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Economic transformation of mining cities in transition economies: lessons from Daqing, Northeast China

All mining cities need to address the problems associated with resource depletion. However, there are crucial differences between mining cities in transition economies and those in market economies. Through a case study from Daqing, which is also known as the oil capital of China, this article sheds light on how mining cities in transition economies transform economically in anticipation of the eventual decline in mining prosperity. With rich empirical evidence gathered through extensive fieldwork, this article argues that mining cities in transition economies are faced not only with problems stemming from the boom-and-bust economic cycles of the dominant mining industry and the inevitable exhaustion of resources, but also with issues associated with the legacy of planned economies. Therefore, the transformation of mining cities in transition economies is often situated in a multi-level governance framework. In contrast, the transformation of mining cities in market economies is mainly a local process in the sense that the key actors are local governments and community-based organisations. This case study contributes to the theorisation of mining cities in transition economies and the practical knowledge of those engaged in similar economic transformation.

Keywords: mining cities, economic transformation, transition economies, strategies, challenges, North-east China, Daqing

Introduction

Mining cities are a vulnerable category of urban settlement because their economy is based on the extraction of natural, non-renewable resources. Due to their narrow economic foundations the fate of mining cities is closely associated with the boom-and-bust economic cycle of the leading mining industry (Bradbury and St-Martin, 1983; Lockie et al., 2009; Tapela, 2002). Facing inevitable resource depletion, mining cities that fail to transform their economies in time suffer from urban decline and decay, as characterised by contractions in production and investment, the relocation of capital, increased unemployment and population loss (Pallagst et al., 2009; Martinez-Fernandez et al., 2012b). In the worst cases, mining cities become desolate ghost towns after resource exhaustion or their exploitation is no longer considered economical (Martinez-Fernandez et al., 2012a). The challenge of transformation towards a more diversified and sustainable economy faces mining cities throughout the world.

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A broad range of studies have examined the relationship between resource abundance and regional growth (Sachs and Warner, 2001; Stevens and Dietsche, 2008; Zhang et al., 2008), the life cycle of mining cities (Tapela, 2002; Lockie et al., 2009), the dynamics of mining cities that lead to urban shrinkage (Bradury and St-Martin, 1983; Tsutsumi, 2000; Polese and Shearmur, 2006; Martinez-Fernandez et al., 2012b) and the different transformation theories and practices (Tsutsumi, 2000; Dale, 2002; Martinez-Fernandez et al., 2012b). While the objective of the economic transformation of mining cities is always to diversify away from mining, a diverse array of strategies is used to achieve that objective. Studying four shrinking mining cities in Australia, Canada, Japan and Mexico, Martinez-Fernandez et al. (2012b) identified a number of transformation strategies, including the development of knowledge economies, attracting information and communication technology companies and the involvement of the community in decision-making. Tsutsumi (2000) described how a Japanese coal mining town tried to attract new food industry companies after the closure of the mine. In Norway's mining towns, Dale (2002) observed that museums and other cultural activities based on the heritage of traditional mining were established by local actors to attract tourists.

Compared to the substantial amount of research on mining cities in market economies, particularly in North America, Europe, Japan and Australia, few studies have been carried out on the economic transformation of mining cities in transition economies. A transition economy is defined as an economy that is in transition from a centrally planned system to a free market. The International Monetary Fund (IMF) identified twenty-nine countries with transition economies, including China, Vietnam, Laos, Cambodia, former communist states in Central and Eastern Europe, as well as post-Soviet Union countries (IMF, 2000). Significant differences exist among this diverse group of countries, with the debate between radical reforms (exemplified by Russia) and gradualism (exemplified by China) as one example of this diversity (Aslund, 2013). Nevertheless, as a group, these countries are different from countries with market economies, because they have to deal with the legacy of a planned economy and may still retain certain elements of that history, depending on the stage and approach to transition. It follows that economic transformation as experienced by mining cities in these countries can be significantly different to those in market economies. In fact, one of the central objectives of this article is to examine how the central planning legacy defines the transformation process in this special group of mining cities.

This article uses Daqing, China, as a case study of mining cities in transition economies. China is the world's largest transition economy and has a large number of mining cities, with the official classification indicating 178 mining cities in total (Li, 2007), accounting for nearly one-fourth of Chinese cities. Most mining cities emerged under intensive investment from the central government in the planned era (1949 to 1978), with the primary goal of supporting socialist industrialisation. Since the late

1970s, however, China's reform programmes have focused on marketisation and have shifted the nation's developmental priorities to the coastal areas. China's mining cities have been found to be less adaptable to the new economic circumstances. As a result, many mining cities in China began to experience a recession in the 1980s, which persisted well into the early 2000s (Li et al., 2013). Nevertheless, most mining cities have managed to survive, thanks to a successful economic transformation.

Daqing was selected as a case study because it is arguably the most famous mining city in the country. Also known as the oil capital of China, Daqing once produced more than half of China's oil. Although its relative importance has declined recently, the city still produces over 40 million tons of oil per year. However, the importance of Daqing extends beyond its economic output. In 1965, a mere five years after the establishment of the oil fields and the city, Daqing secured a permanent place in China's communist ideology when it was glorified as a national model of socialist industrialisation (Hama, 1980). The fact that Mao Zedong promulgated the call 'in industry, learn from Daqing' in the 1960s reflects the historic importance of Daqing in the industrial and economic development of socialist China. Daqing's status as the country's leading mining city and as a symbol of communist triumph means that the city retains the attention of Communist Party leaders. For this reason, Daqing was one of the first mining cities to undergo a post-mining transformation in China in the 1990s. The two decades of transformation experience provide a rare opportunity to study transformation processes and their consequences and challenges.

This study adopted a qualitative case study approach. Three rounds of fieldwork were conducted in Daqing from 2007 to 2014, with each round focusing on a different aspect of the economic transformation process. In July 2007, semi-structured interviews were carried out with local government officials, who were responsible for the economic transformation strategies of Daqing, focusing on the diversification of the urban economy. The second round of interviews was conducted in June 2008. Through interviews with urban planners, we obtained information about the transformation of urban spatial structure and its implications for economic transformation. In January 2014, we conducted the third round of interviews with government officials and managers of state-owned enterprises (SOEs) in the petroleum industries to strengthen our understanding of the role of the state-owned sector in the economic transformation of Daqing. During these three rounds of fieldwork, statistical data, government documents, newspapers and local historical materials were also collected.

This article is organised as follows: we begin by retracing the development of Daqing from its establishment under a planned economy to its decline during the early reform period. This is followed by a discussion of Daqing's key approaches to economic transformation and an analysis of the key achievements and challenges. Finally, building on the case study, we discuss the characteristics of the transformation of mining cities in transition economies and some practical lessons to be learned.

Pre-transformation Daqing

Located between the cities of Harbin and Qiqihar in Heilongjiang Province (Figure 1), Daqing covers an area of 21,219km² and had a total population of 2.82 million in 2012, of which 1.45 million were classified as urban residents. The city currently consists of five urban districts and four suburban counties. The city did not exist until an oil field was set up and named Daqing (meaning ‘great celebration’) to commemorate the tenth anniversary celebration of the founding of the People’s Republic of China in 1959. The construction of the Daqing oil fields coincided with the Sino-Soviet split, which eventually led the Soviet Union to completely cut off the oil supply to China (Hama, 1980). To resolve the oil crisis, the development of the Daqing oil fields became a national priority in the early 1960s. With approximately 100,000 workers, soldiers, technicians and cadres assigned to the exploitation and construction of the oil fields Daqing became a blooming oil drilling city almost overnight. To maximise efficiency managers of the petroleum SOEs were also in charge of urban planning and management affairs. At that time this special administrative system played a positive role in the coordinated construction of oil fields and urban areas. Daqing developed at such a speed that, in 1964, the city was promoted as a model of good practice, not just in the mining sector but across all industries. In 1976, when production was at its peak, the annual oil production of Daqing exceeded 50 million tons, accounting for 57.7 per cent of national oil production.

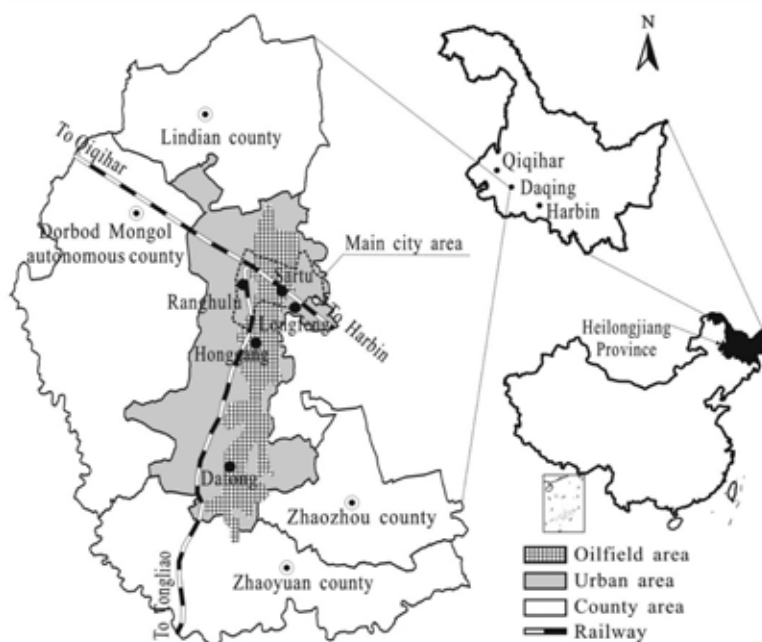


Figure 1 The location of Daqing, Heilongjiang Province, China. Source: Authors.

The early development of Daqing benefited from strong state patronage under the planned economy. However, in the early 1980s, a number of problems began to surface. First of all, due to long-term extensive exploitation, the proven oil reserve increase rate began to slow down and the discovery of proven reserves has remained far below the rate of oil production since the 1970s, resulting in a decrease in proven oil reserves (Zhang, 1993). At the same time, after more than thirty years of drilling, the oil fields began to experience a high water cut, with the water cut rate increasing from 1.38 per cent at the beginning of drilling to 78.12 per cent in 1989 (Editorial Board for 50 Years of Heilongjiang Economic Development, 1999). The reduction in oil reserves and the high water cut made oil drilling more difficult and significantly increased the cost of production. According to the official statistics from 1978 to 1989, the Daqing oil fields' electricity consumption per ton of oil produced increased 1.6-fold, the cost per ton of oil produced increased 4.7-fold from 18.94 RMB to 108.5 RMB and the profit per ton dropped from 79.03 RMB to 10.04 RMB.

In addition to resource depletion, Daqing was adversely affected by the wider context of market reform and the opening-up policy. As market forces gradually replaced central planning and state directives, regional economic growth became increasingly defined by intense inter-city competition for investment. With its roots deep in the socialist system a number of factors made Daqing unattractive to business. First, having been positioned as an important petroleum supply base ever since its foundation, economic development of Daqing became overdependent on oil resources. The oil-based industries accounted for as much as 64.7 per cent of the gross regional product (GRP) in 1990, which resulted in an overspecialisation of labour and complementary services. Second, and relatedly, Daqing's economy was dominated by powerful SOEs that were primarily focused on meeting the production targets set by their parent companies and the central government resulting in a self-contained industrial system isolated from the local economy (the state-owned sector accounted for approximately 90 per cent of Daqing's economy, even in the mid-1990s). The local government of Daqing had limited control over oil resources, which were mostly exported out of the city, leaving insufficient oil for the development of local petrochemical industries. Third, because of Mao's ideology of 'production first, living second', investment was primarily channelled to industrial development, with urban construction perceived as non-productive (Zhong and Hays, 1996). As a result, Daqing had a substandard urban environment up until the 1990s, with insufficient public infrastructure and facilities and poor living conditions. In addition, influenced by the distribution of oil resources, the spatial form of the city was fragmented, specifically in Sartu district (Song and Zheng, 2002). Although more than 500,000 people were living and working in the oil fields by the end of 1978, Daqing did not have an urban core with a high population density. Instead, the majority of the population was dispersed among hundreds of settlements (Hama, 1980). The dispersed nature of settlement further limited the effectiveness of urban construction. Environ-

mental deterioration was also evident due to the high intensity of oil exploitation, such as the over-extraction of groundwater, desertification, salinisation and deterioration of wetland, farmland and grassland. In short, Daqing lacked the social and environmental qualities that are considered necessary for attracting mobile investment in a competitive environment (Begg, 1999).

Daqing therefore faced challenges from both sides of the fence in the 1980s. On the one hand, declining oil reserves meant that the city was losing its most valuable (if not only) economic role. On the other hand, Daqing found it difficult to attract new investment in other industries. Consequently, in the 1980s and 1990s, the economic growth of Daqing significantly slowed, dropping below the national average by the end of the 1990s. The economic stagnation was the biggest motivating factor for transformation, and a consensus was reached among different levels of government that Daqing needed to start preparing for a post-oil future.

Key approaches to economic transformation

Determining what can take the place of mining activities once the resources are exhausted or are no longer considered economical to exploit is a key issue for most mining cities (Pallagst et al., 2009). Because Daqing started its transformation process well before its oil ran out, it has been able to utilise the oil extraction industry to its advantage. Based on our interviews with the relevant informants, we constructed a two-dimensional model of economic transformation in Daqing (Figure 2). Rather

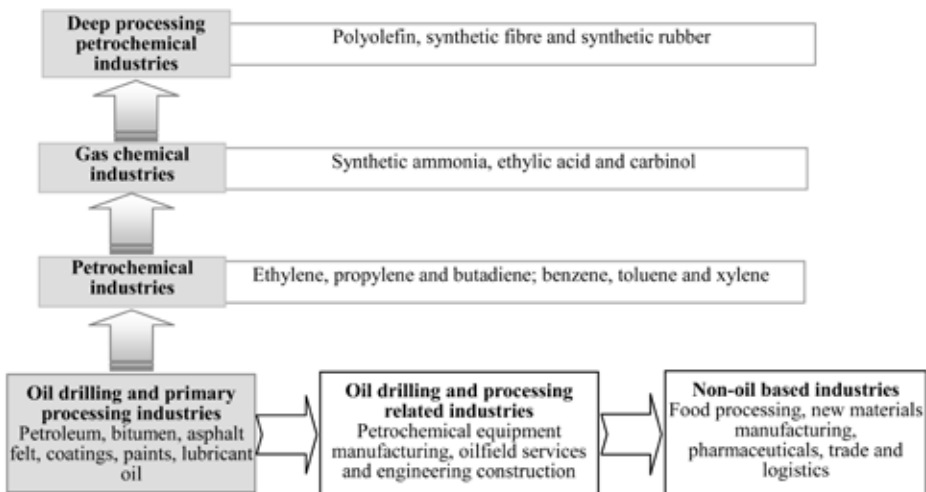


Figure 2 A two-dimensional model of economic transformation in Daqing.

Source: Authors.

than shifting away from oil-related industries, Daqing began to diversify its economy in the 1990s, both vertically into petrochemical industries and horizontally into mining technology service industries, and eventually to non-oil based industries, such as food processing, new materials manufacturing, pharmaceuticals and trade and logistics. As will be illustrated below, the economic transformation of Daqing is a multi-level process consisting of four distinct but interrelated activities carried out by different levels of government and SOEs.

SOE restructuring and increasing local oil processing quota

As the key economic actors of Daqing, the petroleum SOEs have played a crucial role in the economic transformation. In our interviews with senior managers of petroleum SOEs, we were told that following the instruction of the central government to support Daqing's economic diversification, China National Petroleum Corporation (CNPC, the parent company of Daqing's petroleum SOEs) has restructured its subsidiaries in Daqing to diversify vertically into the petrochemical industry and horizontally into the petroleum services and engineering industry. In 1999, the Daqing Petroleum Administration Bureau (DPAB) was separated into two entities. The first was Daqing Oilfield Company Ltd., which has been the leader in driving the development of the petrochemical industry in Daqing. The second was the new DPAB, which has become the leader in the manufacturing of petroleum equipment and the provision of knowledge-intensive petroleum engineering solutions. The new DPAB was transformed into a stock-holding enterprise with the participation of local private capital, which promoted the development of local non-oil based industries. At the same time the CNPC began to explore oil fields in Mongolia and Russia with the intention of exporting mining technologies to these countries. This further stimulated the development of the oil drilling and processing equipment industries in Daqing.

Furthermore, to provide more time for the city to diversify its economic structure before the oil resources are exhausted, CNPC has gradually decreased the annual production of the Daqing oil fields by approximately 1.5 to 2 million tons per year since 1999. As a result, oil production decreased from the peak of 50 million tons per year to 40 million tons per year in 2009. However, the cut in oil production did not negatively influence Daqing's goal of expanding into petrochemical industries, because CNPC also increased the annual quota for local oil processing from 7.573 million tons in 1990 to 1286.5 million tons in 2012.

Government initiatives to promote economic diversification

Daqing's economic transformation is also being facilitated by a number of government initiatives. According to our interviews with local government officials in Daqing one of the most important local government initiatives is the establishment of the national-level high-tech industrial zone, a common economic development strategy of Chinese local state entrepreneurialism (Yu and Zhu, 2009). Located in the eastern part of the city, the development zone was tasked with the development of six pillar industries: petrochemicals, new materials, equipment manufacturing, electronics and information technology, food processing and biomedicine. In addition to offering tax breaks and cheap land to potential investors, a number of research institutions, including Daqing Petroleum Institute, Heilongjiang August First Agricultural College, North-eastern Forestry University Daqing Biotechnology institute and Heilongjiang Chemical Engineering Academy Daqing Division, were invited to establish a campus in the zone to provide human resources and research capacity in areas such as petroleum engineering, chemical engineering, information technology and biotechnology. Collaboration between the research institutions and enterprises have resulted in a series of well-known brand products, such as C₅ Petroleum Resin, Super-high Molecular Weight Polyacrylamide and Injection Installation of Polymeric Compound, as well as a series of software products with independent intellectual property rights in industry control, education, medication and logistics. Since its establishment the high-tech industrial zone in Daqing has become a driving force in fostering new industries and is a key contributor to the city's economic transformation.

At the provincial level, Daqing has benefited from the strategy of developing an industrial corridor including Harbin, Daqing and Qiqihar – the three largest cities in the province (Figure 1). The provincial strategy defines the key directions of development for the three cities to avoid regional competition. Furthermore, this strategy has provided support in land use, taxation, financing, technology and human resources to promote the development of industrial zones throughout the industrial corridor. A total of 660km² of land in Daqing was allocated to the industrial corridor. By the end of 2012, this strategy resulted in the initiation of 446 major projects with a total investment of 23.7 billion RMB in Daqing, significantly contributing to the development of both the oil-based industries and the non-oil based industries in the city.

At the national level, the 2003 'Revitalising Plan for Northeast Old Industrial Base' brought financial aid and preferential policies to the three Northeast provinces (Zhang, 2008). Since 2004, enterprises in eight industries can claim additional tax deductions for some of their expenses, notably the purchase of new mechanical equipment. Furthermore, a number of small oil fields and coal mines can receive a reduction in resource tax by up to 30 per cent. These favourable policies effectively

reduce the tax burden on Daqing's petrochemical and non-oil enterprises and attract investment to the city. In addition to tax cuts, the central government has also made available a grant to support the enterprises in the Northeast to upgrade their production capacity. From 2004 to 2005, Daqing's enterprises obtained ten grants with a total of 6.65 billion RMB.

Institutional reform

A number of institutional reforms, introduced with the intent of stimulating local development conditions and facilitating economic transformation, have been engineered by the central and provincial governments. In urban governance, the steady increases in urban areas and population in the post-reform era made it increasingly difficult for the SOEs to fulfil their responsibilities, such as urban construction, public service and social welfare. On the one hand, urban development was neglected. On the other hand, the SOEs, burdened with heavy social responsibilities, became less competitive in both the domestic and international markets. In 1984, with permission from the central and provincial governments, the oil SOEs were separated from the Municipal Government of Daqing and some urban development functions were also transferred to the municipal government. This reform continued in 2004, when the central government made CNPC the pilot of reducing SOE social responsibilities. In this wave of reform, a large number of SOE-affiliated institutions and facilities, such as schools, hospitals, police stations and fire departments, were taken over by the municipal government. To avoid overburdening the municipal government in its ability to provide services, the central government offered financial assistance by increasing fiscal transfer payments. As a result of these reforms, the social responsibilities of the SOEs were significantly reduced, enabling SOEs to focus on their core businesses.

Additionally, the provincial government has used fiscal reforms to facilitate the economic transformation of Daqing. A longstanding problem with Daqing was that the profits generated by the SOEs were extracted to higher levels of government and, consequently, the municipal government lacked the financial resources it required to carry out tasks associated with the transformation process. To improve the financial situation of the municipal government, the provincial government provided Daqing with additional tax revenue in 1996, including the city construction tax, the education fee, the land-use tax, stamp duties, the travel tax and the property tax. Furthermore, 25 per cent of value-added taxes collected from municipal-owned enterprises and 50 per cent of business taxes (with the exception of businesses from the finance, insurance and telecommunications sectors) were allocated to the municipal government.

Reconfiguring urban space

The planning era left Daqing with dilapidated and insufficient urban infrastructure and a dispersed settlement pattern without an urban centre, the condition of which was not conducive to the new direction of economic development. To address these spatial problems, the municipal government spearheaded the transformation of urban space. According to our interviews with urban planners and government officials in Daqing, the municipal government implemented an urban development strategy of ‘building two wings’ in 1982, with the intention of building two urban cores in the eastern and western parts of the city. To accelerate the development of the eastern part of the city, the municipal government relocated its headquarters from the old city centre in Sartu district to the eastern fringe of the city at Dongfeng New Village. This strategy is often used by Chinese local governments to attract residents and businesses to newly developed areas that have insufficient infrastructure and services (Liu et al., 2012). Similarly, the Daqing Petroleum Administration Bureau moved its headquarters from the city centre to the western fringe of the city in Ranghulu district. To further correct the scattered settlement pattern, new residential areas have not been allowed to be built close to the oil fields since 1984 and existing worker–farmer villages scattered across the oil fields have gradually been relocated to areas along railways (Zhao, 2007). Because of these aggressive policies, the number of worker–farmer villages decreased from approximately 300 in 1978 to seventy by the end of the 1990s. The new urban areas had attracted close to 300,000 residents, becoming the new engines of economic and urban growth in Daqing. Figure 3 graphically illustrates the spatial transformation of Daqing from 1978 to 2004.

Improving urban infrastructure and environment has been another important objective. Since the 1990s, the municipal government has invested heavily in producing

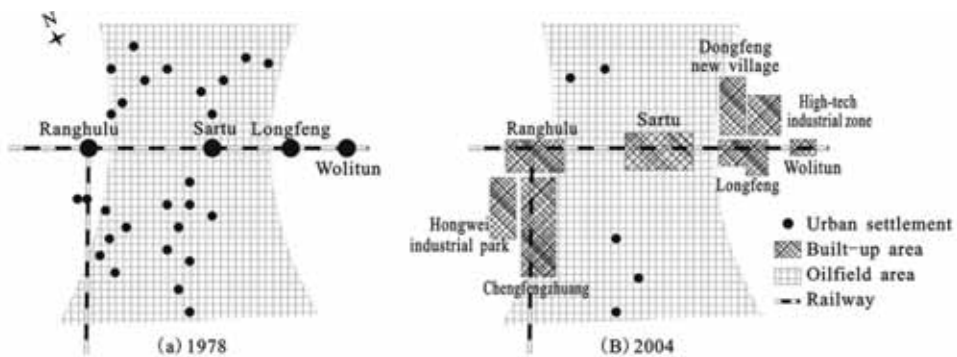


Figure 3 Spatial transformation of Daqing from 1978 to 2004.

Source: Authors.

new urban spaces, such as industrial parks, high-tech development zones and housing estates, resulting in massive reconfigurations of urban space. A variety of mechanisms have been employed to finance urban infrastructure, including government revenue, bank loans, public–private partnerships, funding from central and provincial governments and donations. Many municipal facilities have been built and put into service including airports; water, heat and gas supply stations; solid waste and wastewater treatment plants; and conference centres, theatres and sports complexes. Furthermore, in 2001, the Municipal Government of Daqing initiated the eco-city development strategy with the intent of improving the city’s urban ecological environment. From 2006 to 2012, a total of 15.276 billion RMB was invested in improving environmental qualities and repairing ecological degradation. Together, these measures in urban reconfiguration have made a key contribution to Daqing’s economic transformation by providing a better physical environment for investment.

Achievements and challenges

The economic transformation of Daqing has resulted in the emergence of a number of new industries, including the petrochemical industries, the petroleum services and engineering industries and a number of non-oil based industries, including food processing, new materials manufacturing, pharmaceuticals, information technology and trade and logistics. Economic transformation has effectively absorbed the negative economic impacts associated with oil production cuts and the rising cost of oil exploitation. After a prolonged period of economic stagnation, recent economic data from Daqing reports a strong economic performance. Daqing’s GDP has maintained a stable upward trend since 1993, and the per capita gross domestic product (GDP) of Daqing was more than 142,000 RMB in 2012, which was the highest in the Northeast. The city is now an important petrochemical industry base, with an annual production capacity of 600,000 tons of ethylene, 300,000 tons of polypropylene and 760,000 tons of urea. The petrochemical industry gained an added value of 38 billion RMB in 2012, representing 12 per cent of the city’s industry added value. At the same time, the rapid development of oil drilling and processing related industries and non-oil based industries has led to a sharp rise in the proportion of the non-oil economy since 2000, reaching 54 per cent in 2012 (Table 1). Daqing has also become more open and connected. During the eleventh Five-Year Plan (2006 to 2010), total trade increased from 0.44 billion USD to 2.16 billion USD. Daqing has established long-term trading relationships with 104 foreign cities and has over 100 companies in international trading. Moreover, thirty-eight of the top 500 corporations internationally have invested in Daqing, and nineteen companies in Daqing are listed on the stock exchange (Xia, 2012). For its achievement, Daqing was nominated as one of China’s top fifty cities in terms of competitiveness in 2010 by the Chinese Academy of Social Sciences (CASS).

Table 1 Changes in the industrial structure of Daqing

Year	Composition of oil-based industries (%)		Year	Composition of gross regional product (%)	
	Oil and gas mining industries	Petrochemical industries		Oil-based industries	Non-oil based industries
1980	77	23	1980	61	39
1985	77	23	1985	59	41
1990	77	23	1990	65	35
1995	73	27	1995	68	32
2000	74	26	2000	77	23
2005	69	31	2005	65	35
2012	61	39	2012	46	54

Source: Data from the Policy Research Center of the CCP Daqing Municipal Party Committee (2007) and the Daqing Statistic Bureau (various years).

Daqing's economic transformation has also resulted in changes to the urban environment. Avoiding the fate of shrinking cities, the built-up areas grew from 133km² in 1992 to 233km² in 2012. During the same period, the urbanisation rate (measured by the share of non-agricultural population) increased from 39.7 per cent to 51.4 per cent. The urban environment has improved since the 1970s, and for its strong performance in environmental protection and the provision of municipal services, Daqing was awarded the honorary title of 'National Environmental Protection Model City' in 2001 by the Environmental Protection Bureau. Meanwhile, the average disposable income of the urban population in Daqing increased from 1453.5 RMB in 1991 to 25,425 RMB in 2012. These changes have all contributed to the improvement in the quality of life among Daqing's residents.

The economic transformation of Daqing can be regarded as a success story, because the process has promoted the diversification and revitalisation of the economy before resource exhaustion. Nevertheless, the process has not been entirely smooth and significant challenges remain. First of all, although the strategy of building on (instead of shifting away from) the oil industry has worked well, the drawback is that Daqing is now home to a large number of highly polluting and energy-intensive industries, such as petrochemicals and equipment manufacturing. In 2012, these industries accounted for 74 per cent of industrial value added. In comparison, the tertiary sector, which has only grown modestly, contributed to 15.3 per cent of Daqing's GDP in 2012. This figure is far below the national average for mining cities in China, which was 32 per cent in 2012. Because of the unbalanced economic structure, environmental problems continue to persist. Water scarcity and pollution are becoming a pressing issue for Daqing lately, due to the over-extraction of groundwater by the petroleum processing

industries. According to data from Daqing's Land Resource Bureau and Environmental Protection Bureau, excessive groundwater exploitation has resulted in the formation of 3750km² of underground funnel which causes ground layer depression. Energy conservation is another key challenge. In 2012, Daqing's energy intensity was 1.158 ton of standard coal/10⁴ RMB, which was almost double the national average. Given the rising interest in sustainable and low-carbon development in China (Yu, 2007; Lo and Wang, 2013; Lo, 2014; Liu et al., 2013), improving the environmental regulation of mining and industry and shifting the economy away from dependency on heavy industries to a less polluting, service-oriented economy has become a priority for Daqing's officials in recent years.

Second, SOEs continue to dominate Daqing's economy, especially the industry sector. In 2012, SOEs contributed 70.3 per cent of industrial value added (Table 2). This is mainly because after decades of development, SOEs have developed a relatively complete industrial chain of petroleum and petrochemical products. Local and private enterprises, as latecomers, lack the production scale and developed technology to effectively work with SOEs as parts providers. Furthermore, CNPC continues to monopolise the expropriation and distribution of oil resources in Daqing. Although CNPC has recently increased the quota for local oil processing, the majority of oil is allocated to its petrochemical subsidiaries, leaving little for local and private enterprises. In 2012, local enterprises only processed 908,000 tons, which was 7.1 per cent of the total. Consequently, the room for developing local and private oil processing enterprises is extremely limited. At the time of writing, SOEs and local enterprises have yet to overcome the separation that traditionally characterised Daqing's economy. Working out how to break through the barriers and promote cooperation among public and private enterprises is a tough challenge facing Daqing today.

Table 2 Changes in the ownership structure in Daqing

Year	1: Added value of the state-owned economy (billion RMB)	2: Added value of the non-state-owned economy (billion RMB)	Ratio (%) (1:2)
1990	136.0	4.4	96.9:3.1
1995	378.3	10.5	97.3:2.7
2000	858.0	39.7	95.6:4.4
2005	1039.3	132.1	88.7:11.3
2012	2219.0	938.4	70.3:29.7

Source: Data from Zhang et al. (2011) and Daqing Statistical Yearbook (various years).

The fiscal system presents the third challenge. Local officials we interviewed often complained about the fiscal system, because many taxes, including the resource tax and the value-added tax for SOE, are passed on to higher levels of government.

Consequently, the revenue of the Municipal Government of Daqing is still relatively small. In 2012, the fiscal income was 26.3 billion RMB, only 6.6 per cent of the regional GDP, much lower than the average of 11.9 per cent in Heilongjiang Province. Insufficient revenue slows down the transformation process by limiting the municipal government's ability to invest in urban infrastructure and attract capital for investment in non-oil based industries.

Finally, most of the support from higher levels of government and the CNPC was provided on a short-term basis, contributing to a state of uncertainty over the long-term future of Daqing's transformation project. Moreover, the responsibilities of the key actors involved in Daqing's transformation have not been clearly defined in the legislature. For example, the SOEs only irregularly contribute financially to the municipal government to carry out ecological restoration, but are not compelled by law to assume such responsibility. These lingering institutional challenges suggest the need for an overarching body to coordinate the stakeholders, put in place the necessary legislation and monitor progress.

Conclusion

This article has discussed the strategies, challenges and characteristics of the economic transformation of Daqing. It shows that there is no uniform way to transform mining cities. As exemplified by Daqing, the transformation of mining cities in transition economies has several characteristics that distinguish them from their counterparts in market economies. Mining cities in transition economies are faced not only with problems stemming from the boom-and-bust economic cycles of the dominant mining industry and the inevitable exhaustion of resources, but also issues associated with the legacy of planned economies, such as the administrative, fiscal and resource allocation system inherited from the planned economy, the dominance of SOEs and the dispersed pattern of settlement. These challenges are not separate issues, but, rather, are fundamentally interwoven and needed to be addressed holistically. Clearly, while some issues (such as improving the urban environment) can be addressed well within the capacity of local governments, others (such as reforming the state-owned sector) can only be taken up by higher levels of government. As a result, the transformation of mining cities in transition economies is often situated in a multi-level governance framework. In contrast, the transformation of mining cities in market economies is mainly a local process in the sense that the key actors are local governments and community-based organisations (Tsutsumi, 2000; Dale, 2002; Martinez-Fernandez et al., 2012b). The transformation process in transition economies is not only determined by local politics, but also by intergovernmental relations between national and regional authorities. Different governments may have different interests and objectives; hence, their actions may not be necessarily beneficial to economic transforma-

tion. For example, the interest of the central government in protecting the profitability of the SOEs in Daqing goes a long way in explaining the monopoly the SOEs have over the exploitation of oil resources, even though such behaviour is harmful to the economic transformation of Daqing. The mining corporations may also play a significant role, not just as wealth contributors, but also as innovators and adopters of new technologies and opportunities. Here, the nature of ownership is a crucial factor. As a socialist legacy, SOEs in transition economies often remain closely controlled by the government. They are driven to pursue government objectives in exchange for protection from competition and other benefits. At the same time, the local processes of capital accumulation and development are fundamental to the sustainability of economic transformation. To ensure that local enterprises do well requires the right kind of institutions, especially regarding the power imbalance and inequalities in the allocation of resource rights.

Another insight from Daqing is the relationship between changes in urban space and economic transformation. Our study shows that the relationship is reciprocal and synergetic. On the one hand, changes in urban space are a product of economic transformation. At the most fundamental level, successful economic transformation prevents the shrinking of mining cities or even leads to their expansion, as with the case of Daqing. Economic transformation also contributes to an increase in government revenue, which is likely to positively affect public investment in urban infrastructure. On the other hand, urban changes also contribute to economic transformation. Mining cities in transition economies often have inadequate public infrastructure and poor environmental conditions. Fixing these urban problems not only improves the image of the city and attracts more investment, but also provides a better environment for business. There is, therefore, the potential for a virtuous cycle, in which economic transformation and urban changes reinforce one another.

Finally, we would like to conclude by discussing some practical lessons learnt from the Daqing experience. Perhaps the most important lesson is the value of initiating the transformation long before the decline phase begins. Although resource depletion is both foreseeable and unavoidable, transformation initiatives are often developed after the decline in mining has begun. As exemplified by Daqing, the merit of an early start in transformation is that it allows the leading mining industry to provide a longer period of support for the development of alternative industries, enabling the negative impacts brought about by the decline of the mining operation to be effectively alleviated. Moreover, this early adaptation has effectively reduced the withdrawal cost of the mining industry and the development cost of alternative industries. Thus, the Daqing experience has implications for mining cities that have not yet entered the decline phase. In light of the inevitability and predictability of resource depletion, integrated planning for transformation needs to happen as early on in the lifecycle of a mining city as possible.

Regarding the transformation strategies, the case of Daqing shows that while the diversification of industrial structure is essential in the transformation of any mining city, a rush to sever ties with the mining sector is not always the best strategy. Unlike most cases reported in the literature from mining cities in market economies, the economic transformation of Daqing does not rely on the deindustrialisation of the urban economy and the rise of the tertiary sectors, such as the creative and tourism industries, which have been regarded as an instrumental tool in the urban regeneration of Western countries. In contrast, Daqing's current economic success is associated with a commitment to a new path of (re)industrialisation that builds on the city's existing assets as the oil capital of China. For mining cities with a sufficient resource supply, the transition can be carried out by extending the mining industry both vertically and horizontally. This initial diversification can serve as a stepping stone to further economic diversification into non-mining industries. However, the strategy of (re)industrialisation is highly dependent on local competitive advantages and requires careful consideration of the availability of resources, the environmental carrying capacity, the local and national economic context, the international division of labour and the suitable scale of development.

As regards transformation strategies, Daqing illustrates the need for a comprehensive approach to economic transformation. All too often, transformation strategies that are narrowly tailored to attract one or two industries have met with mixed results. A comprehensive approach would involve a number of interconnecting activities, including rebalancing the public and private sectors, controlling the rate of resource depletion, promoting economic diversification with government policies, implementing institutional reforms and reconfiguring urban space. While important to all mining cities, a comprehensive approach is particularly relevant to cities in transition economies, because of the additional challenges they face associated with the socialist legacy.

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