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**Spatial Differentiation of Variegated Capitalisms: a Comparative Analysis of Russian
and Australian Oil and Gas Corporate City Networks**

1 **Introduction**

2 The globalization of firms is an embedded characteristic of the industrial and post-industrial
3 capitalist space-economy (Dicken and Malmberg 2001; Sheppard 2010). Though nearly every
4 firm is in some way ‘multinational’ (through ownership structure and/or connections to global
5 supply chains), some political and institutional contexts have been more conducive to, and
6 supportive of, economic globalization than others (Berry 1989; Smith 2014). Since the 1990s,
7 economic geography has been concerned with various forms of territorial embeddedness
8 identifying the manifold state-firm relationships and enduring spatial variations between
9 economies (Dicken 1994; Yeung 2000), increasingly applying the lens of capitalist variegation
10 (Dales et al. 2019; MacKinnon et al. 2009; Peck and Theodore 2007; Peck and Zhang 2013).

11 The variegated capitalism approach (Peck and Theodore 2007) recognizes the divergent yet
12 interconnected multiscalar processes of contextual and industry-specific state-firm
13 relationships underwriting the observed heterogeneity in modes of capitalism, each with its
14 distinctive geographies. The strength of this relational conception is that it balances national
15 particularity and path-dependence with underlying trends of global industry restructuring
16 (Dixon 2011; Peck and Zhang 2013). Previous studies on the uneven spatial development of
17 sectoral modes of capitalism call for the analytical sensitivity towards the strategic behavior of
18 firm and nonfirm actors in different political-institutional and sectoral contexts (Dales et al.
19 2019; Zhang and Peck 2016) as well as engagement with ‘big’ macroeconomic geographies
20 (Peck and Theodore 2007). So far, there has been little engagement with world city networks
21 (WCN) research that increasingly uncovers distinct, if not diverging, spatialities of inter-city
22 connections as produced by multinational corporations (MNCs). Variegation has been found
23 in networks of specific industry sectors (Breul 2019; Indraprahasta and Derudder 2019; Kratke
24 2014; Martinus and Tonts 2015; Toly et al. 2012), especially advanced producer services (APS)

(Taylor and Derudder 2015), and all industry sectors (Alderson and Beckfield 2004; Wall and van der Knaap 2011).

The WCN framework is underpinned by literature that considers cities as strategic sites of globalization (Friedmann 1986; Sassen 1991) and the behavior of MNCs as the key relationship linking cities (Hymer 1972), largely adopting a structural political economy perspective. Its contribution to economic geography lies in its emphasis on the spatial configuration of multiscalar corporate networks for regional economic development (Taylor et al. 2014; Wall and van der Knaap 2011). Though well established as an analytical technique, the theoretical significance of WCN is often interpreted uncritically with regard to how firms globalize and how this varies between institutional contexts (Coe et al. 2010; Robinson 2002). While previous studies recognize the role of the state in shaping firm city networks (Brenner 1998; Breul 2019; Breul and Revilla Diez 2018; Indraprahasta and Derudder 2019; Martinus et al. 2015; Olds and Yeung 2004), WCN has yet to explore how the distinct sectoral economic geographies of the firm locational strategies reflect variegated capitalisms.

Drawing on relational economic geography perspectives, this article develops an analytical framework for studying the spatial differentiation of sectoral modes of variegated capitalism using a WCN approach. We focus on the city networks produced by oil & gas firms as a driving force of uneven global integration with the state in some countries playing a greater role than in others (Odell 2013). Building upon previous studies of global production and city networks of energy firms (Breul 2019; Bridge and Bradshaw 2017; De Graaff 2011; Martinus and Tonts 2015; Stephenson and Agnew 2016), we illustrate divergent oil & gas city network structures through an empirical analysis of Russia and Australia. The two countries represent distinct modes of capitalist variety reproduced by their national contexts and traversed by globalized networks. In Russia, after almost a century of the Soviet rule, state-firm relations have been

characterized as ‘state capitalism’ or ‘political capitalism’, featuring rather weak ‘liberal market economy’ supportive structures in the energy sector (Hanson and Teague 2007; Charokopos and Dagoumas, 2018). The state has controlled the immense oil & gas industry of Russia, with several powerful companies being contemporary derivatives of the planned Soviet energy industry (Bradshaw 2009; Gustafson 2012; Labban 2008). In contrast, the Australian oil & gas sector has been shaped by MNCs activity and the boom-and-bust cycles of global commodity markets (Hay 2009; Taylor and Thrift 1980). Australia is a ‘liberal market economy’, although studies have observed sporadic government interventions (Hay 2009; Taylor and Thrift 1980). We also considered the role of the oil & gas industry in shaping urban systems: centralized, hierarchical and primarily shaped by the Soviet central planning in Russia (Bradshaw and Prendergrast 2005; Hill and Gaddy 2003; Treivish 2005); versus decentralized State-based structure that characterizes Australian federalism with Sydney and Melbourne being the dominant decision-making centers (Ellem and Tonts 2018; Taylor and Thrift 1980).

We apply social network analysis (SNA) (Glückler and Doreian 2016) to a novel large database on energy intrafirm relations encompassing 24,299 headquarter-subsidary ties of 2,121 oil & gas MNCs (as they existed in 2019) linking 1,339 cities. We find a comparable number of firm linkages in both Russian and Australian networks, nested within a global energy network. However, when national network structures are examined, the Russian oil & gas sector exhibits an introverted, centralized and star-like network as opposed to the extroverted, decentralized and multi-core network of Australia. This article aims to unpack the variegation of these network configurations by detailing the national particularity of Russia and Australia in relation to the oil & gas city networks and the impacts of shifts in the global energy order. By doing so, we seek to highlight how the state affects the strategic behavior of oil & gas firms and their particular brand of global orientation.

The article is organized as follows. The next section discusses the literature on the heterogeneous spatial aspects of contemporary firm behavior and identifies a gap in existing literature with respect to the application of WCN approach in studying spatial differentiation of variegated capitalisms. This is followed by a section describing the value of a nation-focused WCN approach for the spatial analysis of sectoral modes of capitalism. The oil & gas sector and Russia and Australia as oil & gas producers are then introduced. The Data and Methodology section provides an overview of intrafirm data and the underlying principles of corporate city network analysis. The next section presents empirical evidence of the divergent oil & gas city networks of Russia and Australia, which leads to a discussion of the spatial variegation of their networks. Finally, the limitations of our approach and contributions to debates within economic geography are outlined in Conclusion.

Spatial Differentiation of Variegated Capitalisms

Addressing the origins of different models of capitalism, Pomeranz (2000) and Arrighi (2007, 2012) argued that the more centralized East Asian system—with introverted economic structures—developed differently during the Industrial Revolution than Western European systems, with the latter having more extroverted economic structures as they internationalized more extensively with liberalization of trade (Pomeranz 2000). The evolution of capitalism through the 20th century was tied to the divergent industrialization paths of different nations. In the mid-20th century, the export-oriented industrial policies of many nations following postwar developmentalist ‘modernization’ agendas positioned key industries for exogenous growth. From the 1970s onward, the Asian ‘Tigers’ were exemplary of national economic globalization with interventionist national industrial policies supported key producers through tariff and subsidy adjustments, monetary policy and infrastructure investment (Markusen and

Park 1993; Yeung 2000; Yeung and Lin 2003). Elsewhere, global interconnections emerged from centralized *dirigiste* state control (Hanson 2009), which loosened as the eastern bloc gradually disintegrated. Petro-states (such as the United Arab Emirates) also adopted tight state-led modes of integrating into global markets (Huber 2019; Labban 2008), indicating that capitalist development was not necessarily connected with neoliberalism. The rapidly growing global economic role of China has also been strongly articulated by the state, with state-owned enterprises dominating strategically significant sectors (Peck and Zhang 2013).

Whilst many fields (international relations, political economy, strategy) have explored how state-firm relationships have deepened global economic integration, economic geography research has recognized the deepening variegation between national economic systems as they globalize (Dicken 1994; Whitley 1999). Indeed, literature on global and regional shifts and the globalization of economic networks (Berry 1989; Dicken 1986, 1994) informed understandings of the role of the state in influencing economic performance and international firm behavior where multinational firms interface with state regulatory efforts to mutually shape markets. Since the 2000s, relational economic geography scholars have moved towards territorial embeddedness (Coe et al. 2004; Dicken and Malmberg 2001; Rodrik 2013). This literature focused on the diverse roles of the state to facilitate, enhance or hinder strategic coupling within different regional global production and financial networks (Hsu et al. 2018; Lim 2018; Smith 2014) through infrastructure development, marketing, financialization and/or legislative changes enabling MNCs to access resources, labor and other local assets.

Scholarship on variegated capitalism is highly relevant in analyzing these firm-state interactions, in particular literature unpacking the heterogeneous spatial aspects of contemporary firm and industry behavior. Seminal studies in ‘varieties of capitalism’ (VoC) literature (Albert 1991; Boyer 2005; Hall and Soskice 2001; Shonfield and Reisman 1965)

contrast regime-centric ‘prototypes’ of capitalism, notably ‘liberal market economies’ such as the United States with ‘coordinated market economies’ such as Germany. A central finding in the VoC literature is that institutions impact corporate strategy to create systematic differences in firm organizational and locational choices across countries (Hall and Soskice 2001). VoC debates have largely developed in heterodox economic scholarship, attracting critique on their nationally scaled analysis of economic performance, binary labeling of countries, and tendency to privilege typological classification over causal explanation (Deeg and Jackson 2007; Peck and Theodore 2007). Nonetheless, there have been many productive theoretical and methodological attempts in economic geography to engage with VoC (Christopherson 2002; Dixon 2011; Haberly and Wójcik 2017; MacKinnon et al. 2009; Peck and Theodore 2007).

Drawing on VoC perspectives, Peck and Theodore (2007) conceptualized the variegated capitalism approach, rooted in economic geography, to analyze capitalist systems as driven by the bidirectional processes emerging from interactions between national political economies and international firm activity in specific contexts. They extended the VoC literature to include emergent typologies of East and Southeast Asian economies which were shown to be different from the North American and European prototypes and reveal the heterogeneous particularities of political-economic contexts (Peck and Zhang 2013; Zhang and Peck 2016). They contend that multiple relations and connections operate within locales and across space, as uneven development is the consequence of the different multiscale institutional and market-led processes across the space and time of economic systems (Peck and Zhang 2013). Economic geography studies employing this approach progressed towards deep investigation into the dynamics of institutional change and sectoral market transformations driven by globally circulating capital (Dales et al. 2019; Deruytter and Derudder 2019; Dixon 2011; Lim 2010). Through a novel application of WCN approach, we address calls by Dales et al. (2019) to adopt analytical sensitivity towards the strategic behavior of firm and nonfirm actors in different

political-institutional contexts. In this way, we seek to advance the problematics of capitalist variegation that:

“call for a much more concerted engagement with ‘macroeconomic geographies’ – more work of a ‘holistic’ nature, concerned with macroeconomic patterns and trajectories, *longue-durée* processes, the restructuring of institutional ensembles (including those at the level of the nation-state, one of economic geography’s less favorite scales of analysis), and with those ‘big geographies’ of capitalist restructuring” (Peck and Theodore 2007, pp. 762–764).

National City Networks of Firms

WCN literature builds on earlier work identifying “command centers” of advanced producer services (APS), an industry sector viewed as critical in the reorganization of global markets around the “new international division of labor” (Harvey 2006; Sassen 1991). As spaces of flows, cities and inter-urban networks represent spatial outcomes of capitalism’s changing geographical organization as evolved in specific geographical, political and economic contexts and through firm strategies (Castells 1996; Friedmann 1995). A well-established strand in urban, globalization and business strategy studies, WCN approaches have been applied productively in economic geography (Taylor et al. 2014; Wall 2009; Wall and van der Knaap 2011), but there are conceptual and methodological choices to be made. This study draws on previous WCN conceptualizations based on MNCs in all industrial sectors (Alderson and Beckfield 2004; Derudder 2006; Wall and van der Knaap 2011) without prioritizing the APS firms (Taylor et al. 2014). This approach builds on Hymer’s (1972) arguments that MNCs are key relationships linking cities. Firms strategically locate in specific cities to construct and participate in multiscalar production, services and financial networks. The diffusion and organization of MNCs production-related activities tend to concentrate in medium-sized and

small cities, whereas corporate decision-making concentrates in hub (global) cities that provide access to capital, government activities, and markets (Hymer 1972).

Since the 1990s, firm organizational architecture has become inherently more complex (Dicken and Malmberg 2001; Maskell 2001), progressing into a complex system of intra- and interfirm relationships (Yeung 2005). The empirical models of the WCN target intrafirm relationships based on ownership structure and office locations, thus, potentially omitting a large portion of network data on interfirm relationships. There are concerns whether the network structure derived from office location data is representative of the actual intercity flows of resources, knowledge, capital and labor (Neal 2012; Pažitka et al. 2019). Studies on global production networks/commodity chains (Parnreiter 2010), interlocking directorates (Heemskerk and Takes (2016)) and inter-organizational projects (Pažitka et al. 2019) provide ways to examine interfirm relationships. However, there is extreme difficulty in collecting data on interfirm networks on global and national scales as well as quantifying the dynamic flows and relations of different nature (Pan et al. 2017).

Recent explorations of sectoral and city-specific differentiation through intrafirm relationships have begun to open up the potential for analyzing the spatial differentiation of variegated capitalisms using the WCN approach. The internal and evolving relationships between headquarters and subsidiaries embody strategic behavior and organizational competition which reflects spatial divisions of labor and capital (Phelps and Fuller 2000). As a result, although firm city networks are a snapshot of complex and dynamic phenomena, they are static reproductions of spatially and temporality contingent path-dependent multiple relations and connections, overlapping spatial scales. Therefore, we argue that WCN framework is well suited to the multi-scalar relational variegated capitalism approach to better understand macroeconomic patterns (Peck and Theodore 2007; Zhang and Peck 2016) and enable

sensitivity towards the strategic behavior of firms and the state (Dales et al. 2019; Peck and Theodore 2007).

Economic geography literature recognizes nation-states as the key agents shaping WCN formation (Brown et al. 2010; Coe et al. 2010). For Brenner (1998), global cities are coordinates of state territorial power, with city networks and territorial states being densely intertwined. Drawing on the study of Singapore, Olds and Yeung (2004) showed that the powers of the nation-state were instrumental in embedding Singapore within the evolving global network relations. Recent globalization studies contend that the global and national city networks are subject to broader politico-territorial and sectoral relations driven by state-specific factors that govern how firms actually globalize (Breul and Revilla Diez 2018; Indraprahasta and Derudder 2019; Martinus et al. 2015). For example, Breul (2019) identified different roles of the state behind the divergent articulation of Jakarta and Singapore into global oil & gas city networks. Jakarta became a national gateway for upstream activities under the regulatory role of the Indonesian government. In contrast, Singapore plays a central role in regional Asian-Pacific oil & gas networks due to the facilitative role of the state. Although previous studies have brought greater insights into the distinctive couplings of individual cities as influenced by national states, WCN research is yet to examine the variegated interdependencies between sectoral city network formation and particularities of nation-states. This indicates a need to engage with the variegated capitalisms literature, defining the original aim of this article.

National city networks (Martinus et al. 2015; Sigler and Martinus 2017) is a particularly useful scale to profile variegated capitalisms. Bringing together top-down and bottom-up approaches to the WCN analysis (Lüthi et al. 2018), it allows assessing spatial effects of the sectoral activity of domestic and international firms by revealing how city networks at the national scale are connected to global networks and detailing connections of individual firms, as influenced

by nation-states. Our analysis follows such nation focused WCN approach which we apply to the study of the oil & gas industry.

The Oil & Gas Sector

The oil & gas sector is one of the largest in the global economy and includes the processes of exploration, extraction, refining, transporting, marketing and retailing of oil & gas products critical to energy production for industries and households. The industry is highly volatile, with the boom and bust cycles occurring in response to over-supply or surging demand on the market (McNally 2017). Over the last four decades, the economy of oil & gas has been shifting to accommodate the effects of internationalization, financialization, shale revolution in the US, the rise of state-owned companies, and sustainable energy transitions (Bridge and Bradshaw 2015; Bridge and Bradshaw 2017; Labban 2010). Economic geographers have explored how these interrelated processes shape flows of resources, knowledge, labor and capital in the energy sector through studies of global production networks (Breul et al. 2018; Bridge and Bradshaw 2017), corporate networks (De Graaff 2011, 2014; Verbeek and Mah 2020) and inter-city networks (Martinus and Tonts 2015; Toly et al. 2012). Overall, these studies have found countries are differentially intertwined in the oil & gas networks driven by the globalizing processes of production, consumption, and exchange with a significant role of the state in some countries but not others. This makes the oil & gas sector of interest for this study, given the likelihood that the state exerts influence over the structure of city networks comprised of oil & gas firms, should such an effect exist. Notwithstanding their different dynamics, both oil and natural gas sectors were included as many firms operate across the two.

Research on contemporary energy networks demonstrates how economic activities are globally interlinked through energy hub cities in some countries (Aberdeen, Calgary, Cape Town,

242 Houston, Stavanger, Tripoli), while national capitals (Accra, Beijing, Buenos Aires, Jakarta,
243 Moscow) feature prominently in others (Breul 2019; Martinus et al. 2015; Scholvin et al. 2019;
244 Toly et al. 2012). Sectoral city network patterns reflect energy firm locational strategies shaped
245 by: 1) needs of firms to hold a physical presence in upstream, midstream, or downstream
246 processes; and, 2) global limitations and national remit. In other words, some oil & gas firms
247 are highly constrained by their role as national producers, while others are ‘free’ to pursue
248 international ventures bolstering competitiveness, efficiency, or market access (Breul and
249 Revilla Diez 2018). In this way, country-specific networks of oil & gas activities are not
250 converging, but instead strongly mediated by geoeconomic and geopolitical imperatives
251 (Glassman 2011; Smith 2014) driven by a complex interplay of national policies and ongoing
252 destabilizing geopolitical effects on the status quo energy regime (Pasqualetti 2011).

253 Spatial differentiation of oil & gas firm locational strategies have in part occurred due to a
254 power shift from large multinational corporations to resource-holding states (Odell 2013).
255 Historically, the industry was developed with private capital leading to the emergence of the
256 ‘Seven Sisters’ (or ‘Big Oil’) firms that dominated from the mid-1940s to the mid-1970s
257 (Pasqualetti 2011). Based in the US and northern Europe, they operated fields globally by
258 establishing offices in peripheral energy towns to gain access to resource reserves and
259 circulating extractive profits back to headquarters and their shareholders. Over the 20th century,
260 concomitant with the establishment of the Organization of Petroleum Exporting Countries
261 (OPEC) to stabilize oil production and prices, many governments (e.g., in Bolivia, Indonesia,
262 the Soviet Union) nationalized their energy sectors to protect domestic assets from foreign
263 exploitation by establishing state-owned enterprises (Guriev et al. 2009). As a result, these
264 resource-holding states ascended economically and their national capitals became significant
265 cities in global and regional energy networks. Since the 2008 financial crisis, the activities of
266 national oil companies (NOCs) have dramatically increased (Pasqualetti 2011). Currently, 80-

90% of the global oil & gas reserves are state-owned firms acting as transnational producers such as Saudi Aramco, Sinopec Group, China National Petroleum Corporation, Petronas, and PDVSA (De Graaff 2011). Although previous research identified global energy city networks or cities important for a particular macro-region, the national network structures—an under-researched aspect of oil & gas city networks—becomes an important element in grasping the spatial differentiation of sectoral variegated capitalisms.

Russia and Australia as Oil & Gas Producers

The research on capitalist variegation commonly addresses the heterogeneous spatial aspects of contemporary capitalisms through comparative studies focused on systematic differences in firm organizational behavior and locational choices across or within countries (Dales et al. 2019; Peck and Zhang 2013). In this article, we focus on Russia and Australia to discern spatialities and draw attention to variegation within oil & gas sectoral mode of capitalism. Russia and Australia are positioned in the relative geographic periphery to the global economic core, however, the two countries are among the major global oil & gas producers and/or exporters. In 2018, the Russian oil accounted for 12% of global oil production and 13% of global oil export; gas accounted for 17% of global gas production and 26% of global gas export (BP 2019). Russia's significant oil & gas trade flows are within Eurasia and with the United States (BP 2019). Australia is the largest LNG exporter accounting for 21% of total global LNG trade, focusing on the Asia-Pacific region (BP 2019). With a rather regional focus of the energy trade, the activity of firms connected to the Russian and Australian oil & gas sector has been more global in coverage, with their domestic firms developing energy projects on all inhabited continents and international oil & gas MNCs, banks and service companies participating in oil & gas projects in the two countries.

As the industry evolved, the domestic and international firm activity as well as state-regulatory efforts have positioned some of Russian and Australian cities as strategic nodes in the regional and global energy networks. However, to date, the two nations have had very different capitalist logics underpinning their respective oil & gas industries, suggesting different structures will define their firm-based city networks. Below, we provide a concise overview of the abundant literature that analyzes the role of the state in shaping oil & gas firm activity in Russia and Australia and identify implications for their urban hierarchies.

Russia

The export-oriented oil industry that emerged in the 19th century in Baku (now Azerbaijan) in Tsarist Russia, was nationalized in 1922 to fuel the industrializing Soviet economy. After significant discoveries were made in the Ural-Volga region, Timan-Pechora and Western Siberia in the 1950s-60s (Kontorovich et al. 2016), single-industry towns were built by Ministries between to develop the fields (Hill and Gaddy 2003). Already in the 1950s, oil was exported to countries of the socialist bloc in Eastern Europe, and by the 1980s, the energy trade became central to the Soviet-West economic cooperation (Lane 2018). The Soviet Ministries of Energy controlled all extraction and trade, and some foreign companies (e.g., Occidental Petroleum) provided technology lacking in the isolated economy. Oil output, already in decline in the 1980s (driven by inefficiency, poor coordination between upstream and downstream functions, the depletion of existing wells and a lack of investments in exploration and technology (Gustafson 2012)), collapsed in the 1990s with the sharp decline of domestic demand (Figure 1). Russian NOCs (Rosneft, Gazprom) were established as successors to the Soviet Union's Ministries of Oil & Gas Industry, and Siberian state-run companies were consolidated into large private firms with 45% of the state capital (Lukoil, UKOS, Surgutneftegaz). Capitalizing on the cheap regional energy assets, they gained significant

economic power at the same time as the weak and constantly reorganizing federal government struggled to control firm activity and Russia's regions in general (Gustafson 2012).

New international projects were realized in the early 1990s, evidenced in the growth of foreign investments in the 'new generation' of projects in Western Siberia, the Arctic, and the Far East (Bradshaw 1997). Major international production-sharing agreements (PSA) were made, including the Kharyaga 1994 PSA (Total, Norsk Hydro, the Nenets Oil Company), the Sakhalin-I 1996 PSA (Exxon Neftegaz, Rosneft, ONGC, and SODECO), and the Sakhalin-II 1995 PSA (Sakhalin Energy, Royal Dutch Shell). To develop the projects, energy MNCs established offices in Moscow and regional capitals to balance between several levels of government. As Bradshaw (2010) documented:

“As the Sakhalin-2 project progressed through Phase I, SEIC [Sakhalin Energy Investment Company] increased its presence on the [Sakhalin] island to handle the day-to-day bureaucratic demands of running the project, but a great deal of time was spent shuttling between Sakhalin and Moscow to get the necessary approvals. The legal instability surrounding the PSAs also required that the parent companies run sizeable offices in Moscow to monitor and lobby the Government and Federal Duma.” (p. 348).

By the 2000s, thanks to foreign investment, modernization and high commodity prices, oil production recovered following the 1998 Asian financial crises. Resource-rich regions of Siberia, Arctic and the Far East have played a central role in economic performance and international competitive advantage, benefiting disproportionately to more impoverished agricultural and industrial regions (Bradshaw and Prendergrast 2005; Hill and Gaddy 2003; Treivish 2005). At the same time, the Russian government has steadily increased its influence over the energy sector as well as reasserted authority over Russia's regions. In particular, the participation of foreign firms was reduced as seen in state interventions through Gazprom and

338 Transneft in the projects at the Kovykta gas field (BP), Sakhalin-2 PSA (Shell), and the Caspian
339 Pipeline Consortium (BP) (Bradshaw 2010; OIES 2007). In 2008, state-owned companies
340 (Gazprom and Rosneft) acquired exclusive rights to develop large onshore and all new offshore
341 fields, with an opportunity for other companies (foreign and private) to partner with them
342 (Vatansever 2020). In essence, the Russian government effected resource nationalism to
343 maximize its geopolitical energy leverage using the geostrategic importance of its energy
344 sources and technological advances brought by foreign companies (Gustafson 2012).

345 Early Russian energy exports have focused on western markets, but the rapid growth of Asia-
346 Pacific economies over the past two decades as well as Moscow's desire to control its
347 peripheral regions led to a re-focusing of Russia's strategic and energy interests marked by the
348 development of the Eastern Siberia – the Pacific Ocean and the Power of Siberia pipelines. The
349 reach of large Russian companies also expanded into international upstream production and
350 downstream ventures. Russian government encouraged Lukoil investing in Kazakhstan oil
351 fields (Panibratov and Michailova 2019). Projects in Iraq (the West Qurna Phase 2) and Syria
352 (the South Kishma oil field) were developed by Lukoil and Tatneft after negotiations between
353 the respective governments with Russia (Kuznetsov 2016). In Africa, Russian firms operate in
354 Angola, Nigeria, Liberia, Ghana, and Cote d'Ivoire, driven by historical political connections
355 and evolving business support networks (Kuznetsov 2016). In Latin America, Rosneft
356 participated in projects in Venezuela, another socialist country (Lavrov and Aleksanyan 2017).

357 Oil export declined during the 2008 global economic crisis, but more so production and export
358 of natural gas. Notwithstanding, the LNG export begun from Sakhalin in 2009, and the Yamal
359 LNG project (Novatek) received a green light from the government in 2010, attracting
360 international and domestic construction and services firms. In 2014, the Ukrainian conflict and
361 oil price crash damaged oil & gas production and export. The imposition of international

US/EU sanctions targeted at the Russian energy sector altered the role of foreign companies and investment. The sanctions made US corporations (for example, Exxon Mobil Corp) and some foreign service providers wary of participating in joint projects (Vatansever 2020). Our Russia's city network might be more introverted than was before sanctions took place. However, EU-based international majors were able to maintain and expand existing partnerships with Russia (Vatansever 2020). Moreover, Russia adapted by reorienting its technological and financial chains relationships towards the Middle East and Asia seeking a stake in expanding global gas market (Lavrov and Aleksanyan 2017; Vatansever 2020; Visenescu 2018). For example, Novatek continues firming relations with China enabling the participation of Chinese major oil & gas corporations in Russia's major LNG projects, although it is the state who play a major role in determining who participates in energy networks (Stephenson and Agnew 2016).

Australia

The extraction, processing, and distribution of energy sources became important from the 1920s as the Australian economy industrialized and urbanized (Ellem and Tonts 2018). The initially small and fragmented industry developed substantially in the wake of the energy security crisis faced by Australia during World War II (Wilkinson 1983). Since the 1950s, domestic firms (notably BHP, Woodside and Ampol) forged partnerships with MNCs (Standard Oil (now Chevron), Royal Dutch Shell and Anglo-Iranian Oil (now BP)) to explore Australia's resource reserves across its States. The development of the oil & gas industry was driven by a similar model to mineral resources, and sometimes by the same companies (e.g., BHP). The Federal and State's governments supported multinational ventures through enabling infrastructure and heavy subsidies for resource exploration (Horsley 2013; Wilkinson 1983). The onshore and offshore production ascended in key geographic regions, including Western Australia (Carnarvon basin), Queensland (Bowen-Surat), South Australia (Otway), Victoria

(Gippsland) and the Bass Strait off Tasmania. During the 1950s-1960s, at a time of geopolitical instability in Asia, an extensive oil refining capability was developed and became central to the economic development aspirations of State governments (e.g., the Kwinana oil refinery near Perth; Horsley 2013).

The economic geography and geopolitics of extraction and processing in Australia have changed considerably since the 1970s (Ellem and Tonts 2018). The logics underpinning domestic investments no longer existed, with cheap petroleum products available from mega-refineries in the rapidly developing South East Asian nations. Industrial policy had shifted in favor of a neoliberal agenda and deindustrialization across many industrial regions followed (Tonts and Haslam-McKenzie 2005). The traditional petroleum industry has experienced significant restructuring and many refineries have been converted to import and distribution terminals. Since 2000, oil production has steadily fallen (Figure 2) and currently the value of imports (8.2 billion USD) exceeds exports (4.8 billion USD) (APPEA 2019). Australia has been participating in the enduring disputes with Timor-Leste over the sea boundaries pertaining to rights to petroleum resources in the Greater Sunrise fields in the Timor Sea (Lundahl and Sjöholm 2008). The combination of diminishing reserves and the high cost of production have reduced exploration activity and the development of new projects, making Australian energy firms localize overseas, primarily in Oceania, Africa, and Asia (APPEA 2019). The ongoing expansion of the Asian economy has reinforced the position of Australian State capital cities (Perth, Sydney, Melbourne, Adelaide) within the global energy complex as important strategic centers for export, sources of fly-in/fly-out labor, and professional services (MacLachlan 2013).

This trend coincided with the rapid expansion of the Australian LNG sector since the early 2000s (Cassidy and Kosev 2015; OIES 2014), underpinned by rapidly increasing global demand for cleaner energy with flexible supply arrangements (Vivoda 2019). Long-term

supply contracts made with Japan, China, and South Korea, accounted for nearly 90% of LNG exports in 2018, have been instrumental in placing Australia atop world's LNG exporters (Qatar, Malaysia, the United States, and Russia) (DIIS 2019). The North West Shelf, for example, is controlled by a series of partnerships between large Australian corporates such as Perth-based Woodside and Melbourne-based BHP working with BP, Chevron Corporation, Royal Dutch Shell, and Mitsubishi Corporation. The Gorgon project —Australia's largest— partners Chevron, Royal Dutch Shell and ExxonMobil with a number of Japanese energy providers.

On the other side of the continent in the Surat, Browse, and Bowen Basins, gas fields have transitioned from the capital expenditure to the operational phase primarily through joint ventures between Adelaide-based Santos, multinational firms such as Total and state-owned companies such as Petronas (Malaysia) and KOGAS (Korea). Further partnerships link Brisbane-based Arrow Energy with state-owned PetroChina. In Queensland, the expansion has been stimulated by the State level support through taxation, infrastructure assistance and other inducements as part of economic development and diversification strategies aimed at export (Queensland Government 2019). At the same time, the strengthening of the decision-making power within the States and the Federal government has been evident in the ongoing political and public tensions over the issues of domestic gas supply and energy security on the East Coast (the most populous regions) versus instant LNG export to lucrative markets (Hay 2009; Macmillan and Beech 2019; OIES 2014). For example, the Queensland Government reserves gas supplies from certain LNG projects for the domestic market only (Queensland Government 2019). New South Wales increased their regulatory burdens on the LNG projects following public concerns around the coal seam gas, restricting several developments (OIES 2014). This indicates that the interaction of firms operating Australian gas fields and foreign markets have become a matter of concern as not only a commercial issue but a subject of the political

interaction of individual States with the Federal government, seeking a leading position of Australia on the global LNG market (OIES 2014).

Data and Methodology

Network data on corporate connections have been increasingly used to examine important questions pertaining to modern capitalism (Babic et al. 2017; Heemskerk et al. 2018). SNA is often used to empirically analyze WCNs based on intrafirm data on ownership structure and office locations. Our dataset includes comprehensive detailed information (address, ownership structure, and industry classification codes) on over 40,000 companies listed on 145 world's stock exchanges. We obtained the database from the Bureau Van Dijk's Osiris Database in January 2019. An energy dataset was constructed of firms whose headquarters or subsidiaries had industry classification codes related to 'Extraction of crude petroleum', 'Extraction of natural gas', 'Support activities for petroleum and natural gas extraction', and 'Transport via pipeline' of the Statistical Classification of Economic Activities in the European Community (NACE), level 3¹. Our initial dataset of 30,963 headquarter-subsidiary ties of 2,573 oil & gas firms was reduced to 24,299 ties of 2,121 firms by excluding entries with no subsidiaries or missing addresses. The resulting dataset represented 1,339 cities across 162 countries and 102 world's stock exchanges, and is significantly larger than datasets used in previous studies on energy city networks (e.g., 33 energy corporations in Toly et al. (2012), the top 100 Platts energy firms in Martinus and Tonts (2015), and 14 petrochemical companies in Verbeek and Mah (2020)).

¹ These industry codes cover most of the up-stream and middle-stream oil and gas sector firms listed in the database, with marketing and distribution of the industry's products (down-stream) being likely included in broader sectors (e.g., 'Advertising and market research') and therefore excluded. The NACE (the European System) was preferred to NAICS (the North American system) as its dataset was significantly more complete.

Headquarters-subsidary ties were converted into the city matrix for SNA, using firm addresses geocoded to the city-region level. Inter-city ties (19,399) were extracted and attribute data (office's country) were assigned to nodes (cities). Inter-city flows were assumed to run from headquarters to subsidiaries reflecting investment decisions and locational strategic choices (Taylor et al. 2010). Weights $w_{ij}^{[a]}$ were assigned based on the number of headquarters in a city i having a subsidiary in city j . The resultant directed weighted matrix $W^{[a]} = \{w_{ij}^{[a]}\}$ was then uploaded into programming software R using the *igraph* package (Csardi and Nepusz 2006) to generate the directed weighted network graph $G = (V, E)$, with nodes V representing 1,339 cities and edges E representing 19,399 inter-city ties.

Degree (the number of ties instant to a node) and eigenvector centralities were calculated to identify important cities. In-degree, K_{IN} , is the number of ties flowing into a node representing the number of subsidiaries being controlled by headquarters. Out-degree, K_{OUT} , is the number of ties flowing out of a node, or the number of headquarters with subsidiaries elsewhere. Eigenvector centrality, C_E , is a relative node-level measure of influence in a network and is determined by its connections to other influential nodes. In WCN literature, it is commonly regarded as an indicator of urban 'power' as opposed to other measures of nodal influence or brokerage (closeness and betweenness centralities) (Neal 2011; Sigler and Martinus 2017).

From this global network, nationally scaled networks for Australia and Russia were generated by extracting firms with headquarters or subsidiaries in Australian and Russian cities. After calculating degree and eigenvector centralities, domestic and international connections were identified and compared. Degree and eigenvector centralities, when applied to national networks, indicate significant cities for these particular sub-subnetworks (Sigler and Martinus 2017). National city network structures were compared using measures of network density, average degree, network centralization. These measures were selected as less sensitive to direct

comparisons of networks with a different number of nodes and edges (Anderson et al. 1999; Van Wijk et al. 2010). Network density, D , is the sum of all connections divided by the number of possible connections. Higher densities indicate the existence of a greater number of interconnections among a larger number of cities or a broader geographical coverage by firm connections. Average degree, $\langle K \rangle$, is the summation of all nodes' degree divided by the total number of nodes. It characterizes connectedness based on the average number of firm connections incident to a city. Network centralization, C , is the difference between the centrality scores of the most central cities and those of all other cities, being the ratio of the actual sum of differences to the maximum possible sum of differences and applied for both in-degree and out-degree centrality measures. Network centralization reflects the extent to which firm connections are 'centralized' around particular focal cities, and applied to inflows (in-centralization) and outflows (out-centralization). The combination of these measures characterizes distinct network structures of the two countries. Additionally, we identified the sectoral spatial differentiation and the specificities of corporate flows with specific cases of the major oil & gas firms in Russia (Gazprom and Rosneft) and Australia (Woodside Energy and BHP).

Divergent Oil & Gas City Networks of Russia and Australia

Figure 3a shows a reduced (ties with weight more than five) global geographical city network of oil & gas firms. At the global scale (19,399 corporate connections linking 1,339 cities), the majority of connections are produced by firms with locations in North American and European cities (36.2% of total network connectivity and 28.6% of this connectivity respectively). The ten most connected cities (as measured by degree) are global cities and global energy hubs. Houston, London, Calgary, New York, and The Hague are atop the ranking each with more

than 1,000 corporate connections, followed by Paris, Beijing, Dallas, Toronto, Denver, and Moscow each with more than 500 corporate connections (Table 1). Houston, London and New York have the highest influence in the global network (as measured by eigenvector centrality), functioning as central nodes for energy corporations and nations in the global energy networks.

At the national scale, the Russian network (909 corporate connections of 108 firms linking 210 cities in 49 countries) and the Australian network (840 corporate connections of 292 firms linking 136 cities in 47 countries) represent 4.7% and 4.3% of global oil & gas network connectivity respectively (Figures 3b and 3c). Despite being of similar size, their network structures differ significantly, as depicted in Figures 4a and 4b.

In Russia, 656 connections (72.2% of Russia's network connectivity) are produced by firms with offices in Moscow. Only 122 connections link St. Petersburg (13.4%) and 85 connections link Almet'yevsk (9.4%). Numerous domestic oil & gas production and distribution centers in Siberia, the Arctic and the Far East have much less connections, such as Surgut (32), Novy Urengoy (25), Khanty-Mansiysk (24), and Tyumen (15). The principal international cities in the Russian network are in Eastern and Central Europe (Vienna, Budapest, Zurich, Belgrade), Central Asia (Astana) and North America (Boston, New York). Amsterdam and Nicosia appear as prominent financial jurisdictions and tax havens for the Russia's oil & gas industry.

In Australia, the five major state capitals of Perth (375 connections, or 44.6% of Australia's network connectivity), Sydney (298, or 35.5%), Melbourne (134, 16.0%), Adelaide (116, 13.8%), and Brisbane (65, or 7.7%) share relatively high eigenvector scores in the global network (Table 2) and form a decentralized core in the Australian network. These are mostly connected to global energy hubs in Northern America and Northern Europe (Houston, Denver, Calgary, Aberdeen, and Tulsa), and linked to the capital cities of regional production hubs in the Pacific (Port Moresby, Wellington) and the growing Asian market (Singapore, Jakarta,

530 Kuala Lumpur, Bangkok, Beijing). New York, Paris, Tokyo and Toronto are global cities that
531 provide access to capital, government activities, and markets, while Amsterdam, Zurich,
532 Hamilton (Bermuda) and the British Virgin Islands are tax havens and offshore financial
533 centers (THOFCs).

534 The respective structures of the national networks of Russia and Australia appear to represent
535 the different degrees to which they have globalized, as shown in Table 2. There are several
536 observations to emerge. Firstly, in the Russian network, domestic ties are more numerous than
537 international ties ($n=540$ against $n=369$). The number of international inter-city ties of the
538 Australian network outnumbers fourfold the domestic ties ($n=681$ against $n=159$). Secondly,
539 in Australia, the proportion of outward to inward ties is balanced (equal to 1.000) whereas in
540 Russia outbound ties outnumber inbound ties ($n=217$ against $n=152$), reflecting a paucity of
541 foreign firms interacting within the country. Thirdly, the number of foreign firms ($n=68$) with
542 offices in Russia is seven times more than the number of Russian firms ($n=10$) with offices
543 overseas. In Australia, the proportion of outbound ties to inbound is 0.662 – the number of
544 foreign firms with offices in Australia ($n=151$) outnumbers the Australian firms with offices
545 abroad ($n=100$). Finally, two-thirds of Australian domestic firms (100 out of 141)
546 internationalize their activities whereas in Russia less than one-fifth of domestic firms
547 internationalize (10 out of 65).

548 The dissimilar orientation of Russian and Australian networks is conspicuous when network
549 measures are considered, including network density D , average degree $\langle K \rangle$ and centralization
550 metrics C (Table 3). The denser ($D=0.046$) and more complex ($\langle K \rangle=12.353$) Australian
551 domestic network represents a high number of inter-connections between domestic and
552 international cities and characterizes the ability of the Australian economy to sustain diverse
553 geographical relations. For the Russian domestic network, the measures of network density

($D=0.021$) and average degree ($\langle K \rangle=8.657$) are lower due to the limited geographical orientation of Russian oil & gas firms which are focused on specific countries (Eastern Europe, Central Asia and the Middle East). The centralization of the Russian network is higher than of the Australian network, with out-degree centralization ($C_{OUT}=2.477$) being significantly higher than in-degree centralization ($C_{IN}=0.187$). The in-degree and out-degree centralization in Australia is more balanced ($C_{OUT}=1.665$ and $C_{IN}=1.494$).

The Russian network is introverted (domestically focused), centralized and ‘star-like’, whereas the Australian network is extroverted (globally-focused), decentralized and multi-core, as conceptualized in Figure 5. Both oil & gas city networks are shaped by a complex interplay between domestic and international production sites, energy hubs, global cities, and THOFCs. It is possible to link the structure of nationally scaled city networks to different actors. The high centralization of the Russian network is explained by the extensive connectivity of Russia’s large energy corporations headquartered in Moscow. Gazprom, a Russian state-controlled NOC and the largest natural gas company in the world, was responsible for 180 out of Moscow’s 656 connections across 92 cities (in 2020 its headquarters were moved to St Petersburg). Rosneft, a state-controlled (through Rosneftgaz) integrated energy corporation had 89 across 51 cities. In Australia, 16 out of Perth’s 375 connections were generated by Woodside Petroleum, Australia’s largest operator of oil & gas production. Out of Melbourne’s 134 connections, 26 were produced by BHP, an Anglo-Australian MNC (which also has 198 connections in mining). Appendix I details these corporate connectivities, providing the relative importance of different production, services, and financial functions in the supply chains that reflect upstream and downstream geographies.

Discussion: Spatial Variegation in Russian and Australian Networks

Both Russian and Australian networks have comparable extensive firm linkages (909 and 840 edges respectively) with global reach. However, our analysis of their national city networks revealed divergent structures, as demonstrated by the results of SNA. Russia's oil & gas city network is significantly less dense and more centralized than the Australian network, with Moscow having the highest degree. The network is introverted, with a higher number of domestic than international ties and a low number of domestic firms that internationalize. In contrast, the Australian network is more dense and decentralized among state capital cities (Perth, Sydney, Melbourne, Brisbane, Adelaide). The network is extroverted as international ties significantly outnumber domestic ties, and a high proportion of domestic firms has international activity.

Drawing on the previous literature published on the geographical and economic dimensions of energy transformations in Russia and Australia, this section identifies some of the sources of variegation as they relate to the city network structures through oil & gas firms. Adopting a variegated capitalism perspective, we demonstrate how variegation between respective Russian and Australian oil & gas city networks, as they were in 2019, reflect each country's national institutional and political-economic particularity as well as underlying trends of energy industry restructuring and its boom-busts cycles. A key distinction emerges in a discussion of how the respective states may have contributed to the current form of network structures by affecting the strategic behavior of firms.

In Russia, globalization and territorial processes have produced a highly uneven economic geography which reflects a certain post-Soviet path dependency. Despite the fall of the Soviet Union 30 years ago, the legacy of state-led central planning created many lasting sites for energy production, processing and transportation (single-industry towns built between the 1950s-1980s) (Gustafson 2012). They are featured in our network as domestic energy hubs and

regional administrative centers (Almetyevsk, Khanty-Mansiysk, Usinsk) hosting regional companies (e.g., Tatneft) as well as offices of NOCs (Gazprom, Rosneft), and large Russian (Lukoil, Novatek) and consortiums (e.g., Exxon Neftegaz). These extensive city networks underlie the hierarchical and centralized geographical pattern shown in our network, which corresponds to previous research highlighting the persistent and increasing centralization of Russia's political and economic systems in Moscow (Bradshaw and Prendergrast 2005; Treivish 2005). Offices in Moscow provide firms direct access to decision-making, finances and professional services needed to run projects in remote resource energy hubs and production centers (Stephenson and Agnew 2016).

Internationally, Russian NOCs and private firms concentrate activity in a limited set of cities in countries that are strategic to the Russian state, many of which are either current or ex-socialist nations, or form the geopolitical 'pivot' of Eurasia, much as Mackinder and his contemporaries have described (Bassin and Aksenov 2006). This signals that firms capitalize on the transboundary connections of the state or reinforce the state activity abroad (Panibratov and Michailova 2019). Moreover, our network shows strong links to Cyprus and connections exists with the British Virgin Islands, the Cayman Islands and the Isle of Man, as prominent THOFCs. Since the collapse of the Soviet Union, such locations have become important for companies and individuals wishing to avoid public and government scrutiny of profits and use opportunities of round-tripping (Ledyaeva et al. 2015). The current networks also depict the relative insularity of the Russian energy sector for foreign firms because of recent international sanctions (Vatansever 2020) and the increasingly strategic nature of oil & gas projects, too sensitive to be controlled by foreign actors (Panibratov and Michailova 2019). This finding is not surprising because in Russia state control over resources, the companies that handle them, resource-rich territories and revenues has been increasingly crucial for the maintenance and the exercise of state power (Charokopos and Dagoumas 2018).

Australia's extroverted city network is defined by the opposite perspective, with extensive, diversified, and decentralized global connections. The small domestic economy has underpinned an economic structure that has long been highly integrated into global circuits of capital, particularly with regard to the export of natural resources but also through the presence of MNCs in Australia (Ellem and Tonts 2018). The latter have historically played an important role in injecting the scale of investment required to develop and sustain large oil & gas projects (Horsley 2013). Thus, extroversion in the Australian network is a result of the neoliberal and globalizing policies. State- and Federal-level policies have encouraged MNCs to participate in both the exploitation and distribution of oil & gas from domestic reserves. The rapid development of the LNG capacity in Western Australia and Queensland contributed to the LNG construction boom from 2010 to 2014, significantly contributing to the level of internationalization as well as decentralization of firm activity across States. However, an growing list of troubled and cancelled projects (due to political influence and public concerns over energy security and sustainability as well as saturated global markets) entails a lesser degree of network extroversion in 2019 (OIES 2014).

Conclusion

In this article, we have developed an analytical framework for studying the spatial differentiation of sectoral modes of variegated capitalism using the WCN approach. Conceptually, we combined insights from the variegated capitalism literature with the WCN framework to further a novel theoretical understanding of uneven spatial effects of globalization processes and distinct sectoral models of capitalism. More specifically, we have sought to bring locational strategies of firms captured by the city networks of firms to the forefront of variegated capitalism approach (cf. Dales et al. 2019). Central to the approach was

the examination of national city networks of firms embedded in the global networks and continuously evolving with national economies. The intrafirm data obtained from the Osiris database (2019) informed SNA of national city networks as they existed in 2019, providing results to compare to disruptions caused by the global COVID-19 pandemic in the global economy and the oil & gas industry in particular. The analysis was performed using SNA metrics (degree and eigenvector centralities, measures of average degree, network density and network in- and out- centralization) as well as characteristics of national network orientation based on the node's attributes data on the country of firm's location. Using this approach, we have explored city network structures of the Russian and Australian oil & gas industry to profile their variegated capitalisms. Sources of spatial variegation between Russian and Australian networks were examined, demonstrating how each country's oil & gas network structure reflects its national particularity of the institutional and political-economic landscape in dialogue with energy globalization processes. Specifically, we focused on how the role of the state may have contributed to the divergent network structures in Russia and Australia through its influence on the strategic behavior of firms.

One limitation of this approach is that Osiris and other corporate databases of intrafirm relationships do not capture the interfirm relations (Pažitka et al. 2019), and future studies should investigate opportunities for bringing the two together if city networks are to capture actual corporate flows. Another limitation is that the analytical framework cannot illuminate the nature and evolution of the linkages in city networks, oil & gas industry cycles, and sector-specific transformations, as achieved by qualitative and longitudinal studies (Dales et al. 2019). However, it is sensitive to the strategic behavior of firms and the state in distinct sectoral modes of variegated capitalism, embodied in evolving headquarters-subsidiary relationships, reproduced by institutional, political and economic contexts and embedded in globalized networks of production, services, and finance. The connectivity patterns which emerged from

our static analysis of intrafirm relationships provide empirical evidence of the processes of globalization, financialization, and the rise of state capitalism found in previous studies on the transforming energy sector that explain the positions of global cities (Goerzen et al. 2013), energy hubs (Martinus et al. 2015; Toly et al. 2012), national capitals (Breul 2019; Toly et al. 2012) and THOFCs (Sigler et al. 2019; Verbeek and Mah, 2020) at the core of global oil & gas firm networks.

This article contributes to debates within economic geography on the spatial differentiation of contemporary variegated capitalisms by utilizing the WCN framework. Specifically, our approach provides a comparative method for capturing and interpreting uneven (variegated) spatial outcomes of diverse political-institutional contexts vis-à-vis specialized economic activity in Russia and Australia. We extend the ongoing conversation over distinct sectoral modes of capitalism to the oil & gas sector and its firms' networks as strategic spaces of global integration and regional development. By applying the WCN, we bring firm locational strategies to the forefront of variegated capitalism approach (cf. Dales et al. 2019). These goals unite this article with another field of economic geography research that focuses on the geopolitical aspects of the global oil & gas production networks (Stephenson and Agnew 2016). Similarly, our research recognizes the critical relationships between firms and the state which interact in a path-dependent manner, extending the WCN research concerned with the role of the state in the variegated articulation of cities in networks (Breul 2019; Breul and Revilla Diez 2018; Indraprahasta and Derudder 2019; Martinus et al. 2015). Different from the previous WCN approach, our framework provides a new approach to understanding of the spatial differentiation in distinct geographic, sectoral and political-economic landscapes, as reflected in variegated city network structures of nations, holding potential for longitudinal and mixed-methods analyses.

699 **References**

- 700 Albert, M. 1991. *Capitalisme contre capitalisme* (Vol. 11). Paris: Seuil.
- 701 Alderson, A. S., & Beckfield, J. 2004. Power and position in the world city system. *American*
702 *Journal of Sociology* 109(4), 811–851. doi:10.1086/378930
- 703 Anderson, B. S., Butts, C., & Carley, K. 1999. The interaction of size and density with graph-
704 level indices. *Social Networks* 21(3), 239-267. doi:10.1016/S0378-8733(99)00011-8
- 705 APPEA. (2019). *Key Statistics*. Adelaide: Australian Petroleum Production and Exploration
706 Association.
- 707 Arrighi, G. 2007. *Adam Smith in Beijing: lineages of the twenty-first century*. London and
708 New York: Verso Trade.
- 709 Arrighi, G. 2012. States, markets and capitalism, East and West. In *Worlds of Capitalism:*
710 *Institutions, Economic Performance and Governance in the Era of Globalization*, ed. M. Miller,
711 123-159. London: Routledge.
- 712 Babic, M., Fichtner, J., & Heemskerk, E. M. 2017. States versus corporations: Rethinking the
713 power of business in international politics. *The International Spectator* 52(4), 20-43.
714 doi:10.1080/03932729.2017.1389151
- 715 Bassin, M., & Aksenov, K. E. 2006. Mackinder and the heartland theory in post-Soviet
716 geopolitical discourse. *Geopolitics* 11(1), 99-118. doi:10.1080/14650040500524129
- 717 Berry, B. J. 1989. Roepke Lecture in economic geography comparative geography of the global
718 economy: cultures, corporations, and the nation-state. *Economic Geography* 65(1), 1-18.
719 doi:10.2307/143475

720 Boyer, R. 2005. How and why capitalisms differ. *Economy and Society* 34(4), 509-557.
 721 doi:10.1080/03085140500277070

722 BP. (2019). BP Statistical Review of World Energy. Retrieved from
 723 [https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-](https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html)
 724 [energy.html](https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html)

725 Bradshaw, M. 2009. The Kremlin, national champions and the international oil companies: the
 726 political economy of the Russian oil and gas industry. *Geopolitics of Energy* 31(5), 2-14.

727 Bradshaw, M. 2010. A new energy age in Pacific Russia: lessons from the Sakhalin oil and gas
 728 projects. *Eurasian Geography and Economics* 51(3), 330-359. doi:10.2747/1539-
 729 7216.51.3.330

730 Bradshaw, M., & Prendergrast, J. 2005. The Russian heartland revisited: an assessment of
 731 Russia's transformation. *Eurasian Geography and Economics* 46(2), 83-122.
 732 doi:10.2747/1538-7216.46.2.83

733 Bradshaw, M. J. 1997. The geography of foreign investment in Russia, 1993–1995. *Tijdschrift*
 734 *voor Economische en Sociale Geografie* 88(1), 77-84. doi:10.1111/j.1467-
 735 9663.1997.tb01585.x

736 Brenner, N. 1998. Global cities, glocal states: global city formation and state territorial
 737 restructuring in contemporary Europe. *Review of International Political Economy* 5(1), 1-37.
 738 doi:10.1080/096922998347633

739 Breul, M. 2019. Cities in ‘multiple globalizations’: insights from the upstream oil and gas
 740 World City Network. *Regional Studies Regional Sciences* 6(1), 25-31.
 741 doi:10.1080/21681376.2018.1564628

742 Breul, M., & Revilla Diez, J. 2018. An intermediate step to resource peripheries: The strategic
743 coupling of gateway cities in the upstream oil and gas GPN. *Geoforum* 92, 9-17.
744 doi:10.1016/j.geoforum.2018.03.022

745 Breul, M., Revilla Diez, J., & Sambodo, M. T. 2018. Filtering strategic coupling: territorial
746 intermediaries in oil and gas global production networks in Southeast Asia. *Journal of*
747 *Economic Geography* 0, 1-23. doi:10.1093/jeg/lby063

748 Bridge, G., & Bradshaw, M. 2015. Deepening globalisation: Economies, trade and energy
749 systems. In *Global energy: Issues, policy, and implications*, eds. P. Ekins, M. Bradshaw, & J.
750 Watson, 52-72. Oxford, UK: Oxford Scholarship Online.

751 Bridge, G., & Bradshaw, M. 2017. Making a global gas market: territoriality and production
752 networks in liquefied natural gas. *Economic Geography* 93(3), 215-240.
753 doi:10.1080/00130095.2017.1283212

754 Brown, E., Derudder, B., Parnreiter, C., Pelupessy, W., Taylor, P. J., & Witlox, F. 2010. World
755 City Networks and Global Commodity Chains: towards a world-systems' integration. *Global*
756 *Networks* 10(1), 12-34. doi:10.1111/j.1471-0374.2010.00272.x

757 Cassidy, N., & Kosev, M. 2015. Australia and the global LNG market. *Reserve Bank of*
758 *Australia Bulletin*(March Quarter), 33-44.

759 Castells, M. 1996. *The Rise of the Network Society*. Cambridge, MA: Blackwell.

760 Charokopos, M., & Dagoumas, A. 2018. State Capitalism in Time: Russian Natural Gas at the
761 Service of Foreign Policy. *Europe-Asia Studies* 70(3), 441-461.
762 doi:10.1080/09668136.2018.1448367

763 Christopherson, S. 2002. Why do national labor market practices continue to diverge in the
 764 global economy? The “missing link” of investment rules. *Economic Geography* 78(1), 1-20.
 765 doi:10.1111/j.1944-8287.2002.tb00173.x

766 Coe, N. M., Dicken, P., Hess, M., & Yeung, H. W. C. 2010. Making connections: Global
 767 production networks and World city networks. *Global Networks* 10(1), 138-149.
 768 doi:10.1111/j.1471-0374.2010.00278.x

769 Coe, N. M., Hess, M., Yeung, H. W. C., Dicken, P., & Henderson, J. 2004. ‘Globalizing’
 770 regional development: a global production networks perspective. *Transactions of the Institute*
 771 *of British Geographers* 29(4), 468–484. doi:10.1111/j.0020-2754.2004.00142.x

772 Csardi, G., & Nepusz, T. 2006. The igraph software package for complex network research.
 773 *InterJournal Complex Systems* 1695(5), 1-9.

774 Dales, A., Coe, N. M., & Hess, M. 2019. Variegated national retail markets: negotiating
 775 transformation through regulation in Malaysia and Thailand. *Economic Geography* 95(1), 90-
 776 111. doi:10.1080/00130095.2018.1476060

777 De Graaff, N. 2011. A global energy network? The expansion and integration of non-triad
 778 national oil companies. *Global Networks* 11(2), 262-283. doi:10.1111/j.1471-
 779 0374.2011.00320.x

780 De Graaff, N. 2014. Global networks and the two faces of Chinese national oil companies.
 781 *Perspectives on Global Development and Technology* 13(5-6), 539-563.
 782 doi:10.1163/15691497-12341317

783 Deeg, R., & Jackson, G. 2007. Towards a more dynamic theory of capitalist variety. *Socio-*
 784 *Economic Review* 5(1), 149-179. doi:10.1093/ser/mwl021

785 Derudder, B. 2006. On conceptual confusion in empirical analyses of a transnational urban
786 network. *Urban Studies* 43(11), 2027-2046. doi:10.1080/00420980600897842

787 Deruytter, L., & Derudder, B. 2019. Keeping financialisation under the radar: Brussels Airport,
788 Macquarie Bank and the Belgian politics of privatised infrastructure. *Urban Studies* 56(7),
789 1347-1367. doi:10.1177/0042098018809912

790 Dicken, P. 1986. *Global shift: industrial change in a turbulent world*. London: Harper and Row.

791 Dicken, P. 1994. The Roepke Lecture in economic geography global-local tensions: firms and
792 states in the global space-economy. *Economic Geography* 70(2), 101-128. doi:10.2307/143650

793 Dicken, P., & Malmberg, A. 2001. Firms in territories: a relational perspective. *Economic*
794 *Geography* 77(4), 345-363. doi:10.1111/j.1944-8287.2001.tb00169.x

795 DIIS. 2019. *Resources and Energy Quarterley*, Department of Industry, Science, Energy and
796 Resources. Canberra.

797 Dixon, A. D. 2011. Variegated capitalism and the geography of finance: Towards a common
798 agenda. *Progress in Human Geography* 35(2), 193-210. doi:10.1177/0309132510372006

799 Ellem, B., & Tonts, M. 2018. The global commodities boom and the reshaping of regional
800 economies: the Australian experience. *Australian Geographer* 49(3), 383-395.
801 doi:10.1080/00049182.2017.1388761

802 Friedmann, J. 1986. The world city hypothesis. *Development and Change* 17(1), 69-83.
803 doi:10.1111/j.1467-7660.1986.tb00231.x

804 Friedmann, J. 1995. Where we stand: a decade of world city research. In *World Cities in a*
805 *World-System*, eds. P. Knox & P. Taylor, 22-47. New York: Cambridge University Press.

806 Glassman, J. 2011. The geo-political economy of Global Production Networks. *Geography*
807 *Compass* 5(4), 154-164. doi:10.1111/j.1749-8198.2011.00416.x

808 Glückler, J., & Doreian, P. 2016. Editorial: social network analysis and economic geography—
809 positional, evolutionary and multi-level approaches. *Journal of Economic Geography* 16(6),
810 1123–1134. doi:10.1093/jeg/lbw041

811 Goerzen, A., Asmussen, C. G., & Nielsen, B. B. 2013. Global cities and multinational
812 enterprise location strategy. *Journal of International Business Studies* 44(5), 427-450.
813 doi:10.1057/jibs.2013.11

814 Guriev, S., Kolotilin, A., & Sonin, K. 2009. Determinants of nationalization in the oil sector: a
815 theory and evidence from panel data. *The Journal of Law, Economics, and Organization* 27(2),
816 301-323. doi:10.1093/jleo/ewp011

817 Gustafson, T. 2012. *Wheel of Fortune*. Cambridge, MA: Harvard University Press.

818 Haberly, D., & Wójcik, D. 2017. Earth incorporated: centralization and variegation in the
819 global company network. *Economic Geography* 93(3), 241–266.
820 doi:10.1080/00130095.2016.1267561

821 Hall, P. A., & Soskice, D. 2001. *Varieties of Capitalism: The Institutional Foundations of*
822 *Comparative Advantage*. New York: Oxford University Press.

823 Hanson, P. 2009. The resistible rise of state control in the Russian oil industry. *Eurasian*
824 *Geography and Economics* 50(1), 14-27. doi:10.2747/1539-7216.50.1.14

825 Harvey, D. 2006. *Spaces of global capitalism*. New York: Verso.

826 Hay, J. L. 2009. Challenges to liberalism: The case of Australian energy policy. *Resources*
827 *Policy* 34(3), 142-149. doi:10.1016/j.resourpol.2008.05.001

828 Heemskerk, E., Young, K., Takes, F. W., Cronin, B., Garcia-Bernardo, J., Henriksen, L. F.,
829 Winecoff, W. K., Popov, V., Laurin-Lamothe, A. 2018. The promise and perils of using big
830 data in the study of corporate networks: Problems, diagnostics and fixes. *Global Networks*
831 18(1), 3–32. doi:10.1111/glob.12183

832 Heemskerk, E. M., & Takes, F. W. 2016. The corporate elite community structure of global
833 capitalism. *New Political Economy* 21(1), 90-118. doi:10.1080/13563467.2015.1041483

834 Hill, F., & Gaddy, C. G. 2003. *The Siberian curse: How communist planners left Russia out in*
835 *the cold*. Washington, D.C.: Brookings Institution Press.

836 Horsley, J. 2013. Conceptualising the state, governance and development in a semi-peripheral
837 resource economy: the evolution of state agreements in Western Australia. *Australian*
838 *Geographer* 44(3), 283-303. doi:10.1080/00049182.2013.817038

839 Hsu, J.-y., Gimm, D.-W., & Glassman, J. 2018. A tale of two industrial zones: a geopolitical
840 economy of differential development in Ulsan, South Korea, and Kaohsiung, Taiwan.
841 *Environment and Planning A*, 50(2), 457-473. doi:10.1177/0308518X16680212

842 Huber, M. 2019. Resource geography II: what makes resources political? *Progress in Human*
843 *Geography* 43(3), 553-564. doi:10.1177/0309132518768604

844 Hymer, S. 1972. The multinational corporation and the law of uneven development. In
845 *Economics and World Order*, ed. J. N. Bhagwati, 113–140. New York: MacMilan.

846 Indraprahasta, G. S., & Derudder, B. 2019. The geographically variegated connections of the
847 Jakarta metropolitan area as produced by manufacturing firms. *Growth and Change* 50(2), 705-
848 724. doi:10.1111/grow.12298

849 Kontorovich, A., Eder, L., Filimonova, I., Mishenin, M., & Nemov, V. Y. 2016. Oil industry
850 of major historical centers of the Volga-Ural petroleum province: past, current state, and long-
851 run prospects. *Russian Geology and Geophysics* 57(12), 1653-1667.
852 doi:10.1016/j.rgg.2016.10.011

853 Kratke, S. 2014. Global pharmaceutical and biotechnology firms' linkages in the world city
854 network. *Urban Studies* 51(6), 1196-1213. doi:10.1177/0042098013494420

855 Kuznetsov, A. V. 2016. Foreign investments of Russian companies: competition with West
856 European and East Asian multinationals. *Herald of the Russian Academy of Sciences* 86(2),
857 77-85. doi:10.1134/S1019331616020039

858 Labban, M. 2008. Contradiction of space, centralization of capital, and the hybrid state oil
859 company: the case of Russia. *Human Geography* 1(2), 59-71.
860 doi:10.1177/194277860800100210

861 Labban, M. 2010. Oil in parallax: Scarcity, markets, and the financialization of accumulation.
862 *Geoforum* 41(4), 541-552. doi:10.1016/j.geoforum.2009.12.002

863 Lane, D. 2018. The political economy of Russian oil. In *Business and State in Contemporary*
864 *Russia*, ed. P. Rutland, 101-128. New York: Routledge.

865 Lavrov, S., & Aleksanyan, A. 2017. Case study: The transnationalization of Russian oil and
866 gas companies. *International Organizations Research Journal* 12(1), 209-228. doi:
867 10.17323/1996-7845-2017-01-209

868 Ledyaeva, S., Karhunen, P., Kosonen, R., & Whalley, J. 2015. Offshore foreign direct
869 investment, capital round-tripping, and corruption: empirical analysis of Russian regions.
870 *Economic Geography* 91(3), 305-341. doi:10.1111/ecge.12093

871 Lim, K. F. 2010. On China's growing geo-economic influence and the evolution of variegated
872 capitalism. *Geoforum* 41(5), 677-688. doi:10.1016/j.geoforum.2010.04.003

873 Lim, K. F. 2018. Strategic coupling, state capitalism, and the shifting dynamics of global
874 production networks. *Geography Compass* 12(11), e12406. doi:10.1111/gec3.12406

875 Lundahl, M., & Sjöholm, F. 2008. The oil resources of Timor-Leste: curse or blessing? *The*
876 *Pacific Review* 21(1), 67-86. doi:10.1080/09512740701868898

877 Lüthi, S., Thierstein, A., & Hoyler, M. 2018. The world city network: evaluating top-down
878 versus bottom-up approaches. *Cities* 72(B), 287-294. doi:10.1016/j.cities.2017.09.006

879 MacKinnon, D., Cumbers, A., Pike, A., Birch, K., & McMaster, R. 2009. Evolution in
880 economic geography: institutions, political economy, and adaptation. *Economic Geography*
881 85(2), 129-150. doi:10.1111/j.1944-8287.2009.01017.x

882 MacLachlan, I. 2013. Kwinana Industrial Area: agglomeration economies and industrial
883 symbiosis on Western Australia's Cockburn Sound. *Australian Geographer* 44(4), 383-400.
884 doi:10.1080/00049182.2013.852505

885 Macmillan, J., & Beech, A. (2019). Federal government to consider domestic gas reserve.
886 Retrieved from [https://www.abc.net.au/news/2019-08-06/federal-government-to-consider-](https://www.abc.net.au/news/2019-08-06/federal-government-to-consider-domestic-gas-reserve/11385596)
887 [domestic-gas-reserve/11385596](https://www.abc.net.au/news/2019-08-06/federal-government-to-consider-domestic-gas-reserve/11385596) (accessed 20 July 2020)

888 Markusen, A., & Park, S. O. 1993. The state as industrial locator and district builder: the case
889 of Changwon, South Korea. *Economic Geography* 69(2), 157-181. doi:10.2307/143534

890 Martinus, K., Sigler, T. J., Searle, G., & Tonts, M. 2015. Strategic globalizing centers and sub-
891 network geometries: a social network analysis of multi-scalar energy networks. *Geoforum* 64,
892 78-89. doi:10.1016/j.geoforum.2015.06.006

893 Martinus, K., & Tonts, M. 2015. Powering the world city system: energy industry networks
894 and interurban connectivity. *Environment and Planning A* 47(7), 1502-1520.
895 doi:10.1177/0308518X15599124

896 Maskell, P. 2001. The firm in economic geography. *Economic Geography* 77(4), 329-344.
897 doi:10.1111/j.1944-8287.2001.tb00168.x

898 McNally, R. 2017. *Crude Volatility: the History and the Future of Boom-Bust Oil Prices*. New
899 York: Columbia University Press.

900 Neal, Z. 2011. Differentiating centrality and power in the world city network. *Urban Studies*
901 48(13), 2733-2748. doi:10.1177/0042098010388954

902 Neal, Z. 2012. Structural determinism in the interlocking world city network. *Geographical*
903 *Analysis* 44(2), 162-170. doi:10.1111/j.1538-4632.2012.00843.x

904 Odell, P. R. 2013. *An Economic Geography of Oil (Routledge Revivals)*. New York:
905 Routledge.

906 OIES. (2007). *Agreements from Another Era. Production Sharing Agreements in Putin's*
907 *Russia, 2000-2007*. Retrieved from [https://www.oxfordenergy.org/publications/agreements-](https://www.oxfordenergy.org/publications/agreements-from-another-era-production-sharing-agreements-in-putins-russia-2000-2007/)
908 [from-another-era-production-sharing-agreements-in-putins-russia-2000-2007/](https://www.oxfordenergy.org/publications/agreements-from-another-era-production-sharing-agreements-in-putins-russia-2000-2007/) (accessed 20
909 July 2020)

910 OIES. (2014). *The Future of Australian LNG Exports – Will domestic challenges limit the*
911 *development of future LNG export capacity?* Retrieved from

912 [https://www.oxfordenergy.org/publications/the-future-of-australian-lng-exports-will-](https://www.oxfordenergy.org/publications/the-future-of-australian-lng-exports-will-domestic-challenges-limit-the-development-of-future-lng-export-capacity/)
913 [domestic-challenges-limit-the-development-of-future-lng-export-capacity/](https://www.oxfordenergy.org/publications/the-future-of-australian-lng-exports-will-domestic-challenges-limit-the-development-of-future-lng-export-capacity/) (accessed 20 July
914 2020)

915 Olds, K., & Yeung, H. 2004. Pathways to global city formation: a view from the developmental
916 city-state of Singapore. *Review of International Political Economy* 11(3), 489-521.
917 doi:10.1080/0969229042000252873

918 Pan, F., Bi, W., Lenzer, J., & Zhao, S. 2017. Mapping urban networks through inter-firm
919 service relationships: the case of China. *Urban Studies* 54(16), 3639-3654.
920 doi:10.1177/0042098016685511

921 Panibratov, A., & Michailova, S. 2019. The role of state ownership and home government
922 political support in Russian multinationals' internationalization. *International Journal of*
923 *Emerging Markets* 14(3), 436-450. doi:10.1108/IJOEM-10-2017-0380

924 Parnreiter, C. 2010. Global cities in global commodity chains: exploring the role of Mexico
925 City in the geography of global economic governance. *Global Networks* 10(1), 35-53.
926 doi:10.1111/j.1471-0374.2010.00273.x

927 Pasqualetti, M. J. 2011. *The Geography of Energy and the Wealth of the World*. New York:
928 Taylor & Francis.

929 Pažitka, V., Wójcik, D., & Knight, E. 2019. Critiquing construct validity in world city network
930 research: moving from office location networks to inter-organizational projects in the modeling
931 of intercity business flows. *Geographical Analysis* 0, 1-22. doi:10.1111/gean.12226

932 Peck, J., & Theodore, N. 2007. Variegated capitalism. *Progress in Human Geography* 31(6),
933 731-772. doi:10.1177/0309132507083505

- 934 Peck, J., & Zhang, J. 2013. A variety of capitalism... with Chinese characteristics? *Journal of*
 935 *Economic Geography* 13(3), 357-396. doi:10.1093/jeg/lbs058
- 936 Phelps, N. A., & Fuller, C. 2000. Multinationals, intracorporate competition, and regional
 937 development. *Economic Geography* 76(3), 224-243. doi:10.1111/j.1944-8287.2000.tb00142.x
- 938 Pomeranz, K. 2000. *The Great Divergence: China, Europe, and the Making of the Modern*
 939 *World Economy*. Princeton, NJ: Princeton University Press.
- 940 Queensland Government, 2019. 'Queensland turns up the gas dial'. Retrieved from the
 941 Queensland Cabinet and Ministerial Directory at
 942 <http://statements.qld.gov.au/Statement/2019/10/30/queensland-turns-up-the-gas-dial>
 943 (accessed 20 July 2020)
- 944 Robinson, J. 2002. Global and world cities: a view from off the map. *International Journal of*
 945 *Urban and Regional Research* 26(3), 531-554. doi:10.1111/1468-2427.00397
- 946 Rodrik, D. 2013. Roepke lecture in economic geography—who needs the nation-state?
 947 *Economic Geography* 89(1), 1-19. doi:10.1111/j.1944-8287.2012.01177.x
- 948 Sassen, S. 1991. *The Global City*. New York, NY: Princeton University Press.
- 949 Scholvin, S., Breul, M., & Diez, J. R. 2019. Revisiting gateway cities: connecting hubs in
 950 global networks to their hinterlands. *Urban Geography* 40(9), 1291-1309.
 951 doi:10.1080/02723638.2019.1585137
- 952 Sheppard, E. 2010. Geographical political economy. *Journal of Economic Geography* 11(2),
 953 319-331. doi:10.1093/jeg/lbq049

954 Shonfield, A., & Reisman, D. A. 1965. *Modern Capitalism: The Changing Balance of Public*
955 *and Private Power* (Vol. 156). Oxford: Oxford University Press.

956 Sigler, T., Martinus, K., Iacopini, I., & Derudder, B. 2019. The role of tax havens and offshore
957 financial centres in shaping corporate geographies: an industry sector perspective. *Regional*
958 *Studies*, 1-13. doi:10.1080/00343404.2019.1602257

959 Sigler, T. J., & Martinus, K. 2017. Extending beyond ‘world cities’ in World City Network
960 (WCN) research: urban positionality and economic linkages through the Australia-based
961 corporate network. *Environment and Planning A* 49(12), 2916-2937.
962 doi:10.1177/0308518X16659478

963 Smith, A. 2014. The state, institutional frameworks and the dynamics of capital in global
964 production networks. *Progress in Human Geography* 39(3), 290-315.
965 doi:10.1177/0309132513518292

966 Stephenson, S. R., & Agnew, J. A. 2016. The work of networks: Embedding firms, transport,
967 and the state in the Russian Arctic oil and gas sector. *Environment and Planning A* 48(3), 558-
968 576. doi:10.1177/0308518X15617755

969 Taylor, M. J., & Thrift, N. 1980. Large corporations and concentrations of capital in Australia:
970 a geographical analysis. *Economic Geography* 56(4), 261-280. doi:10.2307/143325

971 Taylor, P. J., & Derudder, B. 2015. *World City Network: A Global Urban Analysis*. Abingdon,
972 UK and New York, NY: Routledge.

973 Taylor, P. J., Derudder, B., Faulconbridge, J., Hoyler, M., & Ni, P. 2014. Advanced producer
974 service firms as strategic networks, global cities as strategic places. *Economic Geography*
975 90(3), 267-291. doi:10.1111/ecge.12040

976 Taylor, P. J., Hoyler, M., & Verbruggen, R. 2010. External urban relational process:
 977 introducing central flow theory to complement central place theory. *Urban Studies* 47(13),
 978 2803-2818. doi:10.1177/0042098010377367

979 Toly, N., Bouteligier, S., Smith, G., & Gibson, B. 2012. New maps, new questions: global
 980 cities beyond the advanced producer and financial services sector. *Globalizations* 9(2), 289-
 981 306. doi:10.1080/14747731.2012.658252

982 Tonts, M., & Haslam-McKenzie, F. 2005. Neoliberalism and changing regional policy in
 983 Australia. *International Planning Studies* 10(3-4), 183-200. doi:10.1080/13563470500378861

984 Treivish, A. 2005. A new Russian heartland: the demographic and economic dimension.
 985 *Eurasian Geography and Economics* 46(2), 123-155. doi:10.2747/1538-7216.46.2.123

986 Van Wijk, B. C., Stam, C. J., & Daffertshofer, A. 2010. Comparing brain networks of different
 987 size and connectivity density using graph theory. *PloS One* 5(10), e13701.
 988 doi:10.1371/journal.pone.0013701

989 Vatansever, A. 2020. Put over a barrel? “Smart” sanctions, petroleum and statecraft in Russia.
 990 *Energy Research & Social Science* 69, 101607. doi:10.1016/j.erss.2020.101607

991 Verbeek, T., & Mah, A. (2020). Integration and isolation in the global petrochemical industry:
 992 a multiscalar corporate network analysis. *Economic Geography*. doi:
 993 10.1080/00130095.2020.1794809

994 Visenescu, R. S. 2018. Russian-ASEAN cooperation in the natural gas sector. Lessons from
 995 the Russian-Vietnamese relation. *Energy Policy* 119, 515-517.
 996 doi:10.1016/j.enpol.2018.05.006

997 Vivoda, V. 2019. LNG import diversification and energy security in Asia. *Energy Policy* 129,
998 967-974. doi:10.1016/j.enpol.2019.01.073

999 Wall, R. 2009. *Netscape: Cities and Global Corporate Networks*. Rotterdam: Haveka.

1000 Wall, R. S., & van der Knaap, G. A. 2011. Sectoral differentiation and network structure within
1001 contemporary worldwide corporate networks. *Economic Geography* 87(3), 267–308.
1002 doi:10.1111/j.1944-8287.2011.01122.x

1003 Whitley, R. 1999. *Divergent Capitalisms: The Social Structuring and Change of Business*
1004 *Systems*. Oxford: OUP Oxford.

1005 Wilkinson, R. 1983. *A Thirst for Burning: The Story of Australia's Oil Industry*. Sydney: David
1006 Ell Press.

1007 Yeung, H. W.-c. 2000. State intervention and neoliberalism in the globalizing world economy:
1008 lessons from Singapore's regionalization programme. *The Pacific Review* 13(1), 133-162.
1009 doi:10.1080/095127400363677

1010 Yeung, H. W.-c. 2005. The firm as social networks: An organisational perspective. *Growth and*
1011 *Change* 36(3), 307-328. doi:10.1111/j.1468-2257.2005.00279.x

1012 Yeung, H. W.-c., & Lin, G. C. 2003. Theorizing economic geographies of Asia. *Economic*
1013 *Geography* 79(2), 107-128. doi:10.1111/j.1944-8287.2003.tb00204.x

1014 Zhang, J., & Peck, J. 2016. Variegated capitalism, Chinese style: regional models, multi-scalar
1015 constructions. *Regional Studies* 50(1), 52-78. doi:10.1080/00343404.2013.856514

1016

Table 1

Selection of cities with the highest degree scores and their eigenvector centralities in the energy city network globally, in Australia and in Russia.

Rank	City	Country	Degree	Eigenvector centrality
1	Houston	United States	4,021	1.000
2	London	United Kingdom	3,017	0.733
3	Calgary	Canada	1,616	0.462
4	New York	United States	1,478	0.702
5	The Hague	Netherlands	1,192	0.372
6	Paris	France	972	0.256
7	Beijing	China	789	0.040
8	Dallas	United States	774	0.301
9	Toronto	Canada	709	0.345
10	Denver	United States	668	0.238
11	Moscow	Russia	656	0.054
...21	Perth	Australia	375	0.098
...28	Sydney	Australia	298	0.080
...51	Melbourne	Australia	134	0.039
...59	St. Petersburg	Russia	122	0.005
...62	Adelaide	Australia	116	0.024
...75	Almetyevsk	Russia	85	0.007
...87	Brisbane	Australia	65	0.018
...133	Surgut	Russia	32	0.001
...169	Novy Urengoy	Russia	25	0.001

1022 **Table 2**

1023 Characteristics of inter-city domestic network orientation based on the node’s attributes data
1024 on the country of firm location.

1025

Characteristics	Australia	Russia
The proportion of international ties to domestic ties	4.283	0.683
The proportion of outflows to inflows	1.000	1.428
The proportion of out-going firms to in-coming firms	0.662	0.147
The proportion of domestic firms that internationalize among all domestic firms	0.709	0.154

1026

1027 **Table 3**
 1028 Comparative analysis of network measures.

1029

	Australia	Russia
Network nodes, V	136	210
Network edges, E	840	909
Average degree, $\langle K \rangle$	12.353	8.657
Network density, D	0.046	0.021
Network centralization, C	1.353	1.556
Out-degree centralization, C_{OUT}	1.665	2.477
In-degree centralization, C_{IN}	1.494	0.620

1030
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1032

1033 Figure 1. Oil & gas production and export in Russia. Source: BP Statistical Review of World Energy.

1034 Note: No data availability for natural gas export prior to 1995.

1035

1036 Figure 2. Oil & gas production and export in Australia. Source: BP Statistical Review of World Energy.

1037 Note: No data availability for natural gas export prior to 1995.

1038

Figure 3. Global geographical city network through oil & gas firms connectivity (3a) globally significant firm linkages (only ties with weight more than 5 are shown) (3b) all firm linkages of Australian cities (3c) all firm linkages of Russia cities. Nodes are scaled by degree centrality in their respective networks. Names are provided for five cities with the highest degree centrality.

Figure 4. Australian (4a) and Russian (4b) city domestic networks through oil & gas firms connectivity. Only ties with weights more than 3 and nodes with degree more than 5 are shown. Names of nodes are scaled by eigenvector centrality CE. Colored ties show domestic linkages, grey ties show international linkages.

1050

1051

1052 Figure 5. The divergent city networks through oil & gas firms connectivity in Russia and Australia.