

INCOME ESTIMATION FROM MONETARY DATA: FURTHER EXPLORATIONS

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This note explores further the utility of national income estimates derived from monetary data, an issue recently revived in this journal by Professor Leff. Income estimates for New Zealand are extended back from 1918 to 1870 and it is argued that while such figures are not a substitute for more laboriously compiled product or factor reward estimates, they are a useful stop-gap in what is otherwise an historical vacuum.

In a recent paper in this journal,¹ Professor N. H. Leff describes a technique for estimating income trends from currency data and applies it to nineteenth century Brazil. His argument is essentially that if one knows the trend of some monetary variable, and if one is able to put bounds on the trend of the corresponding velocity variable, then one can deduce the trend of income. In the case of Brazil, Professor Leff has to deduce the monetary variable from statistics of currency issued, but while this obviously introduces further uncertainties into his results it is not at issue here.

The basis of Leff's argument is indisputable. It begins with the Fisher's equation tautology and the essential argument follows very readily. It 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 can be bounded. Leff's argument that income grew more slowly in Brazil than some other writers have suggested follows from the assumption that velocity in Brazil in the early nineteenth-century was not less than velocity in the U.S., an assumption for which he supplies some plausible if not conclusive rationalization.

While estimates of long-term rates of change may be preferred to nothing at all, it would be difficult for an economic historian to stop at that point. Professor Leff, himself, is unable to resist the temptation to look also at the implied level of income in a particular year, and to look at rates of change within more limited periods.² The requirement of accuracy in the estimates of V is then more stringent but the argument is essentially unchanged. We explore it further in the specific case of New Zealand.

Leff recommends his technique especially for less developed countries, but some of the richer countries of the world are underdeveloped in respect of historical statistics. New Zealand is among them. The official estimates of national income begin effectively with the Second World War and unofficial estimates

¹Nathaniel H. Leff, "A Technique for Estimating Income Trends from Currency Data and an Application to Nineteenth Century Brazil," *Review of Income and Wealth*, 18 (4) (Dec., 1972), pp. 355-368.

²Leff looks explicitly at the periodization of only the currency series, but the implication that this serves also to periodize the growth of income is almost irresistible.

carry the historical series back only to 1918. On the other hand, quarterly and quite comprehensive figures on various banking variables are available from the middle of the nineteenth century.

Furthermore, there is reason for thinking that estimates of velocity would be more readily available for New Zealand than they are for Brazil. This follows from the availability of both income and monetary estimates for Australia and the expectation that the course of velocity in Australia and New Zealand would not be very different. After all, for many purposes New Zealand was just one of the various colonies in Australasia until the formation of the Commonwealth of Australia in 1901. Furthermore, Australia and New Zealand had very similar banking systems. Indeed, they really shared the same banking system. Three of the six banks operating in New Zealand from 1873–95, three of the five from 1895–1912, and four of the six from 1912–33 were primarily Australian banks, while the Bank of New Zealand, the largest bank in New Zealand, also had some business in Australia. Hence, it might be thought that Australian data on velocity would provide a very acceptable proxy for the New Zealand variable. This would be even more true of price series if we wished to follow Leff in applying a purchasing power parity theorem, but this note is restricted to his central argument.

With this assumption, we can follow Leff and calculate long-term trends.³ Australian velocity declined by about 0.8 percent per annum over the relevant period, the New Zealand monetary stock increased by about 4.5 percent, and hence the New Zealand GDP increased by about 3.7 percent, just a little faster than was the case in Australia.

This conclusion is unexceptionable, if hardly of great interest. Effectively we have said that the long-term experiences of Australia and New Zealand were similar, and checked that this was so in the monetary sphere. More interest could be gained by following Leff and looking at more restricted periods. In particular, we should like to extend the available annual statistics of national income back through the period 1870–1918. We proceed by calculating V for Australia for each year, the monetary variable for New Zealand as before, and hence calculate the income estimates labelled (a) in Table 1. These estimates look plausible in the light of the conventional literary discussions of the economy, except that the extent and duration of the decline in income in the 1890s look too great. In that decade Australia experienced a lengthy drought and the suspicion is that the Australian velocity estimates are too linked with Australian income experience to be satisfactory as estimates for New Zealand. (We return to estimates (b) below.)

This suspicion can be tested against the experience of a later period. For the period 1918–33,⁴ GDP estimates have been constructed for New Zealand by the laborious technique of aggregating estimates for various sectors.⁵ It is possible, therefore, to compare those estimates with figures generated from monetary data. The comparison is shown in columns (2) and (3) of Table 2 and it gives added

³Information on sources and methods is contained in the appendix.

⁴We conclude at 1933 to avoid complications introduced by the founding of a central bank in New Zealand.

⁵B. T. Lineham, "New Zealand's Gross Domestic Product 1918–38," *N.Z. Econ. Papers*, II (1968), pp. 15–26.

TABLE 1
ESTIMATES OF NEW ZEALAND GROSS DOMESTIC PRODUCT, 1870-1918
(£ MILLIONS)

| Year | Money (1) | Estimates of Gross Domestic Product | | Annual percentage rates of change in (b) (4) |
|------|--------------|-------------------------------------|---|---|
| | | (a) ($V_{NZ} = V_A$) (2) | (b) ($\log V_{NZ} = 0.43 + 0.19 V_A$) (3) | |
| 1870 | 3.7 | 13.9 | 11.8 | |
| 1871 | 3.9 | 13.6 | 11.8 | 0 |
| 1872 | 4.6 | 16.4 | 14.1 | 19.2 |
| 1873 | 5.4 | 19.9 | 17.0 | 20.5 |
| 1874 | 6.3 | 22.3 | 19.4 | 13.9 |
| 1875 | 6.8 | 23.1 | 20.3 | 4.8 |
| 1876 | 7.1 | 21.6 | 19.7 | -2.8 |
| 1877 | 8.0 | 22.3 | 21.3 | 7.7 |
| 1878 | 9.9 | 28.4 | 26.6 | 25.3 |
| 1879 | 8.9 | 25.9 | 24.2 | -9.3 |
| 1880 | 9.4 | 27.3 | 25.5 | 5.6 |
| 1881 | 9.9 | 26.5 | 25.7 | 0.9 |
| 1882 | 9.9 | 24.5 | 24.6 | -4.3 |
| 1883 | 9.6 | 24.9 | 24.5 | -0.6 |
| 1884 | 10.6 | 24.7 | 25.7 | 4.7 |
| 1885 | 11.0 | 25.2 | 26.5 | 3.3 |
| 1886 | 11.5 | 25.4 | 27.2 | 2.8 |
| 1887 | 11.9 | 27.3 | 28.7 | 5.2 |
| 1888 | 12.0 | 25.8 | 28.1 | -1.9 |
| 1889 | 12.4 | 28.0 | 29.6 | 5.5 |
| 1890 | 13.2 | 27.8 | 30.7 | 3.6 |
| 1891 | 13.7 | 28.3 | 31.6 | 2.8 |
| 1892 | 14.5 | 25.4 | 31.4 | -0.4 |
| 1893 | 15.4 | 25.9 | 32.9 | 4.7 |
| 1894 | 14.8 | 26.5 | 32.4 | -1.6 |
| 1895 | 14.5 | 24.8 | 31.2 | -3.6 |
| 1896 | 15.4 | 29.1 | 34.3 | 9.9 |
| 1897 | 15.3 | 28.5 | 33.8 | -1.4 |
| 1898 | 15.2 | 33.9 | 36.1 | 6.8 |
| 1899 | 15.7 | 34.9 | 37.3 | 3.3 |
| 1900 | 16.8 | 36.8 | 39.7 | 6.4 |
| 1901 | 17.3 | 38.4 | 41.1 | 3.6 |
| 1902 | 18.5 | 41.3 | 44.1 | 7.3 |
| 1903 | 20.4 | 49.0 | 50.2 | 13.8 |
| 1904 | 20.5 | 52.1 | 51.8 | 3.2 |
| 1905 | 21.8 | 53.6 | 54.3 | 4.8 |
| 1906 | 23.8 | 59.2 | 59.5 | 9.7 |
| 1907 | 24.9 | 61.5 | 62.1 | 4.4 |
| 1908 | 23.2 | 58.0 | 58.2 | -6.3 |
| 1909 | 23.4 | 60.6 | 59.7 | 2.5 |
| 1910 | 26.4 | 67.3 | 66.8 | 12.0 |
| 1911 | 28.2 | 69.0 | 70.0 | 4.8 |
| 1912 | 27.1 | 69.2 | 68.6 | -2.0 |
| 1913 | 27.1 | 75.8 | 72.0 | 5.0 |
| 1914 | 29.4 | 76.6 | 75.2 | 4.4 |
| 1915 | 34.0 | 81.8 | 83.7 | 11.3 |
| 1916 | 41.2 | 100.3 | 102.0 | 21.9 |
| 1917 | 48.1 | 118.2 | 119.5 | 17.2 |
| 1918 | 51.4 | 119.8 | 124.7 | 4.3 |

Source: See text and appendix.

weight to our suspicions of the estimates for the nineteenth century. The errors involved for individual years in the later period reach almost 40 percent. More importantly, the course of income growth over the period as a whole is markedly distorted. The monetary estimates overstate income levels in the early 1920s, date the downturn much too early, and overstate the extent of the decline.⁶

It is, however, possible to improve on these estimates. For this same period, 1918–19 to 1932–33, we can calculate New Zealand’s V directly from the monetary data and the “product” estimates of GDP. Comparison of this V with that of Australia is, of course, simply another way of looking at the comparison of columns (2) and (3) of Table 2. But it also reveals directly that while the year to year changes in the two countries varied considerably, the velocity variables are not entirely dissimilar. Changes tended to be in the same direction, although the volatility of the New Zealand series was less. Correlation analysis suggests that the best representation is obtained by

$$\log V_{NZ} = \log 1.54 + 0.19 V_A \quad R = 0.52$$

$$(t = 2.20)$$

where V_{NZ} is the New Zealand velocity variable and V_A is the corresponding Australian variable. From this equation, the income estimates (b) of Table 2 are calculated. While not all the estimates for individual years are improved, the “fit” over the whole period is closer.

This result can then be projected backwards to obtain the income estimates (b) for the period 1870–1918. It can be seen that these estimates are not as much subject to the criticism previously raised against estimates (a) in that the Australian drought of the 1890s has been “smoothed out” of the New Zealand income estimates. At the same time, the “Vogel boom” of the 1870s, a period of marked government attempts to extend the European economy in New Zealand, appears much more strongly in the revised estimates. Together, these two points imply that the revised estimates give a higher rate of growth in the late nineteenth century, although the 1880s still appear as a period of little more than stagnation. Price movements and population increases will tend to cancel out so that the estimates are consistent with the traditional literary account of a period of little economic growth in the 1880s after the vigorous extensive growth of the 1870s. Estimates (a) and (b) differ much less after the turn of the century (except for the higher starting point of series (b)) and suggest that the extent of income growth in that period, when dairying and the frozen meat trade were growing rapidly, has been underrated in the literature. The revised estimates are also both plausible and interesting when placed alongside the available statistics of exports and imports, suggesting a tendency towards declining trade-income ratios in the nineteenth century, reversed in the twenty years before the First World War. This suggests that it will eventually be possible to give greater precision to the notion that New Zealand’s development after 1870 can be divided into successive periods, the first being characterized by the provision of social capital and the

⁶One might question whether Lineham’s estimates should be taken as “actual” figures from which “errors” can be deduced. But literary evidence, especially on the timing of the downturn in New Zealand, gives a clear preference for Lineham’s estimates over the monetary ones. Beyond that, Lineham’s figures stand up to a close scrutiny of his sources and methods.

TABLE 2
ESTIMATES OF NEW ZEALAND GROSS DOMESTIC PRODUCT 1918-19—1932-33
(£ MILLIONS)

| Year | Estimates of Gross Domestic Product | | | |
|---------|-------------------------------------|------------------|------------------------------|---|
| | Money (1) | "Product" (2) | Monetary Estimates | |
| | | | (a) $V_{NZ} = V_A$ (3) | (b) $\log V_{NZ} = 0.43 + 0.19 V_A$ (4) |
| 1918-19 | 51.8 | 114.5 | 138.6 | 134.4 |
| 1919-20 | 57.6 | 127.4 | 152.7 | 148.7 |
| 1920-21 | 67.3 | 143.5 | 199.3 | 184.5 |
| 1921-22 | 57.0 | 140.4 | 162.5 | 153.0 |
| 1922-23 | 52.9 | 148.2 | 158.6 | 146.1 |
| 1923-24 | 55.6 | 155.8 | 159.9 | 150.0 |
| 1924-25 | 56.1 | 168.3 | 184.2 | 163.7 |
| 1925-26 | 59.0 | 168.8 | 174.5 | 161.6 |
| 1926-27 | 56.9 | 168.8 | 163.9 | 153.6 |
| 1927-28 | 54.8 | 175.2 | 155.5 | 146.7 |
| 1928-29 | 60.2 | 183.7 | 165.8 | 158.5 |
| 1929-30 | 64.0 | 178.0 | 153.3 | 157.3 |
| 1930-31 | 62.7 | 155.7 | 132.5 | 145.8 |
| 1931-32 | 59.4 | 132.4 | 119.7 | 135.6 |
| 1932-33 | 58.8 | 126.2 | 116.8 | 133.5 |

Source: See text and appendix.

development of pastoral industry, followed by a period of slow growth until the expansion of new export trades from the last years of the nineteenth century. The quantitative economic history of New Zealand is in its infancy, and the income estimates derived here suggest that a much firmer analysis of New Zealand's economic development can be constructed.

The estimates are, of course, only as good as the underlying assumptions, and in particular are dependent on the validity of the assumed link between Australian and New Zealand velocities. The critical assumption is that velocity in New Zealand was a smoothed reflection of velocity in Australia.⁷ We know this to be true of the period 1918-19—1932-33 and it is not difficult to advance particular reasons why it should have been so. For example, features of the "real" economy such as the greater importance of wheat exports and the earlier and deeper problems with the London capital market provide explanations for the earlier and steeper decline of income in Australia from the late 1920s. Similarly, it is possible to rationalize an expectation that the same kind of relationship between velocity in Australia and in New Zealand should have held in the later nineteenth century. For example, banks in Australia were deeply involved in the Melbourne property boom in the 1880s—an investment with a short run high capital-output ratio

⁷For example, replacing the regression equation in the text with a linear relationship between V_A and V_{NZ} has only a limited impact on the estimated New Zealand GDP in either of the periods considered. Both of these formulations also affect the long-term trends calculated previously—approximately halving the decline in New Zealand velocity and so raising the long-term growth of income by 3-4 percentage points.

which could be expected to lower velocity. New Zealand was involved in that some banks in New Zealand sought fixed deposits to use as backing for their Australian activities, but the group of banks in New Zealand were not involved to such an extent that the New Zealand economy fully shared the Australian experience.

Such *ad hoc* explanations will not, however, justify a continuous relationship between the velocities in the two countries, still less the continuation of the same relationship. Some element of faith or a high level of importance attached to pragmatism is involved. But it is not entirely on such matters that the case must rest. Firstly, the two economies did share virtually the same banking system, and although the Commonwealth Bank was taking some faltering steps towards becoming a central bank in Australia in the 1920s, it is a reasonable approximation to regard the countries as sharing a common monetary experience before the 1930s. Monetary history supports the assumption of stability between our two periods in the relationship of Australian and New Zealand monetary variables. Furthermore, New Zealand had a smaller and more cohesive banking system less bothered by competing "near-bank" institutions and operating in a smaller economy than did Australia. It is therefore likely that the New Zealand banks, through control of their lending, would have maintained a closer connection between income changes in the economy and the total of bank deposits. That is, measured velocity in New Zealand would be less volatile than in Australia. It is not, of course, suggested that the New Zealand banks had a rigid control over their lending; merely, that they had a greater degree of control than was the case in Australia. In this way some degree of support for the estimates (b) of Table 1 can be adduced.

It is suggested, therefore, that Leff's technique can be extended beyond long-term trends. But the limitations to the technique remain obvious. Firstly, in not many cases will a proxy to the required velocity series be so readily available as it is in the case of New Zealand.⁸ Secondly, even in the New Zealand case, the constructed velocity series remains "contaminated" by the differences between Australian and New Zealand economic experience and estimates of income deduced from records of factor rewards or product would remain much preferable to any constructed from monetary data. Leff's technique produces a stop-gap rather than a substitute.

APPENDIX: SOURCES AND METHODS

For the purposes of this note, it has been judged admissible to rest content with several approximations. The monetary variable employed is an approximation to M2, the main element of inexactitude being the omission of coinage. This is unlikely to be significant; v. C. B. Schedvin, "A Century of Money in Australia," *Econ. Record*, 49 (Dec. 1973), p. 591. Only in the case of New Zealand estimates

⁸For example, Australia cannot be replaced by the U.K. in our argument, despite the close connections in trade etc. between the United Kingdom and New Zealand. (United Kingdom data from C. H. Feinstein, *National Income, Expenditure and Output of the U.K. 1855-1965*, (Cambridge: University Press, 1972), pp. 112-13 for "compromise" estimate of GDP; D. K. Sheppard, *The Growth and Role of U.K. Financial Institutions 1880-1962*, (London: Methuen, 1971), pp. 182-3 for money stock.

for 1870–1918 are the estimates adjusted for notes held by banks rather than the public. Australian income data (GDP at market prices) are from N. G. Butlin, *Australian Domestic Product, Investment and Foreign Borrowing, 1861—1938–39*, (Cambridge: University Press, 1962), pp. 6–7; monetary data from S. J. Butlin, A. R. Hall and R. C. White, *Australian Banking and Monetary Statistics, 1817–1945*, (Sydney: Reserve Bank of Australia Occasional Paper 4A, 1971), Tables 12 and 42. The New Zealand monetary data for 1920–38 are from M. F. Lloyd Pritchard, *An Economic History of New Zealand to 1939*, (Auckland and London: Collins, 1970), p. 432. For 1938, the Reserve Bank note issue is from *Reserve Bank Bulletin, Decimal Currency Statistical Supplement* (1967), Part A, p. 22. For 1870–1918, the quarterly *Banking Returns* in *N.Z. Gazette* are used. Generally, the average of quarterly data is used, but anyone familiar with these sources will recognize that such sophistication belies the slight differences in dating which are ignored. The New Zealand export and import figures referred to are from J. B. Condliffe, “The External Trade of New Zealand,” *N.Z. Official Year Book* (1915), p. 924.