

Arndt-Corden Department of Economics

Crawford School of Public Policy

ANU College of Asia and the Pacific



Why did agriculture's share of Australian GDP not decline for a century?

Kym Anderson

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

July 2023

Working Papers in Trade and Development

No. 2023/09

This Working Paper series provides a vehicle for preliminary circulation of research results in the fields of economic development and international trade. The series is intended to stimulate discussion and critical comment. Staff and visitors in any part of the Australian National University are encouraged to contribute. To facilitate prompt distribution, papers are screened, but not formally refereed.

Copies are available at <https://acde.crawford.anu.edu.au/acde-research/working-papers-trade-and-development>

Why did agriculture's share of Australian GDP not decline for a century?*

Kym Anderson

Abstract:

The agricultural sector's share of GDP in growing economies typically declines but, for a century from the early 1850s, Australia's did not. Drawing on recent structural transformation literature, this paper seeks explanations for this unusual phenomenon, which is all the more striking because agriculture's share of employment continued to decline throughout and growth in manufacturing was being stimulated by tariff protection from imports. Several factors contributed, including a huge land frontier that took more than a century for settlers to explore, rapid declines in initially crippling domestic and ocean trade costs for farm products, the absence of a need to do any processing of the two main exports during that period (gold and wool), and innovations by farmers and via a strong public agricultural R&D system that contributed to farm labour productivity nearly doubling over those ten decades. The ban on iron ore exports from 1938 and low export prices for fuels, minerals and metals during the two world wars and in the intervening decades also contributed.

Keywords: structural transformation, agricultural development, farm productivity growth, trade costs, mining booms, manufacturing protection

JEL codes: F13, F63, N47, O13, Q17

*This article is a revision of part of the 18th Corden Public Lecture, University of Melbourne, 13 October 2022. [Thanks are due to three referees and to participants at the Lecture for helpful comments, to Ross Garnaut, Peter Lloyd and other co-authors with whom some of the ideas herein were developed, and to Sundar Ponnusamy for compiling Figures S3 and S4 \(drawing on Anderson and Ponnusamy 2023\). Forthcoming in the *Australian Journal of Agricultural and Resource Economics*, Vol. 68, 2024.](#) All data are in the public domain as references in the text.

Why did agriculture's share of Australian GDP not decline for a century?

Abstract:

The agricultural sector's share of GDP in growing economies typically declines but, for a century from the early 1850s, Australia's did not. Drawing on recent structural transformation literature, this paper seeks explanations for this unusual phenomenon, which is all the more striking because agriculture's share of employment continued to decline throughout and growth in manufacturing was being stimulated by tariff protection from imports. Several factors contributed, including a huge land frontier that took more than a century for settlers to explore, rapid declines in initially crippling domestic and ocean trade costs for farm products, the absence of a need to do any processing of the two main exports during that period (gold and wool), and innovations by farmers and via a strong public agricultural R&D system that contributed to farm labour productivity nearly doubling over those ten decades. The ban on iron ore exports from 1938 and low export prices for fuels, minerals and metals during the two world wars and in the intervening decades also contributed.

Keywords: structural transformation, agricultural development, farm productivity growth, trade costs, mining booms, manufacturing protection

JEL codes: F13, F63, N47, O13, Q17

1. Introduction

History reveals how open national economies structurally adjust in the course of economic growth and policy developments at home and abroad. Most strikingly it shows that the agricultural sector of growing economies typically transitions from having a very high to a very low share of Gross Domestic Product (GDP). Yet for a century from the early 1850s, agriculture's share of the growing Australian economy did not decline. This exceptional case is worth exploring because it may have lessons for those conceiving growth strategies for

some later-developing economies that are similarly well endowed in natural resources per worker. This unusual feature of Australia's economic history has not been highlighted in previous studies.

The purpose of the present study is to draw attention to this unusual phenomenon in Australia's history and to draw on recent structural transformation literature to pose possible explanations for it. Unfortunately there are long time series data available for only a sub-set of potential explanatory variables, which precludes formal econometric testing of hypotheses. Nonetheless, the data that are available are able to shed light on at least some key contributing factors.

This study has benefitted from the vast array of theoretical and empirical literature on structural transformation that is surveyed by [Herrendorf](#), Rogerson and Valentinyi (2014) using a 3-sector model of economic growth. It extends that framework in two respects though. One is to separate out a fourth sector that is crucial to understanding the fluctuating sectoral structure of Australia's economy over time, namely mining. The other is to allow trade openness to play a central role. As pointed out by Matsuyama (2009), many earlier studies of structural transformation ignore the trade dimension. Thus they do not take sufficient account of 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 sectoral pattern of production and trade specialization.

The paper is structured as follows. Section 2 presents a summary of the data that reveal the nature and extent of the issue to be explained.¹ Section 3 provides a brief review of literature on the structural transformation of economies as they grow, drawing on trade and development theories to see what is required for a small open growing economy to not structural transform away from agriculture. Since a dominant feature of Australia's economy (including its colonies prior to Federation in 1901) is a series of mining booms and slumps that cause major fluctuations around trends in sectoral GDP and export shares, the standard three-sector framework is extended to include mining in addition to farming, manufacturing and services. Section 4 examines data that shed light on various possible forces behind Australia's structural transformation trends and cycles during the ten decades in which its share of agriculture in GDP plateaued. Trade-distorting policies and institutional

¹ During 1850 and 1950, real per capita GDP in Australia grew on average at 0.8% per year (Butlin, Dixon and Lloyd 2015). How structural changes have influenced the mean and variance of Australia's overall income and its economic growth rate are not addressed in what follows. But see, for example, McLean (2013), Madsen (2015) and Greasley and Madsen (2017).

arrangements are shown to have also influenced the outcome. Space limitations preclude a detailed comparison with other countries but a brief account in Section 5 points to ways Australia differed even from other lightly populated temperate-climate countries of recent European settlement. The paper concludes in Section 6, pointing out that Australia's sectoral export shares are similar now to those in the early 1960s except that mining has swapped with farming.

2. The phenomenon to explain

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).² Even so, agriculture's share of GDP nearly halved between 1810 and 1851 while the service sector's share nearly doubled, as was typical of high-income countries then. 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.³ 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. Only after the Korean War-induced wool price boom of the early 1950s did the agricultural sector resume its relative decline (Figure 1).

[insert Figure 1 around here]

Australia's export shares reflect this long interruption to the relative decline of agriculture. The country'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-enough price per ton or cubic metre to cope with the high cost of transport within Australia to the ports and then to

² GDP and export data are expressed in current prices throughout, so as to capture the combined effect of changes in quantities and prices. Employment data are person years, not accounting for any changes in hours worked per year. Unless otherwise indicated in the text, figures or tables, the historical macroeconomic and sectoral data on Australia's economy have been compiled from Vanplew (1987), a subset of which have been updated by Butlin, Dixon and Lloyd (2015), with sectoral employment data also from Keating (1973) and Withers, Endres and Perry (1985). 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.

³ There was one earlier mining boom: in 1843-44 copper was discovered in South Australia, shrinking agriculture's share of its GSP from 43% to 29% in just five years and replacing wool in the latter 1840s as that colony's dominant export (Figure S1). (This and all subsequent figure and table numbers starting with S refer to ones in the article's online Supplementary Material.)

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 in raw form to Britain (Shaw 1990).

Wool production grew from 23kt in 1840 to 140kt in 1880, 301kt in 1920 and an annual average of 480kt in the 1940s, and Australia's share of world wool production was around one-quarter during 1910-45 (Blau 1946). Since most of that output was exported, Australia had a dominant share of global wool exports: it was still around 50% in the 1980s and 1990s (ABARE 1999, p. 236). Insofar as that increasing dominance depressed the export price, that would have had a downward impact on agriculture's share of the country's GDP, making its non-decline more puzzling.

With the discovery of gold in 1851 in Victoria and New South Wales, agriculture's share of Australia's GDP halved within a year (from 34% to 16%); and its share of exports more than halved to just 26% as mining's share peaked at 61% in 1852 and stayed above 30% until the mid-1860s (Figure S1). 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 S1).⁴ But mining's share of exports had halved again by 1914, and was of minor importance for the next seven decades before booming again from the latter 1960s (Figure 2).

[insert Figure 2 around here]

Australia is thus distinguished in being richly endowed in both mineral *and* agricultural resources. The changing extent of Australia's trade specialization is summarized in Figure 3, 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 exports). In 1913, after Western Australia's gold rush, Australia's RCA indexes for agriculture and mining were both just above 1.5, while that for manufacturing was only 0.13. However, the agricultural RCA index almost doubled between 1913 and 1960-64 while the mining RCA index fell below 1.0.

[insert Figure 3 around here]

⁴ 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. But it is clear from Figure S2 that Australia had one of the highest concentrations. 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 2(b)). Even in the most-recent five decades the agricultural share of Australia's merchandise exports has been more than twice the global average, while the manufacturing share has always been well under half the global average.

The seven-decade hiatus for mining is another intriguing feature of Australia's long-run structural transformation, as is the eleven-decade period in which the services share of GDP sat around 60% until the early 1950s (Figure 1). Those two features are not unrelated to the century-long interruption to the decline in the country's agricultural share of GDP.

This stepped decline of agriculture's GDP share is not a feature of other settler New World countries whose farmers similarly pushed the frontier as their populations grew. In fact Australia was unusual in having a relatively low share of GDP from agriculture compared with other settler New World countries during 1850 to 1880, before it gradually moved to having a relatively high share after the second world war (Figure 4). It was only after the early 1950s that Australia again followed other growing economies' relative decline of agriculture.

[insert Figure 4 around here]

The plateauing of Australia's agricultural GDP share is not because of a plateauing in its growth in GDP per capita. There was steady growth in per capita income apart from the externally induced sudden downturns in the 1890s, the early 1930s and the two world wars. Leaving aside the 1850s' gold rush decade, Australia's annual GDP per capita growth rate averaged a respectable 1.4% between 1860 and 1970 -- despite the population growing at 2.2% per year over that long period thanks to continual immigration. That remarkable income 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. 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 after the United States and Canada. 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.

3. Theoretical literature on structural transformation of a growing economy

The normal pattern of structural transformation of a growing economy is for the agricultural sector's initial dominance to decline as workers are attracted to manufacturing and service

activities, where Lewis (1954) assumed non-farm labour productivity is relatively high and improves with industrial capital accumulation or importation. Later in the development process, the manufacturing sector's share of employment declines as well. Development economists began tracing that pattern of structural transformation many decades ago (Fisher 1939; Clark 1940; Kuznets 1957; Chenery 1960). They note also that agriculture's employment share typically exceeds its GDP share (Timmer 2009; *Deininger, Jin and Ma 2022*). By contrast, the GDP shares of both manufacturing and mining typically exceed their employment shares.

Those features of development are consistent with the pattern of country-year annual data on sectoral shares of GDP and employment for 130+ countries as their per capita incomes grew during 1990-2020 (Figure S3). Very similar evidence is provided in [Herrendorf, Rogerson and Valentinyi \(2014\)](#) using additional data sources and much longer time periods. Growing economies also saw their agricultural share of exports decline on average, although the experiences were more varied once countries moved beyond low-income status (Figure S4).

To explain that pattern of transformation, it is helpful to begin by first considering a two-sector closed economy, and then an open economy that also includes a sector producing nontradable products and a mining sector. To simplify the analysis, assume that there are no intermediate inputs and all markets are perfectly competitive so that there is full employment of all factors of production. Assume initially that growth comes exogenously from improvements in total factor productivity (TFP),⁵ before later considering also the contribution that changes in factor endowments could make. Also ignored until the end of this section are government interventions that alter the relative prices of tradable products away from those at the country's border.

3.1 GDP shares in a closed economy

Consider 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, the sectoral supply curves would shift out at the same rate. However, the demand curve shifts out less for agricultural goods than for other products following productivity-improving income growth (that is, the income elasticity of demand for food is below one). Thus outputs

⁵ Sectoral difference in TFP growth rates are found by Herrendorf, Herrington and Valentinyi (2015) to be the dominant force behind structural transformation of the US economy.

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 and the more the income and price elasticities of food demand fall further as per capita income rises (Matsuyama 2019).

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 and Gollin, Parente and Rogerson 2002), agriculture's GDP share would fall even further because of the low elasticities of demand for that sector's outputs.

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 those of other products will decline over time as global per capita income grows. That 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 the stronger its comparative advantage in farm products (in manufactures).

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.⁶

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

⁶ 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).

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 open 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, making it more likely that agriculture’s share also would decline.

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.⁷ Hence, the manufacturing sector 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. Exceptions could be in those small open economies where manufacturing TFP growth is exceptionally rapid, but even then there is the possibility of faster consequent growth in those economies’ demand for nontradables pulling more resources out of manufacturing and other sectors producing tradables. Once the manufacturing share starts to decline, the rise in the services sector’s GDP share accelerates ([Herrendorf, Rogerson and Valentinyi 2014](#)).

⁷ The share of aggregate consumption expenditure on non-food manufactures does not seem to differ much across the GDP per capita spectrum, unlike that for processed food which declines sharply and for services which rises sharply as incomes rise (Figure 6.9 of [Herrendorf, Rogerson and Valentinyi 2014](#)).

In short, a key condition for agriculture's share of GDP not to decline in a small open growing economy is rapid productivity growth in that sector relative to that in other sectors producing tradables.

3.3 Employment shares

Given our initial assumption of no changes in aggregate factor endowments, the above reasoning is close to sufficient for describing changes in sectoral shares of labour employment: agriculture (services) shares decline (rise) as per capita income grows, while manufacturing shares follow an inverted U-shaped path with the services share accelerating once manufacturing's begins to fall.

Complications arise, however, when there are lags in labour migrating out of declining sectors or when labour 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. Knowledge in farm households about higher income-earning opportunities in urban areas also may be incomplete. 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 households' labour productivity is relatively low.⁸

Productivity impacts on sectoral employment shares can be positive or negative. On the one hand, the adoption by one sector of labour-saving technologies can raise its output and perhaps exports but reduce its employment, thereby *pushing* labour to other sectors (Gollin, Parente and Rogerson 2002, 2007). On the other hand, a new farm technology that is land-saving (e.g., a new seed variety) may be so productive as to attract labour to the sector. That is least likely in lightly populated countries in which land rentals are low relative to farm wage rates (Hayami and Ruttan 1985).

Also, labour could be *pulled out* of a sector due to new job prospects in another sector that is enjoying faster TFP growth, or faster demand growth associated with consumers

⁸ The share of mining in employment, by contrast, is typically less than its share of GDP in settings where mining is highly capital intensive – which 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 sub-soil or sub-seabed reserves, can be a significant source of both mining sector GDP growth and structural transformation.

spending more of their higher incomes on nontradables (Lucas 2004; Gollin, Parente and Rogerson 2007).

The push element has always been present for farmers (and, more recently, also for factory workers where robotics and digitalization are the latest influences in raising labour productivity). This is because as wages rise relative to farmland rentals and interest rates, there is an inducement to develop labour-saving farm technologies (Hayami and Ruttan 1985). That is most likely to be the case in countries at the technological frontier. Meanwhile, producers in later-emerging economies will choose whatever is the most profitable technology from among the full spectrum available as their relative factor prices change.

In short, agriculture's share of employment is likely to be above its GDP share but least so in high-wage countries that are abundantly endowed with farmland per worker where there is an incentive to develop or import labour-saving farm technologies that displace labour from farms while raising farm productivity and output.

3.4 What if factor endowments change?

So far it has been assumed that national income growth comes from exogenous technological change or (as just noted) from investments in innovation or importation and adaptation of foreign technologies. 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, developing a system of roads or rail lines, creating in new mining or farming technologies) in response to rising relative prices of primary products. Both avenues were part of extending the land frontier in lightly populated countries newly settled by Europeans, accompanied through linkages to varying extents (according to the 'staples' model) by growth in related manufacturing and service activities (Findlay and Lundahl 2001).

The stock of produced capital can be enhanced as well through domestic investment or by importing such capital from abroad. The stock of labour can grow through immigration exceeding emigration, births exceeding deaths, and changes in labour force participation (e.g., more women choosing paid work, more years being absorbed in formal education, people choosing to retire later).

Any of these changes can alter the value of per worker endowments of natural resources and produced capital in that country compared with the rest of the world. That changes the country's comparative advantages, to which we now turn.

3.5 Export shares

Changes in agriculture's importance in an economy, and especially in its share of exports, depend on changes in the country's comparative advantage. They in turn depend heavily not only on productivity-improving innovations but also on changes in relative trade costs (the tradability of each sector's output) and relative factor endowments.

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 that country's farm products gain more (less) from a generic decline of trade costs than its nonfarm products, the country would see its comparative advantage in agriculture strengthen (weaken), other things equal.

Factor endowments are crucial in the two key workhorse theories of comparative advantage developed in the 20th century. In the Heckscher-Ohlin-Samuelson model, all (exogenously given) factors of production are intersectorally mobile, while in the specific-factors model, one factor is specific to each sector. These two models have been blended by Krueger (1977) and Deardorff (1984) to account for primary sectors that use specific natural resource capital (farmland and mineral deposits) in addition to intersectorally mobile labour and produced capital. This blended model suggests we should expect primary products to be exported from economies that are well-endowed with agricultural land and/or mineral resources per worker 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 labour 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 (the so-called 'Dutch disease'). 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 labour-saving—leading potentially to 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.

In short, the agricultural sector's share of an economy would decline more slowly the more (compared to average global rates) a decline of trade costs benefits its farm relative to nonfarm products, its investments and export price changes boost the value of natural capital in agriculture more than in mining, and productivity growth in farm production exceeds that in other sectors.

3.6 Induced innovations in institutions and policies

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.

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 trade costs, in relative factor endowments and hence in 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, degradation of the natural environment, and farm animal welfare.

Responses to those concerns can contribute to systematic differences across sectors and nations in the use of trade interventions and other price-distorting regulatory policies. A survey by Anderson, Rausser and Swinnen (2013) finds strong empirical support for the hypothesis that as economies develop, their governments gradually change from taxing to subsidizing the agricultural sector relative to manufacturing, but at a later stage the stronger their comparative advantage in agriculture.

3.7 Summary of forces influencing agriculture's share of an economy

According to the above, agriculture's share of a small open economy would decline more slowly:

- the faster is productivity growth in its farm sector's value chain compared with that of other sectors producing tradables,
 - although less so for agriculture's employment share the more farm productivity growth is biased toward saving labour;
- the faster is the decline in its trade costs for farm products compared with other sectors' products;
- the more domestic prices of its farm products rise compared with those for other sectors; and
- the more its policies, institutions and effective stocks of relative factor endowment change in favour of the farm sector compared with other sectors.

4. Forces behind agriculture's changing shares of the Australian economy

With the above in mind, we turn now to the empirical question posed in the title of this article. Australia's structural transformation away from agriculture was not unusual prior to 1850, nor after 1950. What was unusual and needs explaining is agriculture's share of GDP being virtually constant during the ten decades in between the early 1850s and early 1950s. In this section we search for explanations in terms of the above four dot points.

4.1 Sectoral productivity growth

By the 1880s, Australia was the envy of the New World in terms of the productivity of its sheep industry. Argentina in particular sought to emulate its success (Duncan and Fogarty 1984, pp. 1-3). Wire fencing helped selective breeding and quality upgrading of livestock (Pickard 2010). Dairy and meat production were helped by refrigerated shipping from the 1880s. Wheat production by then was rapidly expanding too. It was helped by labour-saving machinery that was locally innovated or imported from the United States where the world's best farm machinery were being developed (McLean 1973a; Shaw 1990). As well, public research on crops boosted yields per hectare and extended the crop frontier from the 1870s, just as happened in the United States (Olmstead and Rhode 2011); by early in the twentieth century that R&D had helped reverse the earlier decline in average wheat yields (Figure S5).

Also important were public investments in tertiary agricultural colleges and in colonial Departments of Agriculture from the 1870s, which further boosted farmer productivity (McLean 1982). Later, horticulture and viticulture were helped by public investments in irrigation infrastructure post-World War 1 (Shaw 1990).⁹

The development and widespread adoption of labour-saving farm (and mining) technologies and machinery was encouraged by the high and rising level of real wages in Australia (Duncan 1972a). One consequence was that agriculture's share of Australian employment fell throughout the long period in which its GDP share plateaued (Figure 5(a)). That means labour productivity in Australia on farms (the sector's GDP share divided by its employment share) grew steadily over those ten decades, particularly relative to labour productivity in manufacturing and services (Figure 5(b)). According to Broadberry and Irwin (2007), Australia's agricultural labour productivity in the late 1800s was the highest in the world.¹⁰

[insert Figure 5 around here]

4.2 Domestic and international trade costs

During 1850-70, Australia had a relatively low share of its GDP coming from agriculture. One reason was that much manufacturing was still naturally protected from imports by high ocean transport costs. As that natural protection gradually fell with the lowering of those trade costs, agriculture's GDP share was under less pressure to fall.

Public investments in rural infrastructure such as roads, railways, telegraph services, telephones and electricity all lowered internal transport and communication costs.¹¹ The first telegraph lines were erected in the south-eastern colonies in the mid-1850s, less than a decade after the first one began operating in the United States. Services in Queensland and Western Australia followed in the 1860s and the Overland Telegraph to Darwin was operational by 1872 and connected to Europe via Jakarta.

⁹ Productivity growth in Australia since the start of the 21st century has been faster for farming than for both mining and manufacturing (Productivity Commission 2022). That is thanks partly to considerable post-World War II public agricultural R&D investment (Duncan 1972a,b; McLean 1973a,b; Mullen and Cox 1995; Mullen 2010).

¹⁰ Contrary to the common perception that labour is less productive in primary sectors than in manufacturing, the opposite has been true in Australia in most of the past 160 years – and especially so for mining since the 1960s (Figure S6).

¹¹ For comparison, in the United States the gains from greater trade in farm products due to the lowering of internal transport costs are estimated to be of a similar magnitude to those from farm technological improvements between 1880 and 1997 (Costinot and Donaldson 2016).

Ocean shipping costs and travel times shrunk as steam power and steel hulls replaced wooden sailing ships through the middle half of the 19th century, benefitting Australia more than most countries because of its vast distance to Europe (Jacks, Meissner and Novy 2010). The opening of the Suez Canal in 1869 added to that relative decline in costs of shipping bulky exports from Australia.

Meanwhile, Australia's major gold mining booms of the early 1850s and the 1890s did not depress its farm sector for long because those booms were so large as to stimulate major expansions of the overall economy and its population. The 1850s, for example, saw real incomes per capita rise despite the continent's non-aboriginal population nearly trebling, ensuring enormous growth in the domestic demand for farm products – many of which were not internationally tradable until late in the nineteenth century because of high trade costs. That encouraged men to soon return from the gold fields to farming (Maddock and McLean 1984).

Australia's relatively rapid farm productivity growth and decline in trade costs 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), and also high valued in terms of its volume and weight and so able to be competitive despite high domestic and ocean transport costs. Annual wool exports per capita grew from less than \$2 in the 1820s to \$20 by 1850, and they remained around \$20 through to World War I despite the population expanding twelve-fold over that period.

The fact that wool (along with skins, hides and tallow and eventually wheat) was exported in raw form meant the farm sector (like gold mining) did not contribute very much to the early development of the local manufacturing sector. It took until refrigeration allowed exports of perishable meat and dairy products before the food processing part of manufacturing got a boost from agriculture. That contribution to manufacturing continued to grow through to 1950, such that agrifood products continued to be the dominant part of manufactured exports in the interwar period (Figure S7).

4.3 Relative product prices and sectoral assistance policies

The international terms of trade for primary producing countries exporting to the United Kingdom and other west European countries in exchange for manufactured goods improved

enormously over the 19th century, thanks to the spread of the industrial revolution (Williamson 2008, Figure 2). That helped farmers in Australia but also in other countries exporting primary products. The 20th century saw the opposite trend in the index of international prices of agricultural products relative to manufactured goods (Pfaffenzeller, Newbolt and Rayner 2007). For Australia, its international terms of trade fluctuated around a flat trend between 1871 to 1967, just before the mining sector boomed again (Figure S8). Favourable access to the UK market, both pre-World War I and after the signing of the Ottawa Agreement in 1932, would have benefitted Australian (and other Commonwealth member country) exporters. Since farm products dominated exports throughout that period (Figure 2), this suggests the terms of trade would have had a benign effect on the trend share of agriculture in GDP over the century under review.

However, domestic relative prices were not the same as those at the nation's border. Manufacturing and numerous agricultural industries enjoyed considerable natural protection from import competition in the 19th century and through to and during World War I, thanks to high ocean trade costs. While during the colonial period import tariffs added only a little to that protection (Lloyd 2017), manufacturing tariffs grew very considerably soon after Federation in 1901 (Anderson and Garnaut 1987). The manufacturing sector's nominal rate of assistance trebled between 1919 and 1932, to 63%, while assistance to (mainly import-competing) agricultural industries averaged only around 5% (Figure S9).

Iron and steel were among the assisted industries, and they also enjoyed bounties from 1909 to 1948 (Lloyd and MacLaren 2015). That encouraged the biggest mining company, BHP, to open the Newcastle steelworks in 1915 and to begin building military aircraft in 1934 and ships from 1941. Effective protection for steelmaking and steel-using manufacturing was raised further in 1938 when the government imposed a ban on exports of iron ore, one that stayed in place until May 1966 (having been partially lifted in November 1960 – see Lee 2013). That, plus low international prices of energy raw materials and falling non-ferrous metal prices (Figure S10), diverted miners' investments from mining to steel manufacturing. That is, local mining firms invested 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 (Blainey 2003, pp. 276-77). Local demand for the latter had expanded during World War I, and together with food and timber processing they dominated Australia's manufacturing output (Figure S11). As a result, the mining

sector's contributions to GDP, employment and exports were miniscule during 1920 to 1965 (Figures 1, 2 and 5(a)).

Thus while the agricultural sector was made less competitive throughout the middle half of the 20th century by manufacturing protectionism, it was spared 'Dutch disease' pressure from the mining sector for the final one-third of the century-long period under review.

4.4 Institutional developments

The expansion of grazing in the first half of the 19th century had involved 'squatting' illegally on unfenced native pastures and so required no capital outlay for land. In that era funds were needed only for purchasing breeders that reproduced plus paying wages for shepherds. But with population growth and dwindling prospects for gold panning, there was a surge in the demand by potential smallholder farmers for farmland. The ensuing squatter/selector conflict in the 1850s was won in favour of selectors: governments converted some large holdings (especially those close to urban centres) into smaller holdings that were sold as freehold for more-intensive agriculture, where economies of scale were less than for outback pastoral sheep grazing. The rest of the pastoral land that had been squatted on became subject to long-term leases which, by providing new security of tenure, encouraged capital investments in such things as fencing and stock water, and also in the genetic quality of their livestock (Campbell and Dumsday 1990; Raby 1996; Shaw 1990; Greasley 2015). This institutional development reduced the prospect of a few people holding much of the land wealth. It thereby contributed substantially to a more equal distribution of income and wealth in Australia than in most other resource-rich economies (McLean 2013), and thus to political stability.

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). By continuing to provide those services even as regular banks became available in rural areas, those agents contributed greatly to the resilience of Australian farmers in dealing with their fluctuating fortunes during the period under review.

More generally as the nineteenth century progressed, Australia's colonies put in place what Acemoglu and Robinson (2006, 2013) call inclusive political and economic institutions, providing well-defined and secure property rights, law and order, democratic elections, and

essential public goods. Those institutions played a major part in ensuring that the primary sectors' contributions to Australia's economic growth were inclusive.

In South Australia in the 1840s, for example, 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 mining that site 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 often evaded – and were replaced in 1855 by a tax (of about 3%) on gold exported from Victoria so that only successful miners bore that burden and only at the point of sale (La Croix 1992). Also, those two colonies copied South Australia in ensuring that a large portion of that tax revenue was used to subsidize immigration. The resulting inflow reduced the rise in income and wealth inequality as between landholders and others because free immigrants in the 1850s typically had more human and financial capital than locals (Maddock and McLean 1984; Panza and Williamson 2019).

With both incomes and the population growing rapidly, the demand for nontradable goods and services also 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 fact that 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).

4.5 Relative factor endowment changes

High-quality data on relative factor endowments for the period under review in Australia compared with the rest of the world are not available. However, a crude indicator of primary product comparative advantage (disadvantage) is national vs global land per capita (population density). Changes in that can be found simply from population data, assuming national boundaries don't change. Between 1850 and 1950, Australia's population multiplied 13.7 times. That compares with 2.1 for the world, 1.8 for Asia, 2.0 for Europe, 2.8 for Sub-Saharan Africa, 5.4 for Latin America and for South Africa, 5.6 for Canada and 6.5 for the

United States. Only Argentina (15.6) and New Zealand (21.2) saw larger increases than Australia (Inkbaar et al. 2018). This relatively rapid increase in Australia's population density over those ten decades was from an extremely low base though, and was evidently not enough to erode the country's competitiveness in farm products.

5. Comparisons with other temperate-zone countries recently settled by Europeans

Australia in the mid-19th century shared many of the characteristics of other temperate-climate countries of recent European settlement such as Argentina, Brazil, Canada, Chile, New Zealand, South Africa, the United States and Uruguay. Those characteristics included being lightly populated by indigenous people, able to attract immigrants and capital from Europe and export primary products back to that advanced industrial region, and initially being heavily dependent for income and export growth on expanding the land frontier.

However, Australia differed in a number of ways that may have contributed to its agricultural share of GDP not trending downwards like that of other countries of recent European settlement (Figure 4).¹² Space precludes exploring them in detail here, but several are suggested to stimulate future empirical research.

One difference was that Australia had very few aboriginal people per hectare when European settlement began, many of whom soon died from communicable diseases introduced by the new settlers (Butlin 1982). Nor were the locals involved in commercial agriculture (but see the debate between Pascoe (2014) and Sutton and Walshe (2021)), or capable of preventing new settlers from encroaching on their land.

Second, Australia has always had an exceptionally large endowment of natural resources per worker. Its total land area per capita was 123 times the global average in 1850. That compares with 35 times for Canada, 28 times for New Zealand, 23 times for Argentina and just 3 times for the United States. By 1950 Australia still had 18 times the world average

¹² Unfortunately sectoral GDP shares are unavailable for New Zealand before 1875 and from 1915 to 1969. Its agricultural share was higher in 1910-14 than in 1875-79 though, so there may well have been, as in Australia, a lengthy period without it trending downward. Its sectoral employment and export share trends are otherwise not dissimilar to Australia's, including a half-century in which gold was a dominant export along with wool; but typically both its agricultural and manufacturing shares of employment and exports were above Australia's because of very little mining after New Zealand's pre-World War I gold boom (compare Figure S12(a) and (b) with Figures 5(a) and 2). South Africa does not have sectoral GDP data for the 19th century, but its agricultural share fell after the discovery of diamonds in Kimberly in 1870 and gold in Witwatersrand in 1886. Uruguay also has very limited data, but its agricultural share of GDP gradually declined from 15% to 12% between the mid-1930s and early 1960s (Mitchell 2005).

when Canada had 13 times and the other New World settler economies had less than 3 times (Figure S13). Of course quality-adjusted farm land area are not evenly distributed across the world's land surface, nor are mineral reserves. An attempt to estimate values of national endowments per worker have been published by the World Bank (2021) for almost all countries (although not for New Zealand). They reveal that in 2018 Australia was endowed per worker with 3 times as much agricultural capital as the world average, 12 times as much mineral capital and, similar to Canada and the United States, 5 times as much other (including human) capital. Only Uruguay among the Southern Cone countries had (slightly) more agricultural capital per worker than Australia in 2018. That is, even seven decades after the period under review, Australia remains extremely well endowed with agricultural (and mineral) resources per worker.

Third, Australia's productivity in wool production was perhaps the highest in the world over the ten-decade period under review (Duncan and Fogarty 1984), and its investments in farm innovations raised its agricultural labour productivity such that in the late 1800s it was perhaps the highest in the world (Broadberry and Irwin 2007). Over the full ten decades under review, Australia's farm labour productivity grew at about 0.7% per year. That was also the rate in US agriculture over the period 1840-1900, before it accelerated there to 1.3% in 1900-1940 (Figure 3 in Mundlak 2005).

Fourth, while costs of trading with Europe were relatively high in the antipodes compared with the Americas and South Africa, they fell considerably when the Suez Canal opened in 1869, making Australian exporters more competitive in the UK and continental Europe than previously. Australia's internal trade costs also fell dramatically in the middle half of the 19th century, lowering the cost of shifting product from the farm to urban consumers or to ports (Blainey 1966), but how much that contributed to improving agricultural competitiveness in Australia versus other New World countries remains an area for further research.

Fifth, Australia's squatter/selector conflict in the 1850s was won in favour of converting some large holdings into smaller holdings sold for more-intensive agriculture. By contrast, the comparable conflict in Argentina and Uruguay led to a small group of large landholders becoming hugely wealthy and politically powerful (Duncan and Fogarty 1984; Álvarez et al. 2011). Those dominant families probably had far more urban interests than Australian farmland owners, such that they may even have favoured the manufacturing protection that contributed to the declines in their agricultural share of GDP.

Sixth, in the United States and Canada, primary product processing accompanied the movement west of the land frontier, expanding their manufacturing sector (Findlay and Lundahl 2001, p. 100). Possibly that happened more so than in Australia because internal trade costs were lowered more rapidly in North America, but also because Australia's first exports (wool, hides, skins, tallow and gold) were all able to be shipped unprocessed. By contrast, the mineral richness of North America did not result in large GDP or export shares for mining from around 1870 but rather in mineral-rich manufactures dominating their production and exports and thereby contributing to the decline in their agricultural shares of GDP (Wright 1990; Altman 2022).

Seventh, the fall in real international prices of farm products in the 20th century affected all agricultural exporters. So too did the rise of manufacturing protectionism in most of the newly settled economies, but to varying degrees. The rates of assistance to agriculture relative to manufacturing for Australia averaged -22% during 1946-54 and just -10% in 1955-64, while as late as 1965-69 the average was still -20% in Chile, -24% in New Zealand and -49% in Argentina (but close to zero in Canada and the United States – see Table S1). What further distinguished Australia was that miners' profitability also fell after World War I, making it more attractive for cashed-up mining firms such as BHP to invest in minerals processing and manufacturing with metals rather than in primary mining activities. The ban on iron ore exports from Australia from 1938 to the mid-1960s further contributed to the country's mining hiatus that helped maintain its agricultural shares of GDP and exports.

6. Conclusion

This review has revealed an unusual feature of Australia's structural transformation, namely agriculture's near-constant share of GDP for nearly 100 years from the early 1850s. Remarkably, it occurred despite agriculture's share of employment continuing to decline throughout and industrial growth being stimulated by rising tariff protection for Australia's manufacturers. Several factors contributed, including a huge land frontier that took more than a century for settlers to explore, declines in initially crippling domestic and ocean trade costs for farm products, the absence of a need to do any processing of the two main exports during that period (gold and wool), and innovations by farmers and via a strong public agricultural R&D system that contributed to farm labour productivity nearly doubling over those ten

decades. The ban on iron ore exports from 1938 and low export prices for fuels, minerals and metals during the two world wars and in the intervening decades also contributed.

Ironically, Australia 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 primary products continue to dominate hugely, but that is because minerals since the 1960s have replaced farm goods as the dominant export sector; and East Asia (especially China) has replaced Western Europe (especially the United Kingdom) as the dominant region of destination for Australian exports.

[insert Figure 6 around here]

A lesson from Australia for those developing countries that are richly endowed with natural resources per worker is that it *is* possible to become a mature high-income economy and simultaneously retain a strong comparative advantage in agriculture. But that may be possible for only a small number of today's developing countries, not least because few have a large yet-to-be-exploited land frontier.

References

- ABARE (1999), *Agricultural Commodities Statistics*, Canberra: Australian Bureau of Agricultural and Resource Economics.
- Acemoglu, D. and J.A. Robinson (2006), *Economic Origins of Dictatorship and Democracy*, Cambridge and New York: Cambridge University Press.
- Acemoglu, D. and J.A. Robinson (2013), *Why Nations Fail: The Origins of Power, Prosperity and Poverty*, London: Profile Books.
- Altman, M. (2022), *Lessons from a Successfully Export-Oriented, Resource-Rich Economy: Quantitative Adventures into Canada's Past*, New York: Palgrave Macmillan.
- Álvarez, J., E. Bilancini, S. D'Alessandro and G. Porcile (2011), "Agricultural Institutions, Industrialization and Growth: The Case of New Zealand and Uruguay in 1870–1940", *Explorations in Economic History* 48(2): 151-68.
- Anderson, K. and Garnaut R. (1986), *Australian Protectionism: Extent, Causes and Effects*, London: Allen and Unwin. Republished in *Agricultural and Manufacturing*

- Protection in Australia*, Vol. 2 of World Scientific Reference on Asia-Pacific Trade Policies, edited by K. Anderson, Singapore: World Scientific, 2020.
- Anderson, K. and S. Ponnusamy (2023), “Structural Transformation Away from Agriculture in Growing Economies”, *Agricultural Economics* 54(1): 62-76.
- Anderson, K., G. Rausser and J.F.M. Swinnen (2013), “Political Economy of Public Policies: Insights from Distortions to Agricultural and Food Markets”, *Journal of Economic Literature* 51(2): 423-77, June.
- Balassa, B. (1965), “Trade Liberalization and Revealed Comparative Advantage”, *Manchester School of Economic and Social Studies* 33(2): 99–124.
- Barnard, A. (1958), *The Australian Wool Market 1840-1900*, Melbourne: Melbourne University Press.
- Blainey, G. (1966), *The Tyranny of Distance: How Distance Shaped Australia's History*, Melbourne: Macmillan.
- Blainey, G. (2003), *The Rush That Never Ended: A History of Australian Mining*, 5th edition, Melbourne: Melbourne University Press.
- Blau, G. (1946), “Wool in the World Economy”, *Journal of the Royal Statistical Society* 109(3): 179-242.
- Broadberry, S. and D.A. Irwin (2007), “Lost Exceptionalism? Comparative Income and Productivity in Australia and the UK, 1861–1948”, *Economic Record* 83(262): 262-74.
- Butlin, M., R. Dixon and P.J. Lloyd (2015), “A Statistical Narrative: Australia, 1800 -2010”, pp. 555-94 in S. Ville and G. Withers (eds.), *The Cambridge Economic History of Australia*, Cambridge and New York: Cambridge University Press.
- Butlin, N.G. (1982), “Close Encounters of the Worst Kind: Modelling Aboriginal Depopulation and Resource Competition 1788-1850”, Working Papers in Economic History No. 8, Australian National University, Canberra.
- Campbell, K. and R. Dumsday (1990), “Land Policy”, Ch. 11 (pp. 162-71) in D.B. Williams (ed.), *Agriculture in the Australian Economy*, 3rd Edition, Sydney: University of Sydney Press.
- Chenery, H.B. (1960), “Patterns of Industrial Growth”, *American Economic Review* 50(4): 624–653.
- Clark, C. (1940), *The Conditions of Economic Progress* (3rd edition, 1957), London: Macmillan.

- Corden, W.M. (1984), “Booming Sector and Dutch Disease Economics: Survey and Consolidation”, *Oxford Economic Papers* 36(3): 359-80.
- Costinot A, and D. Donaldson (2016), “How Large are the Gains from Economic Integration? Theory and Evidence from U.S. Agriculture, 1880–1997”, NBER Working Paper 22946, Cambridge MA.
- Davidson, B.R. (1981) *European Farming in Australia: An Economic History of Australian Farming*, Amsterdam: Elsevier.
- Deardorff, A.V. (1984), “An Exposition and Exploration of Krueger's Trade Model”, *Canadian Journal of Economics* 5(4): 731-46.
- Deininger, K., S. Jin and M. Ma (2022), “Structural Transformation of the Agricultural Sector in Low- and Middle-Income Economies”, *Annual Review of Resource Economics* 14(1): 221-241.
- Duncan, R.C. (1972a), “Technological Change in the Arid Zone of New South Wales,” *Australian Journal of Agricultural Economics* 16(1): 22-33.
- Duncan, R.C. (1972b), “Evaluating Returns to Research in Pasture Improvement”, *Australian Journal of Agricultural Economics* 16(3):153-68.
- Duncan, T. and J. Fogarty (1984), *Australia and Argentina: On Parallel Paths*, Melbourne: Melbourne University Press.
- Findlay, R. and M. Lundahl (2001), “Natural Resources and Economic Development: The 1870-1914 Experience”, Ch. 6 (pp. 95-112) in Auty, R.(ed.), *Resource Abundance and Economic Development*, London and New York: Oxford University Press.
- Fisher, A.G.B. (1939), “Production: Primary, Secondary and Tertiary”, *Economic Record* 15(1): 24-38.
- Fuchs, V. (1980), “Economic Growth and the Rise of Service Employment”, NBER Working Paper 486, Cambridge MA, May.
- Gallman, R.E. (1966), “Gross National Product in the United States, 1834-1909”, Ch. in *Output, Employment and Productivity in the United States after 1800*, edited by D.S. Brady, Cambridge MA: National Bureau of Economic Research.
- Gollin, D., S.L. Parente and R. Rogerson (2002), “The Role of Agriculture in Development”, *American Economic Review* 92(2): 160–64.
- Gollin, D., S.L. Parente and R. Rogerson (2007), “The Food Problem and the Evolution of International Income Levels”, *Journal of Monetary Economics* 54(4): 1230–55.

- Greasley, D. (2015), “Industrializing Australia’s Natural Capital”, pp. 150-177 in S. Ville and G. Withers (eds.), *The Cambridge Economic History of Australia*, Cambridge and New York: Cambridge University Press.
- Greasley, D. and J. Madsen (2017), “The Rise and Fall of Exceptional Australian Incomes Since 1800”, *Australian Economic History Review* 57(3): 264-90.
- Harris, E., and S.J. La Croix (2021), “Australia’s Forgotten Copper Mining Boom: Understanding How South Australia Avoided Dutch Disease, 1843–1850”, *Economic Record* 97(318): 424-39.
- [Hayami, Y. and V. Ruttan \(1985\)](#), *Agricultural Development: An International Perspective* (revised edition), Baltimore MD: Johns Hopkins University Press.
- Herrendorf, B., R. Rogerson, and Á. Valentinyi (2014), “Growth [and Structural Transformation](#)”, pp. 855-941 in *Handbook of Economic Growth, Volume 2B*, edited by P. Aghion and S.N. Durlauf, Amsterdam: Elsevier.
- Herrendorf, B., C. Herrington and Á. Valentinyi (2015), “Sectoral Technology and Structural Transformation”, *American Economic Journal: Macroeconomics* 7(4): 104-133.
- Inklaar, R., H. de Jong, J. Bolt and J. van Zanden (2018), “Rebasing ‘Maddison’: New Income Comparisons and the Shape of Long-Run Economic Development”, GGDC Research Memorandum GD-174, Groningen Growth and Development Centre, University of Groningen.
- Jacks, D.S., C.M. Meissner and D. Novy (2010), “Trade Costs in the First Wave of Globalization”, *Explorations in Economic History* 47(2): 127-41.
- Keating, M. (1973), *The Australian Workforce 1910-11 to 1960-61*, Department of Economic History, Research School of Social Sciences Australian National University, Canberra.
- Kravis, L.B., W. Heston and R. Summers (1983), “The Share of Services in Economic Growth”, Ch 10 (pp. 188-218) in F.G. Adams and B.G. Hickman (eds.), *Global Econometrics*, Cambridge MA: MIT Press.
- Krueger, A.O. (1977), *Growth, Distortions and Patterns of Trade Among Many Countries*, Princeton, NJ: International Finance Section.
- Kuznets, S. (1957), “Quantitative Aspects of the Economic Growth of Nations: Industrial Distribution of National Product and Labor Force”, *Economic Development and Cultural Change* 5(4): 1-111, July Supplement.

- La Croix, S.J. (1992), “Property Rights and Institutional Change During Australia’s Gold Rush”, *Explorations in Economic History* 29(2): 204-27.
- Leamer, E.E. (1987), “Paths of Development in the Three-Factor, N-Good General Equilibrium Model”, *Journal of Political Economy* 95(5): 961-99.
- Lee, D. (2013), “Reluctant Relaxation: The End of the Iron Ore Export Embargo and the Origins of Australia’s Mining Boom, 1960-1966”, *History Australia* 10(3): 149-70.
- Lewis, W.A. (1954), “*Economic Development with Unlimited Supplies of Labor*”, [*The Manchester School of Economic and Social Studies* 22\(2\): 139–91.](#)
- Lloyd, P.J. (2017), “The First Hundred Years of Tariffs in Australia: The Colonies”, *Australian Economic History Review* 57(3): 316-44.
- Lloyd, P.J. and D. MacLaren (2015), “Relative Assistance to Australian Agriculture and Manufacturing Since Federation”, *Australian Journal of Agricultural and Resource Economics* 59(2): 159-70.
- Lluch, C., A.A. Powell and R.A. Williams (1977), *Patterns in Household Demand and Savings*, London and New York: Oxford University Press.
- Lucas, R.E. (2004), “Life Earnings and Rural-Urban Migration”, *Journal of Political Economy* 112(S1): S29–S59.
- Maddock, R. and I.W. McLean (1984), “Supply Side Shocks: The Case of Australian Gold”, *Journal of Economic History* 44(4): 1047-67.
- Madsen, J.B. (2015), “Australian Economic Growth and its Drivers Since European Settlement”, pp. 29-51 in S. Ville and G. Withers (eds.), *The Cambridge Economic History of Australia*, Cambridge and New York: Cambridge University Press.
- Martin, W. and D. Mitra (2001), “Productivity Growth and Convergence in Agriculture and Manufacturing”, *Economic Development and Cultural Change* 49(2):403-23.
- Matsuyama, K. (1992), “[Agricultural Productivity, Comparative Advantage, and Economic Growth](#)”, *Journal of Economic Theory* 58(2): 317–33.
- Matsuyama, K. (2009), “Structural Change in an Interdependent World: A Global View of Manufacturing Decline”, *Journal of the European Economic Association* 7(2–3): 478–86.
- Matsuyama, K. (2019), “Engel’s Law in the Global Economy: Demand-Induced Patterns of Structural Change, Innovation, and Trade”, *Econometrica* 87(2): 497–528.
- McLean, I.W. (1973a), “The Adoption of Harvest Machinery in Victoria in the Late Nineteenth Century”, *Australian Economic History Review* 13(1): 77-90.

- McLean, I.W. (1973b), “Growth and Technological Change in Agriculture: Victoria 1870-1910”, *The Economic Record* 49(128): 560-74.
- McLean, I.W. (1982), “The Demand for Agricultural Research in Australia 1870-1914”, *Australian Economic Papers* 21(39): 294-308.
- McLean, I.W. (2013), *Why Australia Prospered: The Shifting Sources of Economic Growth*, Princeton NJ: Princeton University Press.
- Mitchell, B.R. (2005), *International Historical Statistics*, Basingstoke: Palgrave Macmillan.
- Mullen, J.D. (2010), “Agricultural Productivity Growth in Australia and New Zealand”, Ch. 5 (pp. 99-122) in **Alston, J.M., B.A. Babcock and P.G. Pardey (eds.), *The Shifting Patterns of Agricultural Production and Productivity Worldwide***, Midwest Agribusiness Trade Research and Information Center, Iowa State University, Ames.
- Mullen, J.D. and T.L. Cox (1995), “The Returns from Research in Australian Broadacre Agriculture”, *Australian Journal of Agricultural Economics* 39(2): 105-28.
- Mundlak, Y. (2005), “Economic Growth: Lessons from Two Centuries of American Agriculture”, *Journal of Economic Literature* 43(4): 989-1024.**
- Olmstead, A.L. and P.W. Rhode (2011), “Adapting North American Wheat Production to Climatic Challenges, 1839–2009”, *Proceedings of the National Academy of Sciences* 108(2): 480-85, 11 January.**
- Panza, L. and J.G. Williamson (2019), “Australian Squatters, Convicts, and Capitalists: Dividing Up A Fast-Growing Frontier Pie, 1821–71”, *Economic History Review* 72(2): 568–94.*
- Pascoe, B. (2014), *Dark Emu Black Seeds: Agriculture or Accident?* Broome: Magabala Books Aboriginal Corporation.
- Pfaffenzeller, S., P. Newbolt and A. Rayner (2007), “A Short Note on Updating the Grilli and Yang Commodity Price Index”, *World Bank Economic Review* 21(1): 151-63.

Pickard, J. (2010), “Wire Fences in Colonial Australia: Technology Transfer and Adaptation, 1842–1900”, *Rural History* 21(1): 27-63.

Productivity Commission (2022), *5-year Productivity Inquiry: The Key to Prosperity*, Interim Report, Canberra: Productivity Commission, July.

Raby, G. (1996), *Making Rural Australia: An Economic History of Technical and Institutional Creativity, 1788-1860*, Melbourne and London: Oxford University Press.

Shaw, A. (1990), “Colonial Settlement 1788-1945”, Ch. 1 (pp. 1-18) in D.B. Williams (ed.), *Agriculture in the Australian Economy* (3rd Edition), Sydney: University of Sydney Press.

Sutton, P. and K. Walshe (2021), *Farmers or Hunter-gatherers? The Dark Emu Debate*, Melbourne: Melbourne University Press.

Timmer, C.P. (2009), *A World Without Agriculture: The Structural Transformation in Historical Perspective*, Washington DC: AEI Press.

van der Ploeg, F. (2011), “Natural Resources: Curse or Blessing?” *Journal of Economic Literature* 49(2): 366-420.

Vanplew, W. (1987), *Australians: Historical Statistics*, Sydney: Fairfax, Syme and Weldon.

Venables, A.J. (2004), “Small, Remote and Poor”, *World Trade Review* 3(3): 453-57.

Ville, S. (2000), *The Rural Entrepreneurs: A History of the Stock and Station Agent in Australia and New Zealand*, Cambridge and New York: Cambridge University Press.

Williamson, J.G (2008), “Globalization and the Great Divergence: Terms of Trade Booms, Volatility and the Poor Periphery, 1782-1913”, *European Review of Economic History* 12(3): 355-91.

Withers, G., T. Endres and L. Perry (1985), “Australian Historical Statistics: Labour Statistics”, ANU Source Papers in Economic History, Australian National University, Canberra.

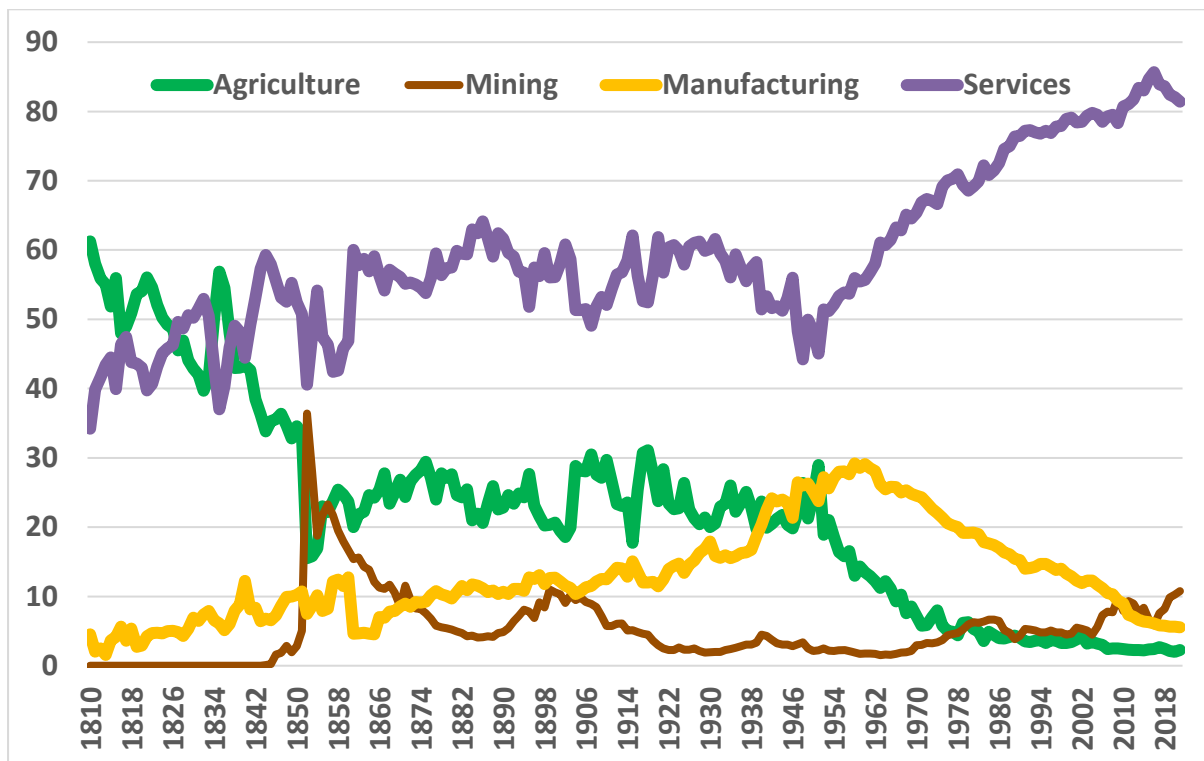
World Bank (2021), *The Changing Wealth of Nations 2021: Managing Assets for the Future*, Washington DC: World Bank.

World Bank (2023), *World Development Indicators*, accessed 12 July 2023 at <https://datatopics.worldbank.org/world-development-indicators/>

Wright, G. (1990), "The Origins of American Industrial Success, 1879-1940", *American Economic Review* 80(4): 651-68.

Yates, P.L. (1959), *Forty Year of Foreign Trade*, London: Allen and Unwin.

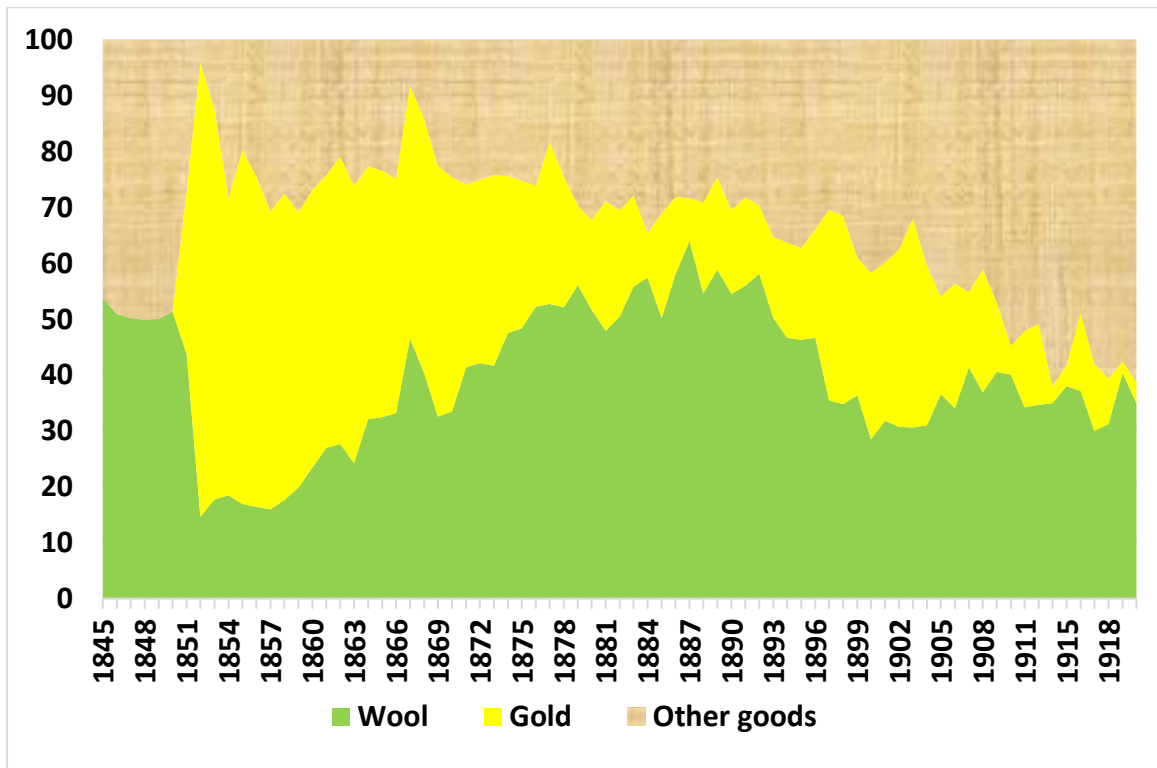
Figure 1: Contributions of agriculture, mining, manufacturing and services to Australia's GDP, 1810 to 2021 (%)



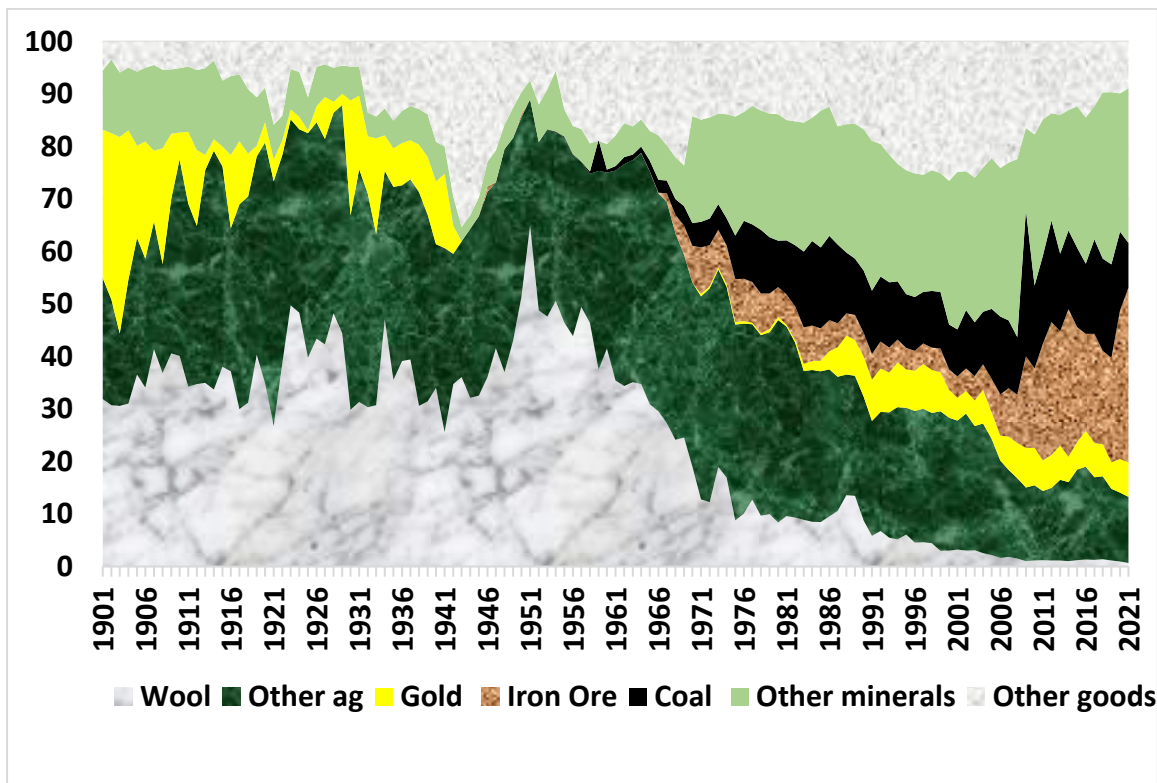
Sources: Vanplew (1987), updated from Butlin, Dixon and Lloyd (2015) and ABS.

Figure 2: Shares of wool, gold and other goods in Australia's merchandise exports, 1845 to 2021 (%)

(a) 1845 to 1920

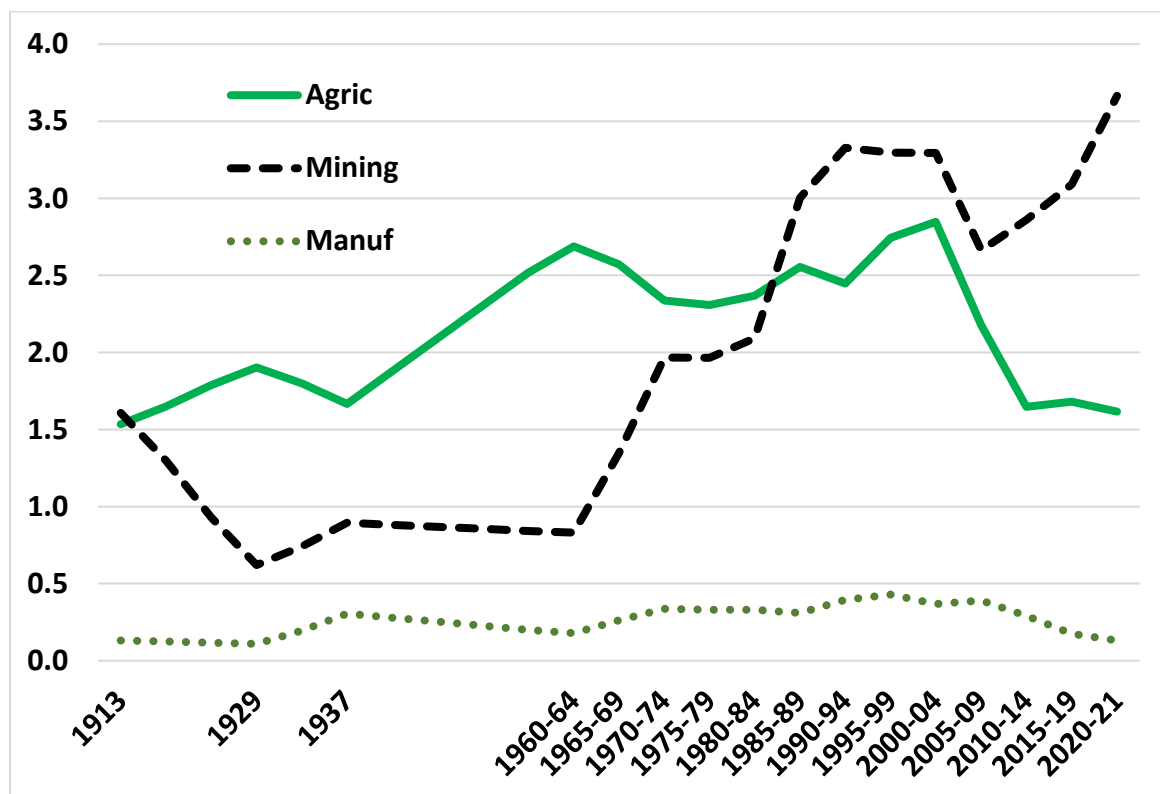


(b) 1901 to 2021



Sources: Vanplew (1987), updated from ABARES and ABS.

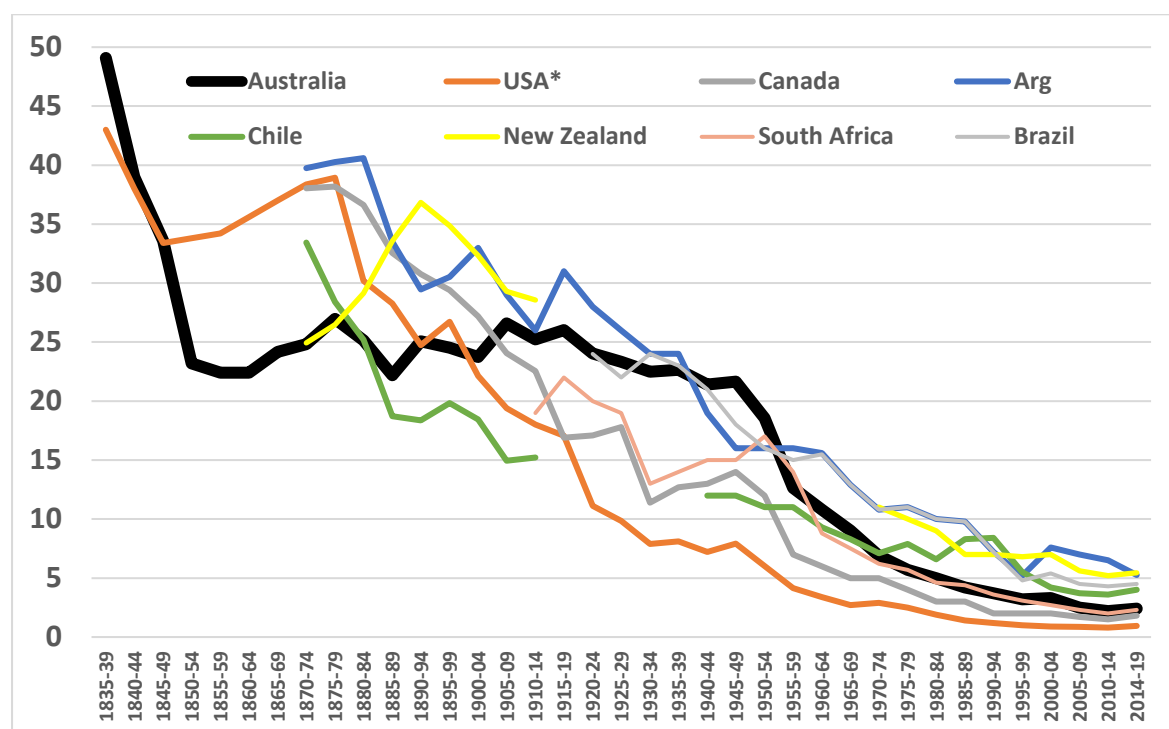
Figure 3: Australia's indexes of 'revealed' comparative advantage,^a 1913, 1929, 1937 and 1960 to 2021



^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).

Sources: Based on World Bank (2023), plus Yates (1959, pp. 222-23) for sectoral shares of global merchandise trade in 1913, 1929 and 1937.

Figure 4: Agriculture's share of GDP, Australia and other New World countries, 1835 to 2019 (% , 5-year averages at current prices)^a

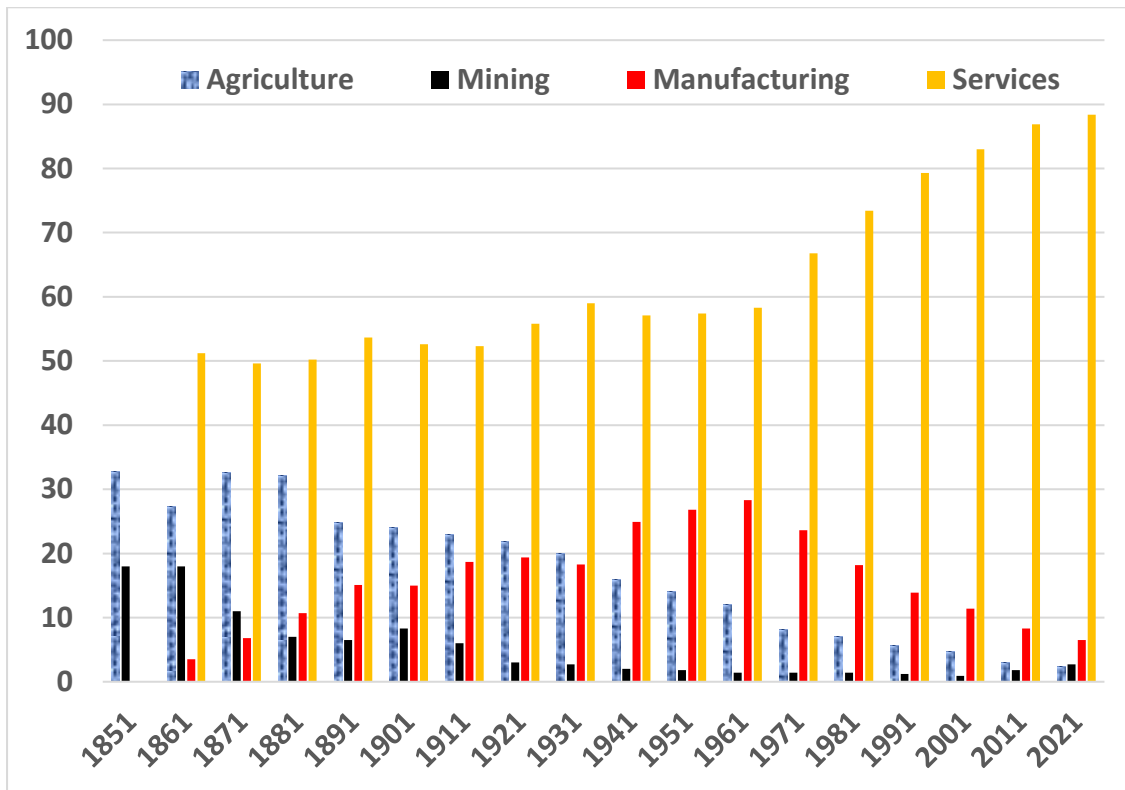


^a US shares for the first seven 5-year periods shown are interpolated from estimates by Gallman (1966, Tables 3 and A-1) for 1839 (42.7%), 1849 (33.4%) and 1959 (34.2%), and Mitchell (2005) for 1870-74 (38.4%).

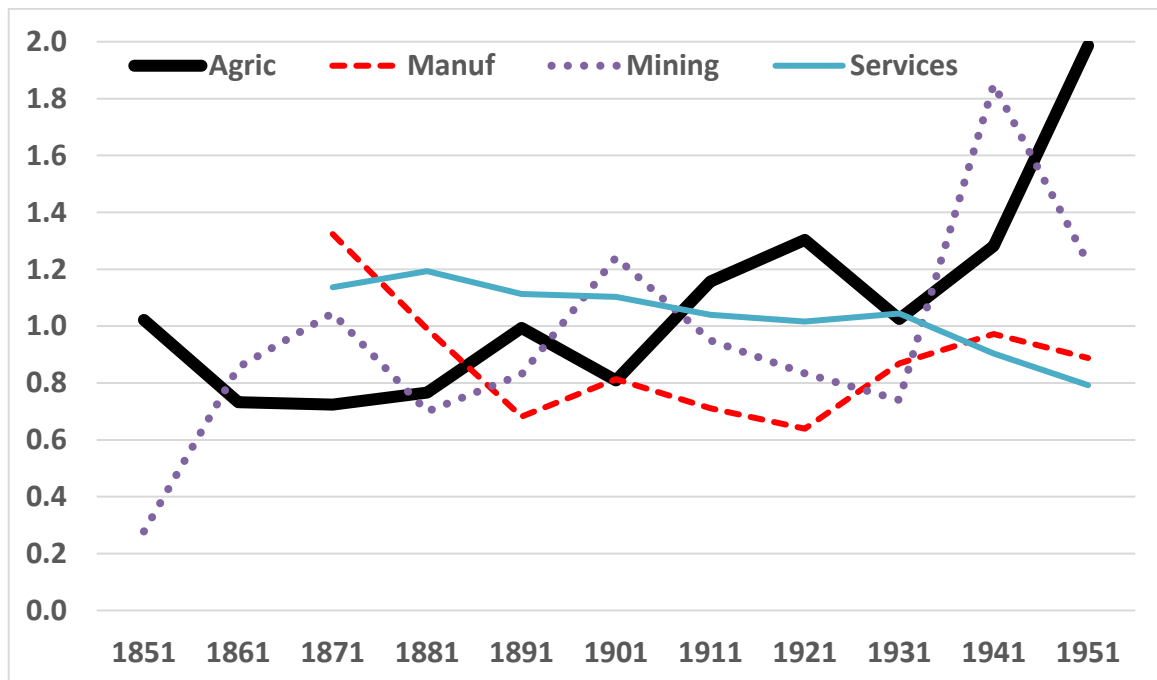
Sources: Author's compilation based on data in Mitchell (2005), Gallman (1966) and World Bank (2023).

Figure 5: Shares of agriculture, mining, manufacturing and services in employment, and agricultural labour productivity,^a Australia, 1851 to 2021 (%)

(a) Sectoral shares of employment (%)



(b) Sectoral labour productivity^a

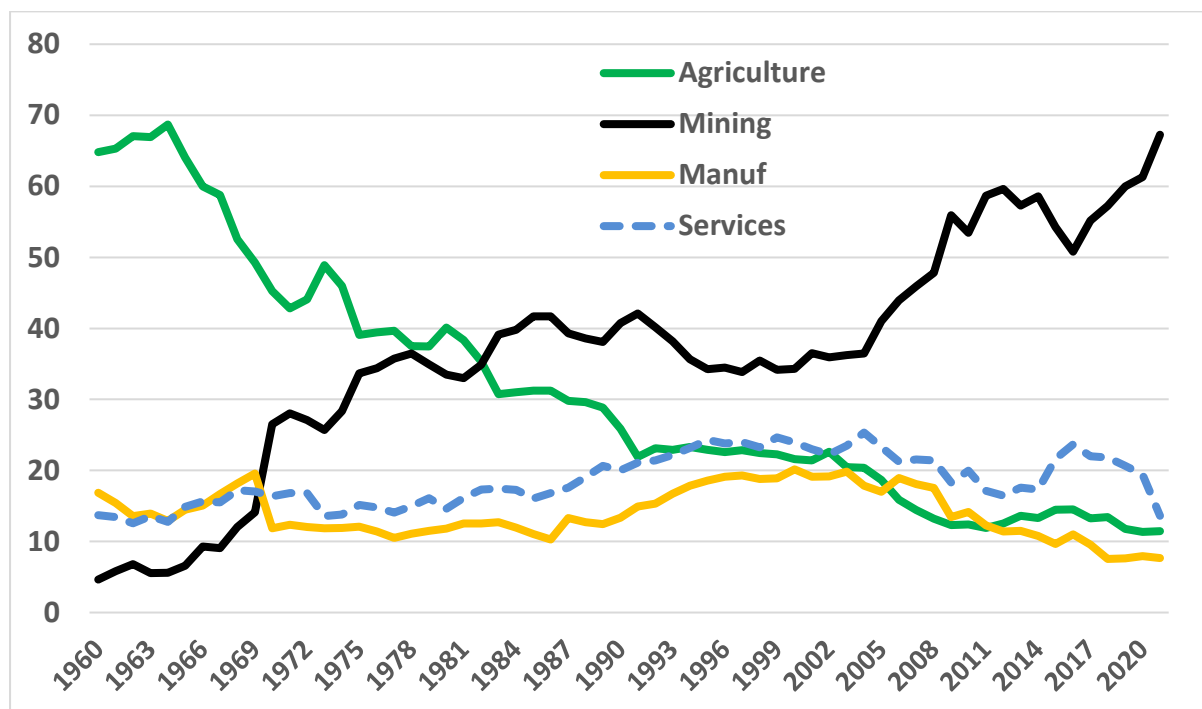


^a Sectoral GDP share divided by sectoral employment share.

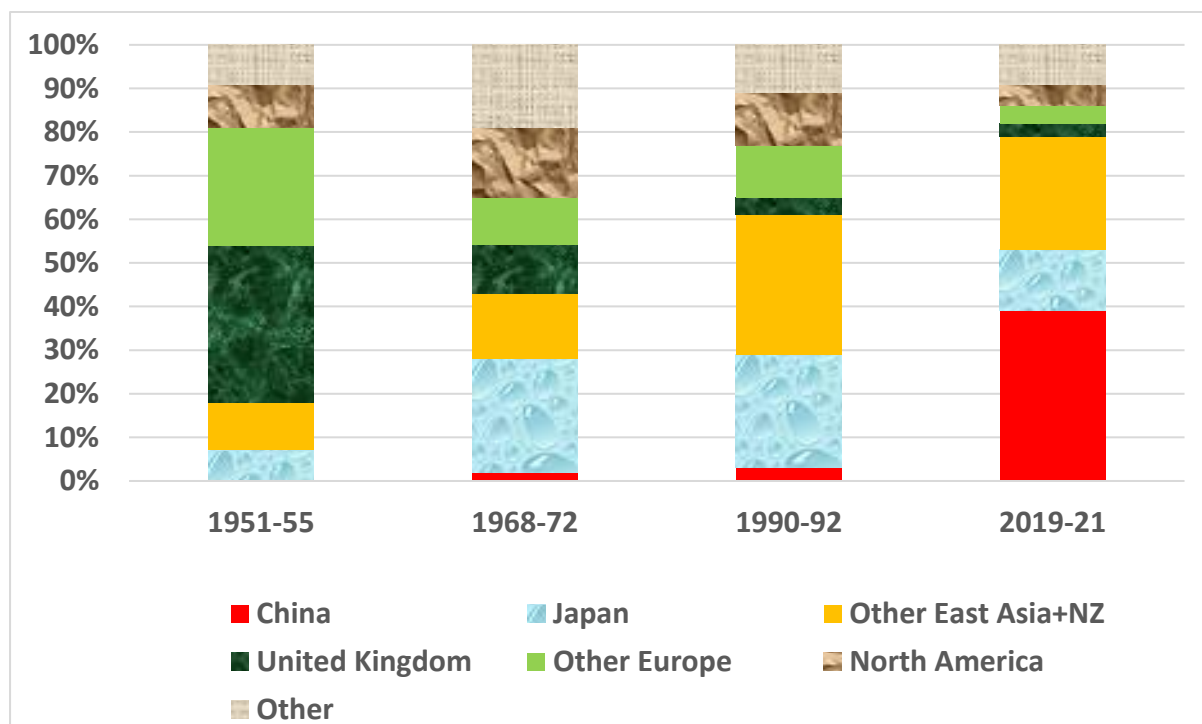
Sources: Author's compilation from data in Vanplew (1987), updated from ABS.

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.

Sources: Author's compilation from Vanplew (1987), updated from ABARES and ABS.

Why did agriculture's share of Australian GDP not decline for a century?

Kym Anderson

Supplementary Material: for online availability

References to sources:

ABARES (2022), *Agricultural Commodities Statistics*, Canberra: Australian Bureau of Agricultural and Resource Economics and Sciences.

ABS (2011), [Historical Selected Agriculture Commodities, by State \(1861 to Present\), Cat. No. 7124.0, Canberra: Australian Bureau of Statistics.](#)

Anderson, K. (ed.) (2009), *Distortions to Agricultural Incentives: A Global Perspective, 1955-2007*, London: Palgrave Macmillan and Washington DC: World Bank.

Anderson, K., P.J. Lloyd and D. MacLaren (2007), "Distortions to Agricultural Incentives in Australia Since World War II", *Economic Record* 83(263): 461–82.

Briggs (2016), *Looking at the Numbers: A View of New Zealand's Economic History*, Wellington: New Zealand Institute of Economic Research.

Butlin, M., R. Dixon and P.J. Lloyd (2015), "A Statistical Narrative: Australia, 1800 -2010", pp. 555-94 in S. Ville and G. Withers (eds.), *The Cambridge Economic History of Australia*, Cambridge and New York: Cambridge University Press.

Condliffe, J.B. (1915), "The External Trade of New Zealand", pp. 859–962 in *New Zealand Official Yearbook 1915*, Wellington: New Zealand Government Printer.

https://www3.stats.govt.nz/new_zealand_official_yearbooks/1915/NZOYB_1915.html

Harris, E., and S. La Croix (2021), "Australia's Forgotten Copper Mining Boom: Understanding How South Australia Avoided Dutch Disease, 1843–1850", *Economic Record* 97(318): 424-39.

ILO (2022), *World Employment and Social Outlook*, Geneva: International Labour Office.

<https://www.ilo.org/global/research/global-reports/weso/trends2021/lang--en/index.htm>

Jacks, D.S. (2019), “From Boom to Bust: A Typology of Real Commodity Prices in the Long Run”, *Cliometrica* 13: 201-20.

Lloyd, P.J. and D. MacLaren (2015), “Relative Assistance to Australian Agriculture and Manufacturing Since Federation”, *Australian Journal of Agricultural and Resource Economics*, 59(2): 159-70.

Mitchell, B.R. (2005), *International Historical Statistics*, Basingstoke: Palgrave Macmillan.

Pfaffenzeller, S., P. Newbolt and A. Rayner (2007), “A Short Note on Updating the Grilli and Yang Commodity Price Index”, *World Bank Economic Review* 21: 151–63.

Vanplew, W. (1987), *Australians: Historical Statistics*, Sydney: Fairfax, Syme and Weldon.

World Bank (2023), *World Development Indicators*, accessed 12 July 2023 at

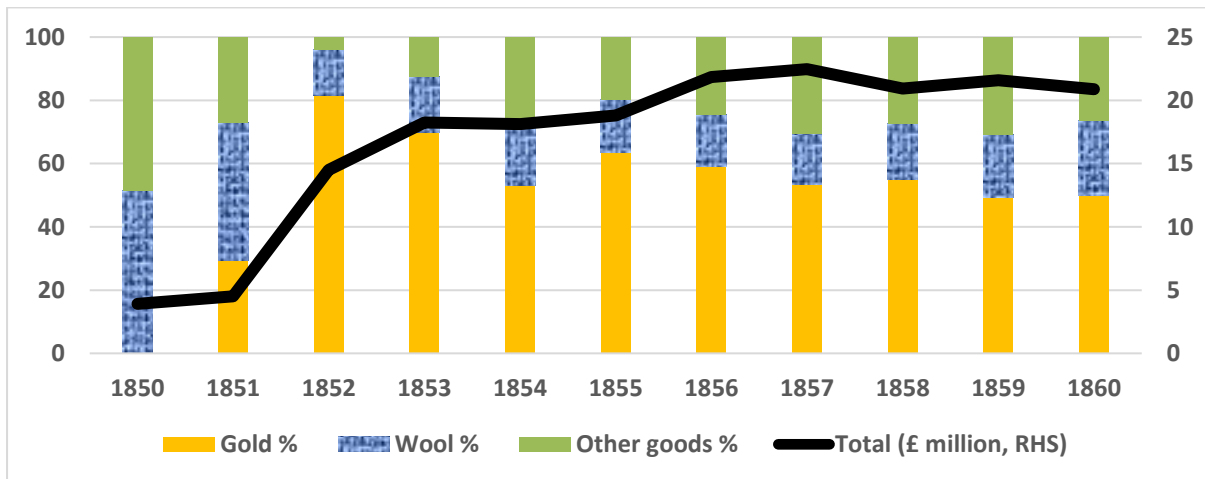
<https://datatopics.worldbank.org/world-development-indicators/>

Figure S1: Nominal 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



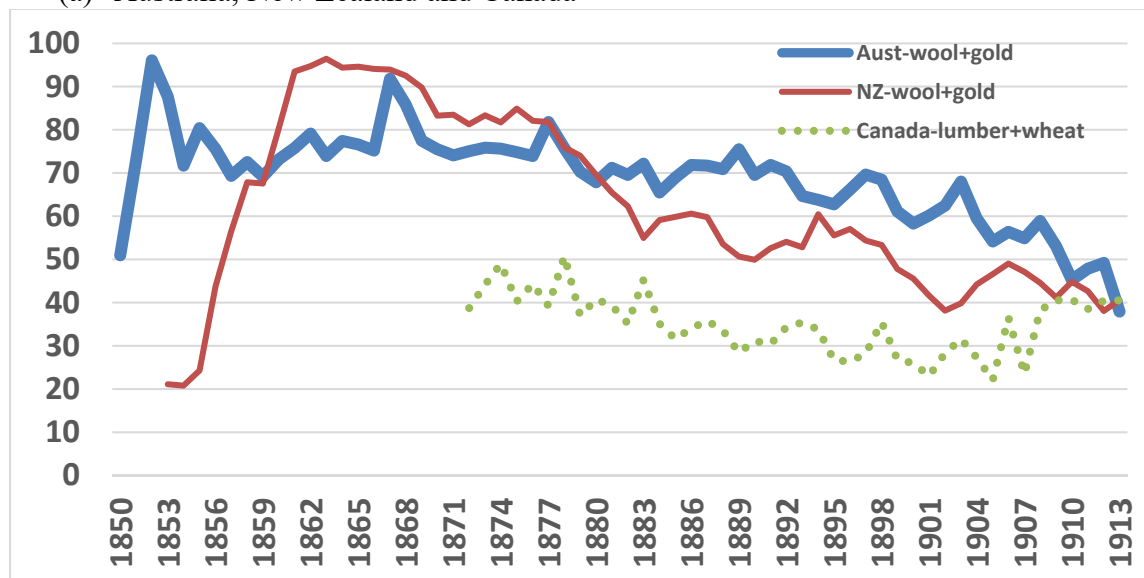
(c) Australia, 1895-1903



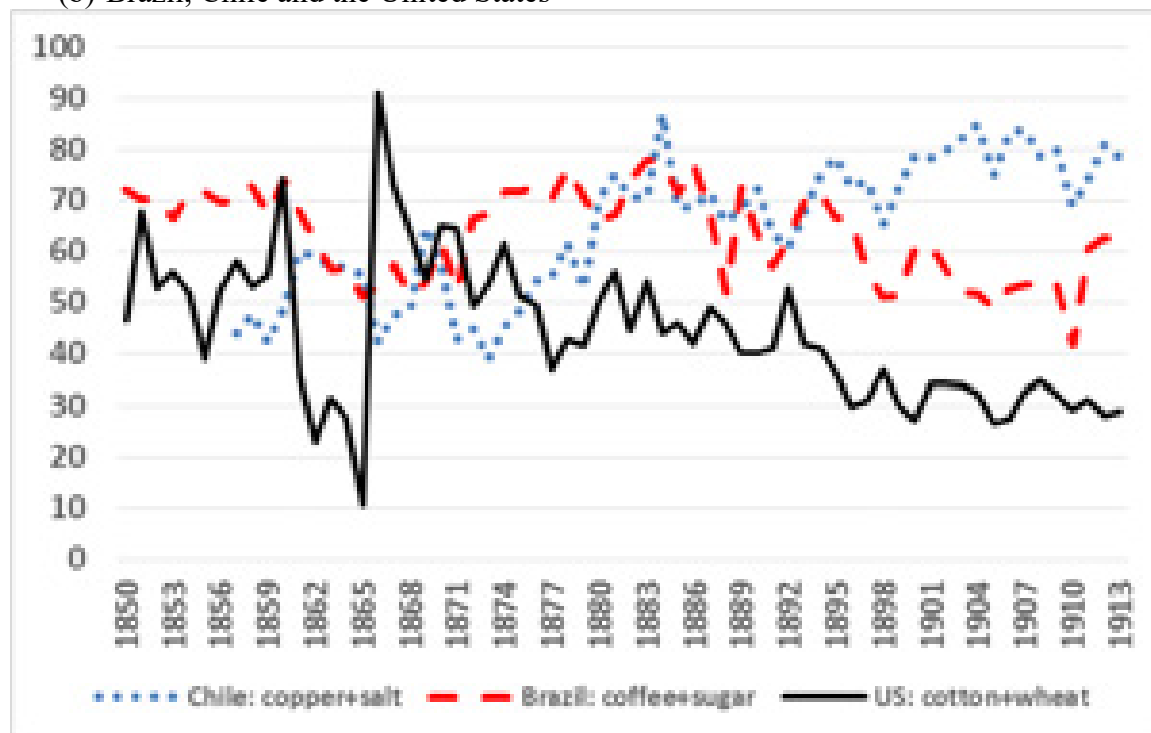
Sources: Vanpew (1987) and, for South Australia, Harris and La Croix (2021).

Figure S2: Share of top two goods in New World settler economies' exports,^a 1850 to 1913 (%)

(a) Australia, New Zealand and Canada



(b) Brazil, Chile and the United States



^a Meat (not shown) contributed more than gold to New Zealand's exports from the mid-1890s, as gold's share fell from about 12% to 3% by 1913 (and meat's rose from 12% to 17%). 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.

Sources: Author's compilation based on data in Mitchell (2005) and (for extending back the New Zealand data) Condliffe (1915).