and the continued need for long-term contracts to underpin financing for upstream LNG projects. The Shell outlook, along with other industry opinions, points to a situation where the recent expansion of LNG markets may be part of a 'boom-bust' cycle (Ross, 2018; Weber, 2018). According to Corbeau (2016a), 'there is a danger that supply will be inadequate when demand picks up, striking a damaging blow to the gas industry' (555).

LNG production networks can be characterized by a moment of disassembly and instability, where the traditional relationships that held production networks together are becoming unraveled. Similar to Bouzarovski et al.'s (2015) analysis of European gas markets, the disassembly of traditional state authorities over natural gas markets leads to the potential for new relationships within novel assemblages. In the context of a pending 'boom-bust' cycle in the LNG industry, commodity traders are starting to play a

significant role as ‘middle-men’ in LNG production networks, by assuming the risk of long-term LNG contracts with upstream suppliers, in order to provide flexible short-term agreements with downstream buyers (Ten Kate et al., 2013; Corbeau and Ledesma, 2016; *LNG World News*, 2018). The interviewed management consultant in Singapore explained the role of commodity traders in the following way:

The big companies and oil majors are going to take a lot more time to realize the change. LNG producers do not want to deal with the difficulties of buyers in low-income emerging economies, and they are going to say ‘wow, this is too much work for such a small margin, I am happy to give up these volume rights’. So, what we will see is that commodity traders who didn’t have much of a role to play in LNG before because of these controlled value chain mechanisms are going to step in. These traders are going to sign long-term contracts and take the risk downstream by selling LNG through spot and short-term deals at a premium.

While the bankers and financiers of LNG terminals are hesitant to invest speculatively in LNG terminals without securing long-term contracts, commodity traders may play an initial role as ‘middle-men’ in LNG production networks by assuming the risk of long-term contracts and selling at a profit in spot markets. In other commodity markets, such as oil, trading houses provide liquidity in spot markets, supposedly reducing the need for long-term contracts (Corbeau, 2016b). However, a key limitation for further growth is that markets for LNG trading in Asia are immature.

Commodity trading markets in the LNG industry in Asia are immature because LNG trade is insufficiently financialized. Labban (2010) notes that financialization is associated with liberalizing ‘the circulation (i.e. expansion) of value from material production and exchange at the same time that it brought the production of value and its realization in exchange under the dominance of financial logic.’ (542). Commodity traders realize profits by actively monitoring prices for commodities at different delivery locations and different delivery dates (i.e. buy now, sell later) (Trafigura, 2018). Physical traders use derivatives, such as future contracts, swaps and options, as price hedging instruments to ensure profitability despite price volatility in markets. Physical trading in the LNG industry is not without significant risk, as economic downturns, weather and supply disruptions produce significant volatility in physical commodity trading. Whereas LNG buyers assumed the risk of LNG trading through ‘take-or-pay’ agreements, traders mitigate these risks by hedging their portfolios through financial markets as ‘insurance’ against demand shortfalls and price declines. Financial markets accumulate profits through interest, dividends and settlement prices for futures, options and swaps (Labban, 2010).

Due to space constraints, the complexities of commodity trading in the LNG industry will not be discussed in this article.¹ What is important to emphasize, however, is that commodity trading uses real-time price signals across different locations in global markets to realize a profit. In addition, real-time price signals are a basis for financial risk management, where profit actualized through exchange markets, which ‘separates space into one space where capital reproduces itself as the circulation of titles of ownership through future contracts and swaps, and another space in which the material production and exchange of commodities takes place as an unavoidable middle term, a necessary evil for the purpose of money making’ (Labban, 2010, 542). Establishing reliable price signals is, therefore, dependent upon the development of market exchanges and price benchmarks

1 There are many practical guides that explain the working of commodity trading and financial management, see Trafigura (2018), Burger et al. (2008), and Pilipovic (2007).

where spot cargos are continuously traded and the contract prices between buyers and sellers are reported transparently. While these market exchanges and price benchmarks have been established in the oil industry since the 1980s, these financial institutions have historically played a limited role in the LNG industry for three key reasons: first, since the majority of LNG trade has been through long-term contracts, spot trades have been historically limited. Second, governments in Asia have typically regulated natural gas prices, thus distorting markets and making price signals unreliable. Finally, with no reliable pricing benchmarks, LNG pricing has historically been fixed to crude oil-linked prices² (Corbeau and Ledesma, 2016; Shi, 2016; Fulwood, 2018).

Since 2000, there has been a shift away from pricing mechanisms based on oil indexation to ‘gas-to-gas competition’ in Europe and the USA (Heather, 2016). However, oil indexation continues to dominate markets in Asia (Stern, 2014). ‘Gas-to-gas competition’ is a pricing mechanism that is indexed to prices reported by traders through market exchanges. Industry experts claim that the continued growth of spot markets is contingent on the development of reliable price benchmarks in Asia, where the growth of LNG is expected to be the highest (Ten Kate et al., 2013; Corbeau, 2016b; Shi, 2016). Pricing benchmarks in Europe and the USA are linked to natural gas trading hubs, such as the national balancing point in the UK, which are platforms where the ownership or ‘title’ of natural gas is exchanged between buyers and sellers³ (Heather, 2016). The point is that traders are obligated through regulations to report the volumes of gas transferred, the time period, the quality of gas and the buying and selling parties to electronic notification systems (Fulwood, 2018). The price of natural gas is established through pricing indexes, run by private exchanges, which calculate pricing based on the assessments of physical traders participating in the exchange. In Europe and the USA, mature and reliable pricing benchmarks established at natural gas trading hubs are used to index prices in contracts between buyers and sellers, even if the gas is not physically traded at the hub itself.

LNG hubs may represent a proliferation of private, financial authorities over natural gas markets. Nevertheless, as explained in the theoretical section, nation-states continue to exert their influence over markets through assemblages that are not extensive to traditional multiscalar hierarchies. These assemblages emerge through new interactions among regulatory authorities, financial markets, infrastructure and pricing indexes. At the same time, these relationships are subject to uncertainty and instability. In the next section, I demonstrate these dynamics by discussing the initiatives by which public and private authorities in Singapore are attempting to establish an LNG hub for Asia.

6. Singapore as an emerging LNG hub

The financialization of LNG markets is not only significant in terms of its potential role in establishing the basis for further growth in LNG trade, but for creating spaces for commodity trading and financial intermediaries to capture value from LNG production networks. However, the financialization of LNG markets is dependent upon unbundling the extensive authorities of nation-states over gas markets, including their capacity to regulate

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- 2 Early buyers of LNG were mainly concerned with replacing crude oil imports with LNG. Therefore, in the absence of reliable price benchmarks and spot markets, LNG buyers and producers agreed upon linking the price of LNG to imported crude oil.
 - 3 A trading hub is not necessarily a single location where natural gas is physically traded, but refers to the points in a country's national-transmission system where physical flows of natural gas enter and exit the system.

market prices and their ownership over natural gas monopolies. Asian countries such as Japan, Malaysia, Thailand, China and South Korea have begun implementing natural gas market reforms, by privatizing government-owned utilities, deregulating price controls, and implementing third-party access. By unbundling traditional forms of state authority, these reforms open the opportunity for standardized pricing regimes and commodity trading as is being developed in Europe (Stern, 2014; Bouzarovski et al., 2015). Commodity trading houses, such as Trafigura, Guvinox and Vitol, which have historically played little role in LNG production networks in Asia, are starting to enter the industry. In order to capture value from these new players, public and private authorities in Singapore have sought to strategically couple to LNG production networks by establishing a hub for LNG trading in Asia. In doing so, public and private actors in Singapore are attempting to establish the city-state as a ‘first-mover’ in the industry, by creating an exchange market for both physical LNG trade and a futures market. In line with assemblage thinking, the capacity of Singapore to establish an LNG hub can be thought of as emergent through new alliances within global assemblages between government authorities, regulators, corporations and financial intermediaries and their initiatives to reorient legal institutions, regulatory frameworks and infrastructure toward financialization of global LNG trade.

6.1. State unbundling and liberalization strategies

Nearly 95% of Singapore’s electricity is generated through natural gas. Historically, Singapore has imported its natural gas through pipelines from Malaysia and Indonesia. However, due to power outages as a result of pipeline failures, Singapore sought to diversify its natural gas supply by coupling to LNG production networks as an importer (SLNG, 2014). In 2006, the Minister for Trade and Industry announced that the Singaporean government would build and finance an LNG terminal to import LNG (MTI, 2012). The Energy Market Authority (EMA) incorporated Singapore LNG (SLNG) to own and operate an import terminal on Jurong Island. The terminal was commissioned in 2013. Furthermore, in 2006, the Singaporean government implemented import controls on new pipeline gas supply for commercial power generation with the intention of building-up the demand for LNG. While the government of Singapore commissioned the Jurong LNG terminal for energy security concerns, the EMA in Singapore has sought to establish a hub for LNG trading by leveraging Singapore’s position as a financial center and trading hub for oil (Ten Kate et al., 2013). These national strategies are in line with city-state’s position as a global city in Asia. As Olds and Yeung (2004) note:

The developmental city-state of Singapore never misses an opportunity to convey how the small city must cope with and exploit (ride) global and regional systemic change in an aggressive and strategic fashion. (491)

Although Singapore has no oil and gas within its city boundaries and has a much smaller market for natural gas than its neighboring countries, Singapore is a key oil trading center in Asia. Singapore has a mature financial market for derivatives trading and is home to many trading houses in the oil industry. According to interviews with LNG-related firms in Singapore, establishing an LNG hub is an opportunity for Singapore to establish itself at the center of LNG trade and financial risk management in Asia and to encourage commodity trading houses and LNG firms to set up trading desks in Singapore.

Olds and Yeung (2004) note that Singapore is unique, in that as a city-state, it is able to draw upon the capacities of both a nation-state and a global city to develop, maintain and

refashion ‘world-class’ infrastructure, legal and financial systems with the aim of ‘embedding Singapore within the evolving lattice of network relations that propel the global economy’ (491). A report by the international energy agency notes that for an LNG hub in Asia to be developed, governments would need to enable competition by actively separating the transport, storage and regasification of LNG from its commercial marketing and ensuring that market participants have non-discriminatory access to facilities (Ten Kate et al., 2013). The report subsequently found that Singapore has come furthest along in this process compared to other Asian countries such as China and Japan and notes that Singapore has considerable experience in regulating energy commodity trade as it is one of the major oil-trading hubs in Asia. Singapore has a world-class supporting system to facilitate trading and financial risk management. As a manager from the LNG terminal corporation in Singapore noted:

Singapore has clear structures, clear stakeholders, good governance, follows timelines, and is a first mover. Some say Singapore can be autocratic, but it thinks things out well ahead of time and gets feedback from the industry.

While enabling competition in natural gas markets may entail unbundling authorities from traditional normative orders, for example, by privatizing state-owned companies, nation-state authorities remain prevalent in shaping natural gas markets. As mentioned in the previous section, unregulated natural gas markets have historically been subject to natural monopolies due to the capital-intensive and networked character of natural gas infrastructure. To enable competition in previously monopolized markets, states exercise their authority by forcing companies that own and operate natural gas infrastructure within the boundaries of the nation-state to offer third-party access to transmission lines and LNG terminals. Third-party access entails granting independent gas shippers a legally enforceable right to access and use energy network facilities owned by other companies.

Since the Gas Act of 2001, the Singapore gas sector has set on a firm course toward establishing third-party access through the deregulation and the unbundling of commercial marketing from transport and storage (Six and Corbeau, 2017). While the oversight over third-party access is located in the nation-state, these authorities are not national in the strict sense of the term. Instead, third-party access entails entrusting oversight authorities to an independent energy regulatory which operates as a denationalized entity within the nation-state apparatus. In Singapore, the EMA is the independent energy regulator which operates as a statutory board under the Ministry of Trade and Industry, but at the same time is supposedly independent from direct political influence. Under the 2001 Gas Act, the EMA has a broad mandate to promote competition in gas markets by drawing up and enforcing third-party access and network codes on infrastructure. In addition, instead of establishing a state-owned company for LNG procurement, Singapore appointed the multinational company, BG Singapore Gas Marketing Pte., to be the LNG aggregator. As an LNG aggregator, BG would aggregate the demand for regasified LNG from all end users in Singapore up to 3 million tons per annum (MTPA).

By unbundling traditional forms of nation-state authority over its natural gas market and establishing third-party access, Singapore’s legal and regulatory institutions are reoriented toward its global ambitions through new interactions with emerging corporate logics and finance in emerging assemblages. These assemblages emerge from new coalitions of public and private actors that are working toward a common agenda of strategically coupling to LNG production networks by establishing an LNG trading hub in Singapore. These new coalitions (which consist of authorities, financial institutions, trading companies and

LNG-related firms) facilitate these coupling outcomes by establishing the basis for the innovation and development of pricing indexes that create new spaces for hypermobile capital flows within GPNs. In the case of Singapore, such a pricing index is the Singapore Exchange (SGX) LNG index which was established in 2015 by the SGX and works as a real-time price assessment tool based on the average reported prices of traders, exporters and importers that participate in the exchange (Shi and Variam, 2016). In addition, SGX is developing a marketplace for speculative financial instruments for LNG trading such as swaps and future contracts. These socio-material assemblages, in effect, deborder existing nation-state territorialities through new connections with global financial networks creating novel geographies of authority. These novel geographies of authority subsequently create spaces for commodity traders to emerge as significant actors within LNG production networks which would further enable the financialization of global natural gas markets.

The extent to which the LNG pricing hub in Singapore has the capacity to shape inter-organizational and spatial arrangements in LNG production networks largely depends on the degree to which traders buy and sell gas on the market exchange. As the volume and liquidity of natural gas traded increases, financial players begin to enter the markets through derivatives trading which subsequently enables the growth of speculative financing and spot market trading in LNG production networks. The Singaporean wealth fund, Temasek Holdings Pte. Ltd., incorporated Pavilion Energy with 1 billion SGD in initial capital to invest in LNG trading, which according to informants was set up to eventually compete with BG (Soh, 2017). Although BG was contracted to import and sell regasified LNG for up to 3 MTPA, the EMA was tasked with issuing licenses to other importers for the second tranche of LNG imports. Pavilion Energy along with Shell Gas Marketing was awarded these licenses in 2016.

Although other Asian countries such as Japan and China have also sought to establish an LNG hub, Singapore's capacity to quickly establish legal and regulatory institutions was considered to be a competitive advantage (Ten Kate et al., 2013). LNG firms such as CNOOC, JERA, Aramco, ENI and PTT have set up LNG trading desks in Singapore. In addition to LNG firms, commodity trading houses such as Trafigura, Guvnor and Vitol have trading activities in Singapore (Daiss, 2016). A survey of 80 senior energy industry leaders by the management-consulting corporation, Deloitte, revealed that 74% of the respondents believed Singapore would attain the position as an LNG hub by 2023 (Deloitte, 2018). In the media release, the Deloitte oil and gas Asia-pacific leader claimed:

Singapore fits all the criteria of an ideal trading hub. It has a world class trading infrastructure already in place, excellent institutions, offers low geopolitical risk whilst situated in an ideal geographic location with deep and liquid financial and capital markets, in addition to an attractive tax and regulatory regime.

The quote from Deloitte expresses how Singapore, as a global city, is a significant site for the services and specialized functions that enable global commodity trading, and therefore is a preferred site for lead firms to set up their operations. More specifically, as a global city, Singapore has the political and economic advantage of being a major node within interconnected systems of capital and information, as well as containing a high density of financial institutions, consulting firms, accounting firms and law firms, which are well suited to facilitate the financialization of trading in LNG production networks in Asia (Sassen, 2013a).

6.2. Reassembling markets and regional connections

The LNG hub in Singapore can be conceptualized as a complex assemblage consisting of interactions between public and private authorities by which the financialization of LNG production networks potentially emerges. However, despite the financial, institutional and human assets at Singapore's disposal to establish and maintain such assemblages, these resources by themselves are not enough to consolidate Singapore's position as an LNG trading hub within GPNs. As a report on LNG trading hubs in Asia from the Columbia University Center on Global Energy Policy explains:

Almost every player in the LNG industry has set up significant operations in Singapore to trade LNG. However, that doesn't make Singapore a location for an LNG trading hub as the trading of LNG could be cargos anywhere in Asia, or even globally, with traders simply 'meeting' in Singapore (Fulwood, 2018, 30)

The quote from the report reflects an argument made previously in the theoretical section, that financial, corporate and political actors do not retain influence and power solely through their control over institutional and financial resources. Rather power is a question of the capacity of different actors to establish and sustain connectivity in the global economy in order to maintain the emerging assemblage. Despite Singapore's capacity to develop 'world-class' infrastructure for trading by deregulating its market and establishing market exchanges, a key challenge for developing an LNG trading hub is that the Singaporean natural gas market is simply too small compared to other Asian markets.

According to several reports, the limited size of Singapore's market means that natural gas trading within the market will not generate enough liquidity to provide a transparent and legitimate price signal for wider Asian LNG markets (Stern, 2014; Fulwood, 2018). Heather (2016) explains that the size of a gas market is related to the churn rate of that market, or the number of times a cargo of gas is traded and retraded between its initial sale by the producer and the final purchase by the consumer. The participation of financial actors on markets is contingent on high-churn rates in markets. A business development manager at an LNG-related corporation, with experience of European gas market deregulation, noted that the Singapore pricing index, SLInG is: 'really a fuss, it is just a marketing tool. They have good PR people working in the government.' Singapore, the manager noted, has a small market and despite pipeline connections to neighboring countries, these pipelines do not have the same technical functionality as cross-border connections in Northwest Europe. According to the manager, current pipelines from neighboring countries are only designed for one-way flows into Singapore and are not currently suitable for trade.

The business development manager suggested that, on article, China would be a better location for an LNG trading hub in Asia, as the market is large enough and there are multiple routes and sources for natural gas in China including domestic production, LNG import facilities and pipelines from Russia and Myanmar. However, the manager also noted that the market in China is heavily monopolized by state-owned gas companies and it might take some time before the market is as liberalized as Singapore. Thus, while Singapore's institutional capacity may be a competitive advantage compared to other Asian nations, a major hinder for Singapore's ambitions to become an LNG hub is its lack of physical connectivity to larger natural gas markets in other countries. To develop a mature trading hub, Singapore would need to establish physical connectivity with natural gas markets in neighboring countries. Ten Kate et al. (2013) suggests that Singapore may be able to do so, by using its LNG import terminal to service neighboring markets in

Southeast Asia. In doing so, Singapore could develop the liquidity and maturity of its LNG trading hub, and establish a price benchmark for trading in Southeast Asia and eventually the rest of Asia and thus solidify its position in LNG production networks.

As discussed in the theoretical section, assemblages endure to the extent that emerging alliances can maintain the assemblage's emerging coherence, while certain dynamics that may destabilize the assemblage are excluded. The capacity of Singapore to develop an LNG hub needs to be actively constituted by alliances among financial, business and political actors through which infrastructural, financial and institutional resources are mobilized to establish and sustain connectivity with surrounding markets in Southeast Asia. These strategies are in line with an outward direct investment strategy in Singapore labeled 'extending the second wing', which focuses on the regionalization of the Singaporean economy in order to overcome the limits of the small Singaporean market (Blomqvist, 2002). However, in line with assemblage thinking, since relations are exterior to related entities, emerging capacities for regionalization depend on the overall coherence between an emerging LNG hub in Singapore and new national strategies for energy development and security in neighboring countries.

A key challenge for developing LNG markets in neighboring countries, such as Indonesia and the Philippines, is that the populations of these countries are spread across multiple islands (DNV-GL, 2012). While these countries seek to take advantage of low LNG prices for energy development, these markets are too small for importing LNG cargos directly from producers (who rely on economies of scale to reduce unit costs; Choy, 2011). According to the manager at SLNG, private and public authorities in Singapore have sought to facilitate the physical trade of LNG to neighboring markets, by offering storage and reloading services at the LNG terminal in Singapore. To do so, authorities in Singapore commissioned the terminal to be built with additional storage and regasification capacity than is needed for the Singapore energy market alone. In addition, authorities in 2017 gave Pavilion Energy the rights to storage and reload services for 2 years (Tey, 2017). By using the Singapore LNG terminal for importing large cargos of LNG, and reloading cargos on smaller LNG carriers to reach multiple, small demand centers in neighboring countries, the overall costs of supply can be significantly reduced. In addition, according to an interview with a business development manager, the Singaporean offshore and maritime conglomerate, Keppel Corporation, has develop a line of small LNG carriers and import terminals to service regional markets in Southeast Asia, according to an interviewed business manager at the corporation. Keppel and Pavilion Energy have co-signed an agreement with the Indonesian government to explore opportunities for Indonesian LNG to be delivered to Singapore, and then re-exported to small markets in west Sumatra (Thomas, 2017).

Through small LNG trade, a large LNG cargo can be physically imported into Singapore, and then retraded through smaller parcels distributed through Southeast Asia. This type of trading could increase the number of participants and volumes traded through the Singapore LNG hub. According to a manager at Pavilion Energy, these types of trades could constitute an integrated regional market in Southeast Asia, with Singapore playing a key role as a LNG hub for the region. However, despite the efforts of public and private authorities in Singapore to establish alliances in the region, the capacity of these alliances to maintain the coherence of the emerging assemblage is limited. Countries in the surrounding region have internal political dynamics regarding energy security and politics that contradict the relations by which an LNG hub in Singapore is established. The limited capacity of the emerging assemblage to exclude or create alliances to circumvent such

contradictions, create a moment of uncertainty and instability surrounding the establishment of an LNG hub in Singapore. For example, according to interviews with managers at LNG-related firms in Singapore, a key challenge is that while Indonesia is a potentially significant market for re-exports from Singapore, authorities have struggled to come to agreement with partners on the terms and conditions of LNG projects, and market development has been stalled. Dodge (2020b) explains that a key challenge for market development in Indonesia is that the Indonesian government has ambitions to develop access to LNG supply infrastructure in the peripheral regions of the country even if some of these regions, on standalone terms, would have negligible returns on investment for LNG suppliers. The disagreement between LNG suppliers and authorities surrounding LNG supply tenders is that authorities are leveraging access to favorable markets in order to require winning bidders to supply regions with negligible returns on investment.

Another key challenge for the development of an LNG trading hub in Singapore, according to an interview with an executive at an LNG trading firm, is that despite efforts of authorities in neighboring countries to deregulate natural gas markets, LNG markets in Southeast Asia continue to be either firmly regulated by state authorities and controlled by utilities with monopolies on markets. Several countries, including Indonesia, Thailand and Malaysia have initiated gas market reforms; however, the pace of reforms has been slow. In his research on natural gas market reform in Thailand, Dodge (2020a) explains that while authorities in Thailand may have implemented the legal basis for reforms through the energy industry act and establishing third-party access on LNG infrastructure, the state-owned gas company, PTT, continues to hold an effective monopoly over natural gas markets in Thailand. Dodge explains that PTT draws upon quieter mediations of power that manipulate third-party access regulations and price regimes to hold customers within its proximity and keep competitors at a distance. To facilitate LNG trading, pricing should be more transparent in Southeast Asia, but currently different tariff regimes distort the market according to the executive at the LNG trading firm. This results in a ‘chicken-or-the-egg’ scenario, where deregulation increases the pressure of LNG buyers to buy LNG from commodity traders in Singapore, and Singapore is dependent on liberalization in neighboring markets to increase the liquidity of its LNG hub to support commodity trading. Due to challenges surrounding market development and liberalization in neighboring countries, the capacity of public and private authorities to establish an LNG trading hub is uncertain.

7. Conclusion

The main aim of this article has been to investigate the uncertain dynamics by which the emergence of novel geographies of authority enables the capacity of nation-states to shape spatial and interorganizational dynamics in GPNs. To investigate these dynamics, this article developed a conceptual framework based on assemblage thinking. Based on the preceding analysis, this article identifies three theoretical contributions of assemblage thinking that can give analytical purchase to current perspectives on state transformation in GPNs.

First, the notion of ‘assemblages’ can provide a useful heuristic to account for the highly specialized political arrangements that exist within, across and between traditional spatial frameworks and that work to shape GPNs. In my empirical study, I use this framework to demonstrate how national infrastructure and traditional nation-state authorities in Singapore become reoriented toward global financial markets through the

establishment of third-party access, the development of re-export facilities on the LNG terminal and the incorporation of Pavilion Energy. These subsequently create the basis for new interactions with financial institutions, corporate logics, and hypermobile capital flows in assemblages that deborder traditional nation-state boundaries. The notion of partially national, partially global assemblages as a useful heuristic is not exclusive to the case of an LNG hub in Singapore. Global carbon finance is also an example of different initiatives by state and non-state actors to reorient judicial and regulatory authorities surrounding property rights in order for carbon to be translated into financial value, thus creating financial assets that can be leveraged in global financial markets (Bridge et al., 2019). The assetization of carbon finance could play a significant role in shaping the nature and location of investments in GPNs. I suggest that assemblages can be developed as a kind of analytical category that GPN scholars can use to identify and describe such public–private initiatives.

Second, assemblage thinking draws attention to how the capacity of states to shape GPNs emerges by identifying how a multiplicity of heterogeneous actors and materials become related through partially global, partially national assemblages and analyzing the quality of these relationships. In the empirical study, I drew attention to the different initiatives by corporate, financial and government actors to create new alliances around certain technological mediations such as establishing a pricing index for LNG or distributing small LNG cargos across Southeast Asia. I discussed how these assemblages' works toward overcoming Singapore's limitations as a small market in order to create a space for capital to reproduce itself as the circulation of titles of ownerships so that commodity traders and financial speculators can realize surplus value from financial risk management. It is through these dynamics that the capacity to shape LNG production networks toward more organizationally fragmented and flexible arrangements emerges. In this way, assemblage thinking can draw attention to the different practices, initiatives and alliances that underpin the emergence and transformation of spatial and organizational arrangements in GPNs. These perspectives could be particularly useful for the emerging orientations toward practices among GPN scholars (Murphy, 2012; Bridge and Bradshaw, 2017).

Third, assemblage thinking conceptualizes the temporality and instability of emerging partially global, partially national assemblages. Component parts of assemblages are subject to multiple dynamics and interactions resulting in capacities that can either reproduce or destabilize emerging assemblages. In the empirical study, I discuss how public and private authorities in Singapore have sought to establish their physical connectivity to surrounding LNG markets by developing an LNG re-export terminal and commercializing technologies to reach markets that have traditionally been excluded by traditional LNG production networks. Assemblage thinking highlights the uncertainty and instability of such processes, as assemblages are not held together by virtue of dominance or resources, but by the extent to which political mobilizations, alliances and technological mediations work to maintain the overall coherence of emerging assemblages and the extent to which dynamics that may contradict this coherence are excluded. The empirical study shows that Singapore's capacity to establish an LNG hub is limited, due to monopolization and state strategies surrounding market development in neighboring countries that are contradictory to the financialization of natural gas trading. For an LNG hub to develop enough liquidity to establish a benchmark for LNG pricing, monopolies and certain state strategies would need to be excluded. The focus on exclusions in terms of maintaining the coherence of emerging assemblages is in line with current perspectives on disarticulations in GPN and

GVC literature (Bair and Werner, 2011; McGrath, 2017). These discussions provide a deeper understanding of the possibilities and limitations for nation-states to actively shape GPNs.

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