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Opportunities and challenges facing the Australian resources sector*

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The resources sector has made a significant contribution to Australia's prosperity over a large part of its postcolonial history. A combination of substantial mineral and energy resources, perceived low sovereign risk, a skilled workforce, technological leadership, openness to direct foreign investment and relative freedom from interventionist government policies has shaped the Australian resources sector into a highly competitive supplier of minerals and energy products to global markets. Despite this strong global market position, the past performance of the resources sector is no guarantee for its future. The sector operates within a highly competitive globalised environment. Its future depends on its ability to remain internationally competitive, while pursuing sustainable development through a combination of resources discovery and exploitation, socially responsible development and effective environmental stewardship.

Key words: Australia, challenges, energy, opportunities, resources.

1. Development of the Australian resources sector

Australia's resources sector has a long and varied history, starting from the early years of the European colony with the 1799 discovery, collection and sale of coal from outcrops near Newcastle (Huleatt 1981). However, the major impetus for resource development came with the discovery of gold near Bathurst (1851) and subsequent rich finds in Victoria. The 'gold rushes' that ensued brought with them a large increase in immigration from around the world (the population trebled in the 20 years to 1871) as prospectors sought their fortunes.

The influx of immigrant prospectors and the exodus of resident workers from towns, cities and farms in pursuit of riches wrought profound changes on colonial Australian society and on the economy. In the case of farming, the exodus of farm labour provided an important impetus to innovation, particularly in regard to the invention, development and speeded adoption of labour saving devices such as mechanised grain harvesting (the

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stripper-harvester 1884), cultivating machinery such as the stump jump plough (1876) and mechanical sheep shearing (1887).

What followed in the second half of the 20th century was a period of consolidation for the Australian resources sector; cementing itself as a cornerstone of the economy, supplanting agriculture as the nation's principal commodities export earner, and creating significant wealth for industries servicing the sector. From the middle of the century, a number of major developments provided the basis for a substantial leap forward in scale and earning capacity to produce the sector of today. Important milestones in the second half of the 20th century included the development of iron ore mining in the Pilbara region of Western Australia; the discovery and development of oil and gas in Bass Strait (Victoria) and later on the North West Shelf (Western Australia and Northern Territory); and the major expansion of coal mining and exporting from Queensland and New South Wales.

The resources sector continues to play a critical role in 21st century Australia, and can be expected to do so for the foreseeable future. One interesting aspect of the resources sector is that many of the issues that were around in the 19th century remain with us today. For example, the expansion of resource extraction in response to rapidly growing global demand for iron ore, coal and natural gas is contributing to a strong Australian dollar, strong economic growth and high demand for skilled labour that is being met in part by increased immigration and the movement of labour from other parts of the economy, including from agriculture.

A few key statistics demonstrate the importance of the resources sector to the Australian economy. In industry gross value-added terms, the mineral resources industries in 2010–11 accounted for around 9.5 per cent (\$122.9 billion) of gross domestic product (ABS 2011a), and at 205,000 employees represented 1.8 per cent of the Australian workforce (ABS 2011b). These figures belie to some extent the significance of the sector to the economy in terms of its contribution to exports and its role in regional (nonurban) Australia where the mines, oil and gas wells, and most processing and shipping facilities are located. With respect to exports, in 2010–11, mineral and energy resources accounted for an estimated 84 per cent (\$177 billion) of Australian commodity exports (BREE 2011), and 59.5 per cent of total goods and services exports (BREE 2011).

There are a range of factors contributing to the prominence of the resources sector in the Australian economy and the day-to-day lives of many of its citizens. Strong economic growth, increasing industrialisation and rapid urbanisation in developing economies, particularly in China, have driven rapid growth in demand for resources over the past decade. A combination of good resource endowments and attractive prospectivity, perceived low sovereign risk for investors, a skilled workforce, technological leadership, openness to direct foreign investment and relative freedom from interventionist government policies means the Australian resources sector is a highly competitive supplier to global markets.

An overview of the key drivers underpinning the performance of the Australian resources sector to date is provided in the first part of this article. This is followed by an analysis of some of the key opportunities and challenges that confront the sector as it enters a period of considerable transformation in the global economy in the decades ahead.

2. The forces that shaped the resources sector

The Australian resources sector is highly competitive globally. This is in part the result of Australia's minerals and energy resources prospectivity, perceptions of low sovereign risk, ready access to global capital and openness to foreign investment, the policy approach to dealing with environmental and social considerations, technological expertise and development, and a skilled labour force. Australia has also benefited from minimal government involvement which has forced the industry to be innovative to remain competitive.

2.1. Resource endowment

Australia's resource endowment has ensured that the resources sector is a significant contributor to the Australian economy. As shown in Table 1,

Table 1 Economic demonstrated resources (EDR) and production, 2009 – Australia

		Australia in world EDR			Australia in world mine production			Australia's EDR to production ratio*
			Rank	Share		Rank	Share	
	Unit	EDR	No.	%	Volume	No.	%	Years
Bauxite	Mt	6200	2	23.0	65.8	1	34.1	94
Black coal	Mt	43800	5	7.0	335.2	4	5.7	131
Brown coal	Mt	37100	1	25.0	64.0	5	7.6	580
Copper	Mt	80.4	2	13.0	1.0	6	6.0	85
Gold	t	7399	2	12.3	224.0	2	8.7	33
Iron ore	Mt	28000	2	17.0	394.4	1†	24.8	71
Lead	Mt	30.8	1	36.0	0.5	2	13.6	59
Manganese	Mt	181	4	13.0	4.4	2	14.4	41
Mineral sands								
Ilmenite	Mt	200.4	2	16.0	1.6	3	15.7	129
Rutile	Mt	22.7	1	49.0	0.3	1	48.2	79
Zircon	Mt	40	1	46.0	0.4	1	39.3	96
Nickel	Mt	24	1	35.0	0.2	4	12.3	145
Silver	kt	70.3	1	16.0	1.6	4	7.8	43
Tin	kt	176	8	3.0	13.3	5	4.3	13
Uranium	kt	1223	1	46.0	8.5	3	16.7	144
Zinc	Mt	58.4	1	25.0	1.3	3	11.2	46

*End of calendar year data (EDR) as a share of production in the same calendar year.

†China produces a larger volume of iron ore, but the total figure is rounded down to account for quality differences.

Sources: Geoscience Australia (2011); ABARES (2010).

Australia has the world's largest economic demonstrated resources of brown coal, lead, mineral sands (rutile and zircon), nickel, silver, uranium and zinc, and significant resources of bauxite, black coal, copper, gold, iron ore and manganese ore (Geoscience Australia 2011). The majority of Australia's mineral and energy resources are located in accessible terrains with favourable climatic conditions.

Australia's success in tapping its substantial resource endowment is in part due to policies that foster the availability of considerable amounts of public access geoscience information. The process includes the collection, collation and integration of basic geoscientific data by the states and territories individually and in collaboration with Geoscience Australia. Contributing to the amount of geoscientific information available is the requirement by the States and the Northern Territory that companies provide exploration results that are made open file after a confidentiality period (Penney *et al.* 2007).

Public geological surveys have an important role in reducing the cost and risk associated with exploration. Hogan (2003) suggested the economic rationale for public geological surveys included that:

- By making basic geoscientific information available as a public good, it can be used simultaneously by private explorers to assess areas for further exploration.
- Publicly funded geological surveys reduce the risk of early stage exploration for private explorers, thus increasing the probability of success of further exploration in these areas.
- Governments can achieve economies of scale in regional mapping and information dissemination as they are not constrained by tenement boundaries.
- Public provision of information about the location and geology of new resource deposits and about the general prospectivity of an area allows additional private explorers to free ride on the investment in exploration, thus increasing the chances of private explorers commencing exploration in a region.

Recent work undertaken in the context of the strategic review of Geoscience Australia provides empirical support to the notion that there is a positive relationship between government expenditure on pre-competitive geoscience and private exploration activity (Commonwealth of Australia 2011). For example, the quantitative modelling found that a one-off \$1 million increase in federal government expenditure on pre-competitive geoscience leads to an increase in private offshore petroleum exploration expenditure of \$31 million (in 2009–10 dollars), with a 3-year lag.

2.2. Perceptions of sovereign risk

While prospectivity has clearly been an important factor underpinning the development of Australia's mineral resources, the sector has also benefited

from Australia's reputation as a country with low sovereign risk – that is, the risk to an investor in a project that a government action will cause loss which could not have been foreseen when the project was committed to, and with no adequate legal remedy available. This stems from relatively stable social, political and cultural structures supported by strong regulatory and legal frameworks, and relatively open trade and investment regimes.

In addition to sovereign risk, resource companies are also concerned with transparency, good process and certainty around policy design and implementation, as these affect the cost of capital. Australia gets a consistently high ranking across a wide range of global risk indexes, both general and mining specific (Fraser Institute 2011).

The sensitivity of potential investors to those risks is well illustrated by events surrounding the Australian Government's announcement (in mid-2010) of its intention to introduce a mineral resources rent tax. The resource sector's initial reaction to the originally proposed tax was overwhelmingly negative. In the Fraser Institute's mining survey 2010 mid-year update, which canvasses mining company executives' perceptions of the relative attractiveness of sovereign jurisdictions as a place to invest, the aggregated average score for the Australian states declined to 40.9 (of 100) from 62.9 in the previous year (Fraser Institute 2010). Following the government's subsequent decision to review the tax proposal and to engage in stakeholder consultation, the score rebounded to 64 in the 2010–11 survey (Fraser Institute 2011). This clearly reinforces the importance of stakeholder engagement in any reform process.

2.3. Access to capital and foreign direct investment

The capital-intensive nature of most resources sector activities means the ability to raise investment finance and capital is critical to success. Companies operating in Australia are able to raise capital through domestic and international borrowings as well as listings and share placements on the Australian Securities Exchange (ASX). As at September 2010, there were 621 metals and mining companies listed on the ASX.

With its small population, geographic diversity and the significance of capital-intensive industries, Australia has always been heavily dependent on foreign direct investment for its development. Openness to foreign investment and participation has been a key driver in the development of Australia's internationally competitive resources sector. For example, investment from Japan and Korea was fundamental in the development of the Australian coal and iron ore industries from the 1960s. More recently, investment has been coming from China and India as those nations seek strategies to secure stable sources of supply to meet burgeoning domestic demand for mineral and energy resources.

Reflecting the attractiveness of Australia as an investment destination, foreign direct investment in the Australian mining sector has increased fourfold

since 2000 and in 2010 was around \$150 billion (Figure 1). Mining accounted for around one-third of all foreign investment in Australian industry in 2010.

The contribution of foreign direct investment to the development of an internationally competitive mining sector in Australia is well recognised (Drysdale and Findlay 2008). As well as providing capital to finance an investment rate in excess of the domestic savings rate, foreign direct investment provides exposure to international standards and best practices, access to new or modernised technology, knowledge sharing, better market access opportunities, availability of lower cost capital and opportunities for shifting risk.

2.4. Environmental and social considerations

The growth of the resources sector in Australia has also been contingent on mining companies recognising that their long-term commercial interests are linked to environmental accountability and social responsibility. This has been supported by a combination of a strong legislative framework that covers the impacts of extractive activities on the environment and on affected communities, rehabilitation and industry self-regulation.

The Environmental Protection and Biodiversity Conservation Act 1999 is the overarching Commonwealth legislation dealing with issues of national environmental significance, and thus has relevance to mining. However, states and territories administer mineral rights through the issue of permits for exploration and mining according to their own mineral and environmental legislative frameworks. For example, the Commonwealth and each state and territory has legislation relating to Environmental Impact Assessment which provides a process for assessing likely environmental impacts of a proposed project that has a potential significant environmental impact.

All applications for mineral tenements are subject to the consideration of the Native Title Act 1993. Where the land may be subject to native title, prop-

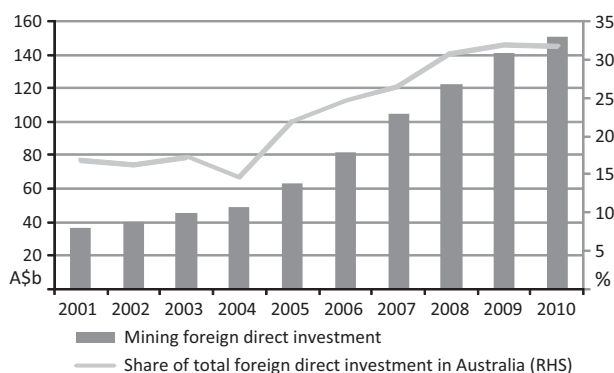


Figure 1 Foreign direct investment in Australian mining. Source: ABS (2011d).

erty rights are assigned to native title parties. As a result, these parties are able to negotiate agreements with exploration and mining companies that involve the receipt of economic benefits in return for the temporary impairment of cultural and social rights.

2.5. Labour, skills and technology

The stock of human capital in the Australian resources sector has also contributed to its competitive advantage. The main drivers behind this are the evolution of a highly skilled and experienced workforce to service the resources sector, and the development of a number of initiatives by governments and industry designed to expand the range of training programs to address short- and long-term skilled labour needs of the sector.

Compared with the general Australian workforce, a higher proportion of the resource sector's workforce has post-secondary qualifications (SkillsInfo 2011a). Approximately 80 per cent of the workforce is aged between 25 and 54 years, with the highest proportion aged between 25 and 34 (SkillsInfo 2011b). This compares with around two-thirds of the workforce across all industries aged between 25 and 54.

The performance of the sector has been underpinned not only by the skills and knowledge of the labour force, but also by access to world-class technologies. With new resources being discovered globally in ever more challenging environments, innovative technological solutions are being increasingly required to bring them to profitable production in a competitive market. The Australian resources sector is widely regarded as a world leader in the design, development and servicing of equipment, software, exploration assessment technology, minerals processing technology, environmental services, and health and safety services and equipment (Tedesco and Haseltine 2010). Investment in the Australian mining technology services and equipment sector has allowed domestic producers to access lower grade ore bodies, extend the life of existing operations, minimise the environmental impact of mining operations, increase efficiency and enhance safety (RET 2011).

The mining technology services and equipment sector in Australia has expanded considerably in response to demand from the domestic resources industry as well as from overseas miners. In 2008–09, the sector's sales revenue was an estimated \$6.2 billion, and export sales revenue was \$2.5 billion. Total research and development expenditure in the sector was estimated at around \$985 million in 2008–09 (Tedesco and Haseltine 2010).

3. Key drivers that will shape the future of the resources sector

3.1. The Asian century

Demand for resource commodities is expected to remain robust over the medium to long term. Although traditional large consumers of raw materials in

advanced economies will remain important to global commodity markets, most of the growth is expected to come from emerging economies in Asia. As Asia continues its historic transformation, rising incomes, aspirations to higher living standards and demography will all support sustained demand for mineral and energy commodities. This offers an unprecedented opportunity to the Australian resources sector flowing from its position as a competitive and reliable supplier to global markets.

3.1.1. China

China has emerged as a significant source of demand for resources, driven by rapid industrialisation and increasing urbanisation associated with strong economic growth and expanding manufacturing output to meet rising domestic and export demand. These trends are expected to continue over the medium to long term (RBA 2010).

Growth in China's industrial production has resulted in the expansion of resource-intensive industries, such as electricity generation and the production of steel, pig iron and cement (ABARES 2011). The process of industrialisation has also necessitated fast-paced expansion of infrastructure.

There has been exponential growth in China's urbanisation, with the urban population having grown more than fourfold between 1970 and 2010. High rates of urbanisation are expected to continue with the urban population expected to reach 62 per cent of the total population by 2030 (United Nations 2009). Rapid urbanisation has been accompanied by a growing middle class as Chinese economic growth is translated into increasing per person income. Accordingly, there has been growing demand for consumer durables that are resource intensive in both production and use.

While China is a major resource producer, domestic production has not been able to keep pace with demand for a number of reasons including: the long distance of resource deposits from demand centres; infrastructure constraints; pricing regimes; and government policies more generally. As a result, China's imports of resources have increased considerably.

3.1.2. India

India has also emerged as a major consumer of resources. Like China, India has experienced substantial economic growth, increasing urbanisation and a rapidly growing middle class. Historically, economic growth has been strong in economies that have a large percentage of the population in the working age category (roughly between 15 and 60). As shown in Figure 2, there is expected to be a significant increase in the Indian population in this age group over the next 40 years, suggesting that India's strong economic growth should persist, provided that some reform momentum is maintained.

However, India's demand growth has been slower than in China as the population is poorer and the urban population is smaller and growing at a slower pace (Coxhead and Jayasuriya 2010). Further, India's economic

growth has been significantly supported by growth in the services sector which is less resource intensive than manufacturing.

3.1.3. Other emerging economies

There are a number of economies where the intensity of resource use is well below that of developed economies. This indicates that there is considerable potential for growth in demand in these economies over the medium to long term as household incomes increase. An example of the relationship between incomes and minerals consumption is copper (illustrated in Figure 3).

The potential for growth in minerals demand in a range of developing or emerging economies can be seen from Figure 4. While per person consumption is relatively low, these economies have rapidly expanding populations and rising household incomes. The economies in Figure 4 all have populations over 50 million and, with the exception of the United States, have relatively low per person income. The size of the populations of these economies means that even a small rise in per person consumption will translate into large increases in absolute demand for minerals and energy as economic development proceeds.

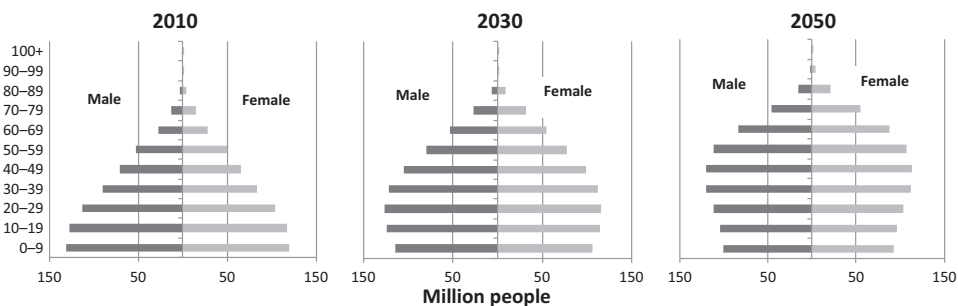


Figure 2 India's population dynamics. Source: United Nations (2008).

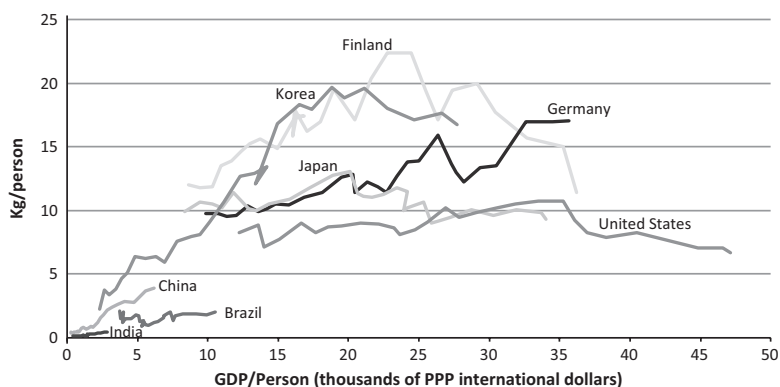


Figure 3 Copper consumption intensity, 1980–2008. Source: ABARES (2010); IMF (2010).

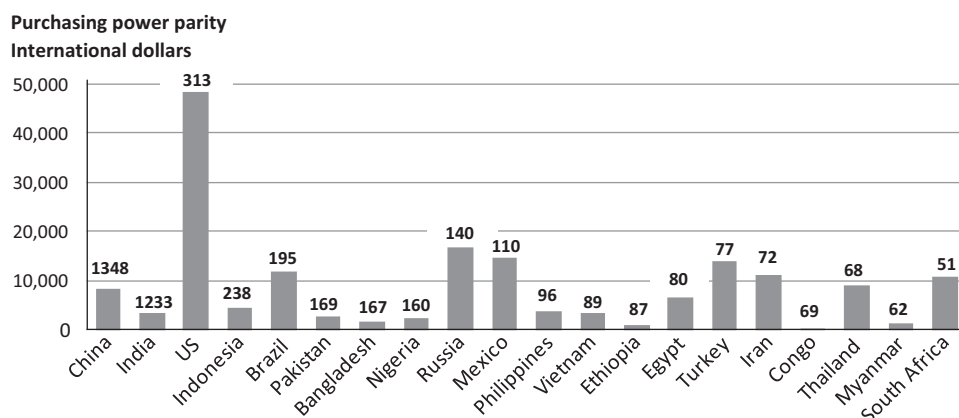


Figure 4 GDP per person and population, 2011. Estimates for 2011, the bolded numbers above each bar represent the population in millions. Source: IMF (2010).

Although each of the developing economies shown in Figure 4 is starting from a substantially lower base than China in terms of resource consumption, collectively they have the potential to contribute significantly to global demand.

3.2. Supply strategy and security

In response to growing global demand and relatively high commodity prices, continued investment in exploration and project development worldwide should ensure there is ample minerals and energy supplies, notwithstanding the expectation that new resource deposits are likely to be smaller, lower grade, deeper and further from markets than those currently in production. However, new suppliers and new procurement strategies are emerging and increasing competitive pressures on the Australian resources sector.

Historically, the majority of global resource supply has been delivered to global markets from North America (the United States and Canada), Latin America (including Brazil, Venezuela, Peru and Chile), the Middle East, Australia, some of Africa and Asia (China, Indonesia and Malaysia). Australia and other traditional major suppliers of resources are expected to remain important to global supply given their resource base. However, production from 'new' regions is expected to increase considerably as companies move to more prospective regions, and large consumers adopt strategies to secure long-term supplies from diversified sources. As an indicator of potential future supply growth areas, recent trends in nonferrous exploration, for example, indicate that Africa continues to attract more exploration spending than Australia, accounting for 13 per cent of global exploration budgets in 2010, compared with 12 per cent for Australia (Metals Economics Group 2011). While in 2010–11, private minerals exploration in Australia amounted

to \$6.2 billion, the second highest level on record in real terms, and around double average exploration expenditure of the past three decades (Copeland and Stanwix 2011), the share of global exploration expenditure flowing to Australia has continued to decline over the past 15 years. The emergence of new players suggests that the Australian resources sector is likely to face growing competition, particularly if some of the challenges associated with resource development in the more prospective and, typically, higher risk regions are addressed.

Africa, for example, is well endowed with mineral resources, having either the largest or second largest reserves of bauxite, chromite, cobalt, hafnium, industrial diamonds, manganese, phosphate rock, platinum group metals and zirconium (USGS 2010). The continent also has substantial coal, iron ore and gas reserves. The Moatize Basin of Mozambique, in particular, has the potential to become a major global centre of coking coal exports, while Tanzania could emerge as a liquefied natural gas exporter.

Although the resources sector is already an important source of export revenue for many African countries, there are significant challenges including the skills and capability of many government and private sector operators; a difficult investment climate; weak governance and poor infrastructure (IFC 2010).

The operating environment within Africa varies considerably, with some countries having a better legislative and regulatory framework than others and, hence, a more developed industry. Nevertheless, there is a general perception that Africa has high sovereign risk, affected by the potential for changes to legislation, regulations and taxation; inadequate enforcement of property rights; and poor physical security for investments and employees. All of these factors, when combined, may not augur well for a rapid expansion of resources output from Africa in response to the strong growth in demand elsewhere.

In Asia, Mongolia has considerable deposits of coal, copper, gold, tin and uranium (USGS 2011). Mongolia has attracted a significant volume of investment to its resources sector since the early 2000s largely because of its mineral prospectivity and liberal minerals legislation (Naranhuu 2009).

Over the medium to long term, Mongolia faces the same challenges as most other resource-rich developing economies in attracting investment to its resources sector. These challenges include improving the stability of the legislative and regulatory framework, the mineral taxation regime, the quality and effectiveness of governance, and infrastructure and skills development (Naranhuu 2009). In addition, as a landlocked country, the geopolitics of negotiating access to export corridors could be highly influential.

Australia's positioning as a leading exporter of mineral and energy commodities is likely to be influenced not only by emerging suppliers, but also by strategies being pursued by large consumers to diversify their supply base. China, for example, is increasing its involvement in mineral exploration globally. In 2010, Chinese companies contributed around 11 per cent of total

global mineral exploration expenditure, with around one-third of their budgets allocated outside China's borders – primarily in Canada, Africa and Pacific/Southeast Asia (Metals Economics Group 2011).

Driven by a strategic push to secure resources and energy to support high economic growth, and also reflecting their integration in global markets, emerging economies of China, India and Brazil are increasing their involvement in the resources sector through both direct and indirect foreign investment in a diverse range of host countries. While the Australian resources sector has benefited from this investment, this trend suggests that the Australian resources sector's future hinges importantly on Australia's ability to continue to offer an attractive investment climate, and the sector's ability to remain internationally competitive through productivity improvements and technological innovation.

3.3. The macroeconomic conundrum

The ongoing resources boom has been of significant benefit to the Australian economy through higher government tax and levy earnings, increased company revenues that have contributed to sustained real income growth in a relatively weak global economic setting, new investment in major mining and related infrastructure projects, increased employment and wages in resources and related sectors, and a higher exchange rate that has benefited consumers of imported goods – all of which have contributed to enhancing Australia's prosperity.

However, high commodity prices and falling import prices have resulted in a substantial and sustained increase in Australia's terms of trade – well outside the bounds of terms of trade movements experienced over the past 50 years (Figure 5). This has created a set of macroeconomic challenges characterised by a multi-speed economy or a patchwork economy, whereby the share of output to GDP falls for the nonresource or lagging sectors, such as

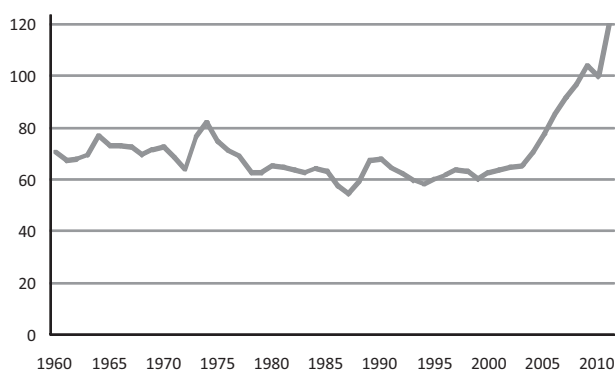


Figure 5 Terms of trade index. Source: ABS (2011e).

agriculture and manufacturing, and rises for resource and related booming sectors, such as mining and construction.

Although it is expected that high prices will bring about additional supply over the medium term, hence placing downward pressure on prices, it is likely that the terms of trade will remain at historically high levels for an extended period (ABARES 2011), notwithstanding a major and chronic setback to global growth prospects.

In the absence of policy interventions, the substantial rise in the nation's terms of trade will stimulate structural adjustment in the Australian economy. This adjustment would come about through lower demand for domestically produced traded goods and through a shift in the allocation of resources (mainly labour and capital) from the lagging to the booming sectors. However, the adverse impacts of the exchange appreciation on some sectors of the economy, particularly agriculture, manufacturing, education and tourism, have led to suggestions that there is a case for government intervention to reverse or offset some of these impacts. However, it is important to recognise that the structural evolution of the Australian economy with a decline in the share of output from agriculture and manufacturing is a long-term trend that is evident in most advanced economies – this trend is only being reinforced by the current mining boom (Banks 2011). Further, it is also the case that some parts of these affected industries are actually benefiting from the resources boom. For example, within the tourism value chain, industries such as regional aviation, commercial accommodation and food services, and more broadly, higher business-related travel demand from Australian and international visitors are all benefiting from the growth in the mining sector (Tourism Research Australia 2011). From these perspectives, promoting the flexibility of resource allocation within the economy, boosting productivity and maximising the spill-over benefits to the nonbooming sectors would be sound policy options.

Alternatively, policy makers could attempt to protect adversely affected industries, either through subsidies or import tariffs in response to calls for industry support. However, the economic arguments against this type of protection are well understood. Another option that is often proposed as a way of moderating an exchange rate appreciation and thereby reducing the adverse impacts on affected industries is the establishment of a sovereign wealth fund. A sovereign wealth fund, through government investment abroad, would increase the demand for foreign currency and, thereby, exert some downward pressure on the exchange rate. A sovereign wealth fund is arguably a form of exchange rate protection that could benefit lagging sector industries (Corden 2011). A sovereign wealth fund would also only make sense when the federal government budget is in surplus. The merits of this type of intervention warrant further analysis, not only in terms of its potential impacts on lagging sector industries, but importantly from a general economy perspective.

3.4. Rising cost structures

Although Australia has a large economic demonstrated resource base for many commodities, most of the low-risk, low-cost development opportunities in Australia have been exhausted. As a result, resource extraction is becoming more challenging as companies attempt to access lower ore grades and develop oil and gas projects further offshore and in deeper water. Ongoing resource depletion is estimated to have had a significant adverse effect on multifactor productivity in the Australian mining sector (Topp *et al.* 2008).

In addition to the challenge of finding and exploiting new resource deposits, the development of large-scale projects globally across most of the energy and mineral commodities over the medium to long term is expected to increase competition for inputs such as raw materials, equipment and energy, and add to production costs. For example, after declining in 2009, the costs of building and operating upstream oil and gas facilities have resumed their upward trend and approaching the record levels seen prior to the global financial crisis in 2008 (Figure 6).

The record levels of investment in the resources sector are also leading to a strong demand for skilled labour. Although successful in attracting significant numbers of low skilled workers from elsewhere in the Australian economy, resource companies face greater challenges in attracting highly qualified staff in the face of intense domestic and global competition for scarce labour. As well, some companies have difficulty in attracting workers because of aspects of the industry such as long shift hours and employment in remote locations. Even though temporary migration programs have contributed to some extent to address labour shortages, the tight labour market has led to significant increases in wages. For example, there is some survey-based evidence to suggest that wages for engineers, geologists and other contractors employed by Australian energy companies increased by 35 per cent in 2011 relative to 2010 and that Australian energy sector salaries were the third highest on a global scale (APPEA 2011).

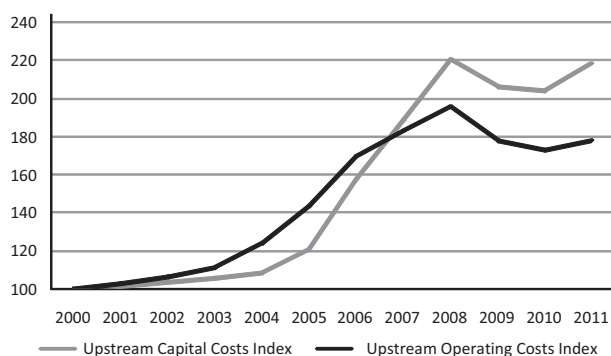


Figure 6 Oil and gas upstream costs. Source: IHS CERA (2011).

Over the medium to long term, there will be a growing need to invest in programs to ensure that the availability of skilled labour does not act as a constraint to development. There are a number of measures that have been suggested under the National Resources Sector Employment Taskforce to address this challenge. These include greater workforce planning and development; increasing the volume of trade professionals employed; increasing the number of engineers and geoscientists graduating from Australian universities; meeting temporary skills shortages with temporary migration; increasing workforce participation, particularly women and the indigenous community; creating stronger ties between industry and education and addressing the need for the development of appropriate social infrastructure to support the expansion of mining communities.

The increasing mechanisation of functions traditionally performed by labour will also be part of the sector's response to labour constraints. An example of this is Rio Tinto's West Angelas iron ore mine in Western Australia where the employment of artificial intelligence in equipment, such as trucks, is currently being explored with the intention of developing a predominantly automated mine (Rio Tinto 2008).

More generally, a rising cost base means innovation, investment in research and development generally, flexible labour arrangements and improved management practices will need to form a major part of company strategies if they are to maintain their competitive edge in a globalised market.

3.5. The infrastructure challenge

Rising global demand for commodities and expanded domestic production have combined to place considerable strain on Australian minerals and energy infrastructure, contributing in some cases to higher transaction costs in trade and constraining Australia's commodity export potential.

In response to expected growth in the sector, there are substantial plans to expand infrastructure related to minerals and energy exports over the coming decade. At the end of October 2011, there were 18 export-related infrastructure projects at an advanced stage of development with a combined capital expenditure of \$24 billion (Copeland and Stanwix 2011).

However, the need for infrastructure investment clearly goes beyond transport and port infrastructure and includes essential infrastructure related to energy, water, telecommunications and social services.

The challenge is not only to ensure there is adequate investment to meet demand for infrastructure services, but also to ensure this investment is efficient and contributes to enhancing the efficiency of industries that rely on it. This involves a combination of effective governance, a balance between providing the right economic incentives for infrastructure providers and infrastructure users, and a coordinated approach to the future development and planning of shared infrastructure. This can prove particularly challenging in the context of Australia's multi-user, multi-

owner export supply chains as illustrated by the significance of ongoing litigation on Part IIIA of the Competition and Consumer Act 2010. As a broad principle, access regimes should be designed to encourage private sector investment and minimise the need for regulation. Where this is not feasible, light-handed regulation through price monitoring should be the preferred approach, with a more heavy-handed approach considered only if the former fails (Exports and Infrastructure Taskforce 2005).

3.6. Renewing the social licence to operate

Maintaining a social licence to operate will continue to have a strong bearing on the development of Australia's mineral and energy resources over the coming decades. A social licence to operate encompasses a wide range of issues from sustainable environmental management and occupational health and safety to stakeholder engagement and the provision of adequate returns to the community for the depletion of Australia's resource base and the loss of any environmental amenity.

With developments in technology and the instant and far-reaching transmission of information, securing community support is undoubtedly becoming more challenging. Major incidents with safety and environmental disasters, even in distant places, can have ripple effects on community support globally. For example, the explosion of the Deepwater Horizon drilling rig operating in the Gulf of Mexico in April 2010 not only had major adverse environmental and socio-economic impacts in the United States but also had a negative influence on community confidence in the oil industry worldwide.

Increasingly, some community concern is also presenting a challenge to resource development particularly in environmentally sensitive areas and where there are competing land uses such as agriculture. This is exemplified by the current debate in Australia about the emergence of a coal seam gas industry in northern New South Wales and southern Queensland and its potential impacts on the environment and food production. It will therefore be critical to ensure that there is sufficient investment in community engagement based on a sound understanding of the potential short- and long-term impacts of coal seam gas developments, both from an environmental and a socio-economic perspective.

Another area in which the resources sector is having to manage its activities in a way that does not conflict unduly with community expectations is in relation to long distance commuting (fly-in fly-out, drive-in drive-out or ship-in ship-out). Such arrangements are an important feature of the Australian resources sector and were introduced as a cost effective means of maintaining workforces at mining operations located in remote areas without the need to develop residential towns, thus enabling the development of some projects that would not have been economic otherwise. These arrangements tend also to have a much lower environmental footprint than that associated with the development of residential towns for particular resource extraction activities

with a finite life. Nevertheless, some state and local governments have raised concerns about the implications of long distance commuting on regional economic development, noting that much of the wealth generated by these employees is not spent in the region it is earned (Briggs 2010).

While all these issues are not trivial, they are not insurmountable. The Australian resources sector has a good track record in terms of being able to work with communities to achieve mutually beneficial outcomes.

3.7. Climate change policies

No analysis of Australia's resources future would be complete without considering the potential impacts of climate change policies, notably the introduction of a carbon price from 1 July 2012. A comprehensive analysis of these impacts is beyond the scope this paper. However, at a general level, carbon pricing can be expected to provide both opportunities and challenges for the sector. Given its export orientation, the impacts of a carbon price on international competitiveness will depend to a large extent on climate change policies adopted in other economies. Another critical factor that will influence the outcomes is the nature and pace of technological development over the coming decades. There are currently divergent perspectives on how emerging renewable energy technologies in particular will evolve over time and, therefore, on how significant a contribution they will make to reducing demand for traditional energy sources, and carbon emissions.

As the world moves to a low carbon society, the sustainability of the remarkable growth spurt occurring in the resources sector will depend at least to some extent on its ability to diversify its economic base to encompass new sectors with a lower carbon footprint, such as those related to mining technology services.

4. Conclusions

The Australian resources sector has a long history of contributing to national economic growth, regional development and the overall wellbeing of the nation's citizens. The sector is currently riding the crest of a demand led wave of prosperity, with much of the associated strong growth in output and investment reflecting the rapid expansion of emerging economies. Substantial endowments of minerals and energy provide a solid base for long-term growth. However, this is clearly not a sufficient condition. The sector faces a number of 'growing pains' that would constrain its growth if they are not addressed. It also faces the prospect of intensifying competition for global capital, and for access to key markets, against a backdrop of changing policy settings both in Australia and abroad.

Sound policies that encourage the expansion of a globally competitive industry that is economically and environmentally sustainable and in tune with the expectations of the Australian community will be essential. A critical

element of community expectations is that resource development decisions are made on the basis of sound and impartial information taking into account a wide range of perspectives. Critical to growth of the resources sector will be its ongoing social licence to operate.

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