

CASE STUDY**AUSTRALIA:
HORIZONTAL LINKAGES****POSITIVE SPILLOVERS THROUGH
HORIZONTAL LINKAGES****OVERVIEW****LEVEL OF OPERATION:**

National; industry

GOVERNMENT ROLE:

Regulator (initial stage); program facilitator

LINK TO POLICY ADOPTED:see [Australian Innovation System Report & Mining Equipment, Technology and Services Growth Centre](#)**KEY COMMODITIES:**Coal (world lead), bauxite, alumina, iron ore, uranium, zinc, LNG¹**TOTAL NATURAL RESOURCE RENTS
(AS % OF GDP) (2015):**4.8 per cent²**NATIONAL EXTRACTIVES COMPANY:**

N/A (Although a number of large multinational mining firms are based in Australia, including BHP Billiton, Rio Tinto, Fortescue Metals Group and Newcrest Mining)

UNDP HUMAN DEVELOPMENT INDEX VALUE (2016):0.939 (Global Rank 2)³

Australia has achieved modern levels of development as a mineral-based economy, thus avoiding the so-called “resource curse.” The extent, location and diversity of minerals available helped the development of upstream and horizontal linkages, but government policy also played a part.

While the government did not target horizontal linkages explicitly, it set the framework for them to occur through enabling the market process, supporting skills and innovation and encouraging strong upstream linkages. First, it created an enabling environment by instituting investor-friendly reforms and reversing policies hampering the development of the sector. Second, it helped ensure a highly skilled labour force and continuous knowledge diffusion through strong education policies and a National System of Innovation. This

¹ Department of Industry, Innovation and Science. (2017). *Australian mineral commodities*. Canberra, Australia: Government of Australia. Retrieved from <https://industry.gov.au/resource/Mining/AustralianMineralCommodities/Pages/default.aspx>

² World Bank Group. (2017). *Total natural resource rents (% of GDP)*. Washington, DC. Retrieved from <https://data.worldbank.org/indicator/NY.GDP.TOTL.RT.ZS>

³ United Nations Development Programme. (2016). *Human Development Reports: Australia*. Geneva, Switzerland. Retrieved from <http://hdr.undp.org/en/countries/profiles/AUS>



benefited mining firms but also supported the development of specialist supplier firms, which played a crucial role in Australia's diversification into new resource products and other industries, and thereby its economic development. This process relied heavily on the development of capability-led horizontal linkages, confirming the key relationship between successful linkages development and long-term economic growth in a mining-rich country. Finally, Australian policy-makers continue to support linkages with the mining sector through local content policies, which have adjusted for the changing marketplace and changes in competitive threats.

Australia is home to some of the world's biggest mining firms. In 2014, among the top 10 global mining giants, three were Australian.

AUSTRALIA'S MINING SECTOR

Australia has been at the forefront of successive global resource booms over the last two centuries, and the mining industry has shaped the country's socioeconomic history. Its mineral reserves are vast, diverse and of high quality. Australia is the world's largest producer of bauxite and iron ore, and the second largest of alumina, lead and manganese. It is the third largest supplier of nickel, gold, zinc and uranium, and boasts the third largest commercially viable deposits of diamonds. It is also the fourth largest producer of aluminum, coal and silver, and the fifth largest producer of tin.

In 2014, the mining sector (excluding services to mining) contributed 8.7 per cent of Australia's GDP. Furthermore, the resources sector represents almost 20 per cent of the Australian Stock Exchange

market by capitalization and almost one-third of all firms listed. Australia is also home to some of the world's biggest mining firms. In 2014, among the top 10 global mining giants, three were Australian. BHP Billiton is one of the world's largest and most diverse mining firms; its Australian operations include iron ore, nickel, coal, copper and petroleum. The British-Australian multinational Rio Tinto is the world's third largest mining company, with the second largest iron ore assets in the world, as well as large exploitations of coal, copper, aluminum, diamond and uranium. Fortescue Metal Group boasts large iron ore operations globally.

Australia is not just a producer and exporter of raw materials. It has one of the strongest upstream supplier bases, particularly mining equipment, technology and services. It is estimated that at least 60 per cent of the world's mines operate with Australian-designed software. This supply base provides specialized equipment for extraction and processing, highly

sophisticated technology and expert services, such as engineering, mapping and geological analysis. Importantly, the mining equipment, technology and services (METS) sector now makes up nearly 7 per cent of GDP and employs 7 per cent of the Australian labour force, more than the mining sector itself.⁴

BRIEF HISTORY OF AUSTRALIA'S MINING SECTOR

Resources have historically represented the majority share of Australia's exports, accounting for more than 70 per cent of goods sold abroad throughout the 20th century, although in 1938, when the country began to export iron ore on a small scale, the government imposed an embargo on all iron ore shipments to conserve the remaining supply. The embargo was lifted only in the 1960s, after which

⁴ Organisation for Economic Co-operation and Development (OECD). (2017). *Local content policies in minerals-exporting countries: Case studies*. Paris: Working Party of the Trade Committee, OECD. Retrieved from [http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=TAD/TC/WP\(2016\)3/PART2/FINAL&docLanguage=En](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=TAD/TC/WP(2016)3/PART2/FINAL&docLanguage=En)



the state started to encourage exploration and construction. A rapid series of new discoveries, not only of iron ore⁵ but also of copper, nickel, bauxite, uranium, phosphate rock and petroleum accelerated the growth in minerals production dramatically.

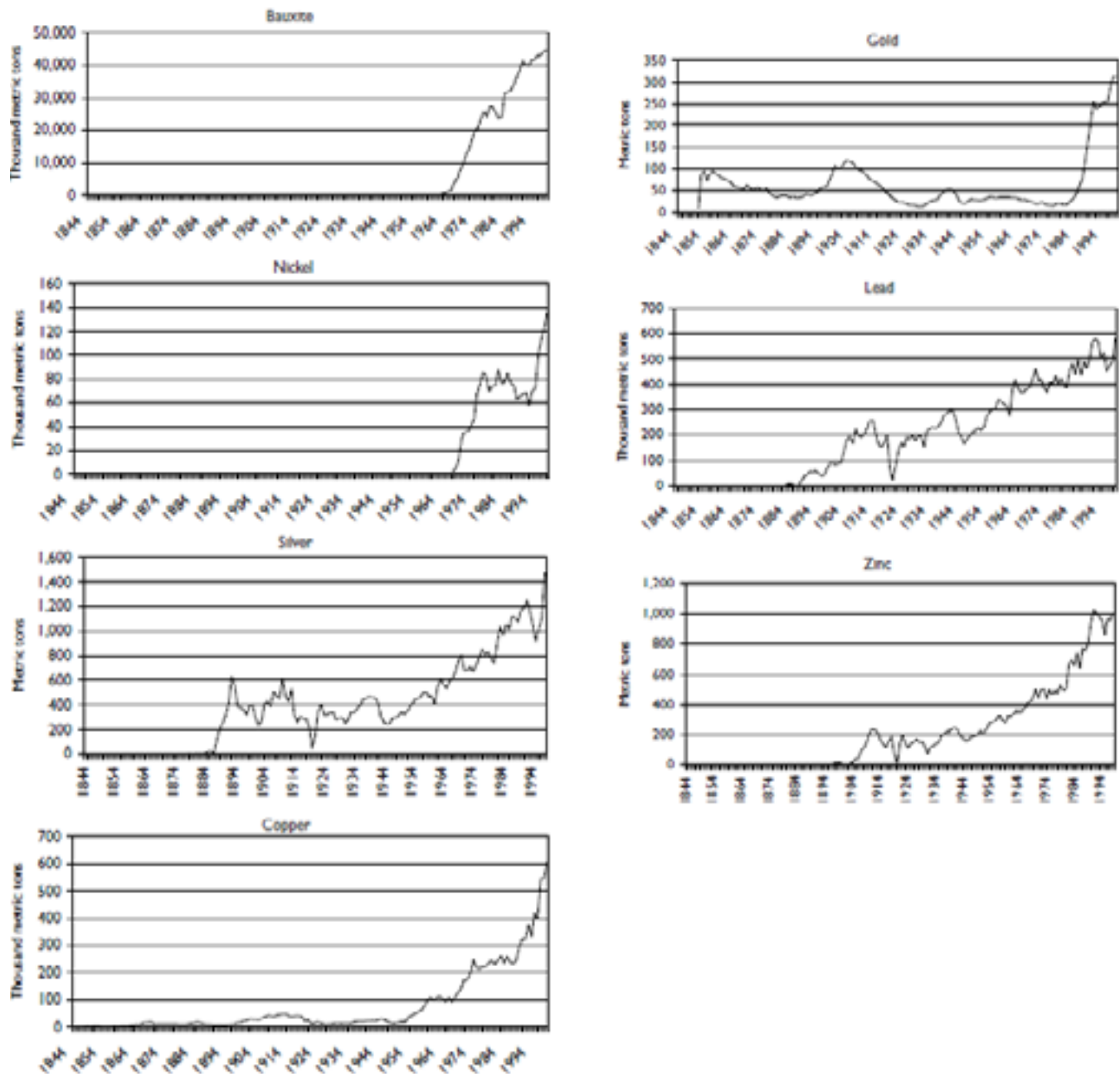


Figure 1. Australia's mine production (selected minerals), 1844–1998

Source: Wright, & Czelusta, 2004.⁶

⁵ By 1967, Australia's proven reserves of high-grade iron ore were more than 40 times the level of 10 years earlier.

⁶ Wright, G., & Czelusta, J. (2004). Why economies slow: The myth of the resource curse. *Challenge* 47(2), 6–38. Retrieved from <https://web.stanford.edu/-write/papers/Wright%20Res%20Curse.pdf>



Australia's long-term growth in extractive industries was the result of the successive discovery and development of new resources. The country's ability to remain a resource-based economy throughout decades of development hinged upon its capacity to repeatedly find, develop and grow new extractive resources in the second half of the 20th century, as reflected in Table 1.

1950s	Oil
1950s-1960s	Rutile/ilmenite
1960s	Aluminum
1970s	Natural gas
1980s	Uranium
1990s	Coal seam gas
2000	LNG

Table 1. Successive development of extractive industries in Australia, 1950–2000.

Source: Ville S. and Wicken O. (2012)⁷

MINING SECTOR AND ECONOMIC GROWTH: DEVELOPMENT THROUGH HORIZONTAL LINKAGES

Australia also represents one of the most striking success stories in mineral-based economic development, defying the notion that natural resource-based economies are bound to experience slow or incomplete development. Beginning in the 1960s, the country saw a prolonged period of simultaneous occurrence of technological progress, successful minerals exploration and economic growth. As the Australian mineral sector's share of GDP expanded through the mid-1980s, new and old Australian industries also benefited, including metal and steel

products, automakers, industrial equipment, ships and chemicals. To date, Australia has continued to rely heavily upon its mining and related sectors.

Attempts at explaining Australia's success bring into focus the role of horizontal linkages. Running counter to the resource curse hypothesis, the successful long-term growth of Australia's

economy is closely related to dynamics in its extractives sector. A central feature of Australia's extractive sector is the strong linkages with other parts of the economy, including the capital goods industry, business services and the science/R&D system. Pol, Carroll, & Robertson (2002)⁸ explained these dynamic linkages between sectors in the

Australian economy by distinguishing between "enabling" sectors, that produce new problem-solving products, and "recipient" sectors buying these products. Their work demonstrates how innovation occurred in the economy that permitted exploitation of new resources. Extractive industries, in their quest for new technologies and processes to improve efficiency of existing operations, spur innovations in related upstream sectors. In turn, these innovations are applied to and benefit other extractive industries and other parts of the economy. In Australia, mining services and mining equipment technologies developed as problem solvers for the existing resource industry. The capabilities developed by the capital equipment companies and mining services firms became a crucial asset for the expansion of the mining industry, thus creating a positive feedback loop. This process also created more horizontal linkages as knowledge developed for the resource sector diffused into many other parts of the economy.

The OECD (2017)⁹ takes this argument further. They argue that this specialist knowledge is better

⁷ Ville, S., & Wicken, O. (2012). *The dynamics of resource-based economic development: Evidence from Australia and Norway* (Working Paper 04-12). Department of Economics, University of Wollongong. Retrieved from <http://ro.uow.edu.au/cgi/viewcontent.cgi?article=1248&context=commwkpapers>

⁸ Pol, E., Carroll, P., & Robertson, P. (2002). A new typology for economic sectors with a view to policy implications. *Economics of Innovation and New Technology* 11(1), 61–76. Retrieved from <http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN014334.pdf>

⁹ OECD (2017), Id. note 4.



placed in outside firms (which can specialize and can access the entire market), rather than be developed in-house. Thus, Australia's comparative advantage in METS also supports its comparative advantage in mining.

THE ROLE OF GOVERNMENT POLICY

Government played a role in introducing and adapting policies when needed, creating a good business environment and focusing on skills development throughout.

Mines were initially required to fund (or make a major financial contribution to) the infrastructure for the mining operation. This covered not only the railways and ports but also the social infrastructure, such as streets, houses, schools, hospitals and recreation facilities. This requirement arose partly because governments had difficulty finding the funds required because of competing demands in a time of rapid economic expansion. Another argument was that, because the mineral deposits belonged to the state, the benefits of their exploitation should go to the general public.¹⁰ This push for infrastructure ended in the mid-1980s as many companies adopted a fly-in/fly-out arrangement to servicing remote mining operations rather than constructing mining townships. Mines in and after the 1980s would not have been economic if a town had to be constructed near the mine site.¹¹

Initially, the government also took a financial interest in mineral exploration and mining. This was subsequently phased out, and by 1987 the

Australian mining industry became wholly owned and operated by the private sector.¹² This was coupled with major economic reforms which built more flexibility into the economy. Changes included market-based reforms to energy, water and transport, the labour market, trade and investment liberalization and taxation reforms. Economic reform has provided a business environment in which new industries have been able to develop, grow and pursue innovation.¹³

The Australian government, at both federal and state levels, has been consistent in its support for skills and innovation. It has historically sought to align its education system to skills needs and to ensure it is able to respond flexibly to changing needs.¹⁴ It has collaborated with mining firms, which in turn influenced the national science system, resulting in a specialization in scientific

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areas relevant to the exploitation of minerals. This started early on, with governments setting up organizations conducting geological surveys (Victoria 1852, Queensland 1868, South Australia 1882) and supporting the establishment of Schools of Mines. These institutions fostered increasingly effective and efficient exploration techniques. A key characteristic of these research communities was the strong interaction with relevant industries; the leading scientists were actively engaged

¹⁰ McKay, B., Lambert, I., & Miyazaki, S. (2000). The Australian mining industry: From settlement to 2000. *Australian Mining Industry*, 1998–99, ABS Catalogue No. 8414.0. Retrieved from <http://www.abs.gov.au/ausstats/abs%40.nsf/94713ad445ff1425ca25682000192af2/93136e734ff62aa2ca2569de00271b10!OpenDocument>

¹¹ Gillies, A. D. S., Wu, H. W. & Jones, S. (1997). The increasing acceptance of fly-in fly-out within the Australian mining industry. *Proceedings Aust. Inst. Min. Metall. Conference*, pp 87–95.

¹² McKay et al. (2000), Id. note 8.

¹³ Satchwell, I. (2013). Mining and development in Australia: Driving structural transformation. *GREAT Insights* 2(2). Maastricht: ECDPM. Retrieved from <http://ecdpm.org/great-insights/growth-to-transformation-role-extractive-sector/mining-and-development-in-australia/>

¹⁴ Ibid.



with firms (as consultants, investors and owners of companies) and developed plans for new investments and technologies.

Horizontal linkages were not specifically targeted for government support; instead, they were a by-product of support for the business environment, innovation and skills development, and upstream linkages. The government has continually supported the development of upstream linkages in many ways, such as tax and grant incentives for R&D and the establishment of research centres, including the influential Advisory Council of Science and Industry¹⁵ (created in 1916), which developed a strong minerals research capacity from the 1930s onward.

This also included a specific focus on upstream linkages. For example, the Cooperative Research Centre for Mining Technology and Equipment was established with government and industry support in 1991. A skilled workforce combined with high-quality education and training institutions have been important success factors in the establishment of upstream sectors and the emergence of horizontal linkages.¹⁶ Hence, Australia's mineral sector has functioned as a driver of knowledge development in upstream sectors, which have enabled the diffusing of technology to many parts of the economy. However, at the same time, the size of the deposits and the remoteness of many mines supported investment into local supply capability and the creation of linkages.

In the last 30 years, the general approach of the Australian government has been to support mining and related industries, adopting relatively light-handed interventions focused on industry participation partnerships and skills support rather than strict local content policies. The government explicitly acknowledged the importance of the

METS sector in 2001 when it announced an Action Agenda for the industry, noting:

- The importance of the METS sector to Australian mining
- The special issues created by the industry's complex interaction with the mining industry
- Its growing importance as an industry and an exporter in its own right.

Australia's mineral sector has functioned as a driver of knowledge development in upstream sectors.

The Action Agenda provided a framework within which METS companies could work with national and state governments, research agencies, educational institutions and the minerals industry to develop a sustainable and internationally competitive sector. Among the issues identified as central to a strategy for growth by the Action Agenda were:

- Access to R&D services and commercialization mechanisms
- Access to venture capital, and building awareness about investment capital
- The need to maintain the supply of specialist staff
- Awareness and understanding of intellectual property

This support, coupled with the mining boom, helped the METS sector to grow five-fold in the past 15 years.¹⁷ It is important to note the timeframe of these developments: while mining has been occurring for more than a century in Australia, global market conditions supported

¹⁵ Today called the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

¹⁶ Satchwell (2013), Id. note 13.

¹⁷ Scott-Kemmis, D. (2013). *How about those METS? Leveraging Australia's Mining Equipment, Technology and Services Sector*. Sydney: Minerals Council of Australia. Retrieved from http://www.minerals.org.au/file_upload/files/publications/mca_how_about_those_METS_FINAL.pdf



by appropriate policies have helped the METS industry become a major player in the Australian economy in recent decades.

The current Australian government aims to maintain its competitive advantage in METS, recognizing its critical role in the country's overall competitiveness. To compete against low-cost suppliers from Asia and a trend toward offshoring manufacturing, Australia uses several incentives and policies to promote linkages.

KEY LESSONS

- Developing capabilities and linkages requires a long-term approach. Governments should devise policies that are realistic given their context. These policies should evolve given feedback from monitoring and evaluation (and from the private sector), and can increase in ambition over time.
- The business environment determines how (or if) linkages occur. Policies to promote horizontal linkages are unlikely to be successful when the overall business environment is not conducive.
- NSI policies require buy-in across a range of governments departments/agencies beyond the mining department and cooperation of many more actors from beyond the mining sector. The system of innovation extends to industry-focused government departments, research entities, whether public or private, the mining sector, the manufacturing industry, etc.
- Horizontal linkages can be supported through investments in the National System of Innovation. This intervention seeks to advance skills and knowledge, with a view toward application to related and unrelated sectors. This can include building ties between the mining sector and higher education institutions that focus on mining-related science and technology, offering R&D and innovation incentives, or directly contributing to R&D programs. Results, however, are not likely to be felt in the short term.
- Capability-led horizontal linkages most often develop from upstream linkages. If upstream linkages do not yet exist or are underdeveloped, then the focus should be to develop these upstream linkages. It may be possible to develop some horizontal linkages in parallel to developing upstream sectors.
- Local context and the market are the main drivers for horizontal linkages. The type and specific conditions of mining required influence the technologies used and the potential for spillovers. The stage of development of the mining sector thus helps determine horizontal linkages.



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