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Kym Anderson

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Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

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Abstract

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Kym Anderson - kym.anderson@adelaide.edu.au
University of Adelaide and Australian National University and CEPR

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Structural Transformation in Growing Open Economies: Australia's Experience

Kym Anderson
School of Economics and Public Policy, University of Adelaide, and
Arndt-Cordon Department of Economics, Australian National University
kym.anderson@adelaide.edu.au

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Correspondence:
Kym Anderson,
School of Economics and Public Policy,
University of Adelaide,
10 Pulteney Street, Level 3,
Adelaide, SA 5005, Australia
Phone +61 414 254 121
kym.anderson@adelaide.edu.au

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Abstract:

Structural transformations in growing economies focus on sectoral shares of national output (GDP) and employment but typically give little attention to exports. This paper compares and contrasts evidence of trends in sectoral shares of GDP, employment and exports in Australia over the past two centuries with those of other advanced economies. Australia's experience is unusual in several respects, explanations for which suggest lessons for less-advanced resource-rich economies. The paper concludes by questioning how societies' evolving environmental objectives, and recent influences on globalization, might alter in coming decades the structure of Australia's economy and its policies and institutions.

Keywords: agricultural and industrial development, trade costs, manufacturing protection, mining booms

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1. Introduction

The world economy has changed dramatically during the latest globalization wave, with developing countries industrializing and converging on the living standards of high-income countries as their population growth slows, and with declining trade costs and (until recently) retreats from protectionism being manifest in rapid rises in the shares of national production being traded internationally. That faster industrialization and overall economic growth of emerging economies since the 1980s, and greater international trade and investment globally thanks to the digital revolution and reforms to trade and exchange rate policies, are affecting the comparative advantages and structural transformations of many economies.

However, recent events have caused a dramatic rise in global economic policy uncertainty (www.policyuncertainty.com). Those events include the global financial crisis of 2008, the emergence of a strident China, increased volatility of international prices of staple foods and fossil fuels, concerns about climate change, and the Covid-19 pandemic. Together

they have contributed to the election of more populist governments in the world in the 2010s than in any of the previous eleven decades (Funke, Schularick and Trebesch 2021). Populist governments tend to be protectionist and xenophobic (Colantone, Ottaviano and Stanig 2022), and their policy actions have triggered retaliatory trade measures by trading partner countries and eroded support for globalization in the rest of the world. Adding to that is the recent rise in civil wars and repression (Besley, Dann and Persson 2021) plus the invasion of Ukraine by Russia from February 2022.

Those and related phenomena (e.g., concern about the decline of global biodiversity) are causing producers, consumers and thus governments to re-assess national development strategies, institutions and policies. In Australia, political parties in recent federal elections have focused heavily on the national economic, sectoral and regional consequences of moving faster toward a low-carbon economy. The country's recent concentration on trade with China also is coming under question. Meanwhile, other countries relatively richly endowed with natural resources per capita, such as in Central Asia, are questioning whether they should diversify their economy so as to be less dependent on primary product exports, in part to reduce the so-called 'resource curse' risk (Auty 1993; van der Ploeg 2011; Venables 2016). Since those countries compete directly with Australia in international markets for primary products, their choice of development strategy will alter the structure and comparative advantages of Australia's economy.

History has much to tell us about how open national economies structurally adjust in the course of economic growth and trade-related policy developments at home and abroad. This paper reviews the structural transformations of Australia's economy over the past two centuries and compares and contrasts it with those of other (including other resource-rich New World settler) economies.[1]

The paper is structured as follows. Section 2 provides a brief review of literature on the structural transformation of national economies. Section 3 summarizes what trade and development theories would lead one to expect about structural transformation first in a closed economy and then in a small open economy as it grows. Section 4 reveals the ways in which the structural transformations of Australia's economy are somewhat exceptional yet consistent with received theory once institutional arrangements and trade-distorting policies are kept in mind. A dominant feature is a series of mining booms and slumps, which have had

[1] How structural changes have influenced the mean and variance of Australia's overall income and economic growth rate, and vice versa, are not addressed in what follows. But see, for example, McLean (2013), Madsen (2015) and Greasley and Madsen (2017).

major impacts on the relative sizes of the economy's key sectors. The period up to the early 1970s involved supply-driven mining booms, while the period since then has been influenced more by demand-driven (primary product export price) booms and slumps. Section 5 examines data that shed light on various possible forces behind these structural transformation trends and cycles. That leads to a discussion in Section 6 as to how evolving societal preferences and policy responses to such things as climate change, biodiversity loss and export market concentration might alter the structure of Australia's economy in coming decades. The paper concludes with Section 7, which draws out implications for development strategies and policies for both Australia and emerging resource-rich economies.

2. Background literature

While countries typically began the process of economic growth with most of the population engaged in producing staple food, an ever-increasing number of countries since the early 1800s have seen workers attracted to manufacturing as non-farm labor productivity improved with the accumulation or importation of industrial capital. Starting in the 1950s, advanced industrial economies have also seen their manufacturing sector decline in relative importance as service activities increasingly dominate the economy. Lewis (1954) assumed that labor was more productive in what he called the modern sector than in the traditional (mainly subsistence agriculture) sector, hence the expectation that the share of the population employed in agriculture would fall as some farm labor sought more-productive employment (Gollin 2014; see also Fei and Ranis 1961, 1964). Those countries fortunate enough to be well-endowed per capita in minerals and energy raw materials or in natural forests find that mining (including the felling of native trees and fishing the waters) employs some workers, but shares of total employment in those activities tend to be quite small and also to decline in the course of a nation's economic development as and where more capital-intensive mining technologies become more profitable than traditional labor-intensive practices.

Shares of value added or gross domestic product (GDP) follow a similar pattern to employment shares. However, agriculture's employment share typically exceeds its GDP share (Timmer 2009; Deininger, Jin and Ma 2022). By contrast, the GDP shares of mining and manufacturing often exceed their employment shares. This implies labor productivity is often lower in agriculture than in the production of other tradable goods. Such labor productivity differences mean that, at the margin, faster migration of labor from traditional agriculture to industrial activities is likely to speed up economic growth. Meanwhile, the

services share of GDP has tended to grow less rapidly than its employment share (Figure S1).[2] This is because (like traditional agriculture) many service activities are relatively labor intensive. Furthermore, the service sector has experienced relatively slow productivity growth, although that is beginning to change for some services thanks in part to the information and communication technology (ICT) revolution.

Development economists have been tracing patterns of structural transformation in the course of national economic growth for many decades (Clark 1938, 1940; Fisher 1939; Kuznets 1957, 1966; Syrquin and Chenery 1989; Timmer 2009; Timmer, de Vries and de Vries 2015). The pace of change has varied widely across countries, however, and not only because of their different rates of economic growth (Nickell, Redding and Swaffield 2008). Also, the peaks in the shares of manufacturing in national GDP and employment have gradually fallen in recent decades, and these peaks are being reached at ever-lower real per capita national income levels. Moreover, in some African developing countries, urbanization is occurring without much industrialization (Rodrik 2016; Gollin, Jedwab and Vollrath 2016), or with manufacturing being limited mostly to capital-intensive large firms that may provide few jobs for former farmers (McMillan and Zeufack 2022; but see also Mendola, Prarolo, and Sonno 2022).

Developments in the sectoral shares of national exports, however, are far more varied across countries. Some of the world's highest-income countries have managed to retain a comparative advantage in a small number of primary products. Meanwhile, some low-income countries have already built a comparative advantage in one or more services: of the world's top 30 countries in terms of the Balassa (1965) index of 'revealed' comparative advantage in services, more than 20 are small island developing countries typically exporting inbound tourism services (Anderson 2022). But for most poor countries agriculture's share of exports is high while for high-income countries it is typically much less than one-tenth (Figure S2).

With the current wave of globalization, numerous trade costs and government restrictions on trade – in services as well as goods (Benz, Jaax and Yotov 2022) – were falling. Notwithstanding the recent (hopefully temporary) halt to that process, a new empirical study finds the trade restrictiveness of both high-income and developing countries since the mid-1990s has been at its lowest since 1950 (Rose et al. 2022), and hence probably since 1913. That is increasing the fragmentation of production processes and lengthening global value chains such that an ever-higher proportion of goods and services have become

[2] Figure numbers starting with S refer to ones in the article's supplementary material.

internationally tradable. As a result, changes in comparative advantage are becoming less predictable (Baldwin 2016, 2019). But restrictions on agricultural trade have been declining slower than, and are well above, those for non-agricultural goods, including in developing countries.[3] As a result, agriculture's measured share of national exports typically will be less predictable than that for mining or manufacturing, and certainly smaller than it would be in the absence of anti-trade farm policies.

There are numerous explanations for the differences in structural transformation patterns across countries. Commonly included in these explanations are differences in rates of change in relative factor endowments (since factor intensities of production vary across sectors), and differences in rates of technological improvements (since multifactor productivity growth rates differ across sectors and in their factor-saving biases). In addition to being developed domestically, both endowments and technologies can be imported (e.g., via immigration and foreign investment). Demand considerations are less commonly considered, but changes in international terms of trade can matter because countries differ widely in their sectoral comparative advantages. Differential growth in per capita incomes matter too because income and price elasticities of demand for products differ across sectors and tend to decline initially for food and then also for manufactured goods as countries become more affluent.

Recent empirical attempts to explain observed structural changes have tended to focus on employment and/or GDP shares and to ignore the trade dimension (as pointed out by Matsuyama 2009). A consequence is that many such studies do not take into account relative factor endowments, which are prime determinants of comparative advantage, or trade-distorting policies, which can alter not only the extent of a country's international trade but also its pattern of production and trade specialization. The next section considers both, initially by assuming they are exogenous determinants of sectoral shares but relaxing that later.

3. Theory

[3] Average import tariffs fell between 1995 and 2019, but for manufacturing they fell from 5% to 2% for high-income countries and from 13% to 6% for developing countries whereas for agriculture they fell from 11% to 7% for high-income countries and from 16% to 14% for developing countries (WTO 2021). On longer-run global trends in distortions to farmer incentives, see Anderson (2009).

We begin by first considering a two-sector closed economy, and then an open economy that also includes a sector producing nontradable products. To keep the analysis as simple as possible, we assume that there are no intermediate inputs and all markets are perfectly competitive and (initially) free of government interventions so that there is full employment of all factors of production. Growth is assumed initially to come exogenously from improvements in total factor productivity (TFP), before changes in factor endowments are also considered below.

3.1 GDP shares in a closed economy

Consider first a closed economy with only two sectors: agriculture and non-agriculture. If its economic growth was due to productivity growth occurring equally rapidly in both sectors, their supply curves would shift out at the same rate. However, the demand curve shifts out less for agricultural goods than for other products after productivity-improving income growth, thanks to the income elasticity of demand for food being below one. Thus, outputs of both sectors rise but less so for agriculture, and the price of farm products falls relative to the price of non-farm products, and more so the more price inelastic is the demand for food. The GDP share of agriculture would fall even more over time in that growing economy as and when income and price elasticities of demand for food fall further below one as per capita income rises (Engel 1857). Were there to be a faster rate of reduction in marginal costs of production in agriculture than in the rest of the economy (as suggested by the empirical work of Martin and Mitra 2001; Gollin, Parente and Rogerson 2002; Productivity Commission 2022, Figure 2.8), agriculture's GDP share would fall even further because of low elasticities of demand for that sector's output.

This model is appropriate not only for a closed economy but also for the world economy as a whole: it suggests that the ratio of the international prices of agricultural products to other products will decline over time as global per capita income grows. This is consistent with what happened to relative prices over the 20th century (Pfaffenzeller, Newbolt and Rayner 2007).

3.2 GDP shares in a small open economy

What about a small open economy that can export any share of its production or import any share of its consumption of both farm and nonfarm products at the prevailing international terms of trade? Such an economy would have a larger (smaller) share of its GDP coming from agriculture if it had a comparative advantage (disadvantage) in farm products.

If productivity growth occurred in this small open economy but the international terms of trade remained unchanged, agriculture's share of GDP would rise or fall depending only on whether that national growth was biased toward farm or nonfarm production. If economic growth at home and abroad was sectorally unbiased, it would lower the relative price of farm products for reasons mentioned above, in which case this small economy's international terms of trade would deteriorate as would its GDP share from agriculture. That is, if productivity growth is occurring abroad and is not heavily biased against agriculture, the farms' share of GDP in this small open economy will decline unless its own productivity growth is sufficiently biased towards agriculture for the change in quantity to more than offset its terms of trade deterioration.[4]

However, a large part of each economy involves the production and consumption of nontradable goods and services because of these products' prohibitively high trade costs. The prices of nontradables are determined solely by domestic demand and supply conditions and related policies, because the quantity demanded has to equal the quantity produced domestically.

If one were to combine the two tradable sectors into one "super sector" of tradables, then the above closed economy conclusion, that agriculture's share of GDP is likely to decline over time, will be stronger if the share of tradables in GDP declines in this growing economy. The income elasticity of demand for marketed services—which make up the vast majority of nontradables—is well above unity in developing countries and tends to converge toward unity as incomes grow (Lluch, Powell and Williams 1977, Table 3.12). If productivity growth is equally rapid for nontradables as for tradables, while demand grows faster for nontradables than for tradables, both the price and quantity and hence the value of nontradables will increase relative to that of tradables. But if productivity growth is faster in tradables than in nontradables (as suggested by the findings for services by Fuchs 1980 and Kravis, Heston and Summers 1983), it is even more likely that the share of nontradables in GDP would rise and the real exchange rate (the price of nontradables relative to tradables) would appreciate. In that case the share of tradables in GDP would fall.

At the global level, the income elasticity of demand for manufactured consumer goods also matters. While that elasticity may be above one in low-income countries, it falls increasingly below one as countries become more affluent. Hence, the manufacturing sector

[4] If the source of growth was entirely learning-by-doing in the manufacturing sector, it is even more certain that agriculture will decline in this small open economy, as shown formally by Matsuyama (1992).

is also likely—thanks to the nature of demand for services—to come under pressure to decline eventually even in small open economies as they become affluent, following the pattern for agriculture. The exceptions would be only in those small open economies where manufacturing TFP growth is exceptionally rapid.

3.3 Employment shares

Given our initial assumption of no changes in aggregate factor endowments, the above reasoning is close to sufficient for understanding changes in sectoral shares of labor employment: agriculture (services) shares decline (rise) as per capita income grows, while manufacturing shares follow an inverted U-shaped path. Complications arise, however, when there are lags in labor migrating out of declining sectors or when labor productivity growth differs substantially between sectors.

Historically, out-migration from agriculture has been sluggish because it typically requires a physical, social, and cultural move from living on or near a farm to a town or city—something that is far less likely to be necessary for an urban worker moving to a new manufacturing or service sector job. Thus the decline in the share of employment in agriculture may lag the decline in agriculture's share of GDP. That tendency would be reinforced if there was less investment in education in rural than urban areas such that farm labor productivity was relatively low.

The share of mining in employment, by contrast, is typically less than its share of GDP in settings where mining is highly capital intensive. Indeed that is the norm, not only in high-income countries but also in numerous resource-rich developing countries that are open to mining-specific (including human) capital inflows from abroad. Such capital inflows, and the (often associated) discovery of new subsoil or sub-seabed reserves, can be a significant source of both mining sector GDP growth and structural transformation but not necessarily of more local jobs if local workers lack the skills required for those tasks.

Productivity impacts on sectoral employment can be positive or negative.[5] On the one hand, the adoption by one sector of labor-saving technologies can raise its output and perhaps exports but reduce its employment, thereby *pushing* labor to other sectors (Gollin, Parente and Rogerson 2002, 2007). On the other hand, labor could be *pulled out* of a sector due to

[5] According to the induced innovation hypothesis, productivity growth will be biased in favor of saving the scarcest factor of production (Hicks 1963; Hayami and Ruttan 1985). That hypothesis is more likely to be supported in countries at the technological frontier, while producers in later-emerging economies will choose whatever is most profitable from among the full spectrum of available technologies as their relative factor prices change.

new job prospects in another sector that is enjoying faster total factor productivity growth and/or faster demand growth associated with spending higher incomes (Lucas 2004; Gollin, Parente and Rogerson 2007). The push element has always been present for farmers and, more recently, for factory workers where robotics and digitalization are the latest influences. Artificial intelligence will replace some workers, but the income growth it generates will lead to the creation of new jobs (Acemoglu and Restrepo 2018; Baldwin 2019, 2022). The net effect of the latter pull factor on sectoral employment is uncertain but, if it favors nontradable services, that would be a further reason to expect declines in employment in tradable goods sectors, including agriculture and (in advanced industrial economies) manufacturing and possibly some tradable services.

3.4 What if factor endowments change?

So far we have assumed that national income growth comes from exogenous technological change. Growth also results from investments in innovation, or importation and adaptation of technologies from more advanced economies. Income growth can also result from net factor accumulation over and above depreciation. Natural resource capital can be discovered through mining exploration or made more productive through investment (e.g., clearing and fencing farmable land). The stock of produced capital can be enhanced as well through domestic investment or by importing such capital from abroad. And the stock of labor can change through births exceeding or falling short of deaths, by changes in labor force participation (e.g., more women choosing paid work, more years being absorbed in formal education, people choosing to retire later), by population aging, and via immigration net of emigration.

Any of these changes alters the value of per worker endowments of natural resources and produced capital and hence the country's comparative advantages. According to Rybczynski (1955), growth in the aggregate stock of capital per worker can have the effect, at constant relative product prices, of expanding the output of the most capital-intensive industries and shrinking that of the most labor-intensive industries. In developing countries where agriculture is among the most labor-intensive industries, this can be another source of relative decline in that sector of growing economies (Martin and Warr 1994).

3.5 Export shares

Sectoral export shares depend on the country's comparative advantage and on how rapidly the tradability of each sector's output increases as technical changes or infrastructure

investments lower trade costs. For example, if a small economy's trade costs fall relative to those of the rest of the world, its comparative advantages will alter and it would become internationally competitive in a larger number of products (Venables 2004). Should its farm products gain more (less) from the decline of trade costs than its nonfarm products, for example, the country would see its comparative advantage in agriculture strengthen (weaken), other things equal.[6]

The two key workhorse theories of comparative advantage developed in the 20th century were the Heckscher-Ohlin model, in which all (exogenously given) factors of production are intersectorally mobile, and the specific-factors model, in which one factor is specific to each sector. These two models have been blended to account for primary sectors that use specific natural resource capital (farmland and mineral deposits) in addition to intersectorally mobile labor and produced capital (Krueger 1977; Deardorff 1984). This blended model suggests we should expect primary products to be exported from relatively lightly populated economies that are well-endowed with agricultural land and/or mineral resources to those economies that are densely populated with few natural resources per worker.

Leamer (1987) developed this Krueger/Deardorff blended model further and related it to paths of economic development. If the stock of natural resource capital is unchanged, rapid growth of produced capital (physical capital plus human skills and technological knowledge) per hour of available labor tends to strengthen comparative advantage in non-primary products. By contrast, a discovery of minerals or energy raw materials would strengthen that country's comparative advantage in mining and weaken its comparative advantage in agricultural and other tradable products, other things equal. Such a mineral discovery would also boost the country's income and hence the demand for nontradables, which would cause its sectorally mobile resources to move into the production of nontradable goods and services, further reducing farm and industrial production (Corden 1984). And conversely when a mine is exhausted or there is a downturn in the international price of mining products.

The more a resource-rich economy directs some of its capital investment to forms that are specific to primary production, the later it would develop a comparative advantage in manufacturing or services. This is all the more likely if, as real wages rise, new technologies developed for the primary sector become increasingly labor-saving—leading potentially to

[6] For recent studies on the importance of trade costs on productivity and comparative advantage see, for example, Tombe and Zhu (2019), Farrokhi and Pellegrina (2020) and Fajgelbaum and Redding (2022).

what are known as factor intensity reversals. This happens when a primary industry in a high-wage country retains competitiveness against low-wage countries by that industry becoming more capital intensive. The primary sector's share of GDP would decline more slowly the faster its productivity growth compared to the average global rate, both relative to that of other sectors.

This possibility of altering a country's comparative advantages – and hence its sectoral shares of GDP, employment and exports – through investing to enhance the productivity of its primary land or mineral resources or workers, is taken up in later sections where the idea is introduced of natural capital that generates (typically non-marketed but nonetheless desired) ecosystem services.

3.6 Induced innovations in institutions and policies

As an economy develops, its institutions and policies are modified over time as its government responds to changing objectives of society. Large differences in relative factor endowments and hence comparative advantages among growing economies ensure that concerns vary regarding the consequences of uninhibited structural transformation for such things as rural–urban income disparities, food and energy security, and degradation of the natural environment. Responses to those concerns can contribute to systematic differences across sectors and nations in the use of trade and other price-distorting policies (Anderson, Rausser and Swinnen 2013).

Examples of important early objectives of European settlers in Australia were to increase the white population, to diversify production and exports away from just wool and gold, and to redistribute the gains from economic growth more equitably. Changes in economic institutions, or in taxes, subsidies or quantitative restrictions on the production, consumption or trade of products or of the factors or intermediate inputs used to produce them, can alter non-trivially the structural transformation of an economy.

4. Empirical evidence for Australia

When Europeans first settled in New South Wales in 1788, production of fresh food was the highest priority. For almost all of the next 60 years, agriculture accounted for more than 85%

of merchandise GDP (that is, ignoring services) at current prices.[7] Australia's international competitiveness was strongest initially in non-perishable agricultural products that were not labour intensive in their production (because real wages were high in this labour-scarce economy) and that had a high price per ton or cubic metre given the high cost of transport within Australia and to the main markets in high-income Europe (Blainey 1966). Up to 1830, whale and seal oil were the main exports, before the quality and quantity of wool was high enough to warrant exporting it to Britain (Shaw 1990).

In 1843-44 copper was discovered in South Australia, replacing wool in the latter 1840s as that colony's dominant export (Figure S3(a)). With the discovery of gold in 1851 in Victoria and New South Wales, agriculture's share of Australia's exports more than halved to just 26% within a year as mining's share peaked at 61% in 1852 and stayed above 30% until the mid-1860s (Figure S3(b)). That first gold rush caused Australia's non-aboriginal population to nearly treble and real GDP to rise by 220% in the 1850s. Gold's share of merchandise exports was more modest during 1870-90, before growing again by the turn of the century because of a gold rush in Western Australia (Figure S3(c)). But it had halved again by 1914 and was of minor importance for the next seven decades (Figure 1).

[insert Figure 1 around here]

While it was not unusual among settler economies of the New World prior to World War I to have exports highly concentrated on just two primary products, it is clear from Figure S4 that Australia had one of the highest concentrations.[8] During the five decades after that war Australia's exports became more diversified, but nonetheless around three-quarters of its value was still contributed by the rural sector (Figure 1(b)). Even in the most-recent five decades the agricultural share of Australia's exports has been more than twice the global average, while the manufacturing share has always been well under half the global average.

Notwithstanding the dominance of primary products in Australia's exports, the primary sectors' contribution to GDP has declined steadily over the decades, from two-thirds in the 1810s to one-eighth in the 1960s, and from more than half to just one-tenth of

[7] Unless otherwise indicated in the text, figures or tables, historical macroeconomic and sectoral data on Australia's economy have been compiled by Vanplew (1987), and a subset of those data have been updated by Butlin, Dixon and Lloyd (2015). Anderson (2015) extended some of those series (and added the colonial/state data) by drawing on, among others, Butlin (1962, 1986), Butlin and Sinclair (1986), Sinclair (2009) and the *Statistical Registers* of each Colony, as well as the Australian Bureau of Statistics and the Reserve Bank of Australia. Years shown are calendar years to 1913 (or 1900 in the case of data from Butlin, Dixon and Lloyd 2015) and fiscal years ending on 30 June thereafter. All values are expressed in current Australian dollars.

[8] Gold (not shown) contributed more than meat to New Zealand's exports in the 1870s. Argentina's exports also were highly concentrated on two products: wool and hides to the 1880s and wool and grain from then to World War I.

employment. Meanwhile, manufacturing grew from almost nothing pre-1850 to a peak of almost 30% of GDP and employment in the early 1960s (Figure 2). What is striking is that between 1860 and 1950 the shares from both agriculture and services hardly altered as manufacturing's growth matched mining's decline. So having been unusual in having a low share of GDP from agriculture compared with other settler New World countries during 1850-80, Australia gradually moved to having a relatively high share after the second world war (Figure 3).

[insert Figures 2 and 3 around here]

In the mid-1960s another supply-driven mining boom began with the emergence of iron ore exports, causing the share of mining in GDP to begin to rise after having changed little during 1920-65; and the most-recent five decades have seen Australia's agriculture and manufacturing shares of GDP and employment shares fall rapidly as the service sector expanded. The latter is what is expected as per capita incomes grow, and what other advanced economies have been doing. The GDP share of services has grown from two-thirds to five-sixths since the 1960s, while manufacturing's GDP and employment shares have shrunk by three-quarters and agriculture's by four-fifths (Figure 2). Australia's GDP share of agriculture is between that of North and South American countries, as one would expect given the rankings of those nations' GDP per capita; its manufacturing share is below that of most advanced economies, again as one would expect given Australia's strong comparative advantage in primary products; and its services share of GDP is about average for an advanced economy (Figure S5).

Australia differs markedly from other advanced economies, though, in the dramatic growth of its mining output and exports over the past half century. While mining's employment share has only doubled since the early 1970s, to just 2.8%, its GDP share has grown five-fold (to 11%) and its share of merchandise exports has grown ten-fold (to 67%) since the mid-1960s and now matches the peak it reached in the 1850s' gold rush (Figures 1 and 2).

This striking transformation in Australia's trade specialization is summarized in Figure S6, using the Balassa (1965) index of 'revealed' comparative advantage (RCA, defined as the sectoral share of a country's exports divided by that sector's share of global merchandise exports). Australia's index of agricultural comparative advantage had almost doubled between 1913 and 1960-64, at which time Australia's comparative advantage index for mining was less than one-third that for agriculture (0.8 vs 2.7); in the 1980s they both averaged 2.5 while manufacturing was 0.32; but by 2020-21 the indexes were 3.7 for mining

and just 1.6 for agriculture and 0.13 for manufacturing. For comparison, the RCA for manufacturing for other high-income countries was 1.15 in the 1980s and 1.02 in the 2010s, while for middle-income countries the manufacturing RCA rose from 0.4 in the 1980s to 0.94 in the 2010s.

How did total population, GDP and the level and distribution of GDP per capita, change during these periods of structural transformation? There was steady growth in GDP per capita apart from sudden downturns in the early 1840s, the 1890s, the early 1930s and the two world wars. Even leaving aside the 1850s gold rush decade, Australia's annual GDP per capita growth between 1860 and 1970 averaged a respectable 1.4% -- despite the population growing at 2.2% over that long period thanks to continual immigration (Figure S7). This remarkable growth began even earlier: Panza and Williamson (2019) estimate that GDP per worker in Australia during 1821-1871 grew at about twice the pace of the US and three times that of Britain. And it kept growing for the next ten decades. By the end of the nineteenth century Australia is believed to have had perhaps the highest per capita income in the world (Broadberry and Irwin 2007; McLean 2013; Inklaar et al. 2018). Thereafter Australia's global ranking fell but it was still third in 1950 and seventh by 1970, before slipping to 21st by 1990 then back to 15th by 2020 of countries with populations over one million, at PPP international dollars (World Bank 2022). Meanwhile, income inequality remained low throughout compared with other advanced economies (McLean 2013; Panza and Williamson 2019). In short, Australia has not been subject to a 'resource curse' (van der Plough 2011), despite its exports being dominated by just a few primary products throughout the first two centuries of European settlement.

This brief review of data raises at least four questions about Australia's unusual structural transformations:

- Why was agriculture's share of GDP virtually constant during 1860-1950 (when the sector's share of employment halved), and its share of exports above 70% as recently as 1946-66?
- Why did manufacturing's shares of GDP and employment rise so high (above US circa. 1960) before then falling rapidly?
- Why was there so little contribution from mining during 1920-65, and then a dramatic re-emergence of mining from the late 1960s?
- Why, with its exports dominated by just two primary products pre-World War I, was Australia not subject to a 'resource curse'?

5. Forces behind Australia's structural transformation trends and cycles

It is not surprising that sectoral shares in Australia are different from those in other high-income countries in some periods, given Australia's extremely rich but varying value of natural resources per worker. Even today, despite rapid growth in the country's population and workforce via immigration, in value terms Australia has more than three times the global average per worker endowment of agricultural capital and twelve times the average endowment of mining resources, as well as almost as much human and other produced capital per worker as North America. In 2018 it was better endowed per worker in value-based farming and mining resources than any other region, apart from oil-rich Middle East and North Africa (Table 1). Australia is thus like many natural-resource-rich developing countries – but unlike most advanced industrial economies – in terms of still having a strong comparative advantage in primary products. But it is further distinguished in being so richly endowed in both mineral *and* agricultural resources, and more so for most minerals now than eleven decades ago despite the mining of the past century (Table 2). Thus a major mineral resource discovery, or spike in mineral relative to agricultural export prices, can alter the relative competitiveness of not just manufacturing but also the agricultural sector – but less so when prices of agricultural products move with those for fuels, minerals and metals. With that in mind, we turn sequentially to the four questions posed at the end of the previous section.

[insert Tables 1 and 2 around here]

5.1 Why did agriculture's share of GDP and exports not decline during 1860-1950?

Agriculture's share of GDP slumped sharply at the start of Victoria's gold rush in the early 1850s, as rural workers abandoned their farm activities and headed for the goldfields. But it soon recovered and remained within the 20-30% range for the next 100 years, dipping only during Western Australia's 1890s gold rush and in the First World War. Otherwise its share just fluctuated with the seasons and with international prices, for example declining during the severe downturn in farm product prices in the depressions of the mid-1890s and early 1930s.

The mining booms of the nineteenth century did not depress the farm sector for long because they were so large as to stimulate major expansions of the economy and population. The 1850s, for example, saw real incomes per capita rise despite the continent's non-

aboriginal population nearly trebling, ensuring the domestic demand for farm products (most of which were nontradables until late in the nineteenth century) grew enormously. That encouraged men to return from the gold fields to farming (Maddock and McLean 1984).

With population growth and dwindling prospects for gold panners came the demand for farmland to become available to potential smallholder farmers. A squatter/selector conflict in the 1850s was won in favour of converting some (close) large holdings into smaller holdings sold for more-intensive agriculture, where economies of scale were less than for outback pastoral sheep grazing, while the rest of pastoral land that had been squatted on became subject to leases. The more-secure tenure associated with leaseholds encouraged capital investments in properties (fencing, stock water, …) and in the genetic quality of their livestock (Campbell 1990; Raby 1996).

Raw wool's high value relative to weight and volume overcame high internal and ocean transport costs, allowing annual wool exports per capita to grow from less than $2 in the 1820s to $20 by 1850 and to remain around $20 through to World War I – despite the population expanding twelve-fold over that period. Initially the expansion of grazing involved 'squatting' illegally on unfenced native pastures and so required no capital outlay for land, just for purchasing breeders that reproduced, with low-wage convicts serving as shepherds. But once land became leasehold or freehold in the 1860s, the institutional innovation of stock and station agents provided essential finance and marketing services for both graziers and crop farmers (Barnard 1958; Ville 2000).

Wheat production was subsequently helped by labour-saving machinery, either locally innovated or imported from the United States which had the world's best farm machinery at that time (McLean 1972a; Shaw 1990). Dairy and meat production were helped by refrigerated shipping from the 1880s. Wire fencing helped selective breeding and quality upgrading of livestock. Public research on crops from the 1870s boosted yields per hectare and extended the crop frontier – just as happened in the United States (Olmstead and Rhode 2011). By early in the twentieth century that had reversed the earlier decline in average wheat yields (Figure S8). Public investments in rural infrastructure such as roads, railways, telephones and electricity lowered internal transport and communication costs.[9] Horticulture and viticulture were further helped by public investments in irrigation infrastructure post-World War 1 (Shaw 1990). Also important were public investments in tertiary agricultural

[9] The gains from greater trade in farm products in the United States due to the lowering of internal transport costs have been estimated to be of a similar magnitude to those from farm technological improvements between 1880 and 1997 (Costinot and Donaldson 2016).

colleges and in colonial Departments of Agriculture from the 1870s, which further boosted farmer productivity (McLean 1982). These developments contributed to labour productivity in agriculture beginning to rise after the 1860s (Figure S9)**.** Indeed Australia had the highest agricultural labour productivity in the world in the late 1800s, according to Broadberry and Irwin (2007).

It was the high and rising level of real wages that encouraged the development and widespread adoption of labour-saving farm (and mining) technologies (Duncan 1972a), such that the shares of primary sectors in GDP fell much less than their shares of Australian employment (Figure 2). True, farm labour and land productivity both tend to be higher in higher-income countries (Figure S15), but it seems farm productivity in Australia grew far faster than in other settler economies for many decades (Figure 3).

Australia's relatively rapid farm productivity growth also helped the rural sector maintain a high share of national exports. Agricultural exports were dominated by wool from the 1830s, it being the farm enterprise that was perhaps least intensive in its use of scarce labour relative to abundant grazing land (Davidson, 1981, Ch. 6). During the five decades to 1960 Australia's exports became more diversified, but nonetheless around 70% of its value was contributed by the rural sector. Even during 1960-2000 the agricultural share of Australia's exports was more than twice the global average, but it has since fallen to just 50% above the global average (Figure S6) – despite productivity growth since the turn of this century being faster for agriculture than for both mining and manufacturing in Australia (Grafton, Mullen and Williams 2015; Productivity Commission 2022), thanks partly to considerable post-World War II public agricultural R&D investment (Duncan 1972a,b; McLean 1973a,b; Harris and Lloyd 1991; Mullen and Cox 1995; Mullen 2010).

The main reason for the recent decline in the country's agricultural competitiveness is because the China-induced rise in import demand for farm products this century has coincided with an even more dramatic rise in China's demand for minerals and energy raw materials such that the price index of Australia's farm exports has risen less than the index for the country's mining exports since 2003 (Figure 4(a)). As well, mining productivity is estimated to grow relatively slowly because of the huge up-front capital expenditure in the sector that was necessarily invested to enable the subsequent output and export growth (Freebairn 2015). Around four-fifths of that capital has come from abroad via the major multinational mining companies this century, and it includes the world's best mining exploration, production and marketing knowledge (Markusen 2002).

[insert Figure 4 around here]

5.2 Why did Australia's manufacturing shares of GDP and employment rise so high before falling rapidly?

Most manufactured goods were imported in the first few decades of European settlement, but what was produced domestically benefitted from natural protection because of high ocean transport costs. The nontradables part of the sector benefitted also during the 1850s gold mining boom as both the population and per capita incomes grew dramatically. But what is odd is that manufacturing continued to expand its shares of GDP and employment right through to the early 1960s (both peaking at almost 30%) even though the sector exported very little other than a few lightly processed primary products.

The key reason behind that industrial development is that, like the governments of many developing countries, Australian governments depressed agricultural and mineral relative to manufacturing incentives facing producers.[10] Tariffs on many manufactured goods were imposed at the outset of the Federation and were steadily raised over time, and were supplemented with binding import quotas between 1952 and 1960 (Anderson and Garnaut 1987). Australia also had a ban on iron ore exports from 1938 until it was partially lifted in November 1960 and removed entirely in May 1966, when permits began to be issued by the Western Australian government to mine iron ore and privately develop new rail and port facilities to allow exports (Lee 2013). As well as those severe direct trade restrictions, myriad regulations affecting services sectors and labour markets discouraged services production and exports and raised wages and intermediate input costs for industries producing exportables. Some of Australia's least-competitive rural industries were assisted as well (Lloyd and MacLaren 2015). These policies not only boosted the initial shares of manufacturing in GDP and employment, they also lowered the ratio of trade to GDP (from around 50% in the early 1860s to barely 20% from the 1930s to the 1970s, see Figure S10) and reduced the range of products exported and thus probably added to the volatility of Australia's international terms of trade.

Australia's manufacturing sector was more highly protected than that of all other advanced economies except New Zealand (Anderson et al. 2009), and was nearly as protected as Argentina (Sturzenegger and Salazni 2008). The manufacturing industries assisted most, prior to the tariffs being mostly phased out over the 1980s and 1990s, tended to be labour-

[10] In the nineteenth century tariffs were imposed, but mainly on 'sin' products such as alcohol as a relatively easy way of raising governments revenue (Lloyd 2017). Prior to the late 1800s, transport costs provided natural protection to import-competing producers and natural restrictions on potential export industries.

intensive, low-wage industries with low value-added shares of output, while those least assisted were those competitively exporting or producing mainly nontraded manufactures (Anderson 1980). That meant the sector had relatively low labour productivity (Figure S9), unlike the majority of countries where labour productivity in manufacturing exceeds that of other sectors (Figure S1(b)).

The extent of the support for manufacturing at the expense of primary products is shown in Figure 5. It reveals the average nominal rates of assistance or NRA to those sectors: the percentage by which the average gross value of output has been raised by government policies such as protection from imports. The huge gap between those sectors' NRAs began to diminish only from the 1970s as policy reforms were gradually implemented. When measured as a relative rate of assistance,[11] it suggests the policy regime reduced the gross rewards from primary production by approximately 20% to 30% in the first half of the twentieth century relative to what would have been the case under free trade, and by about 10% between the mid-1950s and mid-1980s before the gap was eliminated by the start of the present century (Anderson, Lloyd and MacLaren 2007).

[insert Figure 5 around here]

The political economy forces that led to institutions and policies aimed at diversifying and industrializing the economy, and to redistributing some of the gains from economic growth to wage-earners or to encourage more immigration, were similar to those of other settler economies. In Australia's case the case for protecting manufacturing was made more compelling by a report to the government that appeared to make an economic case for such intervention (Brigden et al. 1929). Critics (e.g., Viner 1929) argued it was not the first-best way to achieve those objectives, but supporters argued that first-best policies such as taxing land rents or incomes were not feasible administratively at that time. Anderson and Garnaut (1987, p. 31) point out that such a defence would have weakened over time, had it not been for the publication of the Stolper-Samuelson theorem which invited a conclusion favourable to protection (Stolper and Samuelson 1941; Samuelson 1981). It was not until the specific-factors trade theory was popularized by Jones (1971, 1975) that a more-appropriate model for the case of a resource-rich economy was available to argue against protection of manufacturing as a way to raise real wages, boost immigration and reduce income inequality:

[11] RRA is defined in percentage terms as RRA = $100[(1+NRAp^t/100)/(1+NRAm^t/100) - 1]$, where $NRAp^t$ and $NRAm^t$ are the weighted average percentage NRAs for the tradable parts of the primary and manufacturing sectors, respectively (Anderson 2009).

once a sector producing nontradable services is added to the Jones model, it becomes clear that jobs would have emerged in that services sector as incomes grew.

Policy reforms began to be implemented with an across-the-board 25% cut to import tariffs in 1973 and then with far more comprehensive microeconomic reforms from 1984. The program included not only a virtual phasing out of import tariffs and quotas and other direct industry assistance measures but also a freeing up of markets for labour, capital, foreign currencies and various services, and the privatization of major state-owned enterprises (Productivity Commission 2003; Hatton and Withers 2014). Goods exports plus imports as a share of GDP gradually rose from 21% in the 1970s to 25% in the 1980s, 28% in the 1990s, and 32% in the first two decades of the present century – or 41% when services are included. Substantial though that is, other countries also experienced an increased trade propensity as globalization proceeded, such that Australia has lagged behind the growth in the world's trade-to-GDP ratio (Figure S10).

Policy reforms in Australia had several impacts on tradable sectors. One was a relatively rapid shrinkage of its manufacturing sector's shares of GDP and employment that peaked at 29% in the early 1960s and then fell to 13% and 12% by 2001 and to just 5.6% and 6.7% by 2021 (Figure 2). But coinciding with that policy reform process was a series of booms in the prices of some of Australia's mineral exports, which also contributed to the halving of those shares in the past two decades. The latest mining boom was triggered by rapid growth in Chinese demand for imports of coking coal and iron ore, for which ships capable of carrying loads of up to 250,000 tons of ore became available to export these commodities at relatively low cost. That added to the earlier impact of the demand-induced mining boom of the 1970s that was triggered by the OPEC cartel's quadrupling of the price of petroleum in 1973-74 and then doubling it again in 1979-80, which made it economically feasible for thermal coal and subsequently natural gas to be exported from Australia to East Asia.

Another consequence of the decline of manufacturing protectionism was that, despite the recent mining boom, there has been a non-trivial rise in the extent to which Australia's processed farm products are exported. During 1973-79, the value of rural exports (which includes the post-farmgate costs of getting the primary product processed and then transported to the port and on ships) was 69% of the gross value of farm production at current prices. This rose to 75% in 1980-99 and to 82% in 2000-20. In addition to an increase in the overall level of exports, there has been a much wider range of products exported, and, in some cases, products have switched from net import to net export status, despite the latest

mining boom's impact on the real exchange rate. In the case of dairy products, for example, Australian exports were valued at less than 10% of the gross value of its milk production prior to 1990, but in the 2010s the average was 31% (ABARES 2022). The case of wine is even more striking: less than 4% of the volume of Australia's wine production was exported during 1950-90, and Australia was even a net importer of wine in the early 1980s, but in the 2010s the share exported averaged 61% (Anderson 2018).[12]

A further consequence of the fall in Australia's real exchange rate that resulted from reducing protection of the manufacturing sector has been a boost to service sector exports. The most striking examples of this century are the growth in fee-paying international students and in inbound tourism. In recent years those two sub-sectors have contributed almost two-thirds of services export earnings or one-seventh of all of Australia's goods and services exports. That trade was interrupted by COVID and China's altered attitude to Australia during 2021 and 2022, but it is expected to resume soon.

5.3 Why so little mining GDP and exports during 1920-65, then another growth-enhancing set of mineral export booms?

Those familiar with the book entitled *The Rush that Never Ended: A History of Australian Mining*, by Geoffrey Blainey (2003), would be aware that mining activities continued in Australia during and beyond the interwar period. However, the sector's contribution to the economy was miniscule then compared with the periods before World War I and after the iron ore export ban was lifted in 1966 (Figures 1 and 2).

One reason for that hiatus was the already-mentioned growth in manufacturing protection. Another was the declining prices for primary products relative to manufactures (Figure S11) and in particular the low international prices energy raw materials and non-ferrous metals over that period (Figures 4(a)). Together those developments discouraged British investment in Australian mining (which was seen also as high-wage and too prone to labour disputes), while encouraging local mining firms to invest their huge profits from the previous 3+ decades not in further exploration and new mining technologies so much as in the less-risky downstream processing of minerals and metals for the next 3+ decades (Blainey

[12] Of course trade propensity has been rising in many countries thanks to increasing globalization over the past three decades, but least so for farm products. The global share of production exported in 2010–2013 averaged just 17% for grains and around 25% for tropical products and for oilseeds, and has always been less than 10% for livestock products (based on FAOSTAT data).

2003, pp. 276-77). The latter, together with food and timber processing, dominated Australia's manufacturing output (Figure S12).

The export ban on iron ore from 1938 may not have mattered pre-1950 because of high ocean transport costs for that bulky commodity from Australia to North Atlantic markets. But then as Japan's industrial development resumed and the *Agreement on Commerce Between Australia and Japan* was signed in 1957, that much-closer market became an economically viable option – and potentially a very profitable one, as the price of iron ore in the international market started to rise from 1950 (Figure 4(b)).

The iron ore export ban was introduced ostensibly to ensure the Nippon Mining Company would not develop and export the ore from Yampi Sound in Western Australia, it being argued Australia would not have enough iron ore to serve its own steel producer (BHP Ltd). Indeed as late as 1955, the Minister for External Affairs R.G. Casey (later Lord Casey and Governor-General from 1965) claimed that Australia was poorly endowed with iron ore. The government of Western Australia may not have shared that view by the early 1960s, but it was unwilling to issue leases even for prospecting unless the prospector agreed to establish manufacturing industries in that State (Blainey 2003; Lee 2015). In any case, the fact that the ban reduced that crucial input cost to Australia's steel industry, raising its effective rate of assistance from government, was consistent with the overall manufacturing protection policy of this period.

Once the incentives to explore and exploit Australia's minerals improved, new technologies for locating profitable sites and for mining, processing and transporting ores and concentrates were imported or created and ever-more mine sites were identified (Blainey 2003). This was so during the period of rising energy and iron ore prices in the 1970s (Figure 4(b)), and even more so from 2003 (Figure 4(a)) thanks to the rapid industrialization of China. The real exchange rate appreciations those mining booms generated squeezed other tradable sectors but boosted the nontradables part of the services sector. Manufacturing was especially hard hit, as simultaneously it was facing increasing competition from northeast Asia (Garnaut 1989) and import tariff reductions (Figure 5). Meanwhile, agriculture was harmed less at least in the periods when its product prices were rising in parallel with those facing the mining sector (Figure 4(a)).

5.4 Why did export dominance in just two products in the 19th century not lead to a 'resource curse'?

As the nineteenth century progressed, Australia put in place what Acemoglu and Robinson (2006, 2013) call inclusive political and economic institutions, such as well-defined and secure property rights, law and order, democratic elections, and appropriate investments in public goods. Those institutions played a major part in ensuring Australia's supply-driven mining booms of the 19th century (see Figure S3) led to inclusive economic growth.

For example, in South Australia in the 1840s, the explicit requirement that half of land sales revenue be used to subsidize immigration from Britain ensured rapid population growth and hence demand for local farm and other products in that colony from the mid-1840s; and the colonial government's requirement that the land encasing the copper find near Burra had to be purchased as a 20,000-acre lot at £1 per acre meant a broad group of investors became owners of the Burra copper company, which further spread the benefits of the mine and helped avoid corruption and rent-seeking (Harris and La Croix 2021).

In Victoria and New South Wales in the 1850s, there were very low barriers to entering alluvial gold mining, as there were no economies of scale and mining licence fees were small – and were soon replaced by an export tax on gold so that only successful miners bore that burden and only at the point of sale. Also, those two colonies copied South Australia in ensuring that a large portion of that tax revenue was used to subsidize immigration, thereby reducing the rise in income and wealth inequality (Maddock and McLean 1984).

With both incomes and the population growing rapidly, the demand for nontradable goods and services grew, which pushed up real wages for all wage-earners such that the benefits of the mineral discoveries were soon spread widely (Broadberry and Irwin 2007). That inclusive growth outcome was further helped by the facts that (a) immigrants in the 1850s were more skilled than local workers, so their influx lowered the ratio of skilled to unskilled wages, and (b) farm land in the 1860s was becoming available faster than the number of people interested in farm work, lowering agricultural land prices and rents relative to unskilled wages (Panza and Williamson 2019).

From the 1860s there was the prospect that pastoral 'squatters' could have held onto the vast acreages they had illegally claimed. However, with the population explosion there was a growing demand for more land in the closer-settled areas to be made available to potential smallholders. Eventually governments responded to that growing demand (Campbell 1990; Shaw 1990; Greasley 2015), reducing the prospect – as happened in numerous Latin American countries – of a few people holding much of the land wealth. This

contributed substantially to a more equal distribution of income and wealth in Australia than in most other resource-rich economies, thereby contributing to the island continent's relatively rapid economic growth and avoidance of the 'resource curse' (McLean 2013; Panza and Williamson 2019).

6. How might evolving societal preferences and institutional and policy responses affect the future structure of Australia's economy?

The hyper-globalization of the past three decades, plus the global financial crisis of 2008 and China's re-emergence on the world stage, have contributed to a swell of anti-globalization sentiment this century (Roberts and Lamp 2021). Adding to those concerns are the digital revolution, climate change, biodiversity loss, and water and biosecurity/food safety issues, not to mention the COVID-19 pandemic in 2020-22 and the energy and food price spikes associated with the war in Ukraine and sanctions on Russia that began in February 2022. Populist national political responses to anti-globalization sentiment have included key countries withdrawing from multilateralism and imposing 'temporary' protectionist import tariffs and other trade sanctions, adding substantially to global market and policy uncertainty (www.policyuncertainty.com).

Even though globalization and trade opening are often blamed for increased disruption to and uncertainty in markets, much is due to on-going structural changes that accompany economic growth and to which new technologies and innovations are major contributors along with changes in consumer preferences. Yet key societal concerns in Australia as elsewhere are the trade impacts on such things as inequality of income, wealth and health, unemployment, poverty, resource depletion and damage to the natural environment. The COVID-19 pandemic has added to inequalities and reduced interest in cross-border activities. It has added also – hopefully only temporarily – to trade costs (Ahn and Steinbach, 2022), and to the mean, variance and uncertainty of shipping times (Komaromi, Cerdeiro and Liu 2022; Carriere-Swallow et al. 2022; Carter, Stenibach and Zhuang 2022).

If trade *per se* is not the main reason for these disliked outcomes, then a trade policy instrument is unlikely to be the first-best response and might even worsen the situation (Corden 1997a). But the task for governments challenged with demands to meet multiple policy objectives is becoming more complex as the voices of ever-more single-focused interest groups become louder via the megaphone of social media, and as concerns for the

global commons grow. Thus national governments have been much less enthusiastic about cooperating multilaterally this century than in the second half of the 20th century. With the relative decline of the US as hegemon and no other country or bloc yet able to substitute for it, we now have a less stable multi-polar world (Goldstein, Irwin and Sykes 2022). Yet for addressing global issues such as the digital revolution, climate change, biodiversity loss and epidemics, multilateral cooperation is precisely what is needed to get promptly to efficient solutions. Unfortunately US President Trump failed to see the win-win possibilities offered by the WTO, for example, and his unilateral actions against other countries' trade triggered retaliation and numerous reallocations of bilateral trades globally (Fajgelbaum et al. 2021; Fajgelbaum and Khandelwal 2022; Choi and Lim 2022).

Meanwhile, China's President Xi has chosen to use economic coercion via trade measures to intimidate smaller nations. Australia's primary product exports have been among those targeted since 2020, shrinking China's imports of Australian wine, barley, lobsters and coal in particular. Wine imports were hit in late 2020 with an almost-prohibitive tariff, causing a virtual cessation of a trade that had accounted for 39% (A$1 billion) of Australian wine export sales in 2019. Figure S13 shows the extent to which that trade had become very intense (the Australian share of that wine market rose to around six times China's share of world wine imports, up from three times during 2009-15), making it an obvious target for Chinese coercion.

A fundamental reality for Australia is that it is hardly any more diversified now than it was six decades ago in either the sectoral composition or the direction of its exports. Figure 6 shows that minerals have replaced farm goods sectorally so that primary products continue to dominate hugely, and East Asia (especially China) has replaced Western Europe (especially the United Kingdom) in terms of the dominant destination of its exports of goods and services. Moreover, Australia's economy is and will likely continue to remain very complementary to China's. Even with China's recent sanctions on Australian exports, it still accounted in calendar 2021 for 39% of the country's goods exports and 15% of its services exports (down from 19% in pre-COVID 2019). Re-building that bilateral relationship is therefore crucial to Australia's economic future, because otherwise Chinese students and tourists will go elsewhere and China will invest more in the development of supplies of primary products both at home and in resource-rich countries of Central Asia, Africa and Latin America, weakening Australia's recent comparative advantages.

[insert Figure 6 around here]

Retaliatory protectionism is not a sensible option for Australian and other governments facing anti-globalization forces and China's coercion. Much better would be to directly target the market frictions and market failures that lead to inefficiency, inequality, social immobility, natural resource depletion and environmental damage.

Specifically, to reduce the risk of back-tracking on Australia's trade reforms of recent decades, attention should turn to strengthening the measures that will make its firms and households more resilient in the face of uncertainties, and more assured that optimal domestic policies and institutions are in place to deal with externalities and to supply needed public goods – including meeting society's expectations to contribute to global public goods such as mitigating climate change and biodiversity loss. Taxing carbon emissions more would initially add to costs of production for many industries, but it would also stimulate the creation and adoption of new environmentally friendlier technologies and lead to new activities. Australia is well placed to capture more solar and wind energy which may eventually lower electricity prices in Australia, thereby boosting the competitiveness of energy-intensive activities such as minerals processing of iron and aluminium (Garnaut 2019, 2022). There is also scope to improve water institutions and policies in ways that could lead to more efficient, more equitable and more environmentally beneficial outcomes from irrigation (Grafton and Wheeler 2018; Wheeler and Garrick 2020).

Australia's coal and gas industries would be among those harmed by more taxation of carbon emissions globally, but its uranium output and exports may grow, and more so if Australia allowed nuclear power plants to replace some of its retiring coal-fired plants.[13] Offsetting fossil fuel declines will be growth in demand for renewable energy sources. That global growth in turn will boost the demand for and thus prices of rare earths and minerals needed for batteries to store renewable energy and power electric vehicles. Some of those are mined in Australia (Table 2), and more could be as demand for them grows, especially if current restrictions on their export from other countries remain in place (World Bank 2017; Hund et al. 2020). There will be an adjustment also within the iron ore market as de-carbonization efforts boost the demand for high-grade iron ore at the expense of lower-grade iron ore (Wood MacKenzie 2022).

The country's beef, sheep and dairy industries would be harmed if methane was included in the greenhouse gases targeted by Australia's emission reduction policies. But

[13] Ironically, as fossil fuel international prices rose in 2021-22, the Australian government temporarily reduced the excise duty on petrol and diesel and has been considering restrictions on the export of liquified gas to reduce rises in domestic retail fuel and electricity prices (Liu, Nassios and Giesecke 2023).

some other farmers would benefit. They include not only those able to produce alternative protein sources to ruminant meats (Triech 2021; Frezal, Nenert and Gay 2022) but also those able to take up carbon sequestration options as the market matures for tradable emission permits nationally and abroad (Garnaut 2019, 2022; Thamo et al. 2019). Individual farmers will need to estimate whether the up-front cost of changes in land management practices is more than offset by the subsequent flow of benefits from selling carbon credits (White, Davidson and Eckard 2021).

Farmers and others also could provide other priced ecosystem services as and when markets for those services develop. The demand for such services increases with affluence as society worries more about biodiversity and seeks to get closer to the optimal use of its natural capital. Even if the community can express its willingness to pay for such services and biodiversity credits, the scientific basis for such payments needs to be carefully assessed. Much remains to be learned about the effectiveness of various schemes that have been tried (Börner et al. 2017), because their inadequate design and implementation to date have hampered their success (Wunder et al. 2020). Moreover, before more farmers can become competitive suppliers of those services, and move toward regenerative agricultural practises (Massy 2017), targeted research will need to be undertaken to explore novel institutions and policies to encourage those and related developments (Samuel 2020; Pannell and Rogers 2022).

A prior step is to better value human, natural and social capital so as to be able to measure environmental and social outcomes more comprehensively. The OECD (2020) is gradually contributing in that direction in its national accounting advice, for example by subtracting net depreciation of the total capital stock from GDP each year, while UNEP (2019) is improving global estimates of natural capital. The World Bank (2021a) outlines the development challenges and opportunities associated with blue and green biodiversity and ecosystem services, and has conveniently assembled a time series of the value of traditional capital stocks up to 2018 (Table 1). To that needs to be added (perhaps using willingness-to-pay criteria initially) valuations each year of the stocks of natural capital forms other than those used to generate agricultural and mining outputs. In Australia, the Government of New South Wales is leading this process, having developed a Natural Capital Statement of Intent (NSW Government 2022).

7. Conclusion and implications for development strategies and policies

This review of sectoral trends and shocks in the course of economic growth over the past two centuries reveals a number of unusual features of Australia's structural transformations. Those features are, however, fairly consistent with what trade and development theory would suggest once the country's institutions and policies are taken into account. The data underscore the resilience of Australian producers in dealing with supply and demand shocks associated not only with their own sector's product markets but also with the booms and slumps of other sectors. Manufacturers have fared least well over recent decades, as Asian industrialization and value chain developments have become ever-more sophisticated and competitive. In addition to strong product competition from abroad in the wake of its phaseout of past import protection, Australian manufacturers will have to continue to contend with competition domestically for labour and other mobile resources, both when primary sectors boom and as and when the most internationally competitive of the country's service industries develop (Baldwin 2019, 2022). Future governments may still be tempted to occasionally provide some direct assistance to struggling firms in marginal electorates, but much more efficient generic social safety nets/trampolines are now available to assist the potential losers from economic growth to adjust to future sectoral trends and shocks.

Two key facts about Australia are highlighted in this study. One is agriculture's near-constant share of GDP for nearly 100 years from 1860. It was due to several factors: a big land frontier that took more than a century for settlers to explore, declines in initially crippling domestic and ocean trade costs for farm products, innovations by farmers and via a strong public agricultural R&D system, and reasonably sound macroeconomic policies and openness to immigration (at least from Europe). True, manufacturing protection policies reduced the prosperity of primary production last century, but for farmers and graziers that was at least somewhat offset by the ban on iron ore exports between the late 1930s and mid-1960s and – temporarily – a boom in wool prices in the early 1950s.

The other highlighted key fact is the recurrence of mining booms. The big supply-side ones in the nineteenth century were not random (Blainey 1970), but they were driven by relatively low-tech exploration, prospecting and pit mining. By contrast, the big mining booms in the past half century have been driven by external demand for fuels, minerals and metals and capital-intensive high-tech investments based largely on imported financial capital. Each of the price spikes of 1973-74, 1979-80, 2008-09 and 2021-22 provided immediate windfall gains to many Australians and those owning the foreign firms investing capital into exploration and exploitation of mineral resources. Even before exports began to

expand, the price rise and capital inflow boosted the value of both mining exports and the Australian dollar (Freebairn 2015). Figure S14 makes clear the massive extent of the net beneficial impacts of this century's two price booms, and associated boosts to mining investment, on the contributions to total GDP and export earnings of mining relative to agriculture.

The main lesson from Australia for developing countries that are rich in natural resources per worker is that it *is* possible to become a mature high-income economy and simultaneously retain a strong comparative advantage in primary products. But to do so it is important to:

- establish and maintain inclusive political and economic institutions so as to secure property rights, law and order, democratic elections, and well-operating markets that provide incentives for households and businesses (foreign as well as domestic) to continually invest in the country's prospectively most-profitable industries, technologies and skills;
- retain openness to international markets not only for goods and capital but also for services, which are becoming increasingly tradeable and offer new opportunities even for low-income countries (Baccini et al. 2022); and
- retain a flexible foreign exchange rate regime and labour market, and liberal trade and immigration policies, to allow growth in nontradables and to reduce the extent of downward adjustment required by other tradeable sectors when one of them booms (and conversely when one of the tradable sectors slumps).

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Table 1: Values of endowments of agricultural land, mineral resources, and other capital[a] per worker, and real income per capita (YPC), Australia relative to other countries, 2018 (world =100)

	Agric K	Mining K	Other K[a]	YPC
Australia	**318**	**1209**	**511**	**288**
North America	187	194	545	369
Latin America & Caribbean	123	80	56	96
Europe & Central Asia	119	83	216	131
EU 28 only	*116*	*14*	*260*	*264*
East Asia & Pacific	119	128	129	103
China only	*141*	*46*	*109*	*92*
South Asia	54	3	17	36
Sub-Saharan Africa	57	27	11	22
Middle East & North Africa	53	1609	81	208
WORLD	100	100	100	100

[a] 'Other K' refers to non-natural produced capital including all human capital.

Sources: Author's compilation drawing on the World Bank (2021b) for the value of the various capital endowments per worker and World Bank (2022) for real gross national income per capita (YPC).

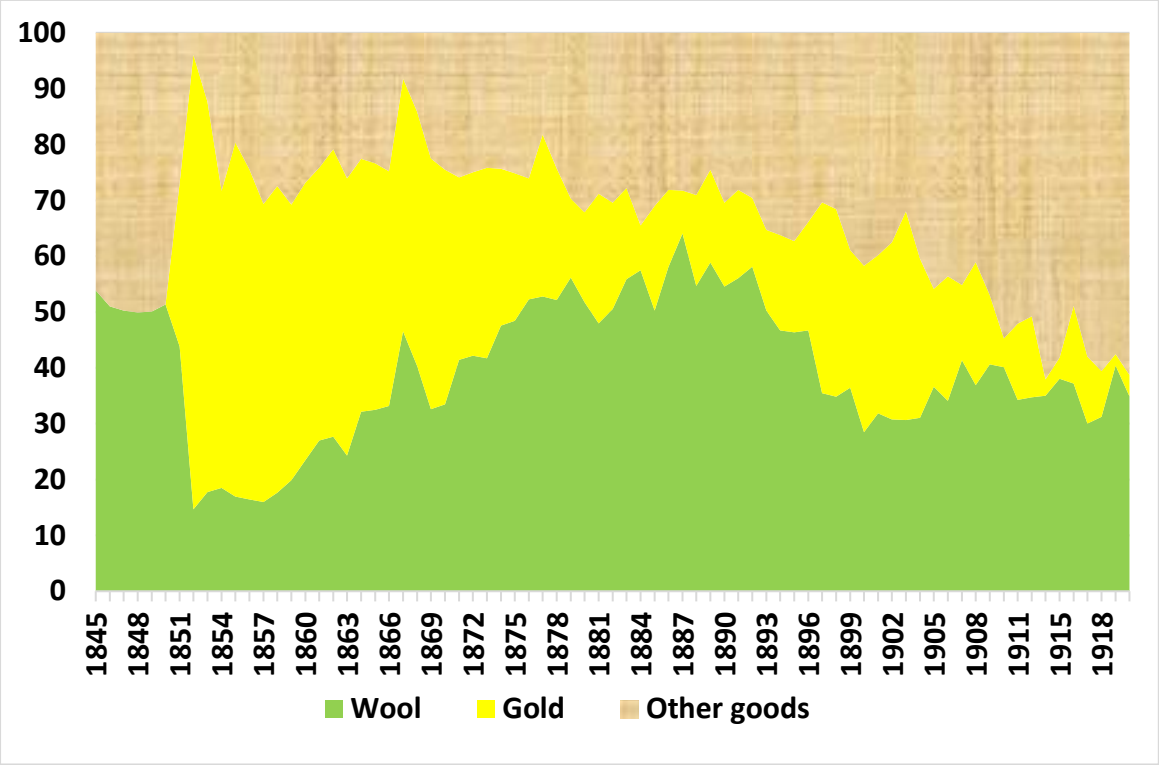
Table 2: Australia's shares of world mineral production and population, 1913 and 2021 (%)

	1913	**2021**
Bauxite	0.0	28.2
Coal	0.9	7.4
Copper	4.7	4.3
Gold	9.9	11.0
Iron ore	0.1	3.5
Lead	21.8	11.6
Lithium	0.0	52.3
LNG	0.0	3.6
Rare earths	0.0	7.9
Silver	7.5	3.3
Zinc	21.8	10.0
Population	0.28	0.33

Source: David and Wright (1979) for 1913 data; 2021 data from BP (2022) for energy raw materials, otherwise USGS (2022).

Figure 1: Shares of wool, gold and other goods in Australia's merchandise exports, 1845 to 2021 (%)

(a) 1845 to 1920



(b) 1901 to 2021

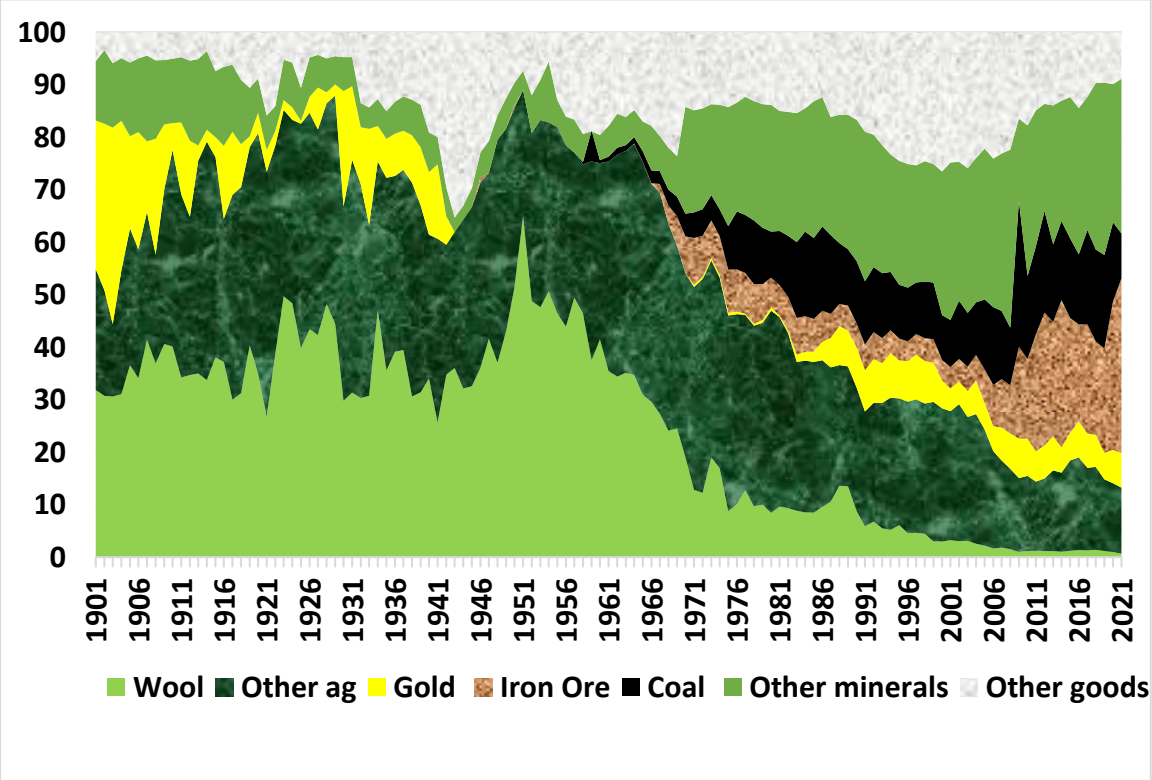
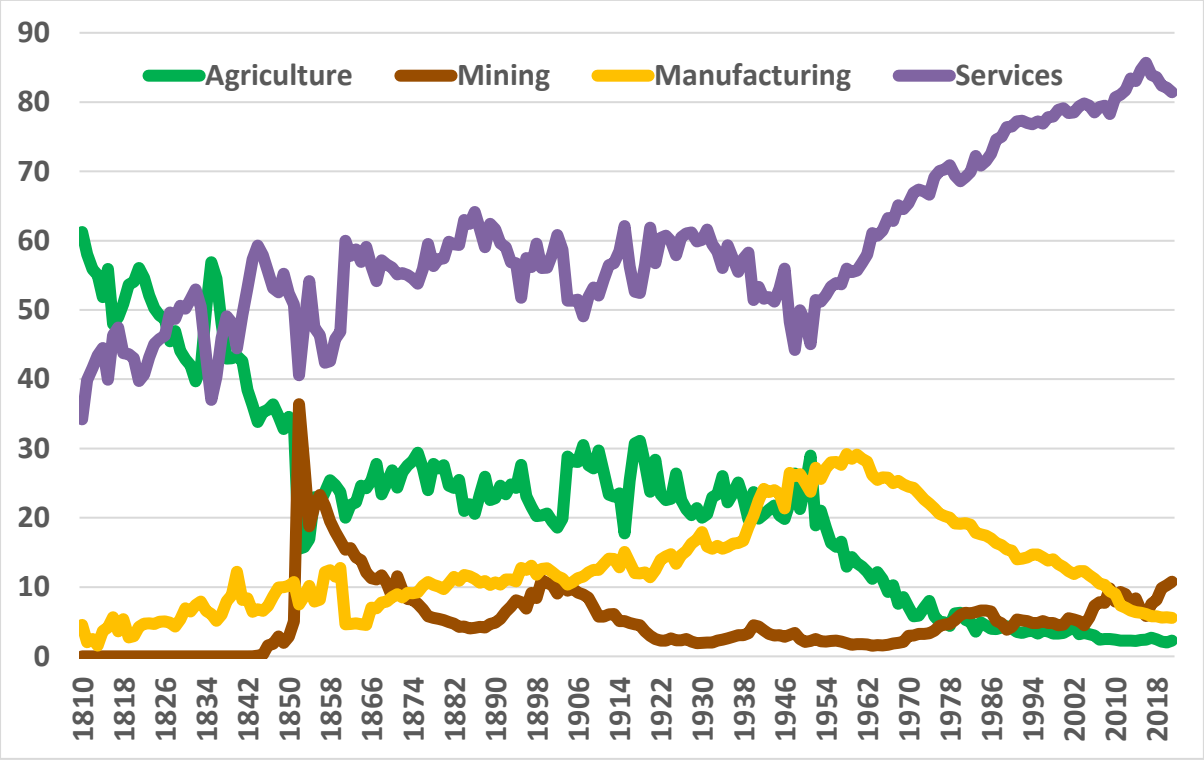


Figure 2: Contributions of agriculture, mining, manufacturing and services to Australia's GDP and employment, 1810 to 2021 (%)

(a) GDP



(b) Employment

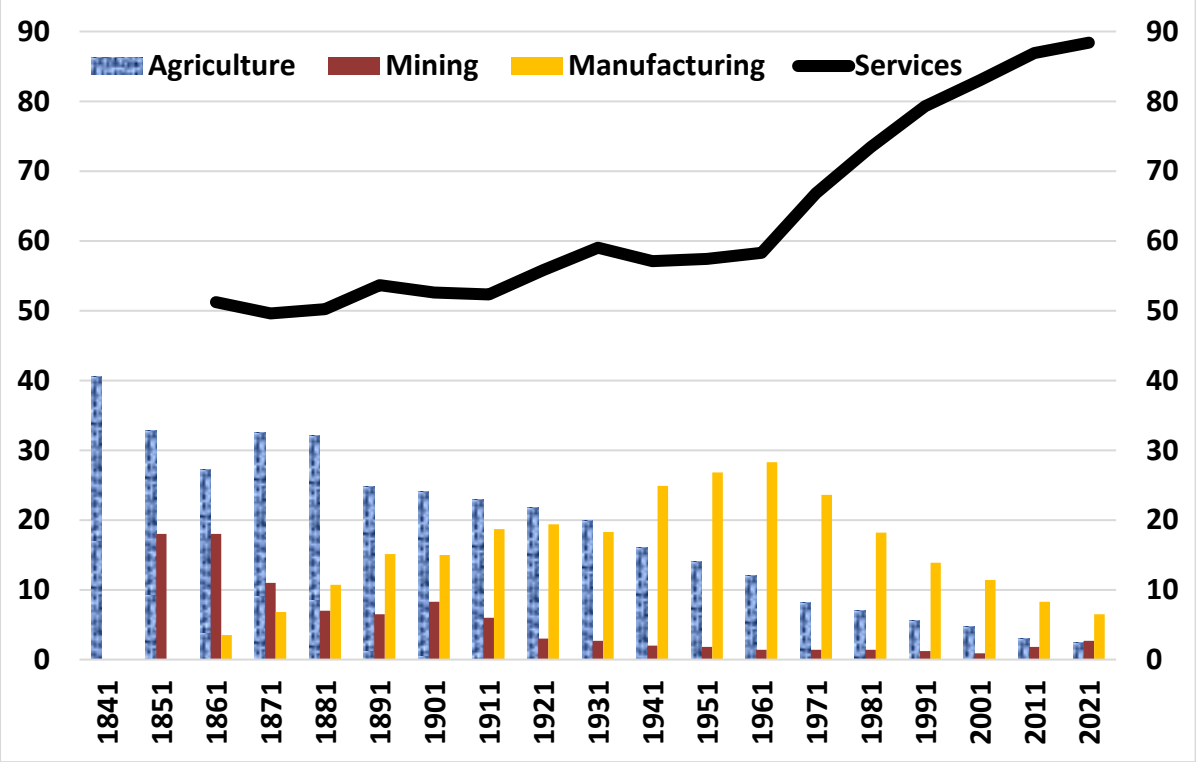
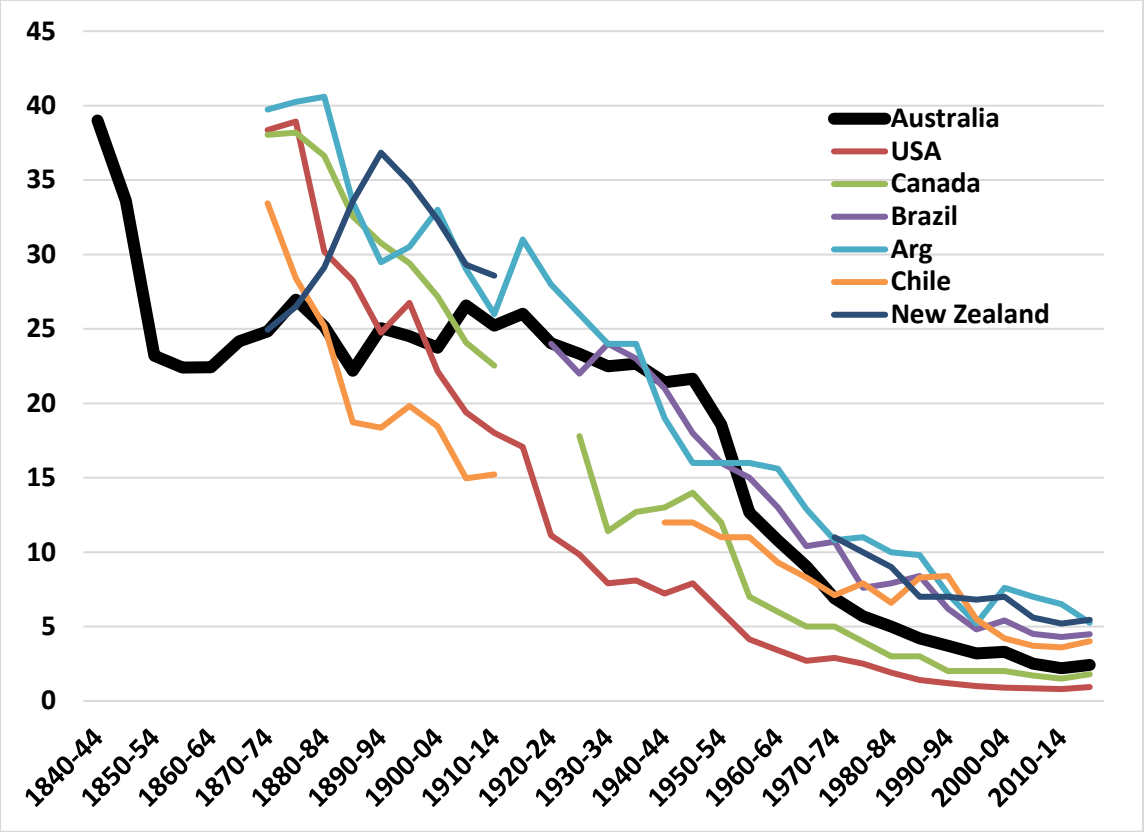


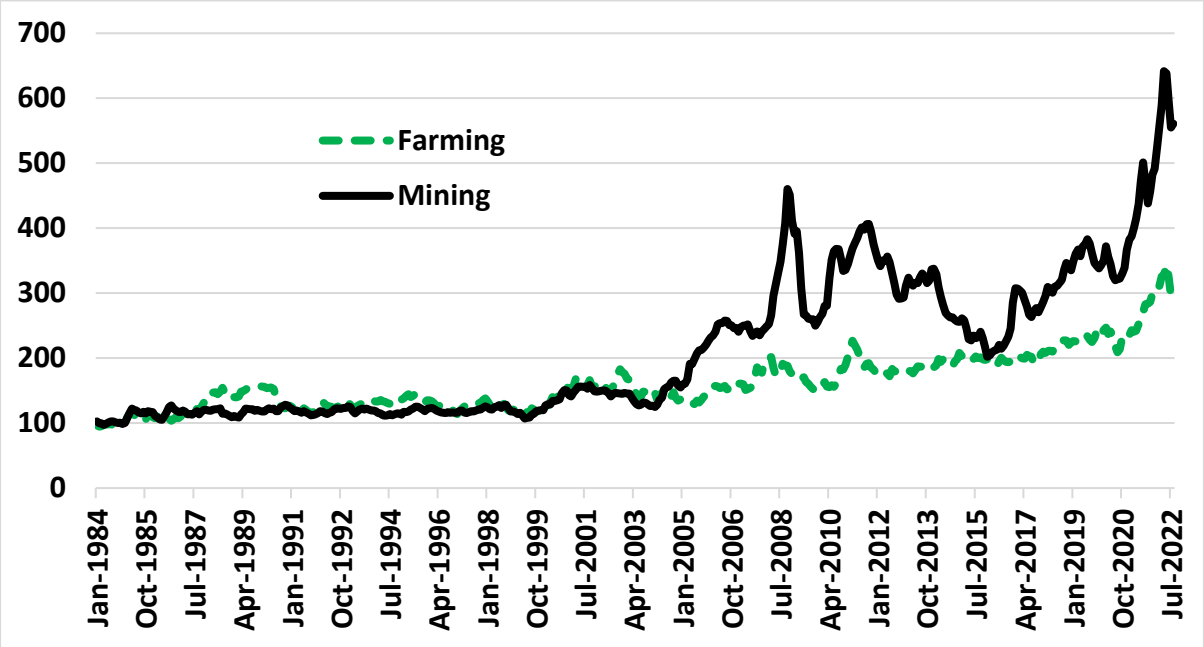
Figure 3: Agriculture's share of GDP, Australia and other New World countries, 1840 to 2019 (%)



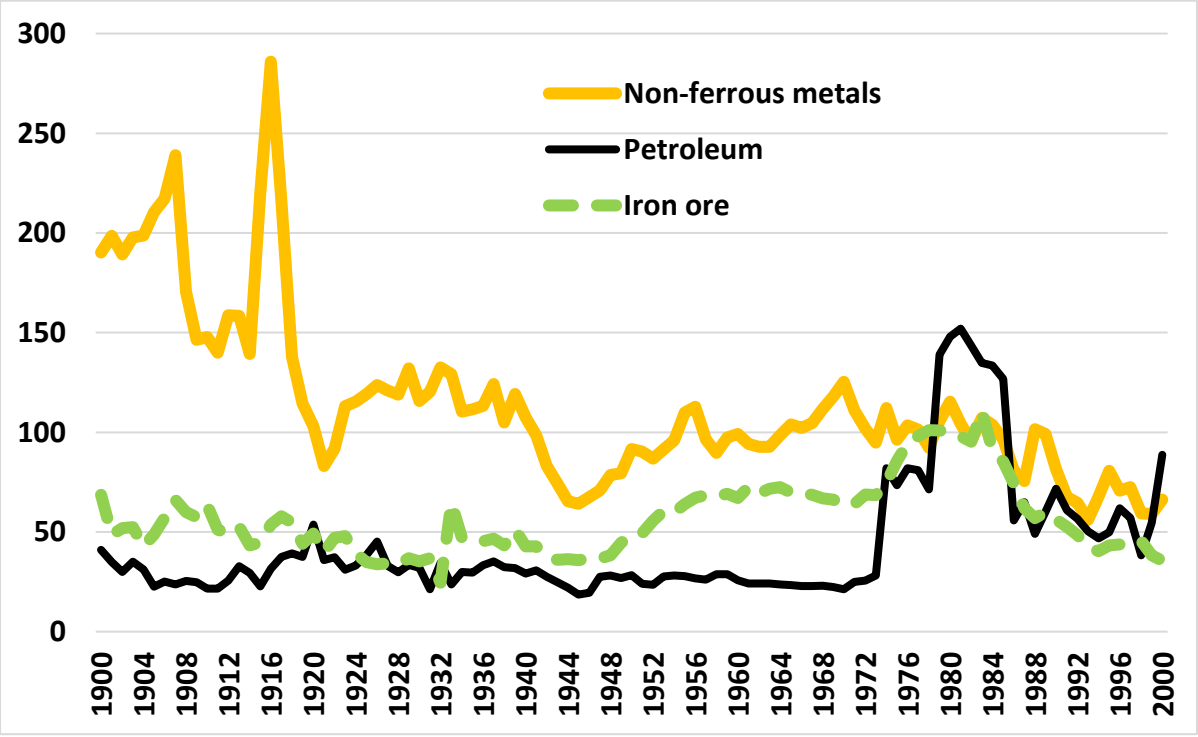
Source: Author's compilation based on data in Mitchell (2005) and World Bank (2022).

Figure 4: Indexes of Australia's export prices for farming and mining commodities and their ratio, 1984 to 2022, and of real international prices for iron ore, non-ferrous metals and petroleum, 1900 to 2000

(a) Australia's export prices for farming and mining commodities and their ratio, January 1984 to August 2022 (January 1985 = 100)

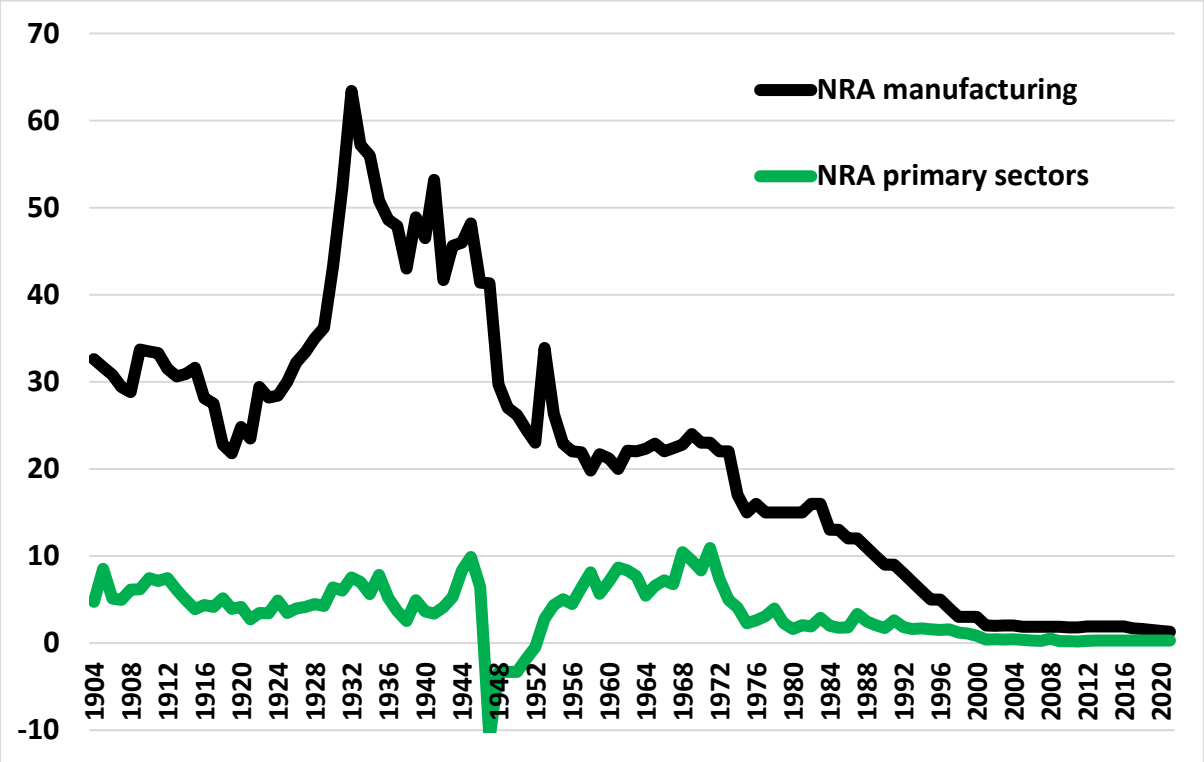


(b) Indexes of real international prices for iron ore, non-ferrous metals and petroleum, 1900 to 2000 (1977-79 = 100)



Sources: Reserve Bank of Australia; and Pfaffenzeller, Newbolt and Rayner (2007) and, for iron ore, Jacks (2019).

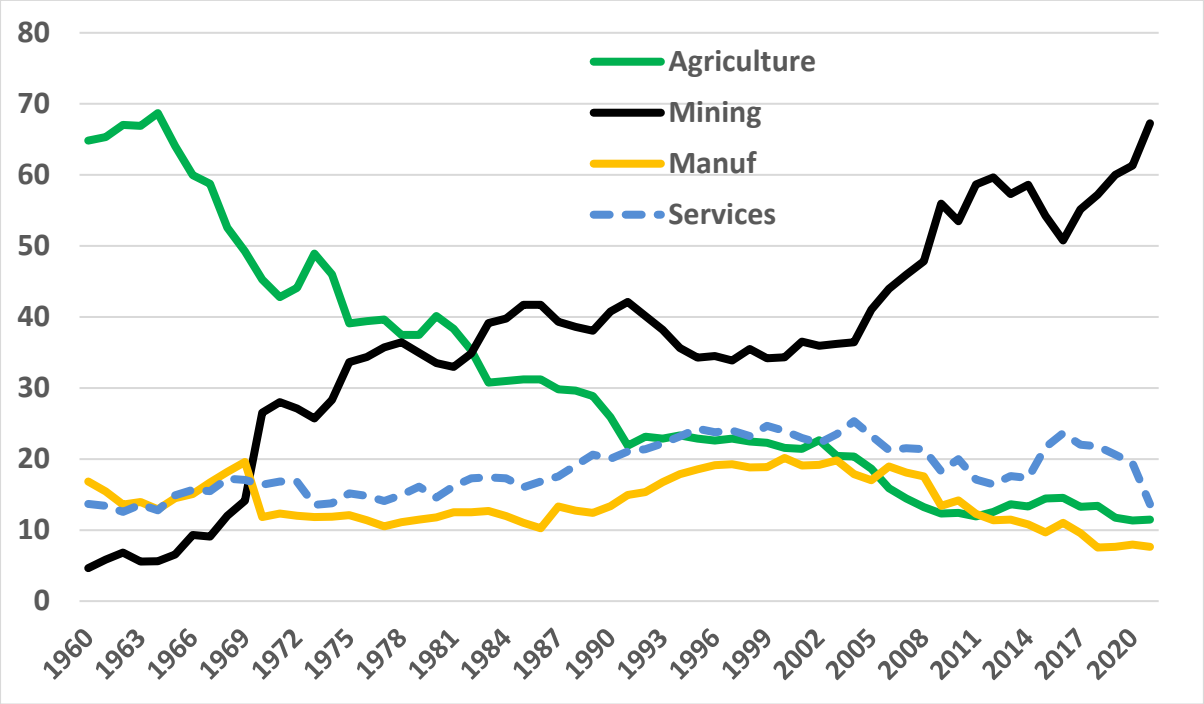
Figure 5: Nominal rates of assistance (NRA) to Australia's manufacturing and primary sectors, 1904 to 2021 (%)



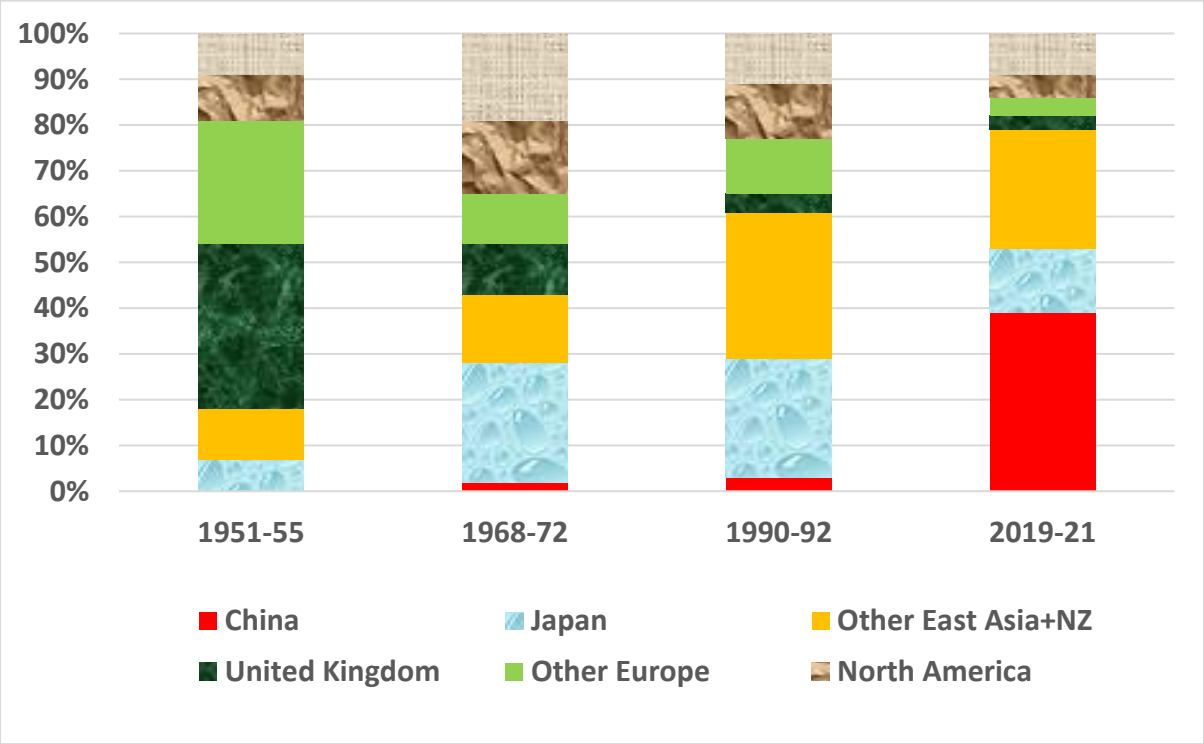
Source: Author's updated compilation based on data in Anderson, Lloyd and MacLaren (2007) and Lloyd and MacLaren (2015), assuming the NRA for mining was zero each year.

Figure 6: Evolving concentration in Australia's production and direction of exports, 1951 to 2021 (%)

(a) Goods and services export shares, by sector (%)



(b) Goods export shares, by destination[a] (%)

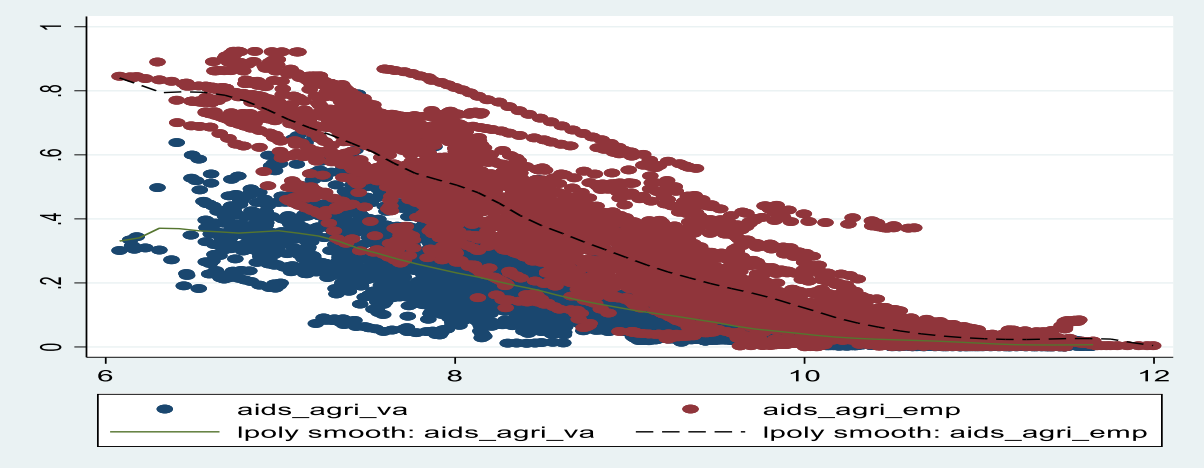


[a] China's share of Australian exports of services rose from 2% in 1990-92 to 18% in 2019-21, while the rest of Asia's share was just under 40% in both of those periods.

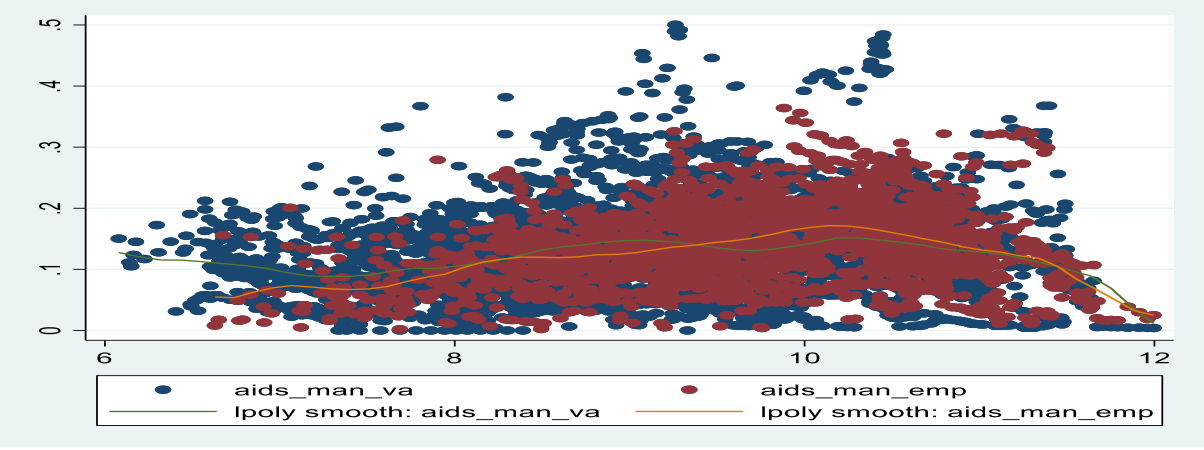
Supplementary Material: for online availability

Figure S1: Proportions of national value added and employment in agriculture, manufacturing and services, 130+ countries, 1990-2020

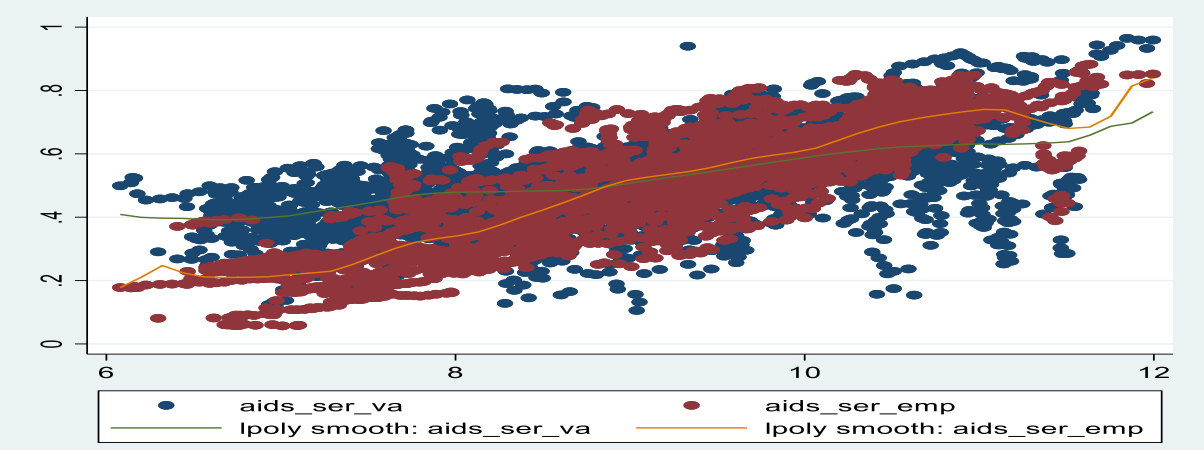
(a) Agriculture



(b) Manufacturing

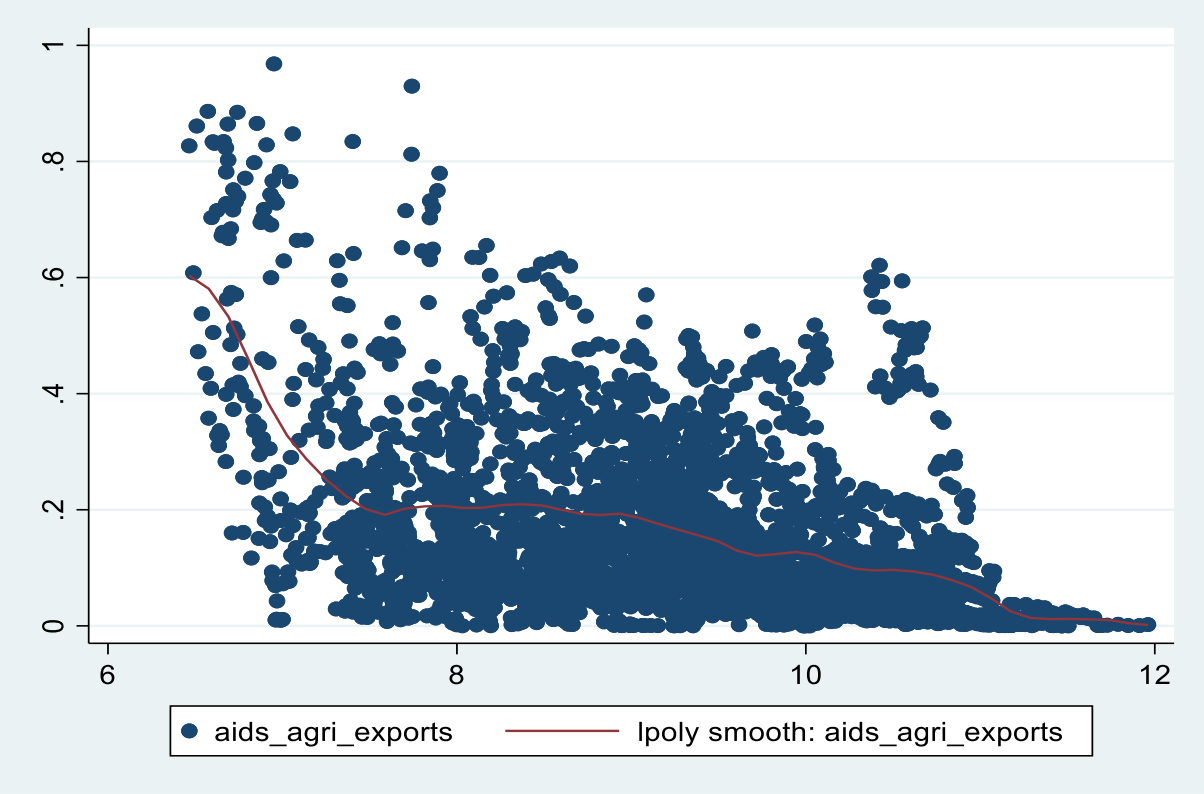


(c) Services



Source: Compiled by Sundar Ponnusamy using World Bank (2022) and ILO (2022) data.

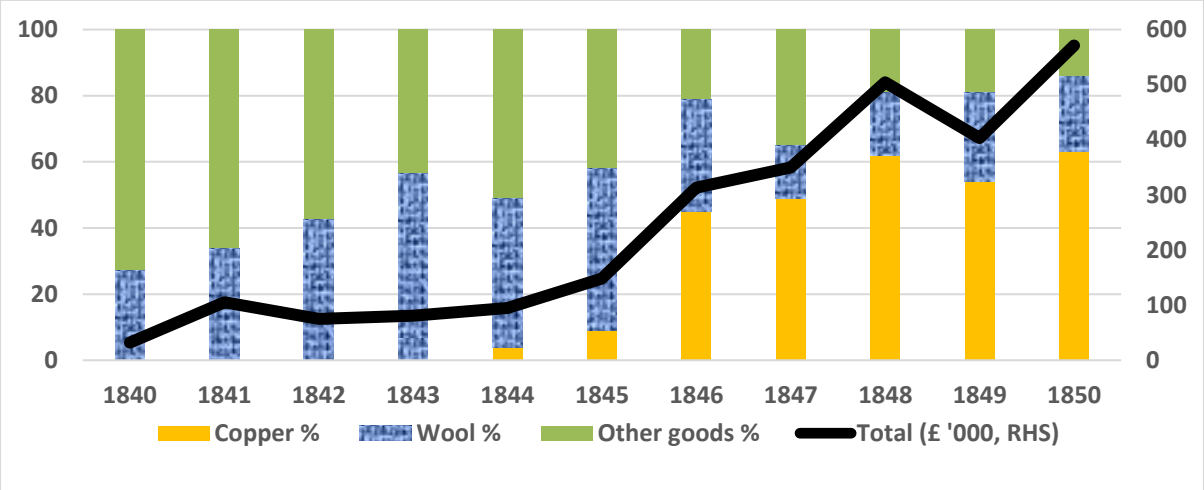
Figure S2: Proportion of national exports of goods and services from agriculture, 160+ countries, 1960-2020



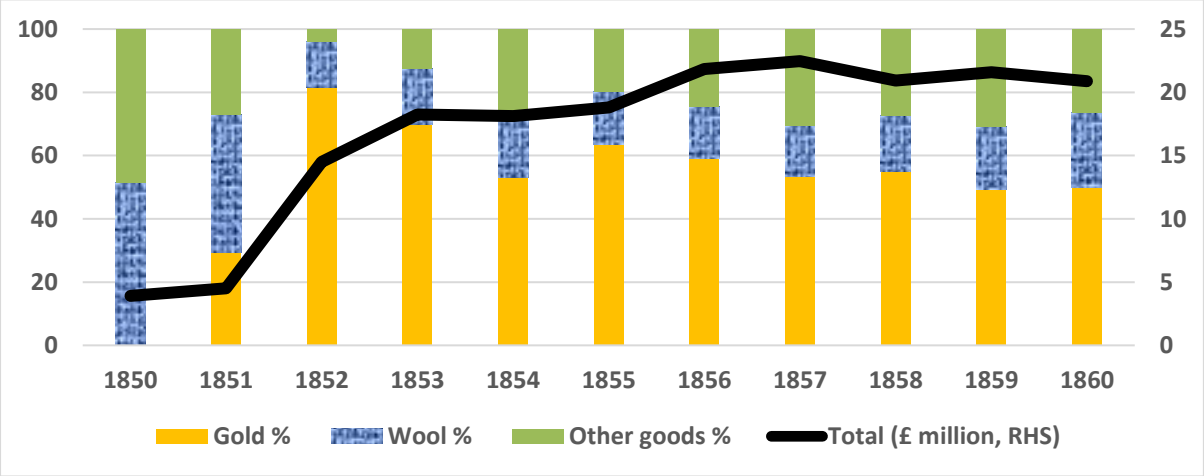
Source: Compiled by Sundar Ponnusamy using World Bank (2022) data.

Figure S3: Value and sectoral shares of merchandise exports, South Australia and Australia during three nineteenth century mining booms, £ (black line) and % (bars)

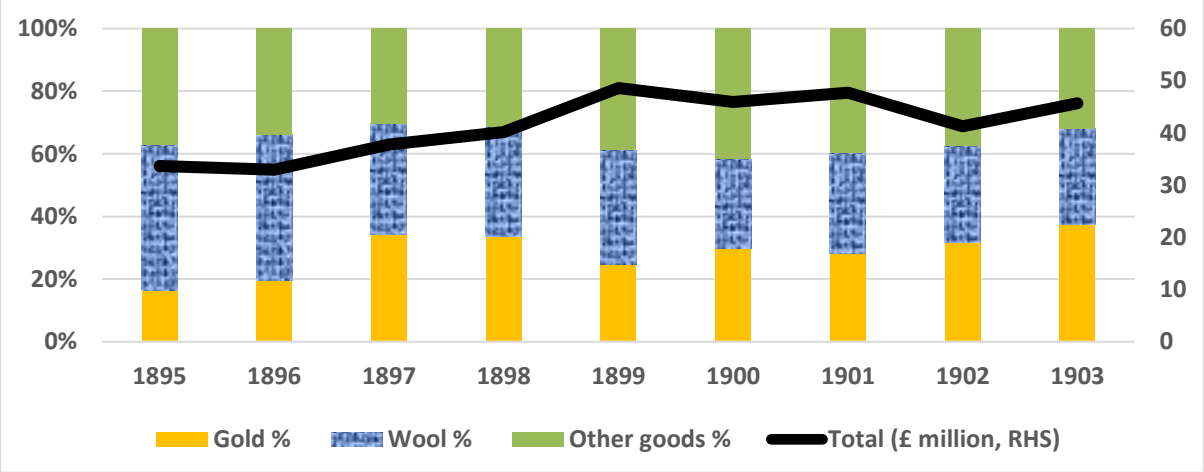
(a) South Australia, 1840-50



(b) Australia, 1850-60



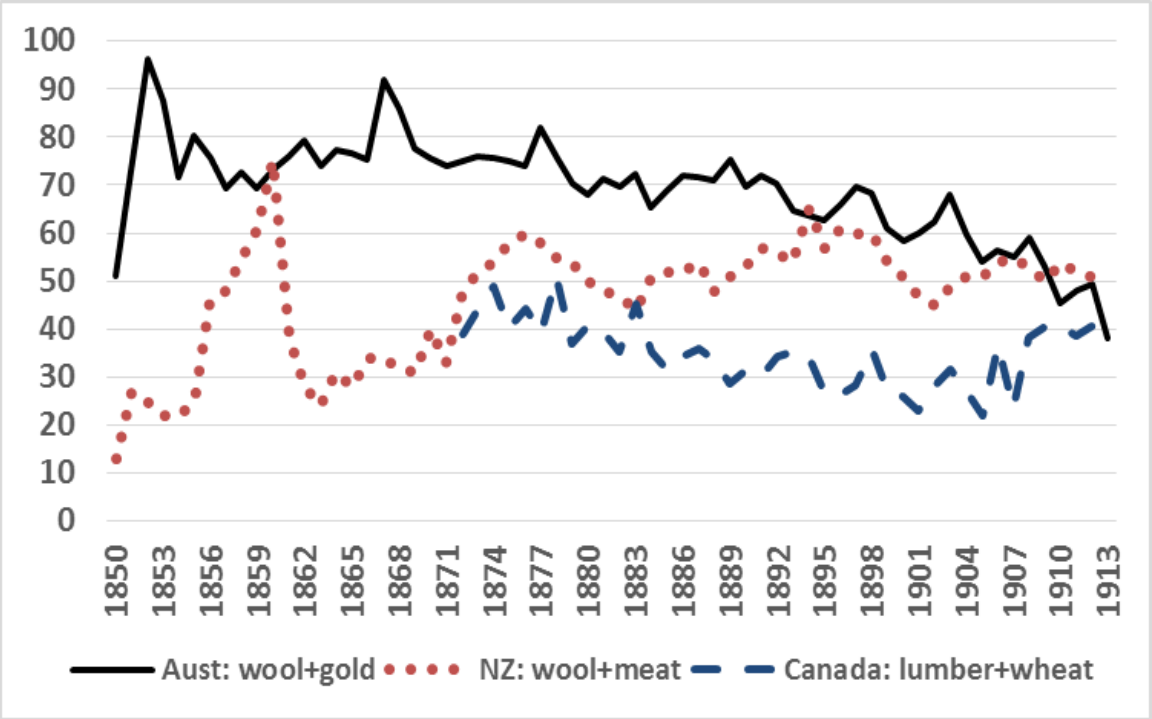
(c) Australia, 1895-1903



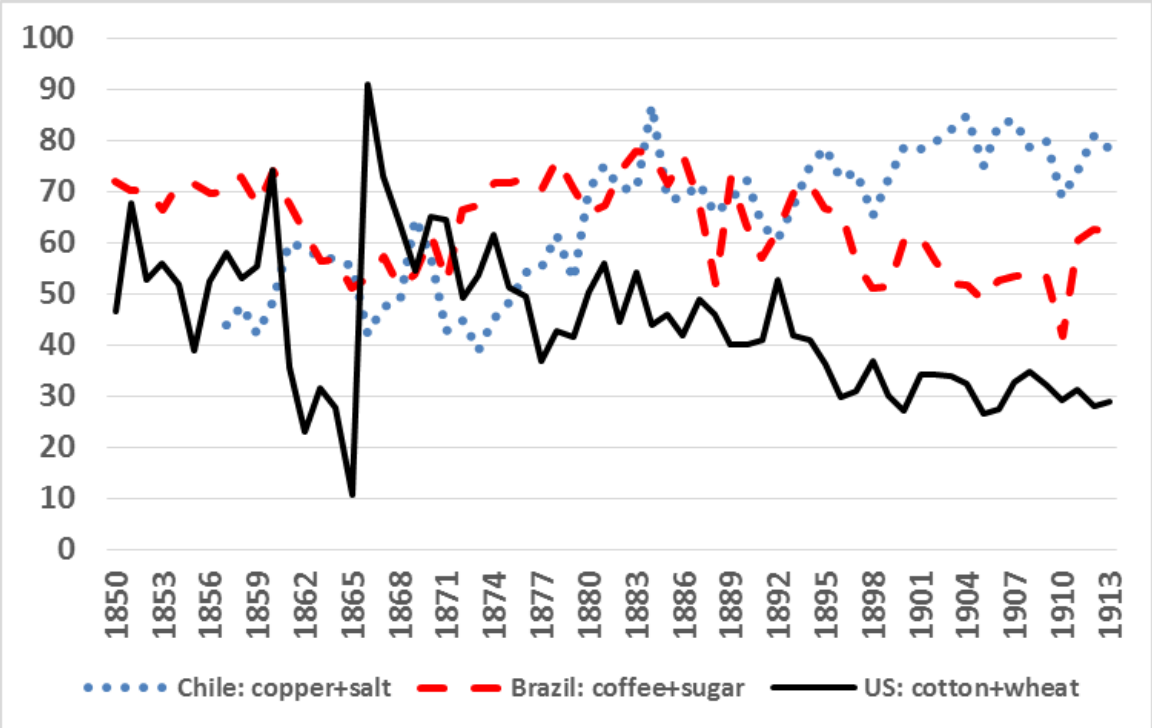
Sources: Vanplew (1987) and, for South Austalia, Harris and La Croix (2021).

Figure S4: Share of top two goods in New World settler economies' exports, 1850 to 1913 (%)

(a) Australia, New Zealand and Canada



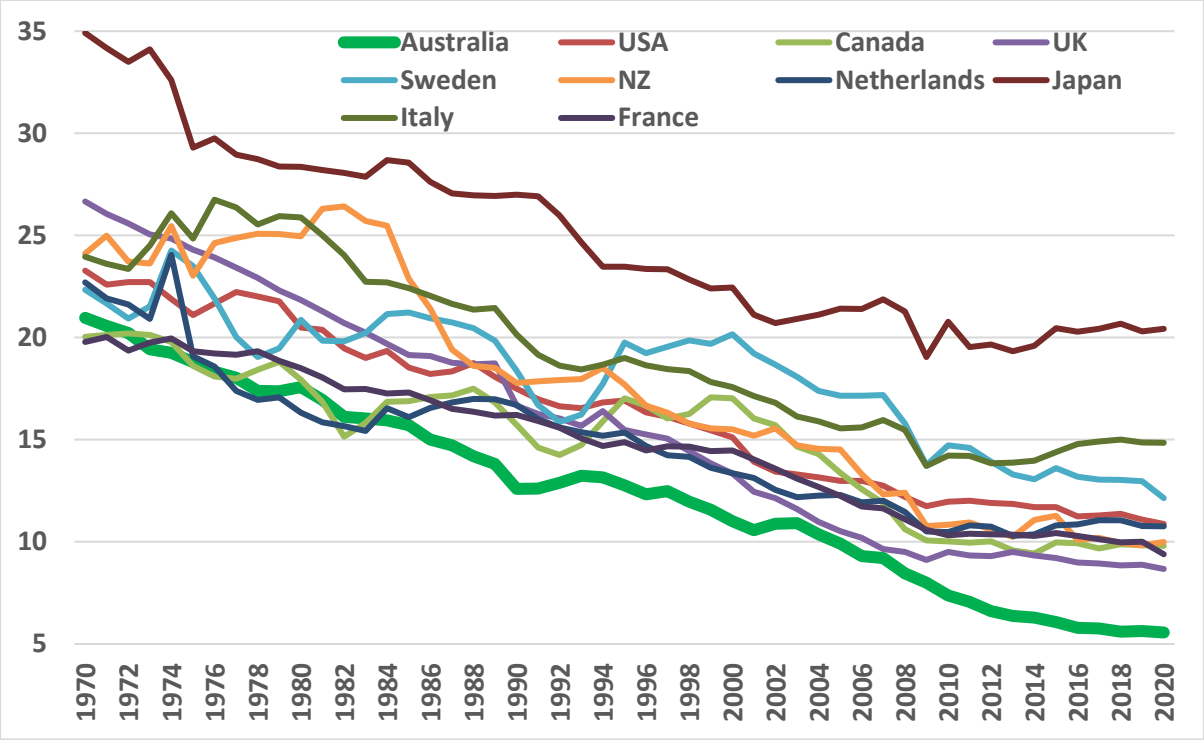
(b) Brazil, Chile and the United States



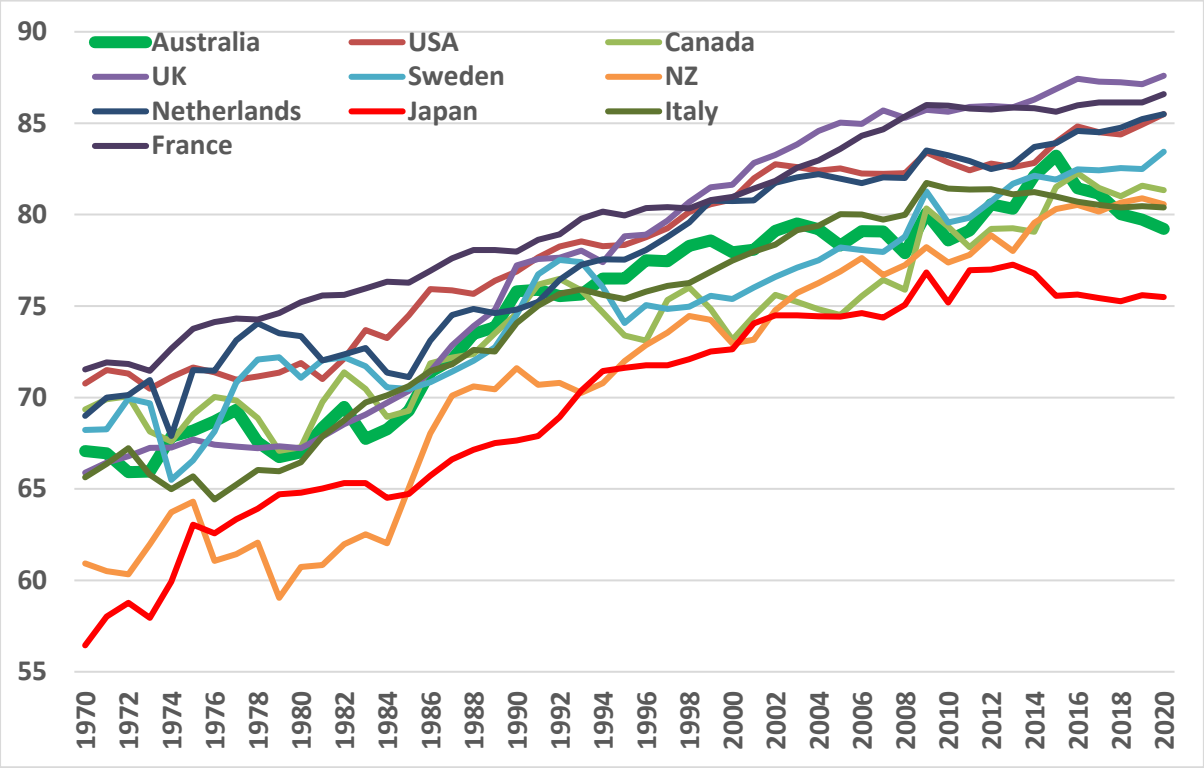
Source: Author's compilation based on data in Mitchell (2005).

Figure S5: Manufacturing and services shares of GDP, Australia compared with other advanced economies, 1970 to 2020 (%)

(a) Manufactures

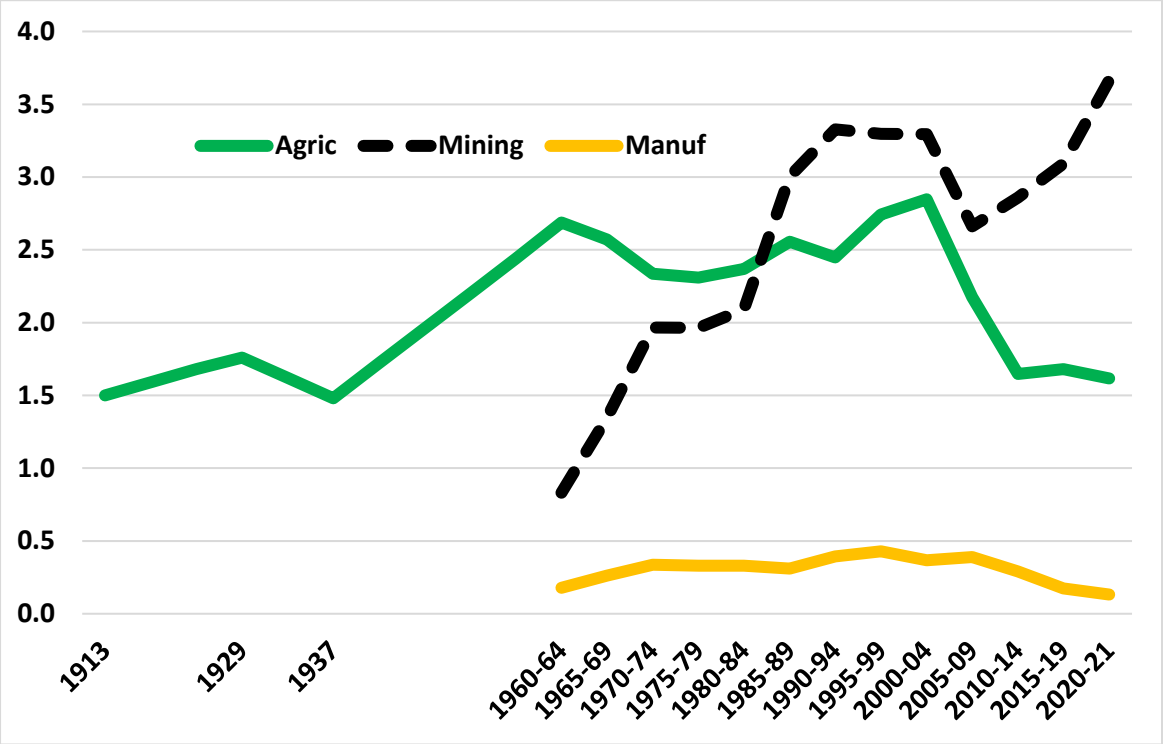


(b) Services



Source: UNSO (2022).

Figure S6: Australia's indexes of 'revealed' comparative advantage,[a] 1913 to 2021

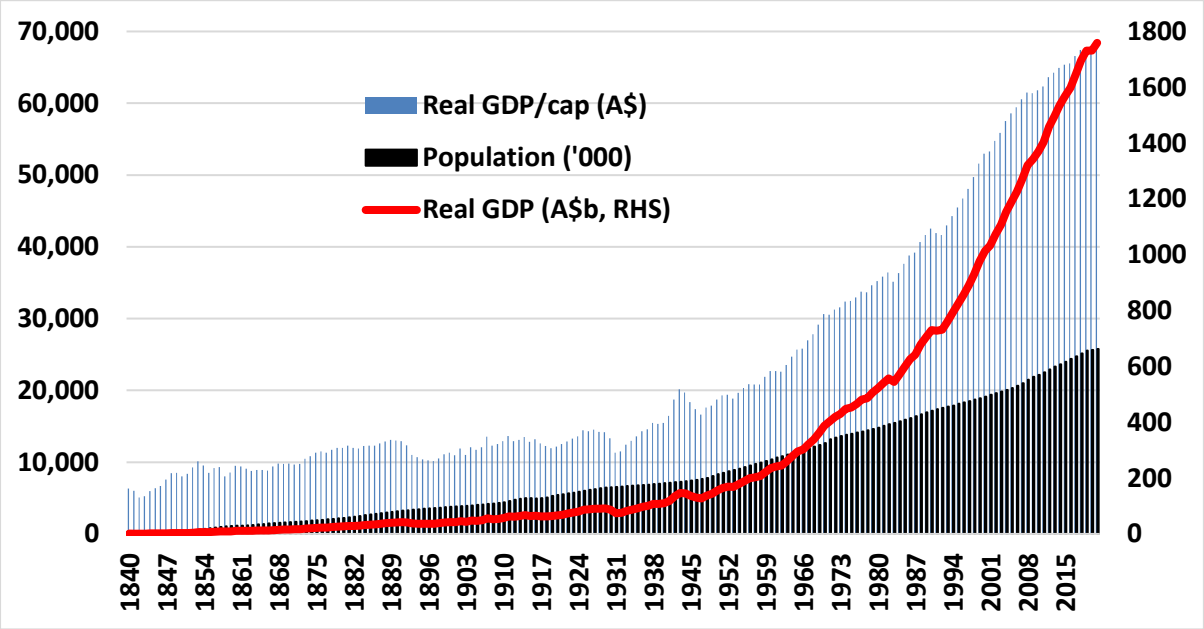


[a] This index is the share of a sector in a country's total goods exports divided by that sector's share in global international trade in all goods (Balassa 1965).

Source: Based on FAOSTAT, plus Federico (2005, page 28) for agriculture's share of global trade in 1913, 1929 and 1937.

Figure S7: Population and real GDP in Australia, 1840 to 2021 (A$ at 2010/11 prices)

(a) Population and real GDP levels



(b) Rates of growth in population and real GDP (%/year)

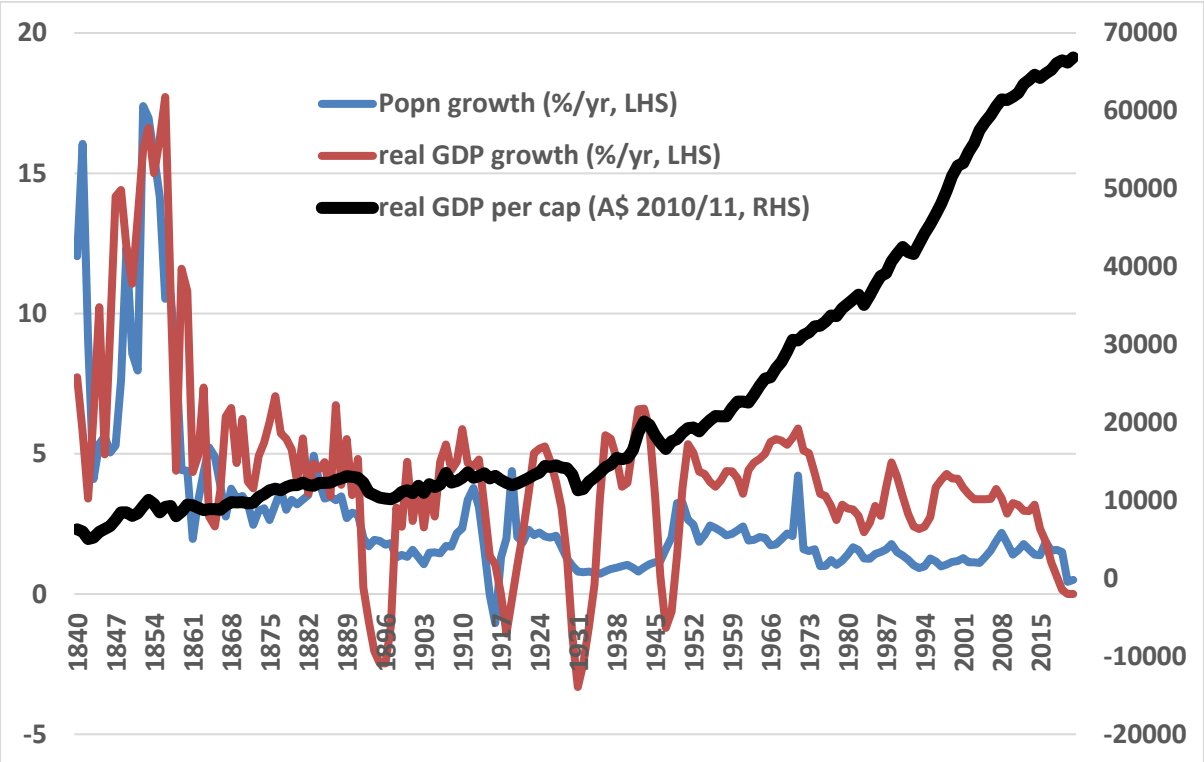
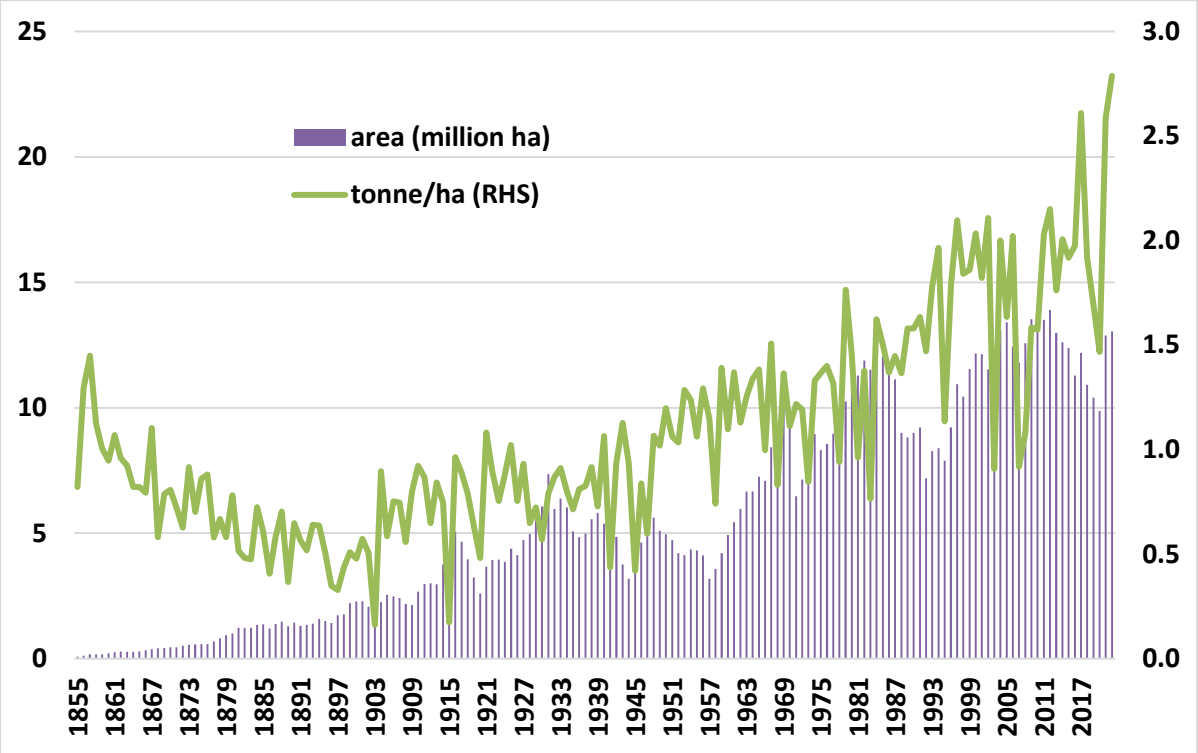


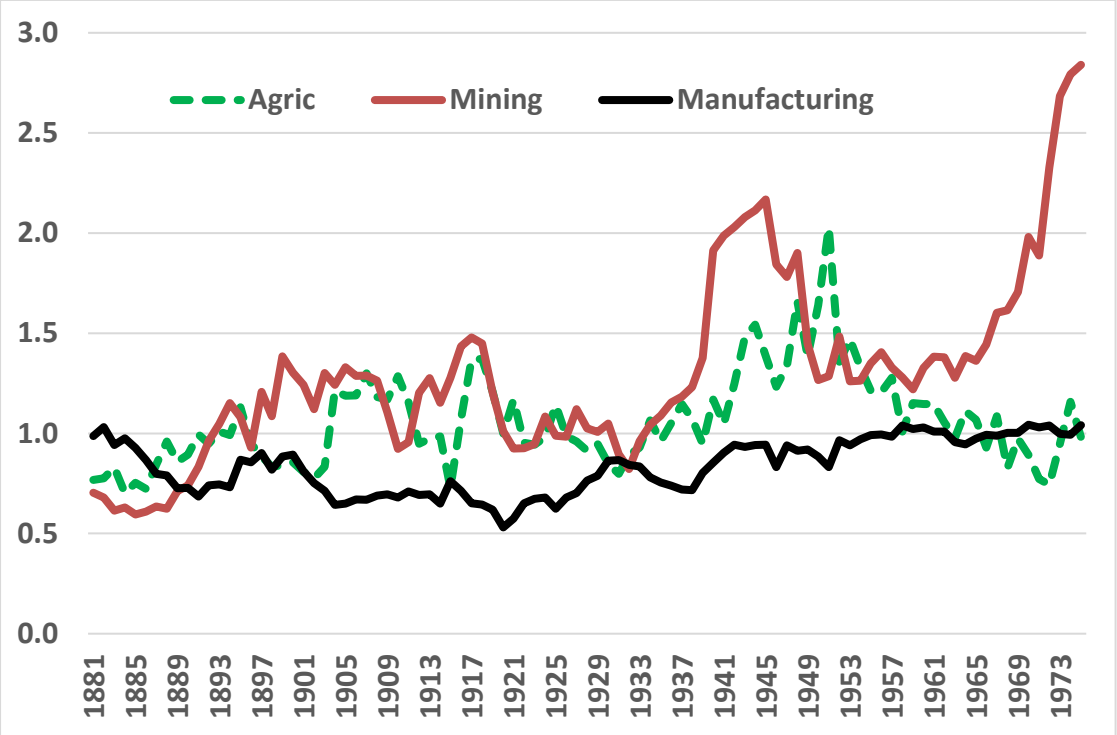
Figure S8: Australia's wheat area and yield per hectare, 1855 to 2021



Source: ABS (2011) and ABARES (2022).

Figure S9: Labour productivity by sector (ratio of sectoral GDP shares to sectoral employment shares), Australia, 1881 to 2021

(a) 1881 to 1971



(b) 1971 to 2021

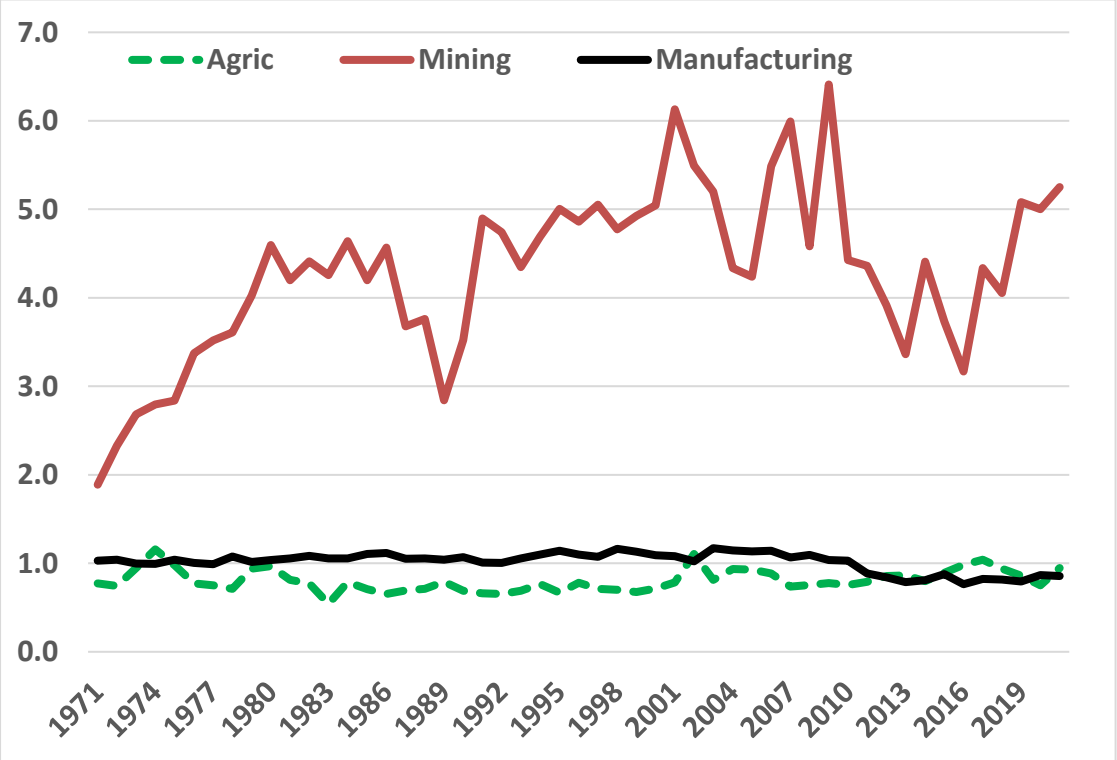
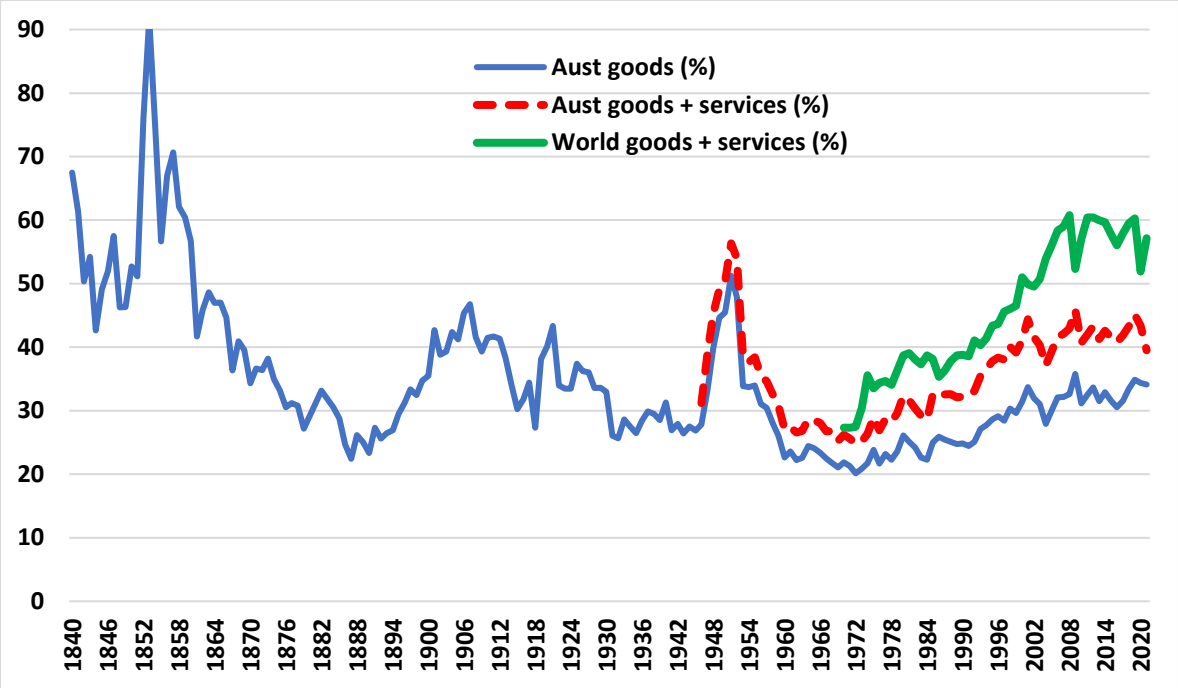
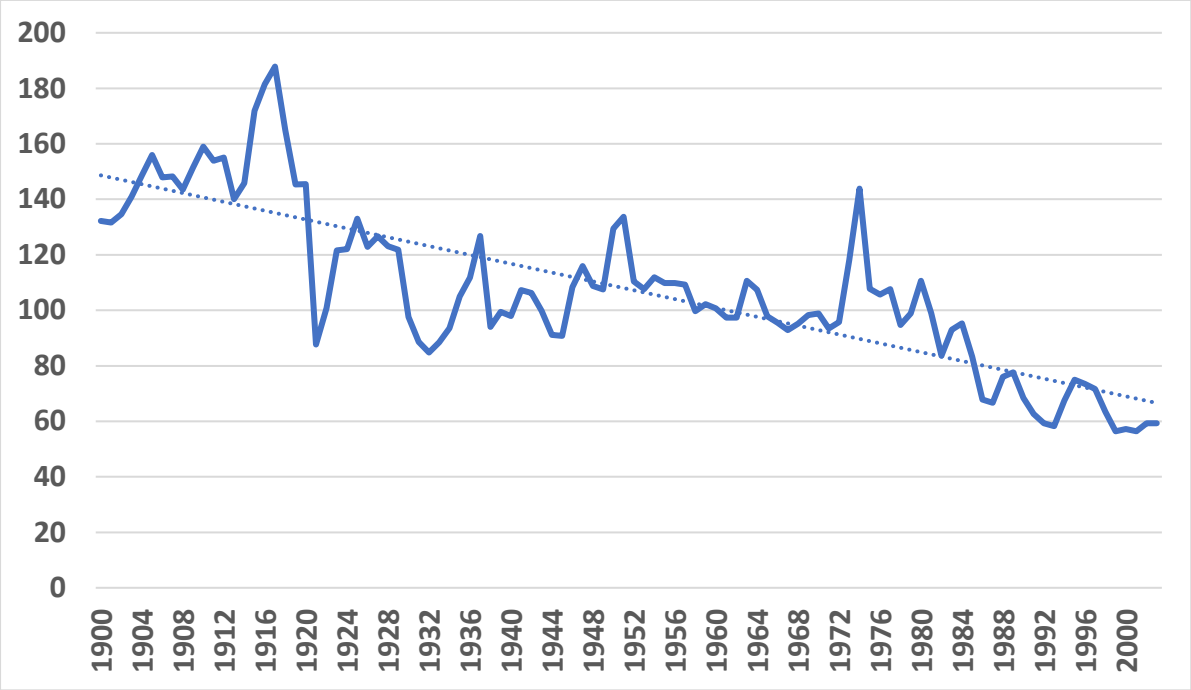


Figure S10: Goods and services exports plus imports as a % of Australian and world GDP, 1840 to 2021



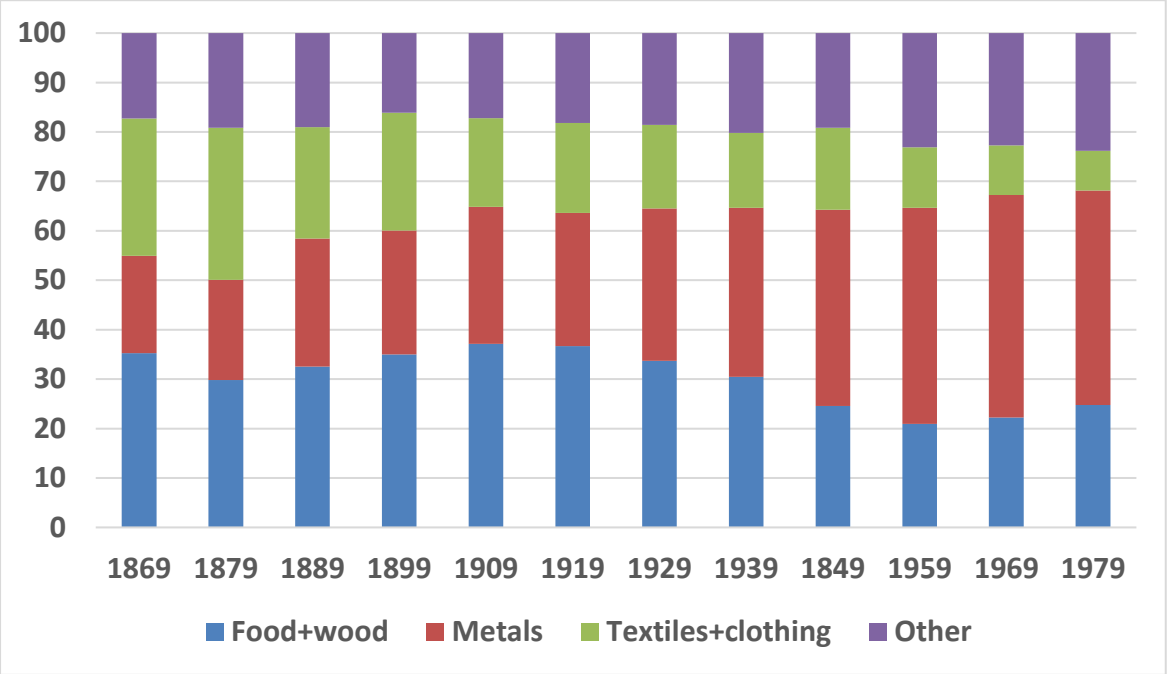
Sources: Butlin, Dixon and Lloyd (2015) and World Bank (2022).

Figure S11: International prices of primary products relative to those of manufactures (1977-79=100)



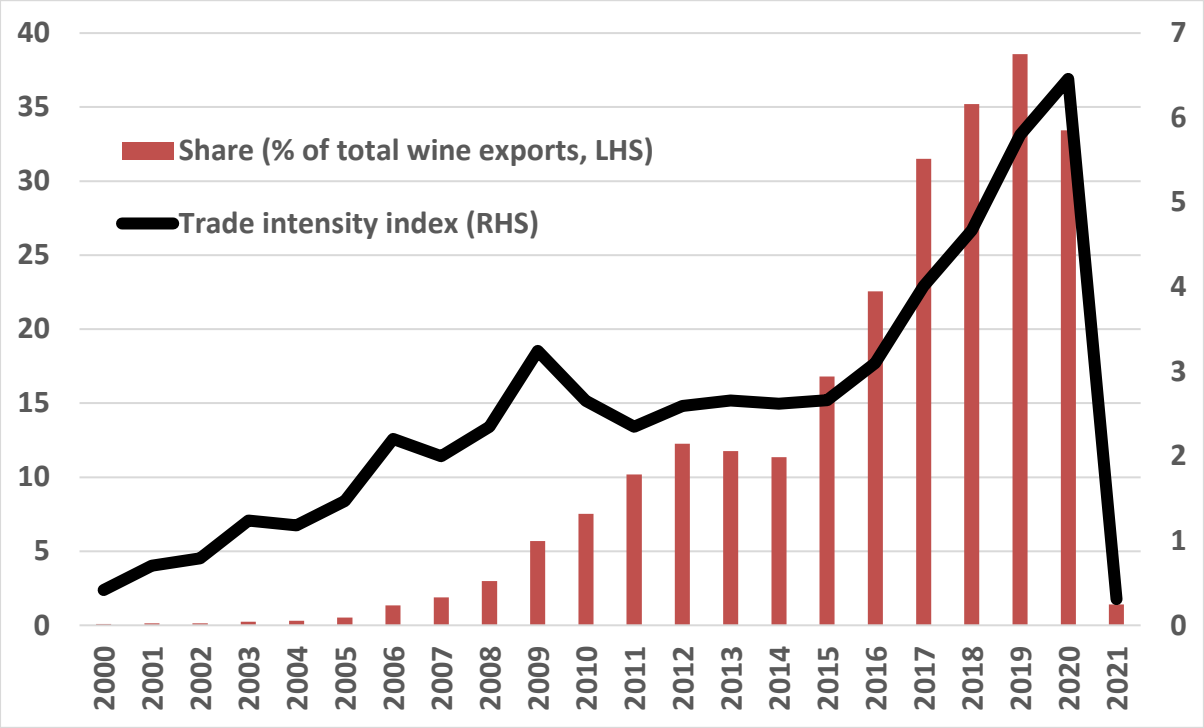
Source: Pfaffenzeller, Newbolt and Rayner (2007).

Figure S12: Sub-sectoral shares of Australian manufacturing value added,[a] 1869 to 1979 (%)



[a] In the absence of value-added data, the estimates for pre-1900 are employment shares, from Vanplew (1987).

Figure S13: Share and intensity[a] of Australia's wine exports to China, 2000 to 2021 (%)



[a] The index of trade intensity is defined as the value share of Australia's wine exports going to China divided by China's value share of world imports of wine, both in US$.

Source: United Nations (2022)

Figure S14: Relative prices of agricultural and mining exports and fluctuations in relative contributions to GDP and exports, Australia, 1984 to 2021

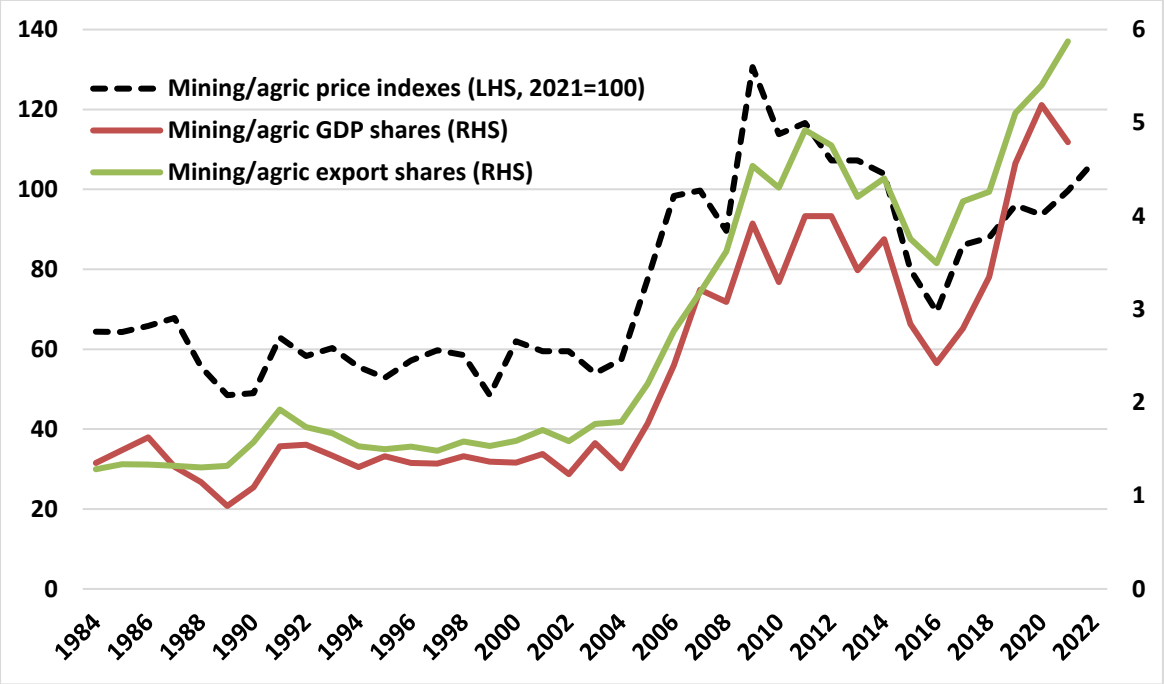
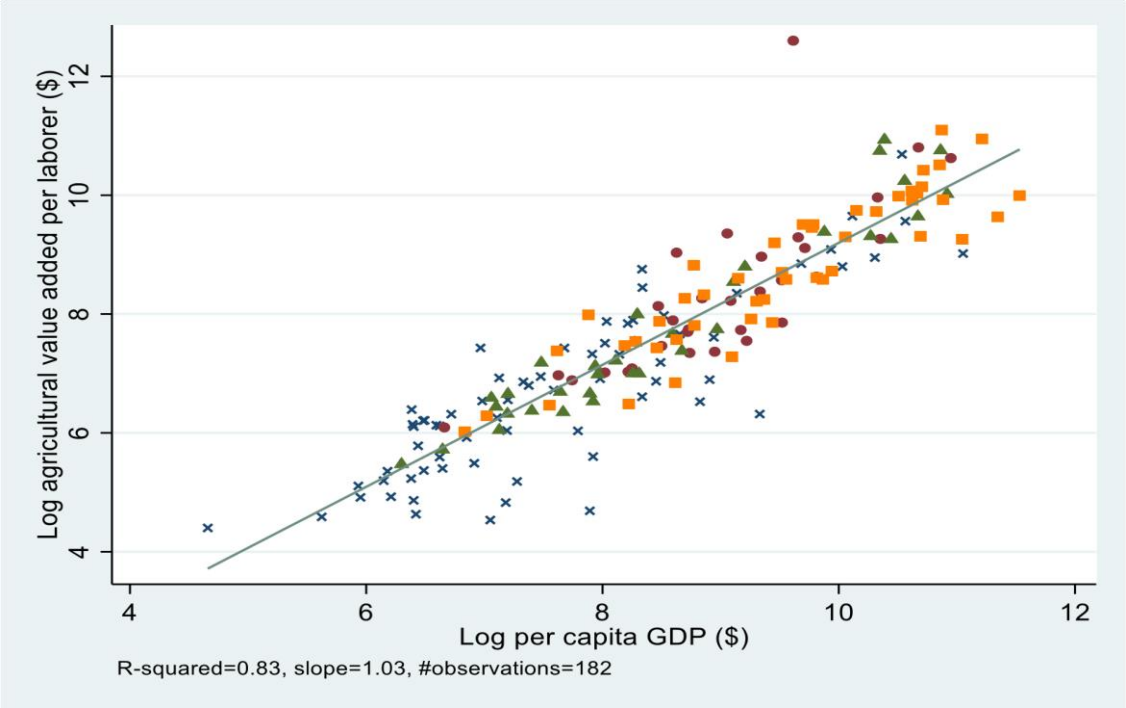
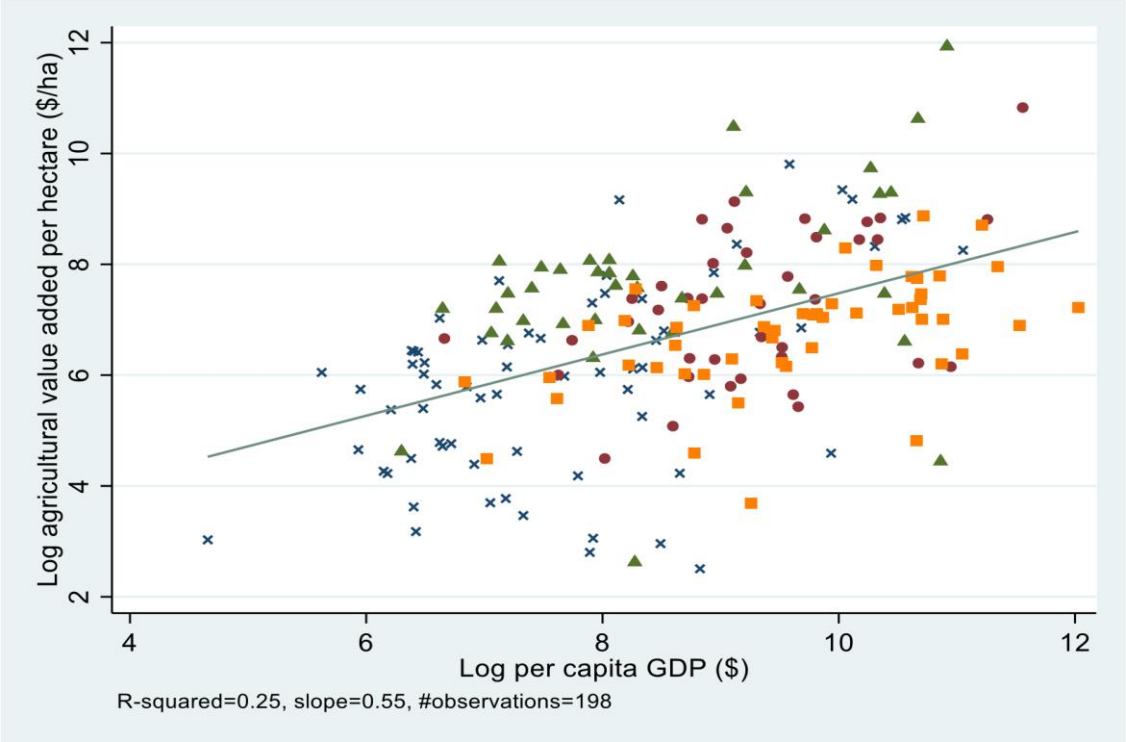


Figure S15: Agricultural labour and land productivity against log of GDP per capita, 182+ countries, 2015

(a) Log of agricultural value added per farm labourer against log of GDP per capita



(b) Log of agricultural value added per hectare against log of GDP per capita



Source: Deininger, Jin and Ma (2022), based on World Bank (2022) and FAO (2021).