

Commodity Price Shocks and the Australian Economy since Federation*

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Abstract

Even though Australia has experienced frequent and large commodity export price shocks like the Third World, it seems to have dealt with the volatility better. Why? This paper explores Australian terms of trade volatility since 1901. It identifies two major price shock episodes before the recent mining-led boom and bust. It assesses their relative magnitude, their de-industrialization and distributional impact, and policy responses. In what way has Australia been different from other commodity exporters experiencing volatile prices?

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1. Introduction

Recent research shows that external price volatility -- terms of trade volatility in particular -- has a negative impact on long run growth (Fatas and Mihov 2006; Blattman, Hwang and Williamson 2007; Koren and Tenreyro 2007; Poelhekke and van der Ploeg 2007; Williamson 2008).¹ Yet, Blattman, Hwang and Williamson (2007) document that between 1870 and 1940 the negative impact of terms of trade volatility on economic growth was far greater in commodity dependent Latin America, Africa and Asia than it was in Australia, Canada, New Zealand, and the United States, even though in some cases the magnitude of the price volatility was even larger. Indeed, they find no evidence to support the view that terms of trade volatility significantly lowered long run growth in the English-speaking European offshoots at all between 1870 and 1940.

What are the secrets of this long run success of the English-speaking offshoots? Was it because their factor markets were better able to respond to external shocks? Was it because of better policy or better institutions? Was it because their governments had more stable revenues so as to pursue long run infrastructure investment without interruption? Was it because the offshoots were better able to diversify (especially in to manufacturing) and thus to mute the impact of the external price shocks? And what was the impact of these price shocks on income distribution? These questions await answers. Not only should the explanations be of interest to economic historians and development

¹ Blattman *et al.* (2007) focus on the period 1870 to 1939, and Williamson (2008) on the period 1780-1913, whereas all the other papers cited in the text focus on the post-1960 period. Some of the early research on the impact of term of trade volatility on long-run growth are Mendoza (1997), Deaton and Miller (1996), Kose and Reizman (2001), Bleaney and Greenway (2001), and Hadass and Williamson (2003).

economists, but they may also offer useful lessons for Australian policy makers dealing with the present mining boom and bust. It may also have implications for economic development in poor African, Asian and Latin American countries where price volatility is frequently documented as a fundamental drag on development (Loayza *et al.*, 2007).

We approach these questions from a country perspective. The paper focuses on Australian terms of trade history since federation in 1901. It identifies two major price shock episodes before the recent mining-led episode, and assesses their relative magnitude, their de-industrialization and distributional impact, factor market responses and policy behaviour. In doing so, we are able to learn what external price shocks did to resource allocation, development and distribution in the Australian 20th century, and thus to understand more about what it might do at the start of the Australian 21st century.

The remainder of the paper is structured as follows. Section 2 reports the complete terms of trade time series since 1901. We identify major episodes of shocks in the net barter terms of trade, as well as in the prices of tradables relative to all commodities, including non-tradables. We compare average volatility across major Australian episodes, identify the most volatile episodes, identify which Australian export commodities had the greatest price volatility, and whether export product concentration played a role. Furthermore, we compare Australian commodity price volatility with that of other commodity exporters. Section 3 explores Australian factor market response to these shocks, primarily the regional impact on employment and migration. The income distributional impact is explored at length and compared across episodes in Section 4. Section 5 takes a close look at Australian policy response. In particular, it assesses government deficits and surpluses, government infrastructure investment, and tariff

policy across these episodes. Did Australia use tariffs as a device to offset de-industrialization forces generated by commodity export price booms? Did Australia governments use revenue booms to accumulate, and revenue busts to spend? Section 6 concludes.

2. A Century of Australian Terms of Trade Shocks

Measuring Price Volatility

This section starts by comparing Australian experience with export price booms with one other English-speaking offshoot, the United States, and then with two late comers, Brazil and Indonesia. We conclude the section by comparing Australian export price volatility with all Third World primary product exporters.

When Australian commodity price shocks are compared with other commodity exporting countries (both rich and poor), two different patterns emerge. First, the Australian and the United States (which used to be a rich commodity exporter) terms of trade moved together during the last half of the 19th and the first third of the 20th century (Figure 1). This correlation continues until the Great Depression when the United States terms of trade improved and the Australian terms of trade slumped. In addition, Australia and the United States exhibited quite different behaviour in the two decades after 1980 (Figure 2), and during the Australian mining boom since the late 1990s, when the US terms of trade shows no rise. Australian terms of trade movements during the second half of the 19th century and after appear to be similar to the terms of trade movement in Brazil and Indonesia (Figure 3). The fact that agricultural raw material and foodstuff prices

show some co-movement may account for similar terms of trade timing for the three economies. But here again, the correlation breaks down after 1980. Relatively high but declining Indonesian terms of trade during the first half of the 1980s following the oil crisis of the 1970s is not matched by Australia or Brazil (Figure 4). The recent Australian mining-driven terms of trade boom has not been replicated in Indonesia or Brazil.

So much for timing. What about comparative magnitudes? Has Australia undergone greater or less volatility in its export prices and terms of trade than have other commodity exporters? We know it did not undergo less volatility during the seven decades before 1940. Blattman *et al.* (2007) have shown that the average terms of trade volatility in Australia over the period 1870 to 1939 was greater than all countries in the European periphery,² most of Latin America,³ and the majority of countries in Asia and the Middle East.⁴ Since 1960, Australian terms of trade volatility, while no longer greater, has been only marginally less than that of other commodity exporting regions. During the 1970s, external price volatility in Australia – defined as the standard deviation of the logarithmic change in terms of trade -- was as much as three-fifths of that of Sub-Saharan Africa and more than four-fifths of that of Latin America (Table 1), two regions that the development literature characterizes as greatly disadvantaged by price volatility (Deaton and Miller 1996). Australian terms of trade volatility was also similar to other commodity exporting regions in the 1980s, although it was less so in the 1990s. Note also, that in every decade from the 1960s to the 1990s, Australian terms of trade volatility

²The European periphery includes Denmark, Greece, Norway, Portugal, Russia, Sweden, Serbia, and Spain.

³The Latin American exceptions were Brazil, Colombia, and Cuba.

⁴The Asian and Middle Eastern exceptions were Ceylon, Egypt, and Indonesia.

was more than double that of the average for all industrial economies. The Australian volatility figure for 2000-07 seems less than that of previous decades, but Table 1 only reports the boom up to 2007; it does not report the recent price collapse in commodity markets. While Australian base metal prices rose by an immense 321 percent between 1998/99 and the peak in May 2007, by November 2008 it had tumbled to only 47 percent of that peak. Meanwhile, the Australian dollar collapsed from almost par with the US dollar (0.96) in June 2008 to 0.67 in October 2008.

Table 1: Comparative Trends in Volatility of Terms of Trade Growth

Years	Australia	Industrialized Economies	East Asia and the Pacific	Latin America and the Caribbean	Middle East and North Africa	South Asia	Sub-Saharan Africa
1960 – 69	4	1.8	5.2	7.2	4.8	12.8	7.2
1970 – 79	11.1	5.2	8.2	13	11.5	18	18.2
1980 – 89	7.1	3.5	6.1	11	9	10.2	12.2
1990 – 99	4.9	2.1	1.9	8.1	7.8	7.8	10.8
2000 – 07	3.7						

Notes: The Australian figures are our own calculation. Figures for other country groups are inferred from Figure 3 in Loayza *et al.* (2007), p. 346. Volatility of terms of trade growth is calculated as the standard deviation of the logarithmic change in terms of trade over each of the four decades 1960–2000.

Thus, it appears that for more than a century, Australia has experienced about as volatile a terms of trade as the average commodity exporter. How was it that Australia seemed to handle these shocks so well?

Identifying Episodes

Figure 5 reports the Australian net barter terms of trade (P_X/P_M) between 1890 and 2007. In addition, two other variables are plotted there, P_X/P_Y and P_M/P_Y . The ratio of

export to import prices is the standard measure of the terms of trade. However, in order to assess the impact of external price shocks on the economy as a whole, the prices of those two tradables should be related to the prices of non-tradables as well. That is, a commodity export price boom (or bust) must be expressed relative to all other prices in the domestic economy in order to assess its impact on resource allocation, output mix and income distribution. Hence, the external terms of trade does not by itself offer an adequate measure of export price booms and busts relative to the rest of the economy. More effective measures are P_X/P_Y and P_M/P_Y where P_Y is the GDP implicit price deflator. It makes a difference in what follows.

Table 2: External Price Shocks and Economic Performance in Australia

Years	Average Real GDP growth	Average Growth in P_X/P_M	Average Growth in P_X/P_Y	Average Growth in P_M/P_Y	Average Growth in P_{XW}/P_Y	Average Growth in P_{XM}/P_Y	Average Growth in P_{XA}/P_Y
1920 – 25	6.3	10.3	0.8	-2.5	2.3	-1.6	-0.7
1925 – 30	-0.3	-5.2	-2.2	-0.4	-4.2	0.5	-1.6
1945 – 50	1.1	21.7	16.1	2.7	35.0	8.9	2.8
1950 – 55	3.3	-17.6	-10.0	0.5	-23.0	-4.7	-6.6
2000 – 03	2.2	1.4	1.9	0.7	4.0	4.4	3.6
2003 – 07	2.6	8.5	2.0	-3.6	-4.8	7.3	-2.9

Notes: These figures are our own calculation. All growth rates are in percent. The average real GDP growth rates are annualized averages of log difference in these variables. The data sources are documented in the Data Appendix.

Australia has undergone three major external price shock episodes over the past century. As Table 2 documents, the first half of the 1920s experienced a sharp increase in Australian export prices and thus in the external terms of trade, P_X/P_M . What is surprising,

however, is that P_X/P_Y hardly increased at all.⁵ Note also that the long boom and subsequent bust in the terms of trade from the late 1890s to the end of World War I (Figure 5) disappears when P_X and P_M are deflated by P_Y . The cycle from World War I to the mid 1920s is, however, apparent in all three series, and it also coincides with a strong real GDP growth performance of 6.5 percent per annum (Pope 1987; p. 35). Note also that the terms of trade bust in the second half of the 1920s coincided with negative GDP per capita growth, five years before the Great Depression hit. The second major price shock occurred during the Korean War episode from the late 1940s to the early 1950s, when P_X/P_M and P_X/P_Y growth were both double-digit (Table 2). Yet, the price bust seems to have left no mark on aggregate economic performance: the GDP growth rate was three times as fast during the 1950-1955 price bust than during the 1945-1950 price boom. Finally, the third major price shock is what we have seen since 2003 (or even 1998), when the average GDP growth rate rose again, this time to 2.6 percent per annum. Each of the two previous export price booms were followed by an equally dramatic price collapse. Of course, we do not yet know whether the current collapse in commodity exports will persist, but so far it appears that the recent boom will also be followed by a dramatic bust. Whether the price bust will drag Australian growth performance down – as in the late 1920s, or not – as in the early 1950s, is yet to be seen, although a world recession will certainly obscure those forces.

What about the magnitudes of these shocks? How large are they when compared across episodes? During the first boom between 1920 and 1925, the total increase in P_X/P_Y

⁵ Over the period 1921 to 1924, P_X/P_M rose approximately 94.5 percentage points compared to 4.1 percentage point increase in P_X/P_Y over the same period.

was 4.1 percentage points and the average year to year change was 0.8 percent. During the Korean War boom up to 1950, the total increase in P_x/P_y was 80.3 percentage points, and the annual rate was a huge 16.1 percent. For the year 1949 to 1950 alone, the increase was over 48.4 percentage points. On the down side between 1950 and 1955, the figure was a huge annual rate of -10 percent. Without a doubt, the Korean War episode recorded the largest boom and bust in export prices over the last century (see also Maddock 1987). The recent export price boom seems pretty modest compared with the Korean episode, but pretty dramatic compared with the 1920s. Between 2003 and 2007, the annual rate of increase in P_x/P_y was 2 percent, compared with 0.8 percent in the early 1920s and 16.1 percent in the late 1940s.

Were these three Australian price shocks driven by the export price of a particularly volatile commodity, or by the fortuitous co-movement of many export commodity prices? To address this question, Figure 6 plots P_{xw}/P_y , P_{xm}/P_y , and P_{xa}/P_y where P_{xw} , P_{xm} , and P_{xa} are export prices of wool, mining, and agriculture goods respectively. Table 2 also reports the average growth rates of these three commodity prices during these episodes. The export price boom between 1920 and 1925 was driven solely by wool prices. The export price of agriculture goods and mineral prices underwent no boom at all, but rather a decline. The Korean War commodity price episode was also driven by wool prices, but on this occasion both mining and agriculture prices also experienced a sharp increase and subsequent collapse. Like the 1920s, the recent price boom 2003-2007 was also mainly driven by one set of commodities, minerals, since the export prices of wool and agriculture actually declined up to 2007. Thus, two things made the Korean War boom unusual: the magnitude of the price boom was unusually

great for all three products; and the co-movement of all three was unusually pronounced. It appears that there is little that is unusual about the recent commodity export price boom (and bust): the magnitude of the recent boom in mining product prices exceeded that of wool in the early 1920s but fell well short of the Korean War boom in the same product; and the fact that the recent boom involved only one product price (minerals), was also shared by the early 1920s. Once again, if we are looking for an unusual commodity price boom and bust over the past Australian century, it is the Korean War, not the current episode.

A comparison of export product concentration during the three episodes reveals that indeed wool was the dominant export commodity during the 1920s. More than 70 percent of Australian exports were primary products with wool making up more than half of it (Table 3).⁶ Therefore, the 1920-1925 boom would have been driven by wool prices even if the relative prices of mining and agricultural products had behaved the same way (which, of course, they did not). Wool could claim an even more dominant position in the export product mix by the Korean War, although residual exports (which included manufactures) gained at the expense of mining and agriculture. However the world commodity boom led to the expansion of all Australian export sectors, including wool, mining, and agriculture, even though the wool price boom was much more dramatic than that of mining and agriculture. In contrast, the recent commodity boom (and bust) has been dominated by mining and the residual sector. Mining accounts for almost half of

⁶ Bambrick (1973) also documents that the export price index for 1890 to 1930 was dominated by the major export commodity, wool. Cashin and Mcdermott (2002) show that, in Australia, the wool export cycle was in synchronization with the business cycle prior to World War I. This link became weaker after the war.

Australian exports. Wool and agriculture no longer appear to be important export items, mining prices are doing all the work.

Furthermore, the residual export category – mainly manufactures – has served to offset the volatility in the three commodities. Indeed, throughout the 20th century, as Australia industrialized, the export mix increasingly shifted towards manufactures, from 28.4 percent of the export total in 1920-25 to 48.2 percent in 2003-07. Thus, while export commodity price volatility is still an Australia attribute, its impact has diminished across the 20th century due to industrialization and post-industrial forces: first, reducing export concentration, and raising the manufacturing export share (with more stable prices); and second, reducing the relative size of agriculture and mining activity in the economy, both serving to mute the impact of export price volatility in Australian markets.⁷

Table 3: Export Product Concentration in Australia during the Three Episodes (%)

Years	Wool	Mining	Agriculture	Others
1920 – 25	39.2	6.6	25.8	28.4
1945 – 50	43.1	5.1	20.7	31.1
2003 – 07	1.7	45.2	4.9	48.2

Notes: These figures are our own calculation using Vamplew (1987), pp. 194 – 195 for 1920 to 1925 and pp. 202-203 for 1945 to 1950. They are percentage share of total exports during each period. Figures for the period 2003 to 2007 are calculated using ABS cat no. 53680, Table 12b.

3. Australian Market Response to the Terms of Trade Shocks

Having established that the Australian economy experienced three major terms of trade booms (the early twenties, the Korean War, and the recent mining boom) and three major busts (the late 1920s and the Great Depression, and the long price bust from 1951

⁷ Martin (1989) shows that, since 1970, Australia’s exports are considerably more diversified and therefore substantially reduces the variability in terms of trade.

to 1973, and the recent months), how has the Australian market responded? We explore two responses. First, we look at the impact of these shocks on the structure of the economy both in terms of employment and output. Is there any evidence of de-industrialisation during the terms of trade booms, and industrial recovery during the slumps? We answer this question by constructing an index of structural change and also by looking at manufacturing employment and output time series. Second, we look at the impact of these price shocks on factor markets.

The structural change index is constructed using the formula $S_t = \sum_i w_i |g_{i,t} - g_t|$, where w_i are value added weights, g_i and g are one year growth rates of individual industrial sectors and aggregate respectively both in terms of employment and GDP (Hatton 2007; Hatton and Boyer 2005). These two indices range between zero (when all sectors grow at the same rate as the aggregate and hence there is no structural change) and one. The SCHEMP index captures structural change in sectoral employment and the (SCHGDP) index captures structural change in sectoral output (Data Appendix). The maximum values of these indices for the corresponding period are presented in Table 4. With the exception of output during the 1920s and employment during the Korean War episode, there is very little evidence of significant differences in the rate of structural change on the upswing versus the downswing during these three price shocks. True, SCHGDP fell from a high 14 percent in the early 1920s to a somewhat lower 9 percent in the late 1920s, but there were no such differences on either side of the price peaks in the other two episodes. Similarly, while SCHEMP fell from a high 16 percent in the late 1940s to a much lower 3 percent in the early 1950s, there were no such differences on either side of the price peaks in the other two episodes. The current boom has, thus far,

exhibited no structural adjustment response at all, at least as measured by SCHGDP or SCHEMP.

Table 4: External Price Shocks and Structural Change in the Australian Economy

Years	Structural Change in GDP (SCHGDP)	Structural Change in Employment (SCHEMP)
1920 – 25	0.14	0.03
1925 – 30	0.09	0.05
1945 – 50	0.07	0.16
1950 – 55	0.09	0.03
2000 – 03	0.03	0.02
2003 – 07	0.02	0.02

Notes: Definitions of SCHGDP and SCHEMP are available from the Data Appendix. The numbers reported above are maximum values of the index reached during the corresponding period.

Figure 7 also plots the deviations from long run trend in the manufacturing sector's employment and GDP shares from 1890 to 2007. The manufacturing sector share exhibits a century-long inverted U reflecting a half century of manufacturing-led growth (and shrinking agriculture) followed by a half century of service-led growth (and shrinking manufacturing). The peak approximately coincides with the Korean War episode. Due to the effect of the secular increase in manufacturing, it appears that the commodity price shocks had very little impact on deindustrialisation or reindustrialisation during Australia's biggest commodity price boom and bust. There are two possible explanations for this result. The first would lie with the fact that the underlying development fundamentals – favoring manufacturing -- completely swamped the impact of the commodity price shocks between 1945 and 1955. The second explanation would be that factor markets did not play the allocative roles we expect of them. These two explanations need not be competing. In any case, the same appears to have been true of

the recent mining boom and bust. The only exception to this rule appears to have been the 1920s (Figure 7 and Table 4) where there does seem to be evidence of deindustrialisation on the commodity price upswing and reindustrialisation on the downswing. This exception is all the more surprising given that the great terms of trade boom and bust in the 1920s was, as we have seen, much more modest when P_X and P_M are both deflated by P_Y , the GDP implicit price deflator (Table 2).

What suppressed deindustrialisation during the commodity price booms and reindustrialisation during the price slumps? To repeat, was it because long run development fundamentals swamped the impact of commodity price booms and busts, or was it because of factor immobility? Conventional wisdom suggests that there should be an influx of foreign labour during terms of trade upswings and exodus during downswings (Hatton and Williamson 1998: Chapter. 4), and that foreign and domestic migrants should both favour the resource-intensive regions on the upswings and disfavour them on the downswing. These labour market effects should have been more pronounced the greater was labour mobility. Was this the case with the three Australian commodity price episodes across the 20th century? There was an Australian immigration boom in the 1920s, but it seems to have lagged behind the commodity price boom by a half decade (compare Tables 1 and Table 5). And while Western Australia, South Australia and Queensland were more heavily specialized in wool and agriculture, only Western Australia reported relatively heavy immigration rates compared with the national average between 1920 and 1925. Furthermore, Western Australia had far higher immigration rates during the bust in the late 1920s (16.7), than during the boom in the early 1920s (9.3), and the immigration rates reported for Queensland were hardly

different on either side of the price spike (5.9 vs 5.2). Thus, migration did not play the consistent and powerful role during the first export commodity price event that a mobile labour market would have predicted. This perverse result was even more notable during the Korean War period: while Western Australia and South Australia were both above the national immigration average 1945-50, Queensland was below it; and all three regions had greater immigration rates during the bust after 1950, than during the boom up to 1950. Similar migration patterns have continued during the current mining boom: while resource-abundant Queensland underwent much higher immigration rates than the rest of Australia, and while resource-scarce New South Wales recorded low growth rates, none of the remaining four states show a significant change between 2000-02 and after. In short, either labour markets have not responded with sufficient power to create de-industrialization during the commodity price booms and re-industrialisation during the slumps, or other forces have offset those forces over the past century.

Table 5: External Price Shocks and Net Interstate and Overseas Migration Rate

Years	Australia	New South Wales	Victoria	Queensland	Western Australia	South Australia
1920 – 25	6.1	6.0	7.0	5.9	9.3	7.3
1925 – 30	5.8	7.6	3.5	5.2	16.7	2.5
1945 – 50	5.0	3.9	4.9	2.8	8.3	8.0
1950 – 55	10.8	6.5	13.9	9.4	18.4	15.7
2000 – 02	6.1	4.1	6.6	13.9	6.0	0.4
2003	6.2	1.8	6.1	15.7	9.4	1.9

Notes: Prior to 1972, net overseas migration was defined as the difference between total arrivals and total departures, including short-term movements. From 1972 onwards net overseas migration is defined as the difference between permanent and long-term arrivals and permanent and long-term departures, plus an adjustment for category jumping from 1976. It is calculated as the number of net movements in a year per 1,000 of the estimated resident mean population. From 1994, the mid-year population has been used instead of the mean population. *Source: Australian Historical Population Statistics (cat no. 3105.0.65.001), Table 65, Australian Bureau of Statistics.*

Now consider the behaviour of unemployment rates across states. Since Western Australia, South Australia and Queensland specialised in resource-intensive activities, a commodity price boom should have generated high employment and low unemployment rates there compared to Victoria and New South Wales, where more manufacturing was located, *if labour was relatively immobile*. If instead labour was very mobile, then unemployment rates would have been similar across states in level and change. Table 6 reports state unemployment rates for the three episodes of external price shocks. The immobile labour thesis seems to be confirmed. During the first half of the 1920s, the unemployment rates in Western Australia and South Australia were well below the national average, but Queensland was above it. During the price bust 1925-30, Queensland and Western were still below the national average in spite of the price bust, but South Australia was above it. This mixed and ambiguous result is also confirmed for the more industrial states during the boom: employment rates in New South Wales were above the national average (5.9) but they were below it in Victoria (4.2).

Table 6: External Price Shocks and Unemployment Rates in Australia

Years	Australia	New South Wales	Victoria	Queensland	Western Australia	South Australia
1920 – 25	5.0	5.9	4.2	5.4	4.1	3.5
1925 – 30	5.7	5.5	6.2	4.1	5.2	6.7
1945 – 50	2.0	2.3	1.5	1.6	2.6	1.7
1950 – 55	1.8	2.3	1.4	2.0	2.4	0.9
2000 – 04	6.1	5.5	5.9	7.0	6.0	6.8
2004 – 08	4.5	4.8	4.7	4.1	3.6	4.9

Notes: Unemployment rates are defined as average unemployed per year as a percentage of total workforce. Data are from Leigh and McLeish (2009).

Similarly, while unemployment rates were lower in Queensland and South Australia during the commodity export price boom 1945-50, resource-abundant Western Australia

was above the Australian average while industrial Victoria was below it. Furthermore, the unemployment rates show mixed performance between the industrial and resource-abundant states after the price boom as well.

To sum up, the Australian labour market response to the external price shocks did not follow the predictions of conventional theory, at least systematically. We find very little evidence of structural change and industrial response during these price shocks, suggesting that long run economic fundamentals were swamping them. In addition, we find very little evidence that labour markets were responsive to these price shocks: labour migration during commodity price booms and busts was modest and inconsistent.

4. Australian Distributional Response to Terms of Trade Shocks

How did these price shocks influence Australian income distribution?

Distribution Responses since 1921

Constructing a time series for the complete Australian income distribution from Federation onwards is impossible due to the paucity of reliable data going back that far. However, some of the earlier research on long-term trends suggests that while there were short-run fluctuations in earnings dispersion between 1914 and 1980, they were not very large nor consistently related to commodity export price experience (Norris, 1977: p. 484; Maddock *et al.* 1984: p. 19). Thus, any short-run impact of external price shocks on the earnings distribution must have been brief and very modest. This result would hardly be surprising if Australia's export sectors had roughly the same labour and skill intensity as

the average of the rest of the economy. Under those circumstances, changes in wage inequality would be manifested only by regional differences in average annual labour earnings between those states specialising in resource-intensive exports and the others. Thus, a weak connection between earnings distribution and export commodity price shocks might have been expected. Property income and top shares in total income are, however, another matter entirely.

Based on Atkinson and Leigh's (2007) evidence, Figure 8 plots income shares of the top 1 percent, 0.05 percent and 0.01 percent of the richest Australians since 1921. The most notable feature there is the long run 20th century decline in this inequality measure, an event shared by almost all industrial countries (Atkinson and Piketty 2008; see also Gordon and Dew-Becker 2008). The second notable feature of Figure 8 is the rise in inequality between the 1970s and 1990s, again a feature shared by most other industrial economies. There have been, however, two distinct departures from those long-run trends in Australia: the Korean War commodity price boom and bust, and the recent mining-led boom, where inequality kept rising after the 1990s, while it levelled out elsewhere. It seems quite clear that commodity price booms have driven up Australian income shares at the top, and that the subsequent busts have erased their big gains, at least based on two of the three commodity price episodes. Unfortunately, the Atkinson and Leigh data only reach back to 1921. While we do see a sharp decline in the top shares in the late 1920s, we cannot be sure that the high shares in the early 1920s were, in fact, higher than what preceded it.

Distribution Responses before 1921

We can, however, fill in the pre-1921 distribution blanks with a useful proxy. Suppose trends in land rents are a good proxy for income at the top – at least for Australia before the 1930s when mining and manufacturing activities were relatively modest. Under these conditions, the ratio of land rents to wages (r/w) ought to be a good index of pre-1921 trends in the relative incomes of the rich at the top. What, then, ought to be the connection between the terms of trade and the rental-wage ratio? The relevant theory can be found in the work done in the 1970s by Max Corden and Fred Gruen (1970), Bob Gregory (1976), and Ronald Jones (1979). The models are simple, but they isolate what should be important. An increase in the price of the land-intensive export commodity (P_X) shifts its isoprice curve outwards, land rents rise, and labour is pulled out of labour-intensive manufacturing to work in the export sector. The rental-wage ratio and, presumably, the top income shares, rise.

We can be a little more precise. Suppose the commodity export sector uses mobile labour, earning the wage w as before, and sector-specific land (R), earning the rent r as before. Suppose further that the manufacturing sector uses mobile labour and sector-specific capital (K), the latter earning a profit rate i . Now, introduce a commodity price shock to the economy by raising its terms of trade, P_X/P_M . It must follow that

$$r^* > P_X^* > w^* > P_M^* > i^*,$$

where Z^* refers to the rate of change in Z . The inequality states that changes in the returns to the sector-specific factors (land and capital) are much more pronounced than the return to the mobile factor (labour), a formal result that makes good intuitive sense. After all, while a mobile factor can emigrate from a sector absorbing a bad price shock,

an immobile sector-specific factor (like arable land, mineral resources or industrial capital) cannot. Furthermore, the rental-wage ratio responds as

$$(r^* - w^*) = \Delta (P_x^* - P_M^*)$$

where then size of $\Delta > 1$ depends, among other things, on the relative size of the commodity export sector. When it was big in the late 19th and early 20th century, Δ was also big; when it is small a century later in the current boom, Δ is also small.

So much for theory. What about fact? The prices of commodity exports underwent great volatility but generally boomed up to 1914, and so did the terms of trade of those countries which specialized in those products, including Australia (Williamson 2008). Furthermore, the rental-wage ratio was highly correlated with those terms of trade movements. Indeed, when the determinants of r/w are estimated in a 19-country sample 1870-1940 using country fixed effects, the coefficient (Δ) on P_x/P_M is +1.78 for the English-speaking European overseas countries (significant at 5%: Williamson 2002: Table 5). If changes in the rental-wage ratio are a good proxy for changes in the top income share pre-1921, then the data in Table 7 imply the following: the top shares did rise to peaks in the mid 1920s from a low in 1920, but the top shares were probably even bigger during the war years when the terms of trade was also higher.

There is one final complication to consider. Is it changes in industrial (and service sector) profits (iK) or agricultural or mining rents (rR) that are likely to dominate changes in the top shares? The answer depends, of course, on the structure of the economy. Where the commodity export sector is a big share in GDP and manufacturing (and modern services) is small, rR/iK will also be big, and so changes rR will dominate changes in the top shares. We think this was likely before the 1930s when the primary sector was big.

Symmetrically, where rR/iK is small, changes in rR will have a smaller impact on changes in the top shares. This has certainly been true for the early 21st century, as Australia has become a post-industrial society. We also think it was true of the 1940s and 1950s when the industrial sector was at its peak.

Table 7: Terms of Trade, Rent-Wage Ratio and Top Income Shares, 1914-1925

Year	Terms of Trade	Rent-Wage Ratio	Top 1%	Top 0.5%	Top 0.1%
1914	151.8	151.0			
1915	147.1	153.5			
1916	141.3	140.8			
1917	129.1	140.3			
1918	110.8	132.4			
1919	102.7	144.1			
1920	100.0	100.0			
1921	100.2	101.4	11.63	8.55	3.97
1922	135.1	110.0	10.68	7.91	3.57
1923	176.6	111.9	11.76	9.08	3.98
1924	199.1	122.3	11.67	8.84	4.25
1925	154.2	123.7	11.31	8.58	3.99

Source: Terms of trade from the Appendix; rent-wage ratio from the data underlying Williamson (2002); and top shares from Atkinson and Leigh (2007).

Unfortunately, we do not have the relevant data which could exactly track rR/iK over time. However, we can certainly measure the relative importance of the primary sector, the manufacturing sector, and the service sector. Such evidence can at least serve as an indirect test of our conjectures about the evolution of rR/iK across the 20th century. In 1925, the manufacturing sector was only half the size of the primary sector⁸ (Vamplow 1987: 133), while by 1956 manufacturing's share in GDP had increased to 28 percent and the primary sector had fallen to 18.2 percent (Maddock and McLean 1987: 19), or one and a half times the size of the primary sector. This structural transformation over just three decades was spectacular. After the 1970s, the primary sector share stabilized at

⁸ The primary sector is defined as the sum of agriculture and mining.

about 10 percent, and the service sector share had reached 41 percent, evidence which certainly supports the view that Australia became a post-industrial society by the late 20th century.⁹

5. Australian Policy Response to Terms of Trade Shocks

How did Australian policy react to these terms of trade shocks? Were higher tariffs used to protect Australian industry during the commodity price booms? Was the additional revenue generated by price booms used for infrastructure investments in the more industrial states? Did the commonwealth government tackle regional imbalance by subsidising slumping states with revenues generated by booming states? If so, were these subsidies and bounties big as a share in total revenue?

The time series in Figure 9 shows that there was a sharp increase in tariffs during and following the great Australian tariff debates in the early 1920s (Coleman and Tyers 2005) when commodity export prices boomed. Lloyd (2008) documents that the 1921 Customs or Greene Tariff increased rates on industries that had grown during World War I: the tariffs met with very little resistance as the proponents of protectionism used defence and national pride in the young manufacturing sector as additional justifications for protection (Anderson 1987). We suspect that it also got votes from the export-booming states by appealing to fairness. Tariffs were raised still further during the years leading up to depression, and after the commodity price bust, following Brigden's (1925) proposition that protection raises real wages, labor's living standards, and the share of the workforce employed in high wage jobs. Brigden's supporters favoured using protection

⁹ Calculated from the RBA Bulletin Statistics (Table G10).

as a redistributive policy instrument over directly taxing land rents – which had been booming from the Great War to the mid 1920s (Table 7) -- as they thought the latter would have been politically infeasible (Anderson 1987).

During the Korean War period, there was one brief but very big increase in average duties between 1951 and 1952 amounting to 11 percentage points (Figure 9). However, Lloyd (2008) argues that this tariff rate increase was because of an increase in imports of dutiable goods relative to free imports and not because of an increase in tariff rates. These increases in imports were paid for by the massive increase in demand for Australian commodity exports. They were also followed by a sharp fall as the boom terminated.

As Australia entered its post-industrial stage of development, the need for protection declined, with or without a commodity price boom. As the service sector became more and more important both in terms of employment and GDP shares, the support for protecting manufacturing jobs to maintain high living standards faded. There was across-the-board cut in tariff rates in 1973 and the trend continued till the current boom (Lloyd 2008).

In summary, the federal government responded to the terms of trade shocks by raising tariffs to prevent deindustrialization and manufacturing unemployment only when politicians thought it mattered. This was certainly the case during the early 1920s when a vibrant manufacturing sector was closely associated with national defence, national pride and fairness. Protectionist policies also served the government well as a redistribution instrument during the depression. The need for such policies diminished when manufacturing underwent its post-war boom and more recently when services became the

dominant sector.

Table 8 confirms that the Australian government enjoyed big revenue gains during export commodity booms. The average growth rate of revenue during the first half of the 1920s was 6.8 percent, a half a percentage point higher than the previous decade (not shown). Payment to the states as a share of total government expenditure was 9 percent. Revenue growth slumped to 4.5 percent during the commodity price bust across the late 1920s.¹⁰ But note that revenues did not *fall* during the bust, suggesting that the federal government's income sources were sufficiently diverse to mute the impact of the commodity price slump. Also, both the shares of payment to the states and subsidies increased during this time, suggesting an effort to smooth the regional impact on the downside of the price cycle. The revenue growth rate during the Korean War almost doubled from 6.9 to 12.3 percent on either side of 1950, showing how unimportant commodity prices were as a determinant of government revenues by mid-century. State transfers also increased, but it appears unlikely that they were driven by a response to the price cycle.

Table 8: Australian Government Finances during the Shocks

Years	Revenue Growth Rate (%)	Payment to States as a share of total expenditure	Subsidies and Bounties as a share of total expenditure
1920 – 2007	8.0	16.8	1.7
1920 – 25	6.8	9.0	0.2
1925 – 30	4.5	11.9	0.7
1945 – 50	6.9	13.2	6.0
1950 – 55	12.3	18.9	3.0
2000 – 07	6.6	25.1	2.7

Source: 1920 – 25, 1925 – 32, 1945 – 53 are calculated using Vamplew (1987: pp. 252 and 258). The other figures are from the RBA Statistical Bulletin except the 2000-07 figures which are from the ABS cat no. 55120 Table 130.

¹⁰ It slumped even more, of course, during the Great Depression.

The revenue increase during the recent boom was 6.6 percent, only two thirds of the growth experienced during the Korean War, but almost equal to the early 1920s. The share of transfer to the states also increased significantly compared to previous episodes. True, this resulted in large part from the introduction of the GST (Goods and Services Tax) by the Howard Government in July 2000, phasing out several state and territory taxes, stamp duties and levies with a promise that the commonwealth would return a proportion of that revenue to the states through the Council of Australian Governments (COAG) mechanism. Thus, the big state redistributive share may not be the result of a conscious redistribution policy driven by commodity export price shocks, but it is certainly consistent with it.

Table 9 reports the growth rate of government gross capital formation during the terms of trade shocks. During the upside of the 1920s price shock, government investment grew at an average rate of 4.4 percent, which was less than revenue growth, suggesting an expenditure smoothing policy. Yet, government investment in infrastructure projects such as posts and telegraph, roads, railways, and educational bricks and mortar collapsed during the slump in the late 1920s. Indeed, when revenue growth fell from 6.8 to 4.5 percent per annum, government investment growth became negative. This hardly can be viewed as a stabilization policy, but rather the contrary. Thus, there is very little evidence that the federation government used investment as an expenditure smoothing device during the price and revenue cycle in the 1920s. The Korean War episode generated a similar policy response. The overall growth in government investment between 1945 and 1950 was a spectacular 22.3 percent per annum, more than six times that of the 1920s boom. Posts and telegraph, roads, and railways all experienced

very rapid growth but the growth of government investment in housing and education were unmatched in Australian modern history.

As with the downside in the late 1920s, after the 1950 peak, and with the

Table 9: Growth Rate of Government Gross Capital Formation

Years	Aggregate	Posts and Telegraph	Roads	Railways	Housing	Education
1920 – 25	4.4	30.4	13.9	6.2	-11.9	8.3
1925 – 30	-1.5	-4.8	4.8	-1.0	-9.5	-5.0
1945 – 50	22.3	21.6	13.8	10.3	40.6	28.7
1950 – 55	12.7	10.2	13.9	11.6	8.7	19.9
2000 – 07	-2.3	--	--	--	--	--

Source: 1920 – 25, 1925 – 32, 1945 – 53 are calculated using Barnard and Butlin (1981). The 2000-07 aggregate figure is from the ABS cat no. 5206 Table 2.

commodity price bust, government investment growth fell by half, although the recorded 12.7 percent per annum was still a very big number.

In contrast, the recent commodity price boom coincides with a drop in aggregate government investment. This break with the past can be explained, of course, by an ideological shift in the role of government, not by some change in views regarding how to smooth expenditures over commodity price cycles. Perhaps the government response to the ongoing collapse of base metal prices will reveal more about the historical persistence of Australian policy response to these external price shocks.

6. Concluding Remarks

This paper has focused on Australian terms of trade history since Federation in

1901. It identifies two major price shock episodes before the recent mining-led episode, and assesses their relative magnitude, their de-industrialization and distributional impact, factor market responses and policy behaviour. In doing so, we are able to learn what external price shocks did to resource allocation, development and distribution in the Australian 20th century, and thus to understand more about what it might do at the start of the Australian 21st century.

In spite of great commodity price volatility that matched most of the primary-product exporting Third World, these price shocks never caused the same great volatility in the Australia economy either in aggregates like GDP or unemployment, or in sectoral and regional performance. Why? Was it because factor markets were better able to respond to external shocks? Apparently not. Was it because the Australian government had more stable revenues so as to pursue long run infrastructure investment without interruption, that is, to stabilize? Yes and no. Yes, revenues came from fairly diverse sources so that commodity price volatility did not produce as great revenue volatility. No, since the federal government made little effort to use countercyclical investment policy. Was it because Australia was better able to diversify and thus to mute the impact of the external price shocks? We think it was (is) diversification that made (makes) the difference – a big and growing industrial sector before about 1970, and a big and growing service sector after about 1970. More efficient factor markets and better institutions didn't seem to matter much at all.

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Data Appendix

P_X : Export Price Index. *Source*: 1890 – 1949 is from Bambrick (1973). Bambrick publishes export price index in Table 1 with base average of three years ending June 1939 = 100; 1949/50 – 1996/97 is from RBA Historical Statistics (annual data - financial year averages) Table 5.6a, weblink (<http://www.rba.gov.au/Statistics/OP8ExcelFiles/5-6a&b.xls>), base year 1989/90 = 100; 1996/97 – 2007 from RBA Historical Statistics (quarterly data converted to annual, financial year averages) Table G04, weblink (<http://www.rba.gov.au/Statistics/Bulletin/G04hist.xls>), chain value index, series ends March, 2008. All series are adjusted to the base year 1989/90 = 100.

P_{XW} : Export Price Index of Wool. *Source*: 1901 – 1929 is from Bambrick (1970), p. 137, Table V/2, we use the index for pastoral produce as a proxy; 1930 – 1935 is from Vamplew (1987), pp. 215-216 and pp. 82-83. We use weighted average (using production of greasy wool as weights) of wholesale wool price index in Victoria and NSW as a proxy; 1936 – 1948 is from Bambrick (1970), Table V/7; 1949 – 1990 is from RBA historical statistics, Table 1.12a: Export Price Index. For 1975 to 1990 'textile and fibres export price index' is used as a proxy. 1991 – 2007 is from the ABS, cat no. 6457.0 - International Trade Price Indexes, Australia, Table 18: Export Price Index by Selected AHECC Section, Index Numbers

(webpage:

[http://www.ausstats.abs.gov.au/ausstats/abs@archive.nsf/0/FC0DAFFFBB7BB914CA2574890016079B/\\$File/6457010.xls](http://www.ausstats.abs.gov.au/ausstats/abs@archive.nsf/0/FC0DAFFFBB7BB914CA2574890016079B/$File/6457010.xls))

P_{XM} : Export Price Index of Mining. *Source*: a) 1861 – 1939 is proxied by Mining Price Index in Australia, Vamplew (1987), Table PC 61-70, p. 217; 1940 is from Bambrick (1970), Table V/7. Bambrick reports separate index for Metal (which includes silver, copper, tin, zinc, lead) and Gold. These indices are averaged using metal and gold production as weights from Vamplew (1987), Tables: ME1-6 & ME7-12, pp. 88-89; 1941 – 1948 is from Vamplew (1987), Table PC 61-70, p. 217. The proxy used is the price index of Mining industry; 1949 – 1974 is from RBA Historical Statistics, Table 1.12a. The export price index of metals and coal is used as a proxy for Mining; 1975 – 2007 is from the ABS (cat no. 6457.0 International Trade Price Indexes, Australia, Table 19. Export Price Index by Selected ANZSIC Industry of Origin Division & Subdivision, Index Numbers). Financial year averages are calculated. All indices are converted to the base 1989/90 = 100, financial year average.

P_{XA} : Export Price Index of Agriculture. *Source*: 1861 – 1900 is proxied by Agriculture Price Index in Australia, Vamplew (1987), Table PC 61-70, p. 217; 1901 – 1928 is from Bambrick (1970), Table V/2; 1929 – 1939 is from Vamplew (1987), Table PC 61-70, p. 217. The proxy used is the price index of Agriculture; 1940 – 1948 is from Bambrick (1970), Table V/7, proxied by the export price index of wheat; 1949 – 1978 is from RBA Historical Statistics, Table 1.12a. The export price index of cereals is used as a proxy for Agriculture; 1979 – 2007 is from the ABS (cat no. 6457.0 International Trade Price Indexes, Australia, Table 19. Export Price Index by Selected ANZSIC Industry of Origin Division & Subdivision,

Index Numbers). Financial year averages are calculated and the export price index of agriculture, forestry, and fishing is used as a proxy. All indices are converted to the base 1989/90 = 100, financial year average.

P_M : Import Price Index. *Source:* 1890 – 1949 is from Bambrick (1973). Bambrick publishes import price index in Table 1 with base average of three years ending June 1939 = 100; 1949/50 – 1996/97 from RBA Historical Statistics (annual data - financial year averages) Table 5.6a, weblink (<http://www.rba.gov.au/Statistics/OP8ExcelFiles/5-6a&b.xls>), base year 1989/90 = 100; 1996/97 – 2007 from RBA Historical Statistics (quarterly data converted to annual, financial year averages) Table G04, weblink (<http://www.rba.gov.au/Statistics/Bulletin/G04hist.xls>), chain value index, series ends March, 2008. All series are adjusted to the base year 1989/90 = 100.

P_Y : GDP Deflator. *Source:* 1901 – 1949 is from Butlin (1977). This series is with 1967 = 100 as the base year; 1950 – 1996 is from RBA Historical Statistics (financial year averages) Table 5.6a: Implicit Price Deflators for Expenditure on Gross Domestic Product, column 'Gross Domestic Product GDP (E)', weblink (<http://www.rba.gov.au/Statistics/OP8ExcelFiles/5-6a&b.xls>). This series is with 1990 = 100 as the base year; 1997 – 2007 is from RBA Historical Statistics (quarterly data) Table: G04 OTHER PRICE INDICATORS, column Gross Domestic Product chain price indices (2006 = 100 as the base year), converted into financial year averages (ie. average of Sep t-1, Dec t-1, Mar t, Jun t), weblink: (<http://www.rba.gov.au/Statistics/Bulletin/G04hist.xls>). We make adjustments so that the entire series is with 1990 = 100 as the base year.

RealGDP at 1990 constant prices. *Source:* 1901 – 1949 is from Butlin (1977). This is evaluated at 1967 = 100 constant price; 1950 – 1996 is from RBA Historical Statistics (financial year averages) Table 5.2a: Expenditure on Gross Domestic Product at Constant Prices, column 'Gross Domestic Product GDP(E)', weblink (<http://www.rba.gov.au/Statistics/OP8ExcelFiles/5-2a&b.xls>). This is evaluated at 1990 constant price; 1997 – 2007 is from RBA Historical Statistics (quarterly data) Table: G11 GROSS DOMESTIC PRODUCT - EXPENDITURE COMPONENTS, column Gross Domestic Product chain volume measure (measured at 2006 prices), converted into financial year averages (ie. average of Sep t-1, Dec t-1, Mar t, Jun t), weblink: (<http://www.rba.gov.au/Statistics/Bulletin/G11hist.xls>). We make adjustments so that the entire series is measured in 1990 constant prices.

SCHGDP: Structural Change in GDP. *Source:* Defined as $S_t = S_i w_i |g_{i,t} - g_t|$, where w_i are the Value added share weights, g_i and g are one year growth rates of individual industrial sectors and the GDP respectively. This index ranges between zero (when all sectors grow at the same rate as the GDP and hence there is no structural change) and one. Calculated on 13 sectors (pastoral, agriculture, mining, dairying forestry fisheries, manufacturing, construction, private water transport, public business undertakings, government services, finance, distribution, other services, house rent) for the period 1900-1939 using Vamplew (1987), p. 133 data. Index for the period 1949 to 1960 is constructed by using Haig (1966). This is calculated on 8 sectors (Primary industry, mining and quarrying, manufacturing, building and construction, gas water and electricity, trade and transport, finance and property, other industries). Index for the period 1963 to 1974 is constructed by using p. 199 of Norton, W. and P. Kennedy. (1985). This is

calculated on 10 sectors (agriculture, mining, manufacturing, construction, gas water and electricity, wholesale and retail trade, transport, finance, public administration and entertainment, ownership of dwellings). 1975 to 1995 is from RBA Historical Statistics, Table 5-10. This is calculated on 18 sectors (agriculture, mining, manufacturing, construction, electricity gas and water, wholesale trade, retail trade, accommodation, transport and storage, communication, finance and insurance, property business services, government administration, education, health and community services, cultural recreational services, personal and other services, ownership of dwellings). Finally, 1996 to 2007 is from ABS data (cat no. 5204.0) - Australian System of National Accounts, Table 9. Industry Gross Value Added: Chain Volume Measure in \$m(a). This is calculated on 18 sectors (agriculture forestry and fishing, mining, manufacturing, construction, electricity gas and water, wholesale trade, retail trade, accommodation cafes and restaurants, transport and storage, communication services, finance and insurance, property and business services, government administration and defence, education, health and community services, cultural recreational services, personal and other services, ownership of dwellings).

SCHEMP: Structural Change in Employment. *Source*: Defined as $S_t = \sum w_i |g_{i,t} - g_t|$, where w_i are the employment share weights, g_i and g are one year growth rates of employment in individual industrial sectors and the economy respectively. This index ranges between zero (when employment in all sectors grow at the same rate as the aggregate and hence there is no structural change) and one. Calculated on 7 sectors (rural, mining, manufacturing, gas electricity and water, building and construction, trade and transport, finance property and others) for the period 1911-1980 using Withers et al. (1985) data. Index for the period 1981 to 1997 is constructed by using RBA Historical Statistics Table 4-10. This is calculated on 6 sectors (agriculture, mining, manufacturing, construction, trade and transport, finance and others). Finally, index for the period 1998 to 2007 is constructed by using ABS data (cat no. 6291.0.55.033) - Labour force, Australia, Detailed, Quarterly, May 2008, Table 04. Quarterly data converted to annual by averaging. This is calculated on 7 sectors (agriculture, mining, manufacturing, gas electricity and water, construction, trade and transport, finance and others).

Average Duty. *Source*: Average duty (customs plus primage, net) - dutiable clearances only, adjusted for revenue duties: from Lloyd (2008).

Figure 1 Comparative Trends in Terms of Trade in 1865-1940: Australia and the United States

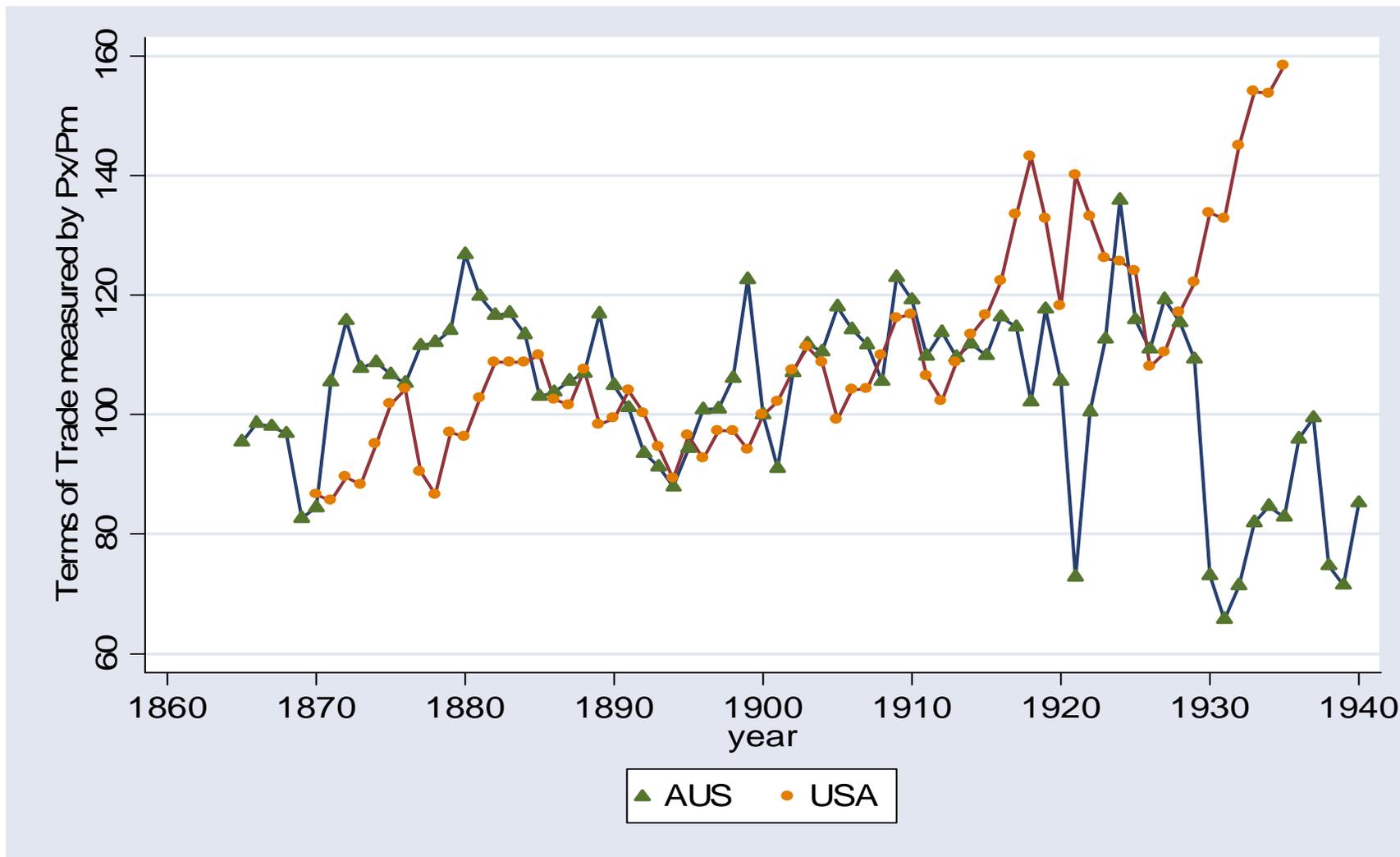


Figure 2 Comparative Trends in Terms of Trade in 1980-2007: Australia and the United States

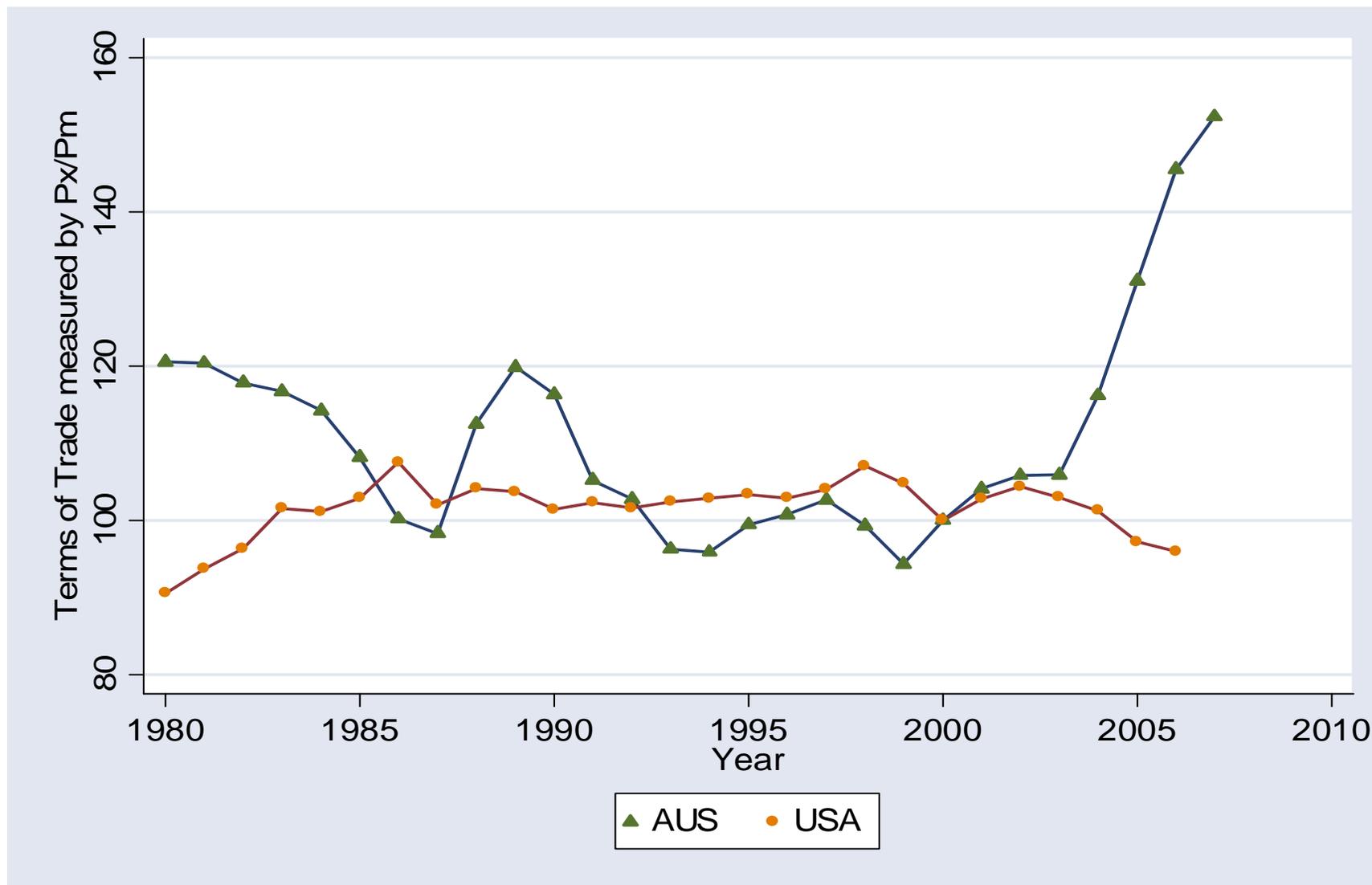


Figure 3 Comparative Trends in Terms of Trade 1865-1940: Australia, Brazil and Indonesia

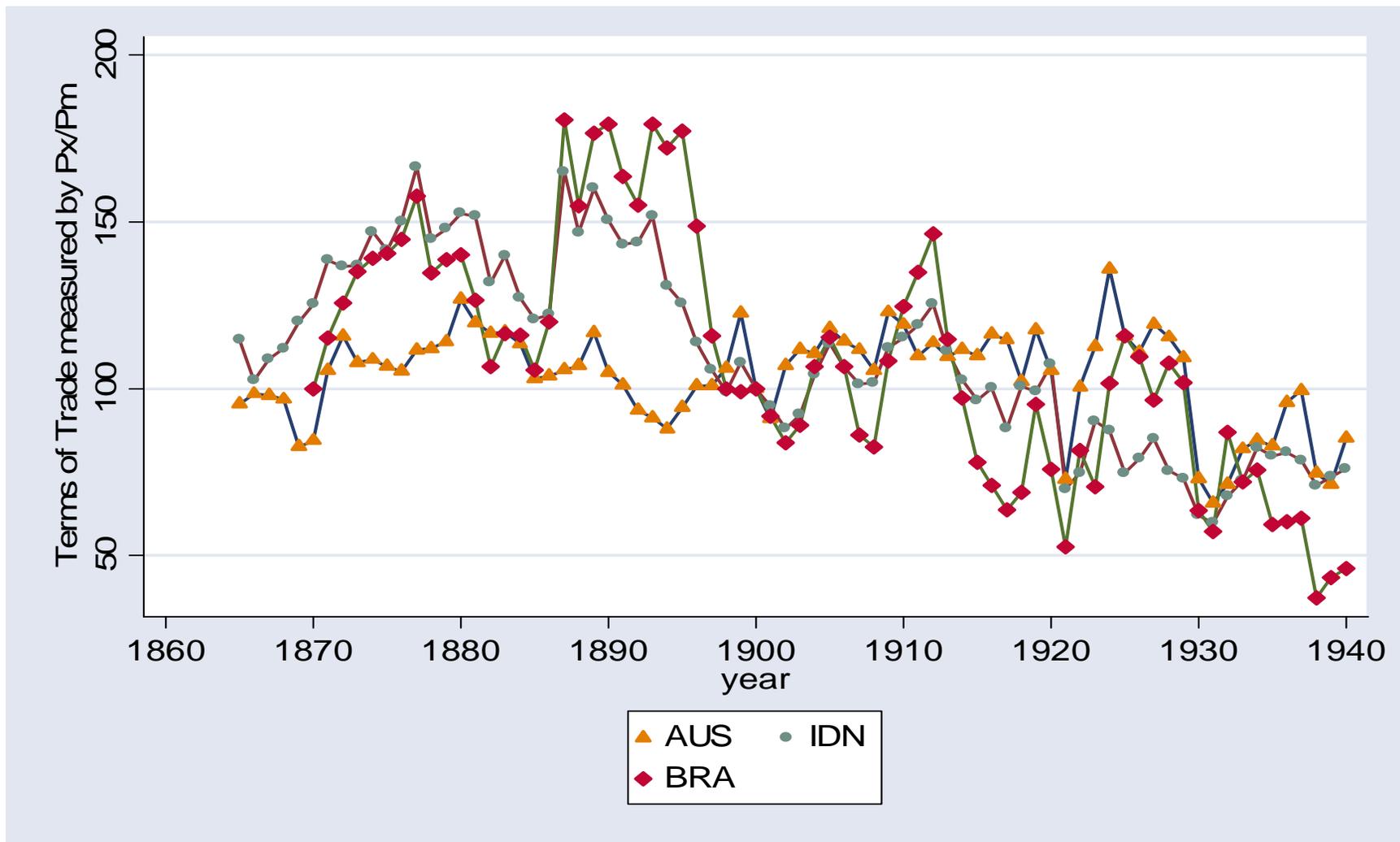


Figure 4 Comparative Trends in Terms of Trade 1980-2007: Australia, Brazil and Indonesia

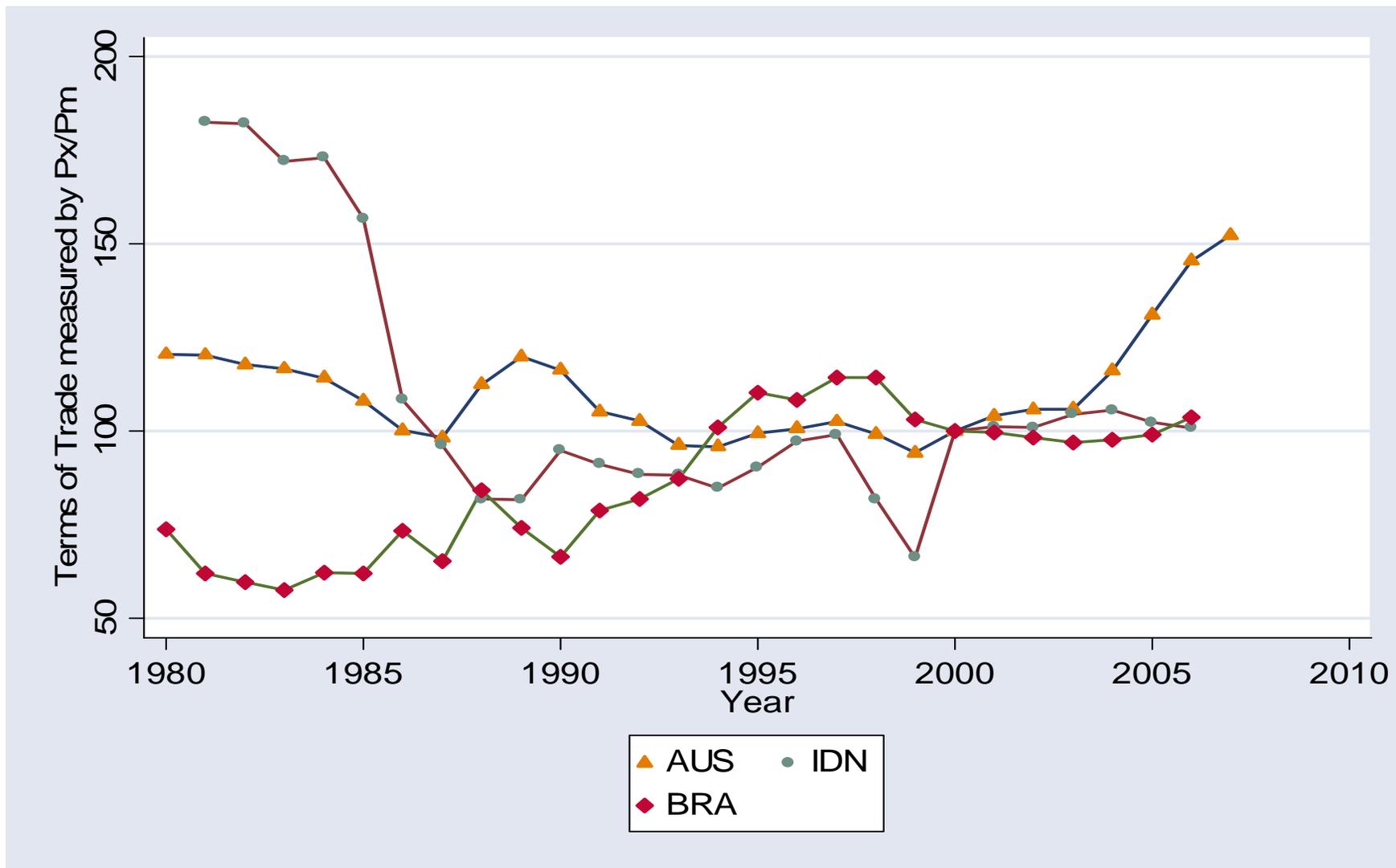


Figure 5 Australian Terms of Trade Time Series 1890 to 2007

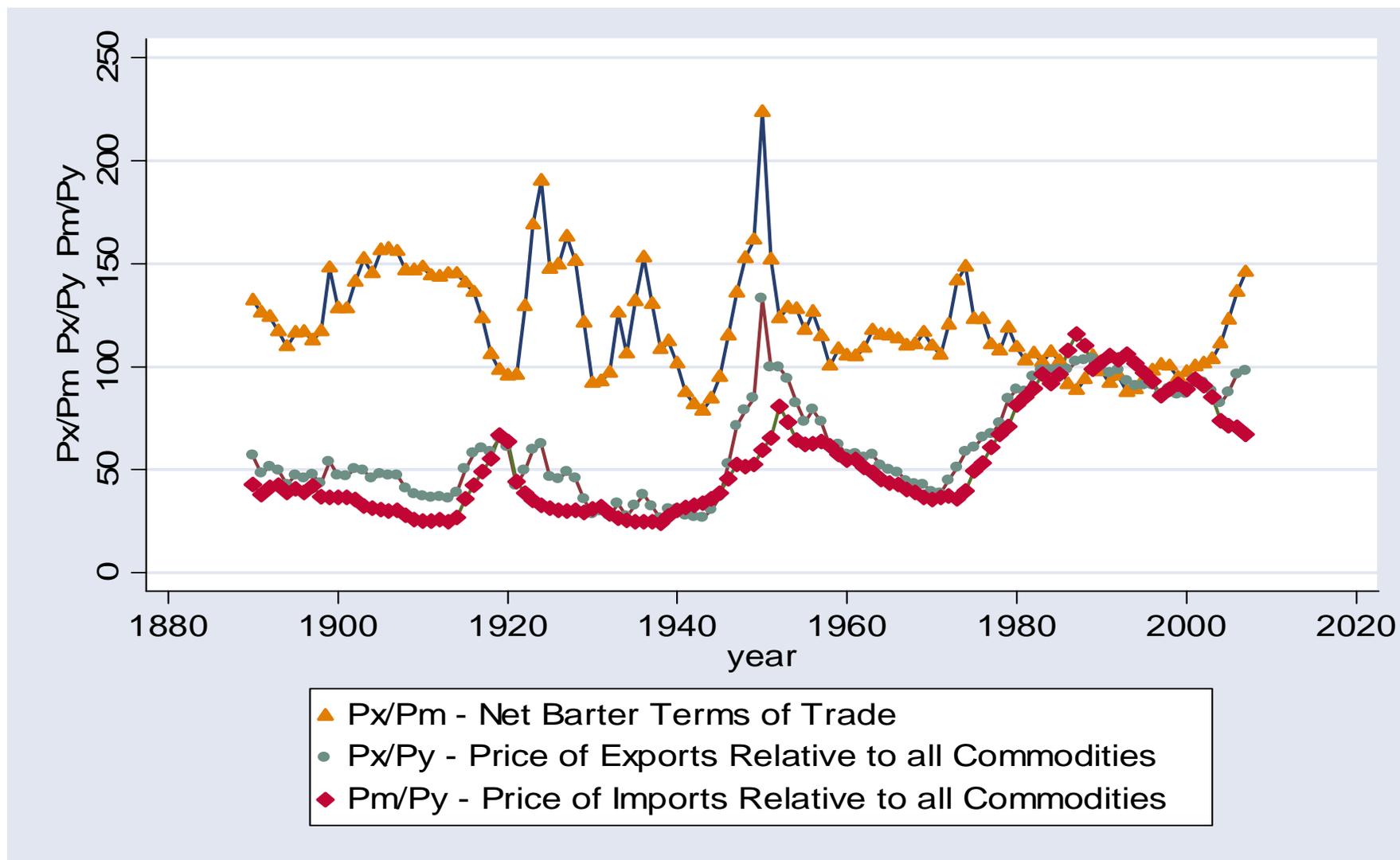


Figure 6 Export Prices of Wool, Mining, and Agriculture Relative to P_{GDP}

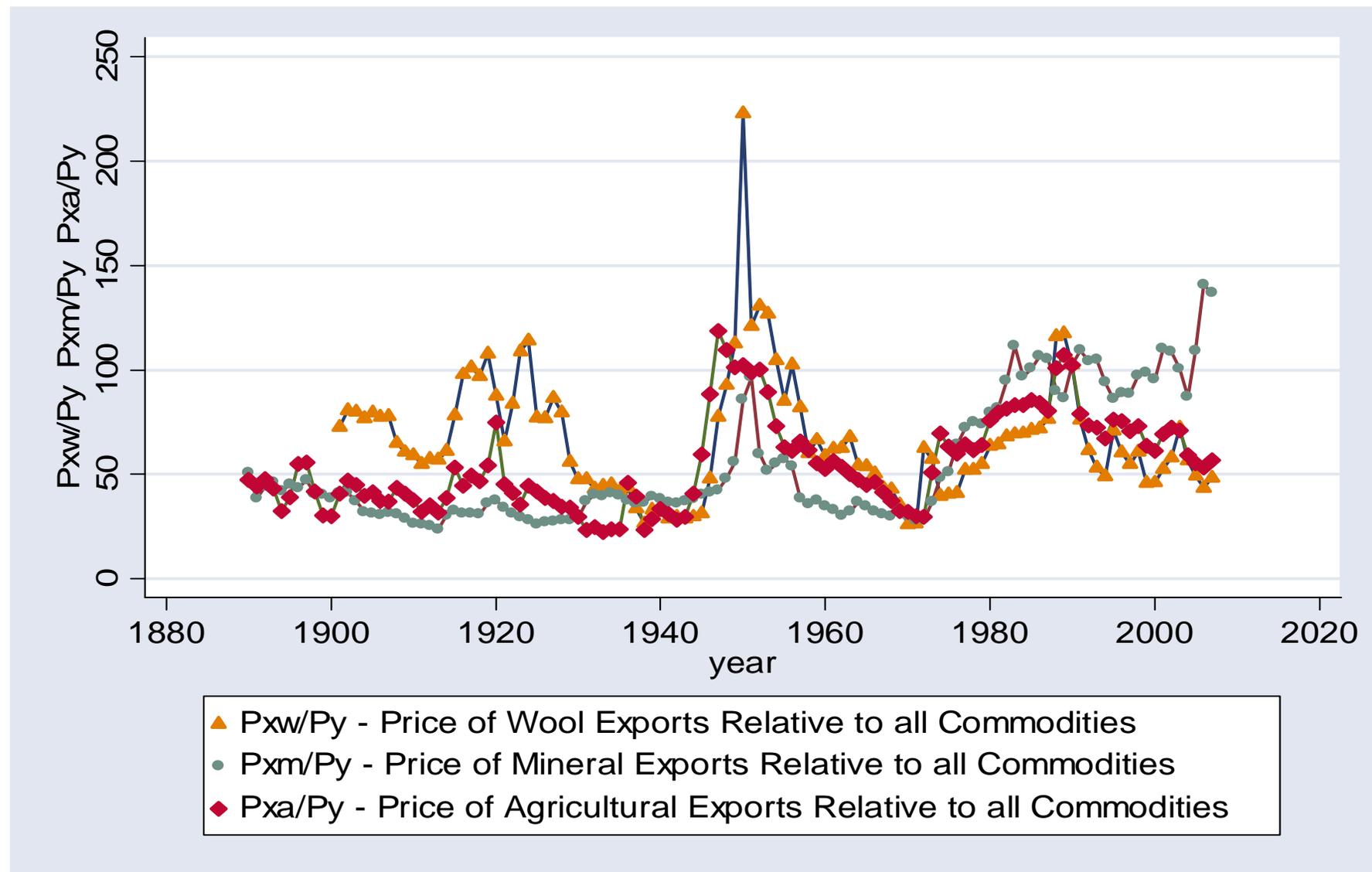


Figure 7: Detrended Share of Manufacturing in GDP and Total Employment in Australia since Federation

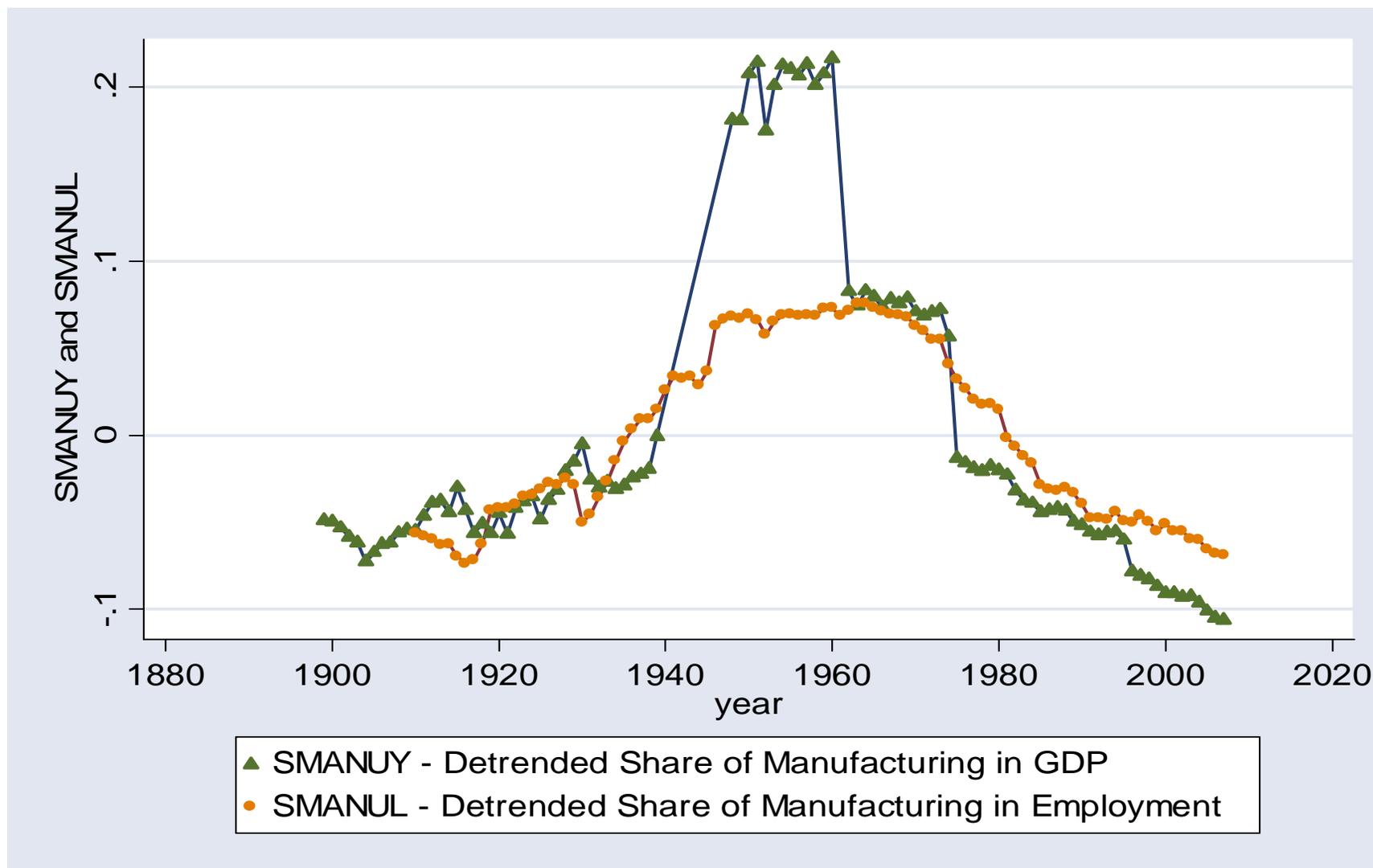
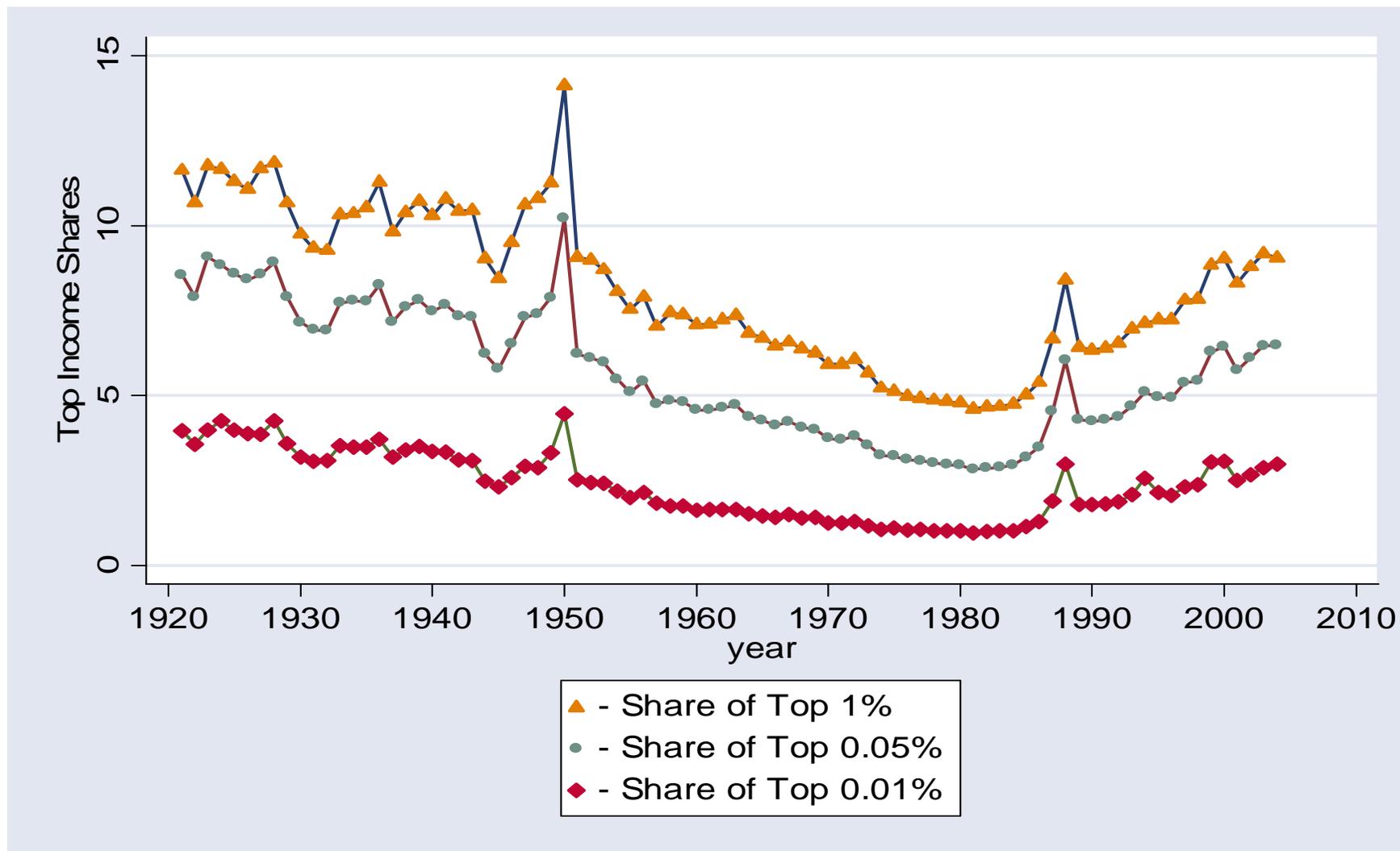
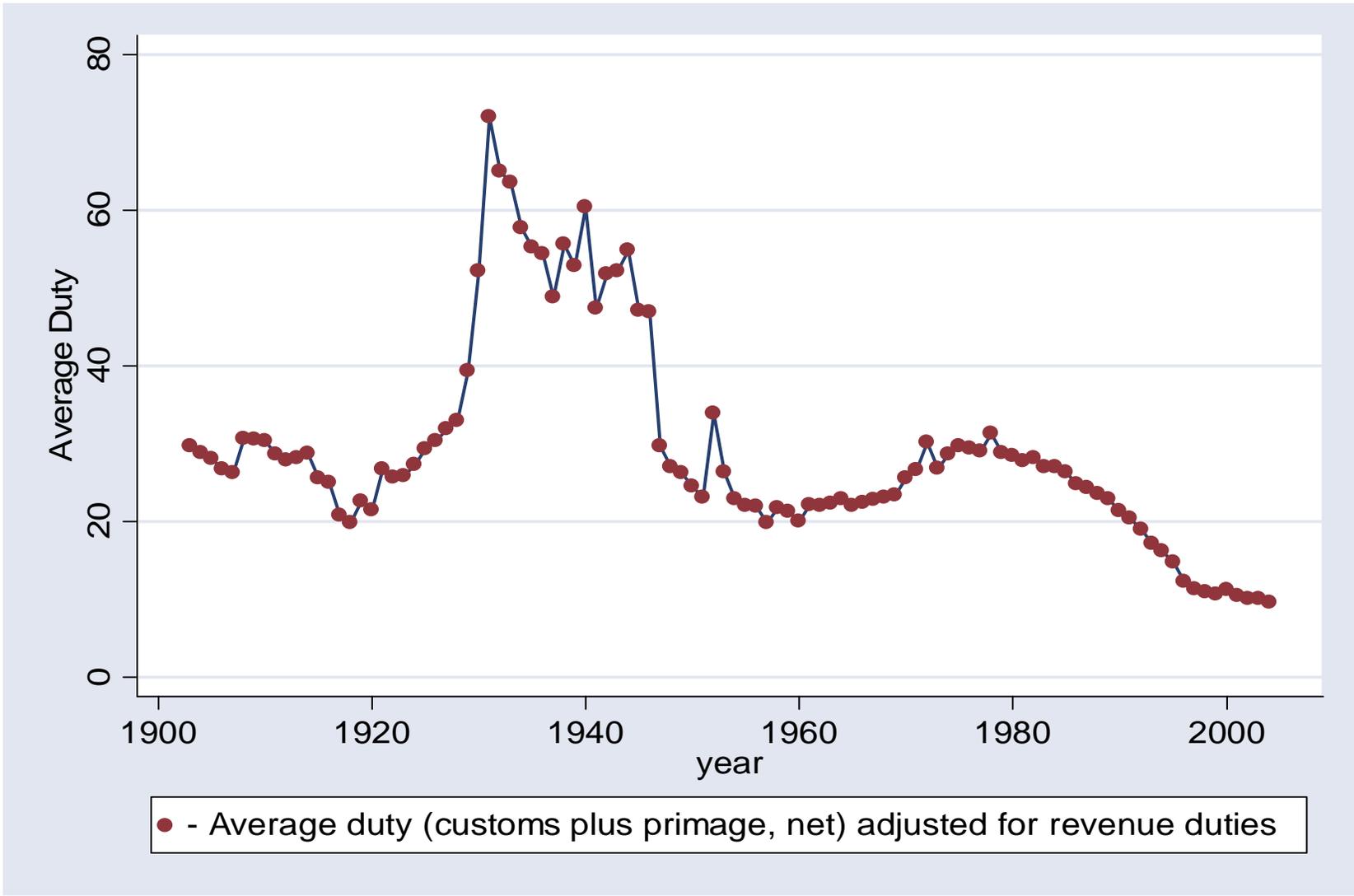


Figure 8: Income Share of the Top 1%, 0.05% and 0.01% since 1921



Source: Atkinson and Leigh (2007).

Figure 9: Average Duty in Australia since Federation



Source: Lloyd (2008).