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Using Data on Money Stocks to Estimate Real Colonial GDP in the Seven Colonies of Australasia: 1861-1991

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Abstract

In this paper I reconstruct the national income aggregates of the seven British colonies of Australasia (Australia and New Zealand) between 1861–1991, using data on the money stocks of each of these economies. Under the assumptions that the income velocity of money of each of the seven colonies equals the velocity of Australia as a whole, and that a common price deflator can be used for all colonies, the aggregate and per–capita incomes for each colony are calculated here for the first time, using the Quantity Theory of money identity.

KEY WORDS: Economic growth; money demand; gross domestic product; Australia and New Zealand.

1. Introduction

This paper uses data on regional money stocks to reconstruct national income aggregates for the seven colonies[0] of Australia[1] and New Zealand for the period 1861–1991. These historical estimates of aggregate colonial income are the first to be constructed on a consistent basis for all seven colonies over this 131–year period. In addition, this data will be used later (in Cashin 1993a) to analyse the process of economic growth and convergence exhibited by these economies during this period.

For contemporary economists it is indeed fortunate that British regulations stated that all banks of issue in the colonies of Australasia were required to provide returns to the British Treasury on a quarterly basis, following the passage of the Colonial Bank Regulations of 1840 (Butlin 1953). Such requirements were continued by the colonial governments of Australasia upon the granting to them of independent government in the late 1850s[2], and in turn by the Commonwealth

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[0] In this and a later paper (Cashin 1993a), the terms 'colony' and 'state' will be used interchangeably to describe the seven regional economies of Australia and New Zealand, although the latter is not a state of Australia.

[1] In this paper and in Cashin (1993a) I use the term 'Australia' in its modern sense, although, as will be described below, the act of confederation did not occur until 1901. Especially in the 19th century, contemporary commentators used the term 'Australasia' to embrace the independently–governed colonies on the continent of Australia and the adjacent islands of Tasmania and New Zealand (see, for example, Coghlan 1904). Modern usage of the term covers these regions as well as the islands of the South–West Pacific (especially Fiji, Tahiti, The Cook Islands, Western Samoa and Tonga).

[2] Dates for the granting of 'responsible government' (essentially self–government with a freely–elected legislature) were: NSW and VIC, November 1855; NZ, May 1856; SA and TAS, October 1856; QLD, December 1857; WA, 1890. After the granting of self–government, responsibility for most Australasian monetary affairs devolved to the individual colonial governments, although Britain continued to be responsible for coinage. Note that the British Treasury continued to administer banking regulations in WA until 1890.

Government of Australia after 1901. The result is a very long time series (from 1841 to 1991) of consistently–defined data on bank note issue, bank assets (including deposits), bank liabilities, capital, reserves, dividends paid and interest rates.

The bulk of this data has been gathered in four seminal volumes, which cover the period 1788–1970: Butlin's (1953) *Foundations of the Australian Monetary System, 1788–1851*, Butlin, Hall and White's (1971) *Australian Banking and Monetary Statistics, 1817–1945*, White's (1973) *Australian Banking and Monetary Statistics, 1945–1970* and Butlin's (1986) *The Australian Monetary System, 1851–1914*. An equivalent body of work does not, unfortunately, exist for New Zealand, but has been partially rectified by recent work of Sheppard, Guerin and Lee (1990) *NZ Monetary Aggregates, 1862–1982*.

Both Doblin (1951) and Friedman (1961) advocated the use of data on monetary aggregates as a means to construct national income estimates when other data are too meagre. The advantage of such data is that it generally becomes available in the early stages of an economy's development, as banks (and particularly banks of issue during periods of free–banking) are likely to be among the earliest private institutions subject to public supervision in any given economy. Both the meagreness of alternative data sources on national aggregates and the early availability of monetary and banking data are attributes common to the seven economies of Australasia. This data on colonial monetary aggregates will be used here to provide estimates of the nominal income in each economy, which will then be deflated and divided by each economy's population to give real per–capita income estimates for the seven economies.

Section 2 sets out the historical background of the seven colonies of Australasia, and Section 3 comments on the nature of the gaps in the existing historical record of the aggregate incomes of the regional economies of Australasia.

Section 4 describes the monetary–based technique for deriving estimates of nominal national incomes from monetary data, and Section 5 presents the results of such calculations for the Australasian colonies. Section 6 points out the *caveats* associated with use of the technique, and Section 7 provides some concluding comments.

2. Historical Background on the Seven Colonies of Australasia

The seven Australasian colonies which Britain established on the Australian continent in the 18th and 19th centuries (New South Wales (NSW) 1788[3], Van Diemen's Land (later Tasmania (TAS)) 1804, Western Australia (WA) 1829, South Australia (SA) 1836, New Zealand (NZ) 1841, Victoria (VIC) 1851, and Queensland (QLD) 1859) were politically independent (of one another) and largely self–governing (since the 1850s) colonies. The older Australasian colonies (NSW and TAS) were initially established to serve as dumping grounds for the surplus of British criminals (given the loss in the 1770s of Britain's American colonies), and as a useful bulwark against French incursion into the South Pacific. Only later did their potential for prosperity become apparent to both the British and those born in the colonies.

A growing sense of nationhood and shared cultural, political and commercial links promoted the establishment of a series of Constitutional Conventions in the 1890s (echoing those of the United States of America over a century earlier), which debated the terms and conditions under which the seven former colonies would

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[3] In 1788 the boundaries of NSW embraced the entire Australian continent and New Zealand, although the exact dimensions of the island continent were not to be ascertained until 1804. Accordingly, the colonies which followed NSW were created from territory previously contained in NSW, until finally with the establishment of Queensland in 1859, the colonies (later states) attained the dimensions which they have today.

federate to form one nation. In the end, six of the seven agreed to join. Due to its much closer trade links with Britain than the six other colonies (which in the 1890s generally engaged in a large proportion of their trade with one another)[4], its slightly higher real gross domestic product (GDP) per capita (see Figure 1[5]), and a desire to retain its political and financial autonomy, NZ declined to join the other six in creating the Commonwealth of Australia, which was formed on 1 January 1901.

The reasoning behind NZ's failure to join the Commonwealth has been debated most concisely in a series of papers by Wood (1968), Chan (1969) and Fairburn (1970). A key reason for NZ's reluctance to join was that the proposed federation intended to establish a customs union with internal free trade and a common external tariff (with the tariff set at near the level of 'protectionist' VIC, rather than 'free trade' NSW). Given that the bulk of NZ's trade with the Australian colonies was with NSW, it was argued at the time that they had little to gain and potentially much to lose by having to dismantle their own trade barriers against imports from the other ex–colonies. It is interesting to note that the introduction of refrigeration in the mid–1880s, (which enabled meat and other products to be readily transported over long distances), was a technological innovation which (along with other advances in agricultural techniques and a recession in Australia from 1895 to about 1903) raised the real GDP per capita of

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[4] In 1890 NZ shipped only 16.7 per cent of the value of its total exports to the other Australasian colonies, and in 1900 this figure was 14 per cent. Corresponding figures for the other colonies were: NSW 52.8 (1890) and 38.6 (1900); VIC 35.1 and 32.8; SA 40.2 and 49.3; QLD 71.7 and 57.3; TAS 82.5 and 42; and WA 28.4 and 16.4. It is perhaps no coincidence that WA was the last ex–colony to agree to federate. Over the decade of the 1890s, Britain's share of NZ's total exports remained at about 80–83 per cent.

[5] Note that the NZ data depicted here and in Tables 2 and 4 was partly derived from the monetary–based technique described in this paper, while the Australian (national) data is from Butlin (1962), McLean and Pincus (1982) and ABS (1992a).

NZ above that of Australia for much of the 1890s and 1900s, precisely at the height of the Federation debates.

The process of economic growth which transformed these colonies from penal settlements into economies with the highest real per–capita GDP of all nations in the space of 70 years (see Figure 1 and Table 1 of Cashin (1993a)), and continues to sustain relative prosperity to the present day, is certainly one worth understanding and examination. Such an examination has not previously been undertaken on a collective basis for the seven Australasian colonies, principally due to the non–existence of colonial GDP estimates for the period 1861–1979. The long time series of the cross–sectional data (from 1861 to 1991) constructed in this paper will also enable (in Cashin 1993a) a detailed examination of the historical growth patterns across the seven Australasian colonies.

3. Construction of the Data

Data was gathered over the period 1861–1991 for all seven Australasian economies, more specifically the Australian census years of 1861, 1871, 1881, 1891, 1901, 1911, 1921, 1933 (delayed due to the Great Depression), 1947 (delayed due to the Second World War), 1954, 1961, 1971, 1981, 1986 and 1991. The data on nominal GDP at market prices for each of the six Australian economies has been taken from official ABS (1992) estimates for the years 1981, 1986 and 1991. The data on nominal GDP at market prices for NZ has been taken from official Department of Statistics (1957, 1991, 1992) estimates for 1933–1991[6].

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[6] While there are estimates of GDP at factor cost and sometimes at market prices for various colonies and years, due to their disparate and inconsistent nature these have been used in this paper only as a check on the accuracy of the estimates derived from the monetary approach (see Sections 4.3 and 4.4 of this paper and Appendix C of Cashin (1993)).

No official estimates of the nominal incomes of the seven economies exist before 1980 for the Australian colonies, or prior to 1933 for NZ. Neither are there any other consistently–derived calculations of such estimates for each of the colonies, as most economic historians in Australia and New Zealand have been content to focus their analysis on secular trends at the national level of both countries. A key contribution of this paper is to fill in this large gap in the available data on the economic history of the colonial economies, using monetary–based estimates of nominal GDP at market prices. The monetary–based estimates of nominal income have been calculated for each of the six Australian colonies between 1861–1979, and for NZ between 1861–1932 (see Section 4 for details).

One potential drawback in converting the monetary–based nominal income aggregates into real income aggregates is the dearth of useful measures of movements in the price levels of the seven economies. As a result, the national Australian implicit GDP deflator is used here to derive real per–capita GDP from nominal per–capita GDP for the six Australian colonies between 1861–1991, given the absence of a consistent series for state–based deflators or consumer/wholesale price indexes prior to 1948–49 for the capital cities of the Australian states[7]. However, use of the same deflator for each of the six Australian colonies could

[7] Note that an earlier state–based price series (the 'C' series) is available to measure price changes for certain consumer items in capital cities from 1921, but there is no direct line of continuity between this series and the GDP deflator. An even earlier state–based price series (the 'A' series) was compiled to measure price changes in a basket of mainly food products for the six capital cities of the Australian states, and is available from 1901. However, it also suffers from many of the same problems as the earlier 'C' series index. Evidence from these state–based consumer price indeces (CPI) indicates that time–series variation in the movements of prices in the various states of Australia is small, and so the use of a common price deflator for all of the states is reasonable.

induce measurement error in the levels of real per–capita GDP if absolute PPP does not hold across these economies, as noted in Barro and Sala–i–Martin (1992). It should be noted that the GDP deflator is a value–added deflator, while the CPI is a commodity–price index, and similarity across economies in the latter need not be replicated in the former. PPP–adjusted real per–capita GDP figures are used here for NZ (the seventh Australasian economy), with NZ nominal per–capita GDP estimates for all years (1861–1991) deflated by a linked index of consumer prices to derive real per–capita GDP estimates.

4. The Monetary–Based Technique for the Estimation of Nominal National Income

To overcome the dearth of data on colonial 'national' incomes, use will be made of monetary data and a technique first suggested by Doblin (1951) and Friedman (1961). This technique uses the income form of the Quantity Equation:

$$MV = Y = PNy = Py' \tag{1}$$

where M is the quantity of money (however defined), V is the income velocity of the circulation of money, P is the price index implicit in estimating national income at constant prices, N is the number of persons in the population, y' is national income in constant prices, y is per–capita national income in constant prices and Y is nominal national income. Given accurate figures for the monetary aggregate of choice (M), the usefulness of the resulting estimates of nominal income ($Y=Py'$) derived from (1) is contingent on an accurate determination of the annual income supported by a unit of money, (V).

This monetary–based technique is used here to derive estimates of 'national' income (as measured by GDP) from 1861 to 1979 (for selected years) for each of the six Australian ex–colonies which later became states of the Commonwealth of Australia (in 1901) and for the seventh colony of New Zealand (from 1861 to 1932, for selected years)), which became in time an independent nation (Dominion status in 1907). It is proposed to use the Australian (all–colony) income velocity of money (V_a) in (1), and multiply this figure by the money stocks of each colony (M_i, where i=NSW, VIC, QLD, WA, SA, TAS, NZ), to derive estimates of the nominal 'national' income of each colony, ($\hat{Y}_i$). Fortunately, a long time series of value–added–based estimates of Australia's GDP (Y_a) has been made from 1788 (when the first colony was established) until 1939 (see Butlin 1962 and Butlin and Sinclair 1984), with official estimates of Australian GDP being available from 1940 (ABS 1992a).

4.1 Calculation of Colonial GDP Data

I proceed by calculating V_a for Australia over the period 1851–1986, using the Butlin–ABS data on Australian GDP at market prices (Y_a) and Australian data on M3 stocks[8] (M_a: for derivation, see Section 4.2 below). Then the colonial

[8] Australasian colonial monetary aggregates follow the conventional definition: M1 is currency held by the non–bank public plus current (that is, demand) deposits at trading (that is, commercial) banks; M2 is M1 plus fixed (that is, time) deposits at trading banks; M3 is M2 plus deposits at savings banks held by the non–bank public. All three monetary aggregates are net of interbank and government deposits.

M3 aggregates (M_i) are multiplied by V_a to yield estimates of nominal GDP at market prices ($\hat{Y}_i$ in (1)) for each of the i economies[9][10][11]. To yield real GDP figures these nominal values are then deflated by: (for the Australian states) the implicit Australian GDP deflator, taken from Butlin (1962) and Vamplew (1987) for 1861–1985 and ABS (1992a) for 1986–1991 (all with base year of 1910–1911); and (for NZ) by an appropriately–linked price index, which is here basically the price index of McIlraith (1913) for 1861–1911 and the consumer price index of the Department of Statistics (1991, 1992) for 1911–1991 (all with base year of 1910–1911). These real GDP estimates are then divided by the respective population of each colony (see Appendix A of Cashin (1993) for sources) to derive real per–capita colonial GDP at market prices.

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[9] Obviously, estimates of colony income deduced from traditional value–added or factor incomes approaches would be preferable to any constructed from monetary data. However, as explained earlier, these are not available either for the Australian states prior to 1980 (estimates for Australia as a whole are available from 1788–1991), or for NZ on an official basis prior to 1933.

[10] Note that given my use of the monetary–based technique, $\Sigma_i \hat{Y}_i$ (for $i \neq NZ$) will be equal to Australian nominal GDP. This is because I am using national estimates of velocity (derived from national estimates of GDP and national money stocks) and regional money stocks to derive regional income figures, as does Hawke (1975) for NZ. This differs from the manner in which Friedman (1961), Leff (1972), and Rankin (1991) use the technique, which is to insert into (1) either: *ad hoc* estimates of V_i (Leff for Brazil); estimates of the secular and cyclical components of V_i (Friedman for the United States); or econometrically–based estimates of V_i (Rankin for NZ), to generate estimates of $\hat{Y}_i$.

[11] An exception to this process is NZ, where (due to a lack of data on M3 prior to 1877) I use M1 as the measure of its money stock (M_{NZ}), and multiply it by V_a' (the Australian income velocity of M1, where $V_a'=Y_a/M_a'$ and M_a' is the Australian stock of M1) to derive my estimate of $\hat{Y}_{NZ}$.

4.2 Calculation of Colonial Monetary Aggregates

The monetary aggregate used in the calculation of NZ's GDP is M1 (currency holdings and demand deposits), taken from Reserve Bank of NZ (1990) and Sheppard, Guerin and Lee (1990) for 1862–1989, and Reserve Bank of NZ (1992) for 1990–1991. The M1 aggregates are then multiplied by Australian velocity of M1 estimates to yield estimates of NZ's nominal GDP. Note that post–1933 official GDP estimates are used in calculating NZ's real GDP per capita after that date. The post–1933 monetary–based estimates are used only as a gauge of the accuracy of the pre–1933 estimates (see Section 4.4 and Appendix C of Cashin (1993)).

GDP estimates for the Australian colonies are based on calculations of M3 (the sum of currency holdings and bank deposits). Statistics on currency held by the non–bank public are not available for the Australian colonies in the 19th century, but (national) estimates from 1901 onward have been provided by Butlin, Hall and White (1971) and White (1973). Schedvin (1973) and Vamplew (1987) provide figures for total Australian currency held between 1861–1900 by extrapolating back in time, on the basis of population, from the average national holdings in the first few years of the 1900s. To divide up these national estimates of currency held, I assume that per–capita holdings of currency are the same for all colonies, and allocate national holdings of currency on the basis of the respective colony shares in the national population[12].

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[12] While this technique is crude, Schedvin (1973) calculates that while currency comprised about 25 per cent of Australian (all colony) M3 in 1861, by 1891 it was only 8.3 per cent and by 1939 6.2 per cent. The rapid fall in the share of currency (particularly between 1861–1891) is attributed to the rise of branch banking (and hence the replacement of currency by deposits) and the wide acceptance of checks as a form of payment.

The commercial and savings bank deposits (net of government and interbank deposits) for each of the Australian colonies are taken from Butlin, Hall and White (1971) and White (1973) for 1861–1970, then from the *Yearbook* of the Commonwealth of Australia (various issues) for 1970–1991. Note that after 1979 official state GDP estimates are used in calculating each state's real per–capita GDP for 1981, 1986 and 1991. The post–1979 monetary–based estimates are used only as a gauge of the accuracy of the pre–1979 monetary–based estimates of state per–capita GDP. Note that Appendix A of Cashin (1993) contains a description of, and sources for, the data on the seven colonies and for Australia as a whole, while Appendix B of Cashin (1993) sets out the values of the relevant data. Appendix C of Cashin (1993) contains a comparison of my estimates with contemporary estimates of GDP for each of the seven Australasian colonies.

4.3 NZ Estimates of Per–Capita GDP

Given the probability of departures from PPP between Australia and NZ, a separate deflator is used for NZ. It is well known that exchange rates are an imperfect tool with which to compare the purchasing power of various national currencies, given that price levels vary across countries and exchange rates capture, at best, only the prices of traded goods and services[13]. Accordingly, PPP conversion rates ($PPP_{A/NZ}$) are used here to convert nominal GDP measured in

[13] Relative PPP can diverge from the nominal exchange rate due to: transport costs and trade barriers, which ensure that some goods are non–tradeables; and monopolistic practices in goods markets, both of which serve to weaken the link between the prices of similar goods sold in different countries. Further, price levels are lower in relatively poor countries (when expressed in terms of a single currency) because the prices of non–tradeables rise with per–capita income. Hence exchange rate conversion alone is likely to bias downward the measured living standards of relatively poor economies.

NZ currency (NZ$) to its Australian currency (A$) equivalent. PPP conversion rates are notional exchange rates which would equate the values of a given bundle of goods and services as expressed in various national currencies; in other words, all countries' overall price levels for GDP are equal when measured in terms of the same currency (converted using exchange rates). My $PPP_{A/NZ}$ data are derived from Summers and Heston (1991) for 1950–1988, and are then extrapolated forward (to 1991) and backward (to 1929, when NZ and Australia left the Gold Standard) from this period, using changes in the consumer price index (for NZ) and the implicit GDP deflator (for Australia)[14].

4.4 Check of the Robustness of the GDP Estimates

Appendix C of Cashin (1993) reveals that my estimates are generally consistent with previous calculations of colonial aggregate incomes, as my monetary–based estimates of aggregate incomes are usually within 5–10 per cent of official gross state product estimates for the Australian states (available from 1980–1991). A similarly small range of discrepancy exists with regard to my estimates of GDP for the Australian states when compared with calculations of aggregate income by earlier researchers (see key contributions by Coghlan (1900,

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[14] For any two countries i and j, Ahmad (1992) details the extent of discrepancies which exist between actual current (country j prices)–price GDP_i realisations and the corresponding figures estimated by using this technique of extrapolating from a given base year PPP_{ij} (using the relative rate of inflation between i and j) to a new year to obtain current (country j prices)–price GDP_i estimates from current (country i prices)–price GDP_i estimates. Over the period 1970–1985 Ahmad found these differences are generally of an absolute average of about 10 per cent. Whilst there are bound to be errors in my use of this technique here, their direction and magnitude are unknown. Moreover, it should be noted that the appropriate expenditure bundle on which accurate country PPPs should be based is likely to have changed significantly over such a long time period (1929–1991).

1902, 1903, 1904), Butlin and Sinclair (1984), Snooks (1979) and Sinclair (1988))[15]. However, such estimates were often made only for individual colonies and for isolated years during the 1861–1991 period. Hence, while they are a useful check on the validity of my estimates, they cannot be used here for estimation.

As noted above, an important test of the robustness of my monetary–based estimates of GDP is their ability to replicate official GDP figures. Using the estimates of NZ GDP of Lineham (1968) for 1919–1932 and official figures of NZ GDP (1933–1991) as a benchmark, Figure 2 reveals that my monetary–based estimates are again generally within 5–10 per cent of these benchmark figures[16]. This is of some comfort, given that any errors flowing from my use of Australian measures of the income velocity of money in forming the GDP estimates of individual economies are most likely to show up in the NZ estimates.

Another important check of my estimates (particularly those for NZ) is the extent to which they are consistent with other data, such as permanent migration (defined to be of at least one year in duration) between NZ and Australia. Figure 3 and Table 1 reveal that in periods of higher real per–capita GDP (as shown in

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[15] A comparison of my estimates with those of Sinclair (1988) for SA is useful, as Sinclair calculated a long time series of SA's GDP at factor cost from 1861–1900 and 1909–1939. While in the early years of the 1861–1991 period my estimates for SA diverged somewhat from Sinclair (1861: monetary–based figure 63.71 % of Sinclair; and 1871: 73.45 %), they thereafter were within the typical 5–10 per cent band (1881: 88.98 %; 1891 97.34 %; 1911 96.28 %; 1921 93.16 % and 1933: 104.66 %).

[16] Note that from Figure 2 the post–1950 monetary–based estimates of NZ's GDP consistently over–estimate the official NZ estimates. This could be due to a divergence from the traditionally similar pattern (pre–1950) of the income velocity of money (V) experiences of Australia and NZ, or perhaps to errors of the type mentioned by Ahmad (1992). Regarding the former reason, the official money stock (M1) and GDP data for both countries reveals V_{NZ} is consistently less than V_a after 1947 (see Figure 4). It appears that after 1947 some exogenous factor (possibly the relatively–slower pace of financial innovations in NZ) caused NZers to demand more M1 than Australians. In any event, it should be kept in mind that the monetary–based estimates of GDP are used for NZ only during the 1861–1932 period, with official estimates of GDP being used between 1933–1991.

Figure 1) for NZ with respect to Australia (the 1890s through 1910s, 1950s through early 1970s) there is net migration to NZ from Australia. When the opposite holds true (the 1870s, 1880s, 1920s through 1940s, late 1970s through to the present) there is net migration to Australia from NZ. The migration data in Table 1 confirm my finding (depicted in Figure 1) of a fall in NZ's real PPP–adjusted per–capita GDP from the early 1970s onward, when compared with Australia. For the decade of the 1980s this fall coincides with an *annual* net migration rate of 6 persons per 1000 permanently departing from NZ for Australia[17].

5. Estimates of Colonial Real Per–Capita GDP

Data on the monetary–based estimates of the levels of real GDP for each of the seven colonies between 1861–1991 (in 1911 A$) are given in Table 2, and the (mostly ten–year) annualised average growth rates are given in Table 3. As expected, the dominance of NSW and VIC (and NZ after 1947) in colonial GDP stands out, as does the sustained rapid rise in colony GDP of NZ, SA, QLD and WA, while TAS' GDP growth has been relatively slow. Note that as stated earlier, the sum of my real colonial GDP estimates (for the six Australian colonies) in Table 2 equals Butlin's (1962) estimate of Australian (all–colony) GDP for the period 1861–1939, and equals the official estimates ABS (1992a) of Australia's GDP from 1940–1979[18]. Between 1980–1991 I use official ABS (1992) estimates of

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[17] The theory of migration would generally attribute a decision to migrate as being partly based on differences across regions in the present value of expected lifetime incomes, rather than differences in contemporaneous incomes. The migration flows observed above may simply be the result of agents believing differentials in contemporaneous incomes to be a reliable indicator of differentials in lifetime incomes.

[18] This arises because $M_a=\Sigma_i M_i$ and so given that from (1) $\hat{Y}_i=M_i V_a$, then $\Sigma_i \hat{Y}_i=\Sigma_i M_i V_a=M_a V_a=Y_a$, and each of $\hat{Y}_i$ and Y_a are then adjusted by a common

the six Australian state GDPs, which sum to the official estimate of Australian GDP (see ABS 1992a) for those years. Table 3 reveals the rapid mean growth rates of GDP in QLD, NZ and WA, and the standard deviation of the growth rates generally diminishes with the size of the economy under consideration (apart from the stable, low–growth case of TAS).

These results also confirm previous qualitative findings of the 1861–1891 period as being one of common, rapid growth across the colonies, with growth generally stalling (except for NZ and the gold–induced spurts of QLD and WA) in the 1890s. A similar pattern is reflected in the relatively good growth performance of the colonies between 1901–1921, with growth very slow in the Great Depression era covered by the 1921–1933 period. After 1933 growth was generally very rapid for all the remaining periods, with a slight slow–down (especially for NZ) in the 1970s and 1980s.

Tables 4 and 5 provide data on real per–capita colonial GDP between 1861 and 1991 (in 1911 A$) and their associated (mostly ten–year) annualised average growth rates. Here there is some evidence of mean reversion in per–capita GDP levels for the seven colonies (Table 4), as the initially–poor colonies in 1861 (WA and SA) had by 1901 largely 'caught up' to their initially rich counterparts (NSW and VIC). This pattern of convergence has continued into the 20th century, apart from the relatively poor performance of TAS and the rapid falling away of NZ (an initially middle–income colony in 1861 and 1901) in the 1970s and 1980s.

An essentially similar pattern emerges with respect to growth rates in Table 5 as that found in Table 3, with some minor differences. The 1860s were generally a slow– or negative–growth decade for colonial per–capita incomes, given slow growth in real aggregate incomes and extremely large levels of international

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price deflator to obtain estimates of real colonial and national (all–colony) GDP.

migration. The 1890s were also a bad decade for colonial per–capita growth rates, as were the 1911–1921 and 1921–1933 periods. Despite another bout of heavy international migration in the post–Second World War period, the colonies enjoyed relatively good rates of growth in per–capita incomes, with a general slowdown (for NZ, a reversal) of growth rates in the 1970s.

It is important to compare and contrast the high growth rates in real GDP (such as QLD in the 1860s and 1870s, WA in the 1880s and 1890s, NZ in the 1860s, 1870s and the period 1933–1947) with relatively low (or even negative) growth rates in real per–capita GDP for these same colonies and years, due to the influence of inter–colonial and international flows of labour (see Table 6 for rates of growth of colonial population) and capital. The most spectacular example of this is the case of WA in the 1890s, when, chiefly as a result of gold discovery and production, its real GDP grew by 12.66 per cent (Table 3), the colony's population grew by 11.89 per cent (Table 6), and so its real per–capita GDP grew by only 0.77 per cent (Table 5). Apart from NSW and TAS, these relatively uninhibited factor flows resulted in the standard deviation of real per–capita GDP being far less than the standard deviation of real GDP (see Tables 3 and 5). Several key assumptions are made in using the monetary–based technique to derive these pre–1980 state GDP estimates and pre–1933 NZ GDP figures, and these are discussed below.

6. Caveats of the Monetary–Based Technique[19]

In using the monetary–based technique it is assumed that the trend income velocity of money ($V_i=Y_i/M_i$, where Y_i is the true colony aggregate income) for each of the seven colonies equals that of Australia as a whole ($V_a=Y_a/M_a$), for which there are both estimates of nominal income (Y_a: Butlin 1962, McLean and Pincus 1982, and ABS 1992a), and monetary aggregates (M_a: Butlin, Hall and White 1971, White 1973, Schedvin 1973 and Vamplew 1987). This similarity in colonial money demand functions is a reasonable assumption given the geographical, social and political closeness of the economies, and their relatively similar degrees of economic development and urbanisation. Section 6.2 below discusses further the key determinants of colonial money demand.

It should also be noted that each of the seven colonies shared a common, centralised banking system for much of this period (see Simkin 1951, p.194, Hawke 1975, p.302)[20]. The highly–centralised Australasian banking sector was and is

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[19] The use of monetary aggregates to estimate national income predates, but is similar to, Feige's (1979) "transactions approach" to estimating the underground economy (which is based on Fisher's (1911) transactions version of the Quantity Equation), in that it assumes that barter transactions are not of great importance. However, money–based estimates of national income do not require any of the additional (often tenuous) assumptions of Feige's transactions approach: in particular, the latter requires both the choice of an appropriate base period from which to measure the underground economy and the calculation of the velocity of both the currency stock and bank deposits (see Porter and Bayer 1984 for a critique of the approaches to estimating the underground economy used by Feige 1979, Gutmann 1977 and Tanzi 1980). Fisher's (1911, pp. 24–34) transactions version had $MV+M'V'=PT$, where M is the volume of currency, M' the volume of deposits, V and V' their respective velocities, P the average price level of all goods exchanged, and T the aggregate volume of transactions. The income version of the Quantity Equation, as in (1), stresses income transactions, where only the net value added by each transaction is included. The transactions version also includes all intermediate transactions, and consequently suffers from ambiguity surrounding the concepts of 'transactions' and the 'general price level'. See Doblin (1951) and Friedman (1974) for further details.

[20] Hawke (1975, p.306) argues that the seven colonies shared the same banking system prior to the 1930s, although the Commonwealth Bank (established in 1912) had exercised some mild influence on the economy as Australia's *de facto* central

characterised by the overwhelming dominance of several large commercial banks, which operate in all states (including NZ), and each of which has significant national branch networks. This contrasts with the United States, where many hundreds of decentralised, locally–based banks operate, more often than not solely within a particular town, state or region[21].

The monetary technique's chief limitation lies in the potential contamination of the constructed velocity series (V_a) by differences between the economic experiences of particular colonies and that of Australia as a whole. The technique:

> '...is, in effect, a formalization and refinement of the habit, common in nineteenth–century financial journals, of judging "progress" by the course of bank deposits. It rests only on the success with which the appropriate V [velocity] can be bounded' (Hawke 1975, p.301).

Despite the aforementioned similarities existing between the seven colonies, Australasian GDP is (and was) largely concentrated in four colonies (NSW, VIC, NZ and QLD) over most of the 1861–1991 period (see Table 2). As a consequence, the dominance in the weighting of Y_a and M_a by these colonies could bias the resulting V_a calculated by the monetary technique, which is then used to derive the estimated colonial GDPs, $\hat{Y}_i$. This bias would be particularly pronounced if:

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bank (its central banking responsibilities and powers were formally set out in 1945), and the Reserve Bank of Australia began operations as a completely separate entity in 1960. The Reserve Bank of New Zealand was not established until 1934, although the Bank of New Zealand had been the *de facto* central bank since 1862 (see Quigley 1992). At p.302 Hawke claims that three of the six trading (or commercial) banks operating in NZ between 1873–1895 were Australian banks, three of the five between 1895–1912, and four of the six between 1912–1933. Moreover, the Bank of NZ was active in the Australian financial market over the whole of the above period.

[21] Australasian trading (that is, commercial) banks and savings banks operate under a branch banking system where each bank has a head office located in a capital city (usually Melbourne or Sydney), with a large number of branches conducting a full range of banking operations over a broad geographical area. Most of these banks trade beyond the boundaries of the state in which their head office is located, although the state government–owned trading and savings banks and some small banks confine their activities to one state (see White 1973 and Appendix D of Cashin (1993) for details).

(i) the coverage of monetary data and/or the development of each colony's financial sector differed between the colonies, or (ii) if not all colonies were at similar stages of economic development during the period under analysis. The consequences of any such differences for the estimated level of real per–capita colonial GDP will be examined below.

6.1 Differential Coverage of Monetary Data

While Friedman (1961) noted that monetary data usually has an advantage in becoming available early in an economy's development, he also listed some of its chief defects. The latter may, as a consequence, preclude monetary data from providing satisfactory estimates of an economy's money stock, on which estimates of aggregate income are partly based. The defects involve a lack of data on: holdings of coinage and other currency by the non–bank public; demand and time deposits in commercial banks; and other time and savings deposits. The latter two problems could preclude the use of broader definitions of money, such as M2 or M3, which are likely to be the more relevant definitions for economies with relatively well–developed financial systems. A further defect is that even if such differentiation of money stocks is available, it may only be so for a relatively small number of large banks, rather than for all banks.

In the context of the Australasian colonies the above defects are likely to present few problems, as banking in Australia and NZ is dominated by a few large banks, and the data on money aggregates derived from Butlin, Hall and White (1971), White (1973) and Sheppard, Guerin and Lee (1990) give a complete coverage of the deposits of *all* banks for all years. This data is available because regular and consistently–defined returns from all banks of issue were required from 1840, under first British, then colonial, then Commonwealth Government

regulations. Moreover, Schedvin's (1973) pre–1901 currency data includes estimates of holdings of coinage and other currency by the non–bank public, as do the post–1901 estimates of Butlin, Hall and White (1971) and White (1973), on which Schedvin's data is based.

6.2 Economic Causes of Differences in M_i

Two stylised facts arising from early work on V by Doblin (1951), Selden (1956), Friedman (1959, 1961), and Cagan (1965) were: (i) that V was inversely related to the level of per–capita income (both between economies and over time in any given economy), and (ii) that V also declines as an economy becomes more diversified in its structure of production. In the present context use of the monetary technique is likely to induce measurement errors in estimating the true colony GDPs when differences arise between the regions in the determinants (and thus the value) of V_i, given that (as noted in Section 6.1) data on regional money stocks (M_i) is robust, due to its complete coverage of colonial financial institutions.

The literature on the income velocity of money (V=Y/M) has attributed the above decline in V to increases in M arising from: (i) growing differentiation of production in the economy which interrupts the synchronisation of payments and necessitates larger cash reserves; (ii) as economies develop there is a shrinkage in the share of total production both consumed by the producer and performed as barter trade, inducing a rise in M by this process of monetization (Tobin 1965); (iii) a change in the habits of wage payments over time from daily to weekly to two–weekly (and longer) payment periods, resulting in a larger M (Fisher 1911, pp.79–88); (iv) the development of the commercial banking system of a country both supplies the public with fiat money and allows bank accounts to be used as

wealth repositories (hence raising M), whereas in more backward financial systems such assets were held in a less–liquid form (Cameron 1972); (v) as development occurs there is likely to be a disproportionate growth in the share of purely financial transactions, requiring the holding of increased M (Doblin 1951); (vi) a larger population size could also contribute to a reduction in V as it increases the number of decentralised decision–makers who need to hold M to carry out their transactions (Leff 1972). Conversely, Cagan (1956) found that: (vii) V rises in the presence of rapid inflation as agents transfer their wealth into non–money forms to escape real wealth losses; and Selden (1956) argued that: (viii) an increase in nominal interest rates raises the opportunity cost of holding M, thus tending to raise V.

In the Australasian context, it should be noted that in the 1860s WA and TAS had a disproportionately large share of their population as convicts, which necessitated neither the holding of M by the government (as a major employer in the colony) for wage payments, nor the need for convicts to hold M for transactions purposes[22]. In addition, the gold discoveries and exploitation of the 1850s and 1860s occurred mainly in NSW and VIC, those of the 1890s mainly in WA and QLD, and both rapidly and disproportionately increased M in these colonies relative to all others.

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[22] The last of the convict colonies were TAS (last convict ship landed in 1853) and WA (1868). In 1871 the population of WA was 25353, of whom some 9000 were convicts and their families (Hughes 1986). As late as 1850, some 51.5 per cent of the male workforce in NSW (including modern–day VIC and QLD) and TAS were convicts and ex–convicts (Butlin 1985). While the gold rushes of the 1850s and 1860s would have greatly reduced the share of convicts in NSW, no such drastic dilution would have occurred in TAS. Note that VIC and SA received no convict shipments at any time during their history, and hence the migration component of their population increases was wholly due to free immigrants. WA was also convict–free from its initial settlement in 1827 until 1850, when the first shipment arrived. The first settlement in QLD was established as a penal station in 1824, which was subsequently closed down in 1842.

Of the above influences leading to differing V_i, (iii) seems unlikely in the context of the Australasian colonies, due to the similarity across colonies in the social influences on payment periods. Similarly, both Cagan's inflation argument and inter–colony differences in Selden's key interest rate variable are highly unlikely here, given the similarity of the experiences of the colonies in both changes in their respective price levels and the level of their nominal interest rates[23].

Note also that the monetary technique relies on the presumption that all or most economic activities (transactions) are paid for by 'money', however defined, rather than by the barter exchange of goods and services, or the consumption of home–produced goods. While this may not have been strictly true in the early years of the survey period (1861–1991), it is certainly so in most of these years[24]. To the extent that this is not correct, then colonial GDP estimates calculated here

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[23] Evidence from Butlin, Hall and White (1971, p.96), Butlin (1953) and Butlin (1986, p.317–332) indicates that up until the early 1870s, sustained differences in bank deposit and lending rates between the colonies sometimes occurred, despite attempts at collusion among banks in setting rates. However, with the introduction of telegraphic transfer technology in 1872, better communications made rapid interest rate arbitrage a possibility, and so the separate colonial rates converged at about this time. Accordingly, it is argued that the use of a single, continent–wide r implied in the V_a measure is justified over most of the 1861–1991 period. Moreover, a key feature of Australasia's centralised banking system is that interest rates are set at a national level, so there is no regional variation in rates as there continues to be in the United States (see Porteous 1993). A potential *caveat* to using variations in nominal interest rates across economies to explain changes in V is that M3 includes time deposits, which bear an interest rate presumably highly correlated with market rates of interest. The proper variable would then be the differential across colonies of this market rate from the rate on time deposits. There appear to be no *a priori* reasons why this differential would not also have been equalised across colonies due to arbitrage.

[24] From 1817–1910 Australia operated under a free–banking system, after which a prohibitive federal tax on the issuance of such bank notes paved the way for the monopolisation of the power of note issue by the Commonwealth Government. From 1826–1929 (after a brief flirtation in issuing notes in terms of Spanish dollars) the Australian colonies (and later the Commonwealth) essentially operated under a British sterling–exchange standard (at a fixed (parity) rate of exchange) for the Australian pound, with British units of monetary accounting and British coins in local circulation (until 1910). See Butlin (1953) for details.

(that is, monetized GDP) will underestimate the true colony GDPs. Further, if the income elasticity of money demand (η) diverges from one (η=1 is assumed in (1)), then a one per cent change in nominal aggregate income for colony i, Y_i, will lead to a greater than one per cent change in the colony stock of money, M_i (for money as a superior good: η>1). Hence, the true colony velocity, V_i, will be less than the Australian average velocity, V_a (which is calculated under the assumption that η=1), and consequently the monetary–based technique will overestimate colonial nominal incomes ($\hat{Y}_i > Y_i$). The opposite occurs for η<1.

The time–series evidence for V_a indicates that, in common with other countries with relatively advanced financial systems, V_a (based on M3, although similar results are found for M1) at first fell from 3.38 in 1861 to a low–point of 1.02 in 1947, thereafter rising to reach 2.53 in 1981 and 1.86 in 1991. Figure 4 plots V_a based on M1 and M3, and also V_{NZ} for the post–1933 period (based on M1) when official estimates of NZ's GDP became available. The evidence for the 1861–1947 period thus appears consistent with η>1, and the evidence for 1947–1991 with η<1.

Of the above rationales for differing V_i, those of (i), (ii), (iv)–(vi) and the specific Australasian influences seem more promising candidates for the inducement of measurement errors in $\hat{Y}_i$ as a result of using V_a (rather than the true V_i) for each of the i colonies. To the extent that certain colonies (TAS, SA and WA seem the most likely): possessed relatively 'less–advanced' economic structures (for example, more agricultural–based); or were relatively backward in terms of their structures of financial intermediation; or carried out relatively less purely financial transactions; or were simply relatively 'small' in GDP terms; or had a relatively large share of their workforce as convicts; or mined a small share of Australia's gold; then it would be expected that the ratio of an individual colony's income to its money stock would be greater than the velocity for Australia

as a whole (that is, $Y_i/M_i=V_i>V_a=Y_a/M_a$). Hence the monetary–based technique, in attributing V_a rather than V_i to such (low M_i) colonies would induce an underestimate of the true regional velocity for these relatively backward regions, and thus the calculated nominal colony aggregate incomes ($\hat{Y}_i$) would underestimate the true (Y_i) nominal colony aggregate incomes ($M_iV_i=Y_i>\hat{Y}_i=M_iV_a$).

An indication of the differing degrees of monetization in the colonies is given by Table 7, which sets out data on the number of persons per trading (commercial) bank branch in each colony. In 1861 WA and TAS have numbers clearly larger than the other four Australian colonies, while in 1871 only SA and TAS have relatively more persons per bank. However, after 1881 TAS appears to be the sole remaining outlier, and so from the early 1880s it appears that the spread of branch banking across the six Australian colonies ensured that approximately the same quantity of per–capita banking services was available in most of the colonies.

7. Conclusion

Using the income variant of Fisher's (1911) money identity, the first consistent set of long–run data on real per–capita GDP has been calculated for the seven Australasian colonies of Britain. In the space of 70 years these colonies rose from mendicant penal and agricultural colonies to the world's richest economies (as measured by real per–capita incomes). These monetary–based estimates fill a previously large gap in the available income data for the regional economies of Australasia. The Australasian colonies were excellent candidates for the use of money stocks to estimate national income, given the long time series of high–quality, consistently–defined monetary data available.

In constructing the colonial GDP estimates two key assumptions have been made: that the V_i across the i colonies is the same and equal to the national (Australian) income velocity of money (V_a); and that the deflator used across all i colonies (except for NZ) is the national (Australian) implicit GDP deflator. It was stated that the strong similarities exhibited by the colonies argued in favour of the plausibility of both of these assumptions. However, a number of *caveats* were presented regarding the former assumption, which if incorrect can induce measurement error in the calculation of aggregate colonial incomes. The most likely cause of such error lies in the potentially different degrees of monetization and financial sophistication existing across the seven colonies, which could cause some or all of the seven V_i to differ from their assumed equality with V_a.

In Cashin (1993a) I will examine in more detail the underlying mechanism of convergence of real per–capita incomes across the seven colonies. To undertake this work I will use the historical data on per–capita GDP calculated in this paper, as well as structural data to control for any differences across the colonies in the sectoral composition of their aggregate production.

Fig 1 Real Per-Capita GDP, 1911 $A, PPP
Australia and New Zealand, 1840-1991

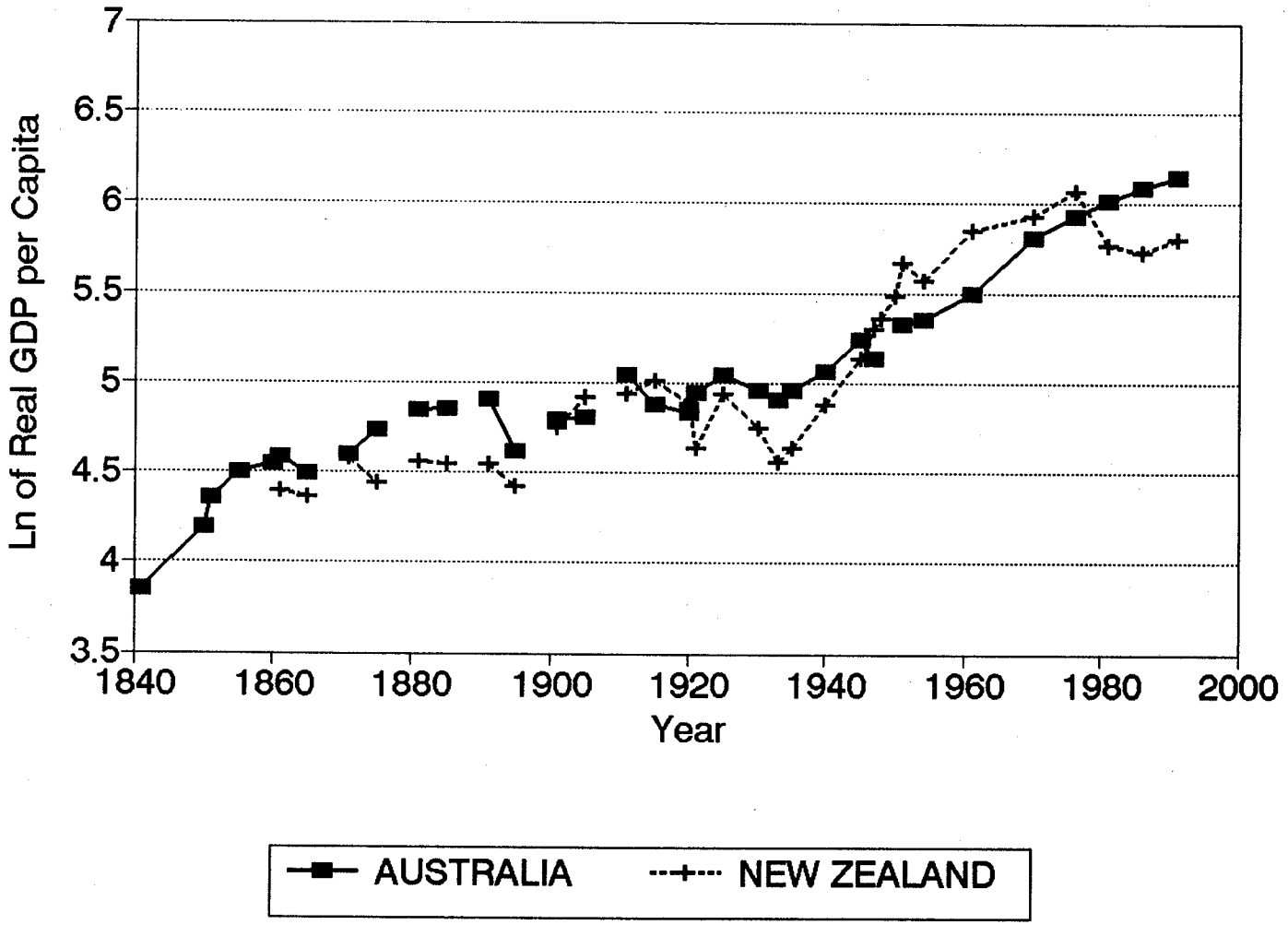

Fig 2 Monetary-Based Technique versus
Lineham/Official Estimates of NZ GDP

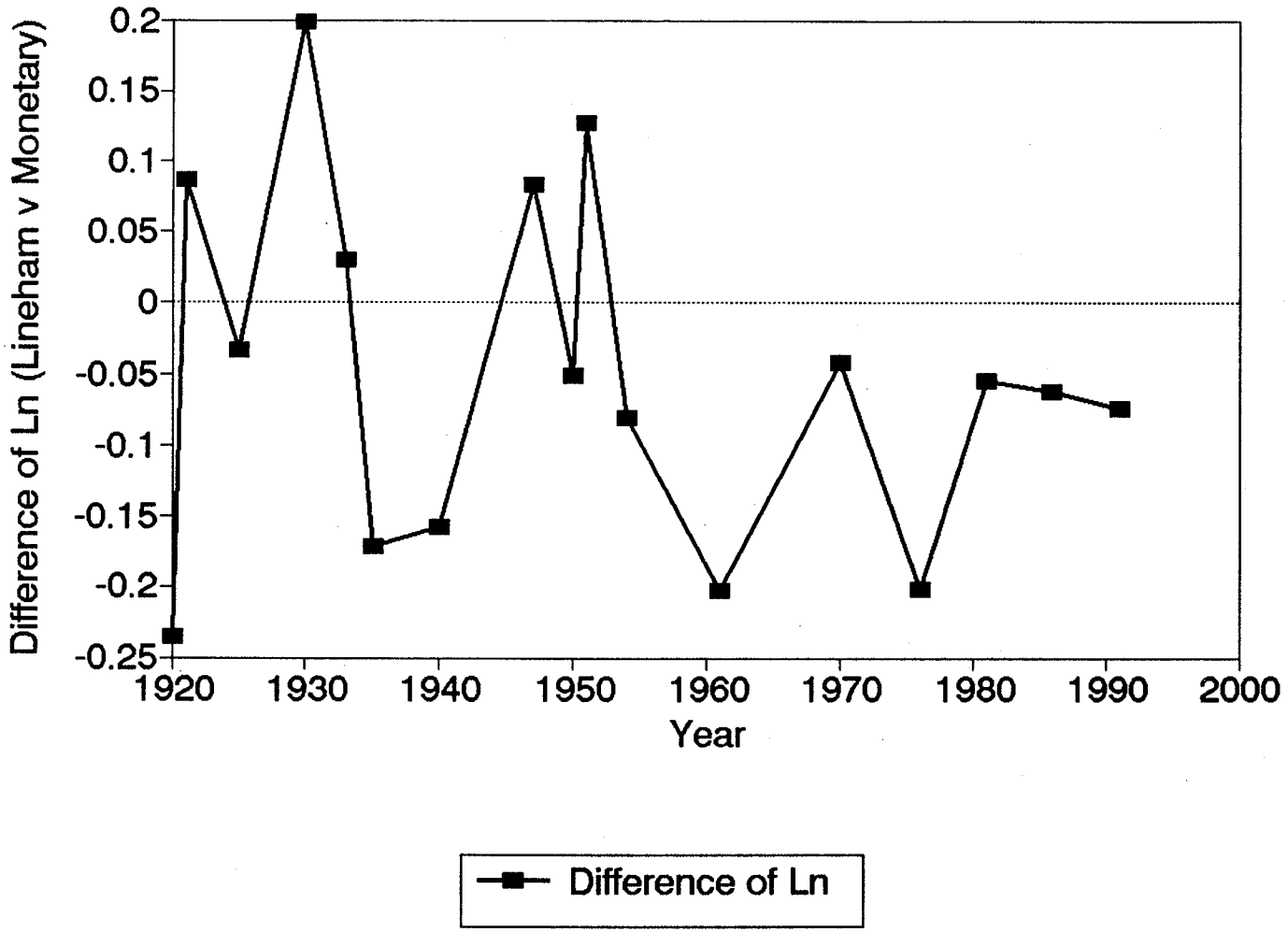

Fig 3 Net Annual Permanent Migration
Australia to New Zealand, 1861-1991

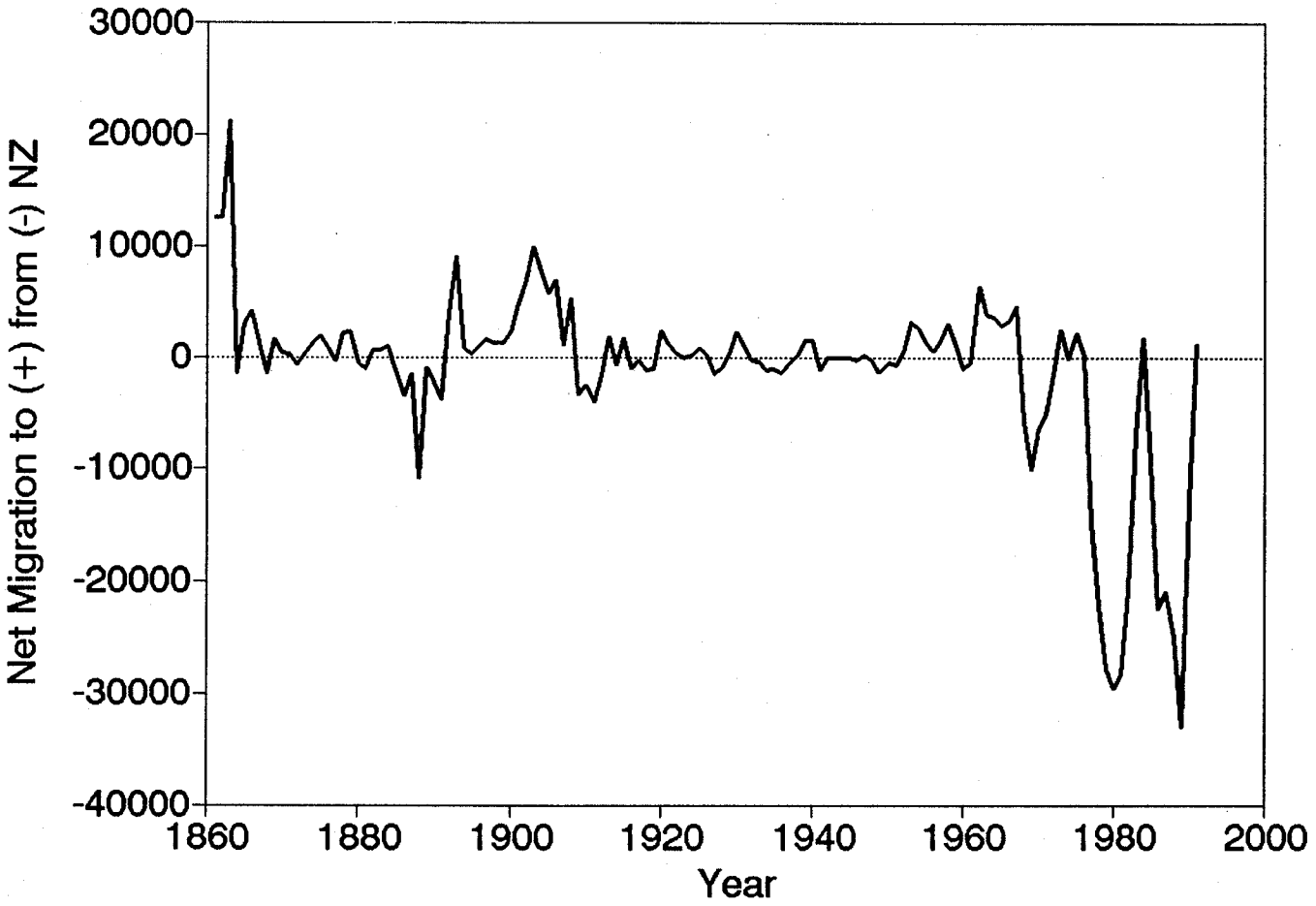

Fig 4 Income Velocity of Money
M1 and M3 Basis, 1861-1991

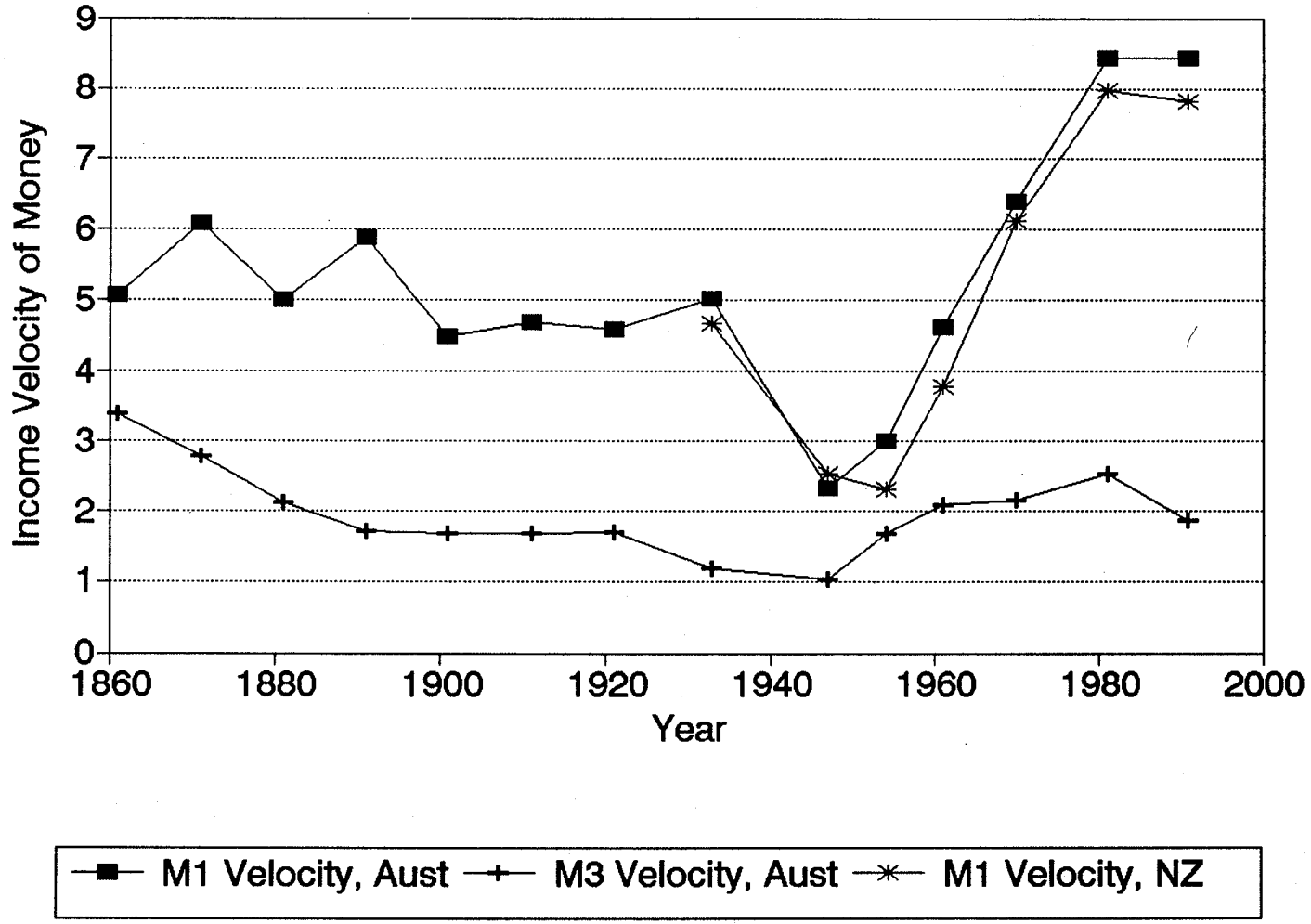

Table 1

Annual Net Intercolonial/Interstate Migration, Including New Zealand, 1861–1990

Intercensal Period	Annual Net Migration Rate Per Thousand[a]								
	NSW	VIC	QLD	SA	WA	TAS	NZ[c]	ACT[d]	NT[d]
1861–1871[b]							29.5		
1871–1881[b]							1.8		
1881–1891	3.3	1.2	4.8	–15.8	7.0	–6.6	–3.2		
1891–1901	0.6	–7.4	2.4	–6.4	88.6	–0.5	2.4		
1901–1911	1.3	–3.8	2.6	–3.5	20.3	–6.8	4.5		
1911–1921	2.5	–0.7	0.1	1.4	–9.0	–9.0	–0.4		
1921–1933	0.0	0.2	1.7	–1.0	0.2	–7.4	0.2	13.5	76.2
1933–1947	0.1	0.8	–0.5	–0.7	–2.1	–2.2	–0.1	45.0	26.9
1947–1954	–1.8	–0.3	3.0	1.6	0.5	0.6	0.05	20.2	30.1
1954–1961	–1.1	0.1	1.8	0.8	–2.1	–3.0	0.6	33.6	51.6
1961–1971	–0.9	–1.5	1.6	–1.6	3.8	–3.8	0.07	na	na
1971–1981	–2.2	–2.7	7.6	–0.7	2.8	–2.1	–3.2	na	na
1981–1990	–3.4	–2.5	9.5	–0.8	4.1	–0.7	–6.0	na	na

Notes:

a Net Migration Rate=[(annual average net migration)/mean population]*1000, where mean population=$(POP_t + POP_T)/2$, and POP_t=population of colony/state at start of period, and POP_T=population of colony/state at end of period.

b Migration data unavailable for the Australian colonies prior to 1881.

c Migration data for NZ is net migration to/from NZ with Australia, with the latter comprising the six Australian colonies as a whole.

d Migration data for the Australian Capital Territory (ACT) and the Northern Territory (NT) is unavailable prior to 1921. Pre–1921 figures for both regions are included in NSW and SA, respectively.

na Not available.

Sources: Rowland (1979); and see the notes for this Table in Appendix B of Cashin (1993).

Table 2

Real Colonial GDP (1911 A$ million), 1861–1991

Year	NSW	VIC	QLD	SA	WA	TAS	AUST[abc]	NZ
1861	39.22	54.54	2.60	7.79	0.69	7.64	112.74	8.05
1871	51.95	81.89	10.26	14.15	1.06	6.61	166.33	25.00
1881	103.75	111.25	25.61	28.93	2.08	13.59	287.00	51.18
1891	153.40	171.80	43.79	37.76	5.52	16.86	430.28	62.85
1901	170.49	152.85	61.86	37.07	22.20	16.61	459.93	94.29
1911	272.14	211.30	81.40	62.87	38.33	19.79	689.20	148.45
1921	305.65	237.32	91.94	69.34	35.71	21.22	767.35	131.85
1933	331.60	297.48	116.48	74.55	46.29	24.04	900.28	148.30
1947	499.95	407.97	185.11	112.08	72.69	38.65	1294.48	366.93
1954	704.67	591.36	243.38	183.92	112.33	52.41	1898.28	555.97
1961	974.86	812.57	335.55	232.56	143.65	68.40	2572.99	835.96
1970	1560.17	1263.86	546.11	353.97	293.45	102.40	4185.45	1070.60
1981	2142.72	1789.87	862.47	457.38	470.24	137.05	6111.06	1018.20
1991	2818.93	2150.90	1217.66	594.05	797.53	172.08	8002.59	1140.87

Sources: Author's calculations, see Appendices A and B of Cashin (1993).

Notes:

a All–colony GDP figures, taken from Butlin (1962), McLean and Pincus (1982) and ABS (1992a).

b The sum of the colonial GDP estimates will not exactly equal the Australian (all–colony) GDP figures due to rounding errors.

c The sum of the monetary–based colonial GDP estimates for 1970, 1981 and 1986 will not exactly equal the official ABS (1992) estimates of Australian GDP due to the inclusion in the latter of the GDPs of the Northern Territory and the Australian Capital Territory, and their non–inclusion after 1970 in the state monetary aggregates. Prior to 1970 the two Territories' monetary aggregates had been included in those for SA and NSW, respectively.

Table 3

Growth Rates of Real Colonial GDP
Annualised Period Averages, in Percentage Terms, 1861–1991

Year	NSW	VIC	QLD	SA	WA	TAS	NZ
1861	2.55	3.69	12.49	5.43	3.82	–1.32	10.31
1871	6.29	2.79	8.32	6.51	6.15	6.55	6.51
1881	3.56	3.95	4.88	2.42	8.89	1.96	1.87
1891	0.96	–1.06	3.14	–0.17	12.66	–0.14	3.69
1901	4.25	2.94	2.50	4.80	4.97	1.59	4.13
1911	1.06	1.06	1.11	0.89	–0.64	0.64	–1.08
1921	0.63	1.74	1.82	0.56	2.00	0.96	0.90
1933	2.74	2.11	3.09	2.72	3.01	3.16	6.04
1947	4.29	4.64	3.42	6.19	5.44	3.81	5.19
1954	4.06	3.97	4.01	2.93	3.07	3.33	5.10
1961	4.70	4.42	4.87	4.20	7.14	4.04	2.47
1970	2.64	2.90	3.81	2.14	3.93	2.43	–0.42
1981	2.49	1.67	3.14	2.38	4.80	2.07	1.03
μ	3.09	2.68	4.35	3.15	5.02	2.24	3.52
σ	1.58	1.52	2.89	2.05	3.17	1.95	3.05

Sources: Author's calculations in Table 2.

Notes:

1861 refers to the ten–year period 1861–1871, and similarly for the other periods given, where 1981 refers to the period 1981–1991. The annualised rate of growth of each colony's real GDP per capita is: $[\ln(RGDP_t/RGDP_{t-T})]/T$, where t is the last year of the sub–period, t–T is the first year of the sub–period, T is the time interval in years between t and t–T, and ln is the natural logarithm. RGDP is the real GDP (in 1911 A$) of each colony, as calculated using the monetary technique of Section 4. μ is the average of the sub–period growth rates; σ is the standard deviation of the sub–period growth rates.

Table 4

Real Colonial Per–Capita GDP (1911 A$), 1861–1991

Year	NSW	VIC	QLD	SA	WA	TAS	AUST[ab]	NZ
1861	111.79	101.26	86.40	61.38	44.43	84.96	97.87	81.26
1871	103.11	111.94	85.39	76.21	41.61	65.55	99.70	97.52
1881	138.37	129.13	119.95	104.66	69.85	117.49	127.54	95.84
1891	136.48	150.72	111.22	119.68	110.82	114.97	135.55	94.00
1901	125.83	127.26	124.19	103.44	120.58	96.33	121.88	115.57
1911	165.26	160.62	134.37	153.89	135.88	103.49	154.70	140.27
1921	145.52	154.98	121.62	140.04	107.33	99.30	141.17	103.68
1933	127.50	163.43	122.93	128.32	105.47	105.65	135.79	95.83
1947	167.50	198.55	167.31	173.47	144.66	150.35	170.79	201.27
1954	205.83	241.14	184.62	230.73	175.58	169.76	211.24	262.45
1961	248.88	277.32	220.92	239.91	195.00	195.24	244.86	346.15
1970	344.99	366.87	304.62	305.67	296.01	264.11	334.64	374.62
1981	409.32	453.48	367.76	346.82	361.71	320.80	409.50	320.62
1991	480.75	488.16	414.27	410.24	483.24	375.22	464.90	332.14

Sources: Author's calculations, see Appendices A and B of Cashin (1993).

Notes:

a All–colony per–capita GDP, calculated from Butlin (1962), ABS (1992a), McLean and Pincus (1982), Commonwealth of Australia (1908), Coghlan (1900) and Vamplew (1987). It is a weighted average of colonial per–capita GDP figures, given the method of calculation discussed in Section 4.

b Note c of Table 2 applies here also.

Table 5

Growth Rates of Real Per–Capita Colonial GDP
Annualised Period Averages, in Percentage Terms, 1861–1991

Year	NSW	VIC	QLD	SA	WA	TAS	NZ
1861	–0.74	0.91	–0.11	1.97	–0.60	–2.36	1.66
1871	2.67	1.30	3.09	2.88	4.71	5.31	–0.16
1881	–0.13	1.41	–0.69	1.22	4.20	–0.20	–0.18
1891	–0.74	–1.54	1.00	–1.33	0.77	–1.61	1.88
1901	2.48	2.12	0.72	3.61	1.09	0.65	1.76
1911	–1.16	–0.33	–0.91	–0.86	–2.14	–0.38	–2.75
1921	–1.02	0.41	0.08	–0.67	–0.13	0.48	–0.61
1933	1.82	1.30	2.05	2.01	2.11	2.35	4.95
1947	2.58	2.43	1.23	3.57	2.42	1.52	3.32
1954	2.37	1.75	2.24	0.49	1.31	1.75	3.46
1961	3.27	2.80	3.21	2.42	4.17	3.02	0.79
1970	1.42	1.77	1.57	1.05	1.67	1.62	–1.30
1981	1.46	0.67	1.08	1.53	2.63	1.42	0.32
μ	1.10	1.15	1.12	1.38	1.71	1.04	1.01
σ	1.56	1.12	1.26	1.55	1.92	1.91	2.04

Sources: Author's calculations in Table 4.

Notes:

1861 refers to the ten–year period 1861–1871, and similarly for the other periods given, and 1981 refers to the period 1981–1991. The annualised rate of growth of each colony's real GDP per capita is: $[\ln(RGDPP_t/RGDPP_{t-T})]/T$, where t is the last year of the sub–period, t–T is the first year of the sub–period, T is the time interval in years between t and t–T, and ln is the natural logarithm. RGDPP is the real per–capita GDP (in 1911 A$) of each colony, as calculated using the monetary–based technique of Section 4. μ is the average of the sub–period growth rates; σ is the standard deviation of the sub–period growth rates.

Table 6

Growth Rates of Colonial Populations
Annualised Period Averages, in Percentage Terms, 1861–1991

Year	NSW	VIC	QLD	SA	WA	TAS	NZ
1861	3.29	2.78	12.59	3.46	4.42	1.04	8.64
1871	3.62	1.49	5.23	3.62	1.44	1.25	6.67
1881	3.68	2.54	5.56	1.20	4.69	2.16	2.04
1891	1.70	0.48	2.14	1.16	11.89	1.47	1.81
1901	1.77	0.83	1.78	1.19	3.88	0.94	2.37
1911	2.21	1.38	2.01	1.75	1.50	1.01	1.67
1921	1.64	1.33	1.74	1.23	2.13	0.48	1.51
1933	0.92	0.81	1.03	0.71	0.90	0.81	1.09
1947	1.71	2.21	2.19	2.63	3.02	2.29	1.88
1954	1.68	2.23	1.77	2.45	1.76	1.58	1.64
1961	1.44	1.62	1.66	1.78	2.97	1.01	1.68
1970	1.22	1.13	2.24	1.08	2.26	0.81	0.88
1981	1.03	1.00	2.05	0.85	2.17	0.64	0.71
μ	1.99	1.53	3.23	1.78	3.31	1.19	2.51
σ	0.90	0.69	3.00	0.93	2.71	0.53	2.27

Sources: Commonwealth of Australia (1908); Vamplew (1987); Coghlan (1900); ABS (1987); ABS (1992a); Bloomfield (1984); Department of Statistics (1991, 1992).

Notes:

1861 refers to the ten–year period 1861–1871, and similarly for the other periods given, where 1981 refers to the period 1981–1991. The annualised rate of growth of each colony's population is: $[\ln(POP_t/POP_{t-T})]/T$, where t is the last year of the sub–period, t–T is the first year of the sub–period, T is the time interval in years between t and t–T, and ln is the natural logarithm. POP is the total population of each colony. μ is the average of the sub–period growth rates; σ is the standard deviation of the sub–period growth rates.

Table 7

Number of Persons per Trading (Commercial) Bank Branch, Australian Colonies[a], 1861–1911

Year	NSW	VIC	QLD	SA	WA	TAS
1861	6049	5034	2505	6342	15593	9997
1871	4708	4156	3640	6143	5071	11207
1881	2559	2367	2296	2254	2285	4628
1891	1941	2069	2009	2405	1556	3333
1901	3226	2561	2846	3891	2023	4207
1911	2499	2056	2161	2782	1669	3414

Sources: Butlin (1986, p.297–298); Vamplew (1987, p.26); ABS (1987, p.90); and ABS (1992a, p.3).

a Data on the number of bank branches is unavailable for NZ.

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