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**TESTS OF CURRENCY
BOARD ORTHODOXY USING
HIGH-FREQUENCY DATA**

Currency Board Working Paper

SeungJae Oh

Johns Hopkins Institute for Applied Economics,
Global Health, and Study of Business Enterprise



Tests of Currency Board Orthodoxy Using High-Frequency Data from Palestine, the Straits Settlements, and West Africa

By Seung Jae Oh

About the series

The *Studies in Applied Economics* series is under the general direction of Professor Steve H. Hanke, Co-Director of the Institute for Applied Economics, Global Health and Study of Business Enterprise (hanke@jhu.edu).

This working paper is one in a series on currency boards. The currency board working papers will fill gaps in the history, statistics, and scholarship of the subject. The authors are mainly students at The Johns Hopkins University in Baltimore. Some performed their work as research assistants at the Institute.

About the Author

Seung Jae Oh (soh32@jhu.edu) is a senior at Johns Hopkins University in Baltimore, majoring in applied mathematics and statistics. He conducted this research for Prof. Steve Hanke as a yearlong seminar course, ending in the spring of 2013. He thanks Nick Krus and Kurt Schuler for comments.

Summary

This paper examines the orthodoxy of the 20th-century currency boards of Palestine, West Africa (Nigeria, Ghana, Sierra Leone, and Gambia), and the Straits Settlements (Singapore). These currency boards were chosen because of the availability of high-frequency data and because they were among the largest currency boards of their time (in terms of their total assets).

The high-frequency financial statements that were used to conduct tests of orthodoxy had various problems of incompleteness. Therefore, it could not be definitively proven whether the currency boards were orthodox. In addition to this, the gaps in coverage on the asset side clearly limited the potential uses of these data. Despite this shortcoming, this paper presents the results of different orthodoxy tests, by appropriately extrapolating annual data where there were no monthly data. It is my intent that this information will be useful for future academic endeavors.

Research Goal

This paper examines the orthodoxy of the 20th-century currency boards of Palestine, West Africa (Nigeria, Ghana, Sierra Leone, and Gambia), and the Straits Settlements (Singapore). In order to test how these currency boards operated, the first step was gathering and entering (by hand) high-frequency (semiannual to monthly) data from the government gazettes and annual reports of the currency boards. These currency boards were chosen because of the availability of high-frequency data and because they were among the largest currency boards of their time (in terms of their total assets).

The high-frequency financial statements had problems of incompleteness. For example, while the annual reports exhibit detailed information¹, the gazettes only show whole amount of currency notes in circulation, investment portion of the note guarantee fund, and the dollar amount of gold and silver in the Colony and in London.

Furthermore, the statements for the Palestine and West African currency boards only show securities as assets; they exclude other assets, the most important of which are bank deposits.² The statements for the Straits Settlements currency board only show notes as assets; they exclude coins. The annual balance sheets for the Straits Settlements board do have information on coins, though only for one month of the year.

Therefore, it could not be definitively proven whether the currency boards were orthodox. In addition to this, the gaps in coverage on the asset side clearly limited the potential uses of these data. Despite this shortcoming, this paper presents the results of different orthodoxy tests, by appropriately extrapolating annual data where there were no monthly data. It is my intent that this information will be useful for future academic endeavors.

Research Procedure

High-frequency money supply data for Palestine, Straits Settlements, and West Africa in the early 20th century are unavailable in the International Monetary Fund's *International Financial Statistics*. Therefore I used the primary data collected by Nick Krus. This paper utilizes particular monthly, quarterly, and annual data for the following currency boards:

¹ This information consisted of currency notes, silver coins, joint circulation, denominations of notes, cancellation of notes, reserve coin, coin receipts and issues, active circulation of notes and silver, subsidiary silver, nickel coin, copper coin, total circulation, re-minting, exchange, etc.

² On the asset side, currency boards held some of their assets in the form of bank deposits in London when they were waiting to invest the funds in securities. They also often held small bank deposits locally so they would have funds for paying staff salaries and meeting other business expenses. On the liability side, some currency boards accepted deposits from banks for the convenience of banks wishing to hold reserves at the currency board instead of just currency board notes and coins.

Palestine Currency Board: 1927 to 1951,
The Straits Settlements Board of Commissioners of Currency: 1905 to 1937,
West African Currency Board: 1913 to 1964.

The Palestine and West African high-frequency data are nearly complete, spanning nearly the full lives of the currency boards. The Straits Settlements data have more gaps and also do not cover the whole period of existence of a currency board in Singapore, which extended to 1970. These data collected are summaries of balance sheet data that are necessary to test the orthodoxy of the currency boards.

I have worked to consolidate and organize the high-frequency data of these currency boards for them to be easily usable by current and future researchers. These data are useful for establishing end of calendar year statistics, which the annual reports cannot do since none of these currency boards operated on a calendar year basis. Also, the high-frequency data can be used to investigate seasonal patterns, and therefore they may give insight into economic activity at a much more detailed level than annual data can.

Nicholas Krus of the Johns Hopkins University photographed copies of most of the official documents that formed the source material for the spreadsheets. He obtained the source documents at the Library of Congress in Washington D.C. and from various libraries in London and Cambridge, England. Prof. Steve Hanke obtained photographs of some issues of the annual reports in effort to fill gaps among data, but some gaps in the source documents remain. Bryant Lie and Nick Krus did a considerable amount of preliminary work on the spreadsheets. I brought the work they started as close to completion as is currently possible given the documents available.

Data were collected in the form of Microsoft Excel spreadsheet. On the spreadsheet, which I received from Dr. Schuler, I have:

- (1) Transcribed these data found in the primary sources, which are gazettes of Palestine, the Straits Settlements, and, for West Africa, Nigeria.
- (2) Transposed these data so that the dates read down the columns instead of across the rows.
- (3) Checked these data for oddities to ensure that there were no numerical or typographical errors and sent them to Dr. Schuler and Nick Krus, who found more data to fill some holes.
- (4) Ran several fundamental tests, which I explain further below.

Statistical Tests Conducted

The following section explains the statistical measures calculated from the Palestinian, Straits Settlements, and West African data. These calculated figures measure how closely the currency boards would have conformed to an orthodox currency board. I

ignored the dates for which we did not have any data in order to preserve consistency. The following are a few useful tests and ways to interpret the results.³

1. Net domestic assets as a percentage of the monetary base: By definition, an orthodox currency board holds all or almost all of its assets as foreign assets. These assets should be equal to or slightly exceed 100% of the monetary base (notes and coins issued by the currency board that are in circulation among the public or held by banks, plus any deposits that banks have at the currency board). Holding domestic assets introduces a temptation to use monetary policy to finance government budget deficits, replacing high-quality foreign assets in the currency board's portfolio with lower-quality domestic assets. So, this test for orthodoxy is calculated by finding the net foreign assets of the currency board as a percentage of the monetary base (net foreign assets are foreign assets minus foreign liabilities – you have to pay attention to the liabilities as well as the assets).
2. Reserve pass-through: The “reserve pass-through” should be close to 100%. According to Prof Hanke, “If a monetary authority is operating as an orthodox currency board, changes in the monetary base only contain a foreign component and the sterilization coefficient is zero (or close to zero).”⁴ Since reserve pass-through is the change in the monetary base divided by the change in foreign reserves (sterilization coefficient plus 1), it should stay around 100%. In other words, an orthodox currency board does not have discretionary monetary policy, when it gains or loses reserves, the monetary base should rise or fall accordingly. However, this simple account neglects that currency boards earn interest and pay expenses in “lumpy” ways instead of smoothly every month. Prof. Hanke and Dr. Schuler found that calculating reserve pass-through on a month-over-month basis does not seem very useful, so I followed their procedure and calculated it on a year-over-year basis in order to eliminate any cyclicalities.
3. Percentage change in net domestic assets (NDA): Nicholas Krus suggested this ratio as an experimental measure. As a currency board should hold close to zero domestic assets or liabilities, this ratio measures by what extent the currency board deviated from orthodoxy by holding domestic assets. The advantages of using this ratio compared to the reserve pass-through are that there is no division required in this number so it will never “blow up” from a small denominator. It is also very easy to understand. The disadvantages are that the net domestic assets are small to start with (say 1% of reserve money) and

³ Summary of the equations used: $MB = NDA + NFA$

Reserve pass through = the change in monetary base/ the change in net foreign assets

The change in NDA = the change in net domestic assets/ the previous period's domestic assets

NDA/MB = Net Domestic assets/monetary base (= currency in circulation, or reserve money)

⁴ Hanke, Steve H. "On Dollarization and Currency Boards: Error and Deception." *Policy Reform* 5.4 (2002): 203-22.

that if one has a small increase nominally, you get a large number in percentage terms (say 2% of reserve money, a 100% increase).

4. Percentage contribution by net domestic assets: This measure is defined by the change in domestic assets divided by the previous period's monetary base. Nicholas Krus also suggested this ratio as an experimental measure. The advantage of the ratio is that the denominator will always be large. In other words, this way precludes running into any of the disadvantages of the reserve pass-through. The disadvantage of this metric is that it may be harder to comprehend than other metrics mentioned above.

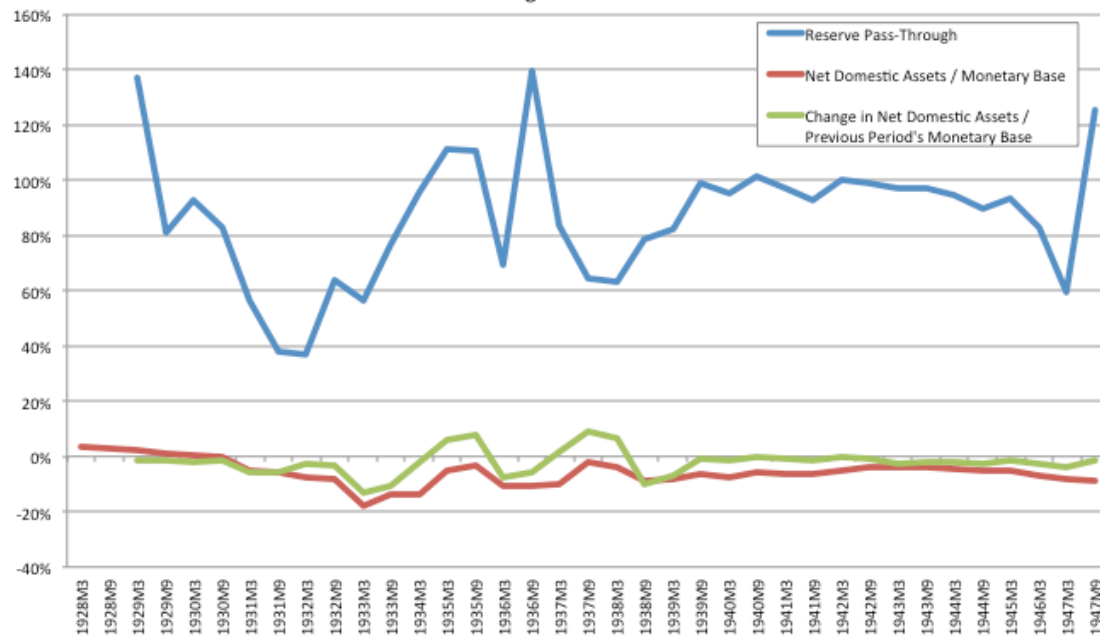
Data Presentation

For Palestine, in the semiannual listings of securities (for the months of March and September), given in the *Palestine Gazette*, the securities are not all the assets of the Palestine Currency Board. The Board held a large share of its assets in bank deposits, which are only listed in the annual report and not in the semiannual Palestine Gazette notices. For instance, the 1948 annual report shows the board holding 48% percent of its assets in bank deposits as of March that year. So, we need a different measure for assets. Since $\text{assets} = \text{liabilities} + \text{equity}$, Dr. Schuler suggested adding the Currency Reserve (which included notes and coins) to the Investment Reserve and assuming that sum equals total assets. Comparing the monthly financial statements to the annual reports indicates that my figures for total assets in March, the end of the Palestine Currency Board's financial year, are the same as or very close to those in the annual report.

In the annual report, there is an item on the asset side of the balance sheet for "bank deposits," which needs further investigation to ascertain whether they were bank deposits in Palestine (local assets) or in London (foreign assets). Consequently, I made two different calculations of net foreign asset ratios. In Figure 1, I assumed that the bank deposits were foreign assets.

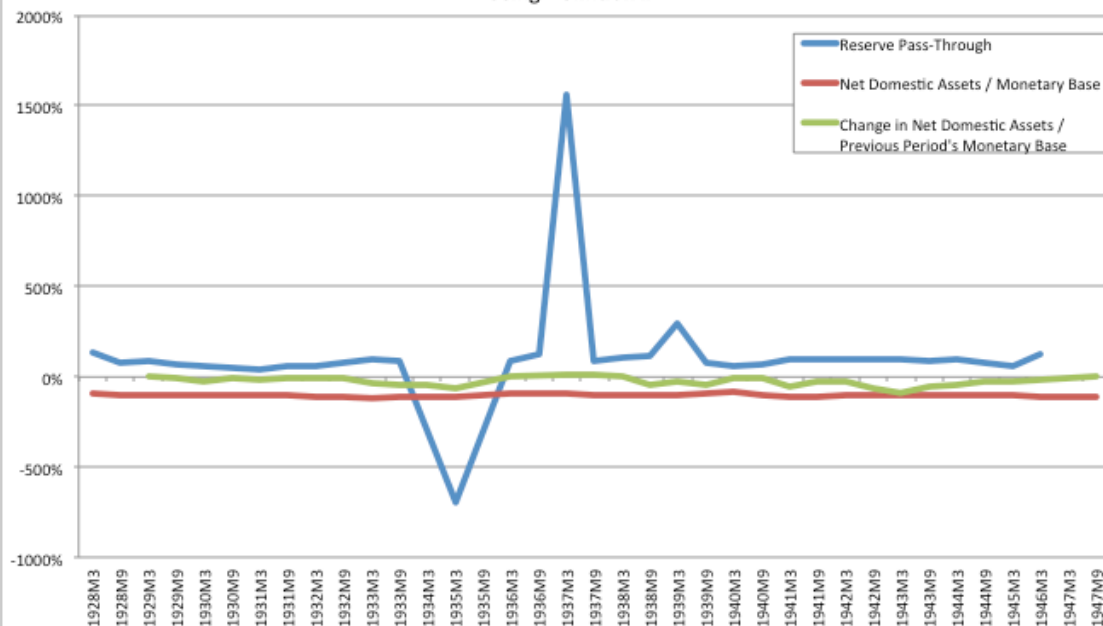
In Figure 2.1 and 2.2, I assumed that the "bank deposits" were a domestic asset. It is important to note that in column F of the "Selected data and calculations" sheet, for each September from 1936 to 1940, I used an average of the previous March and the subsequent March.

Figure 1: Palestine Currency Board - Test of Currency Board Orthodoxy
Using Definition #1

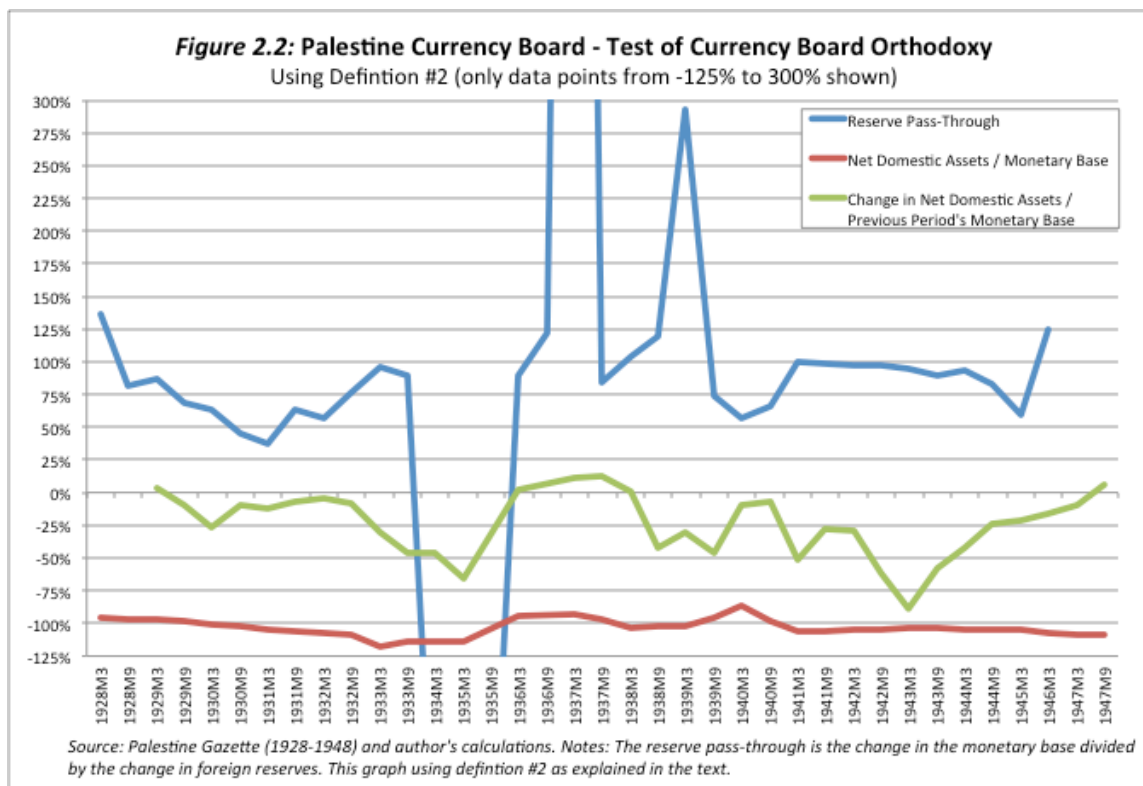


Source: Palestine Gazette (1928-1948) and author's calculations. Notes: The reserve pass-through is the change in the monetary base divided by the change in foreign reserves. This graph using definition #1 as explained in the text.

Figure 2.1: Palestine Currency Board - Test of Currency Board Orthodoxy
Using Definition #2

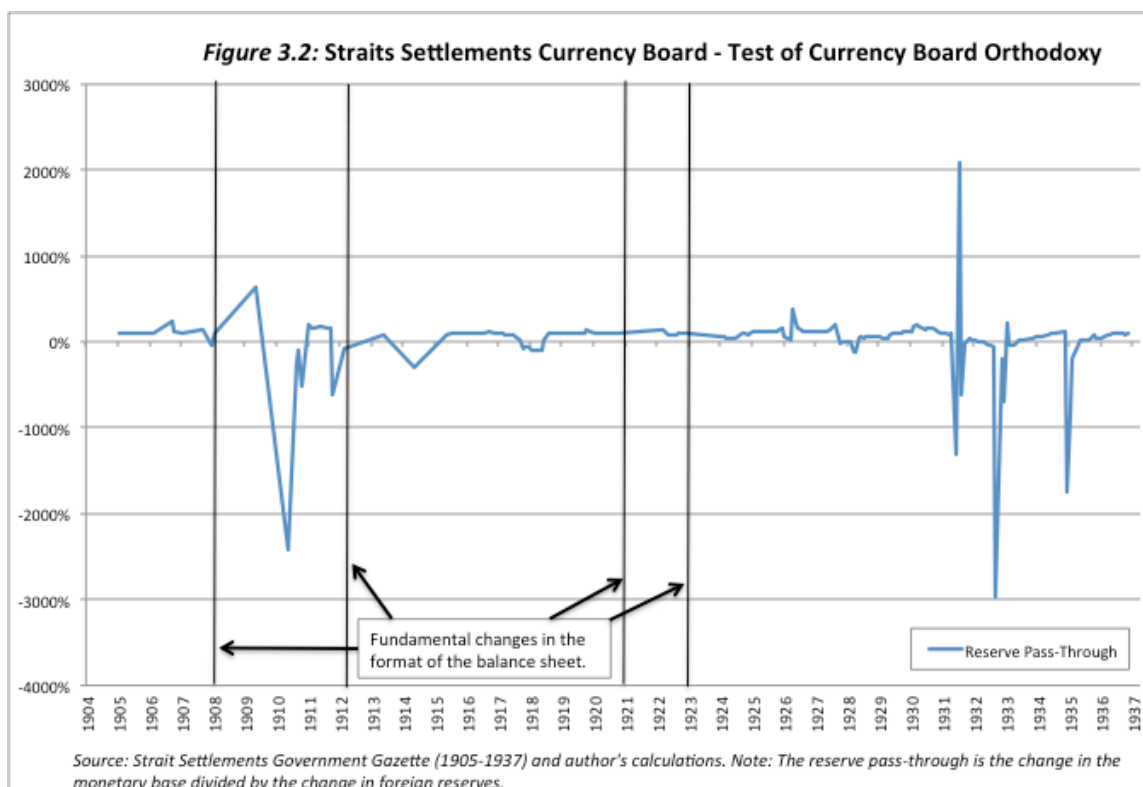
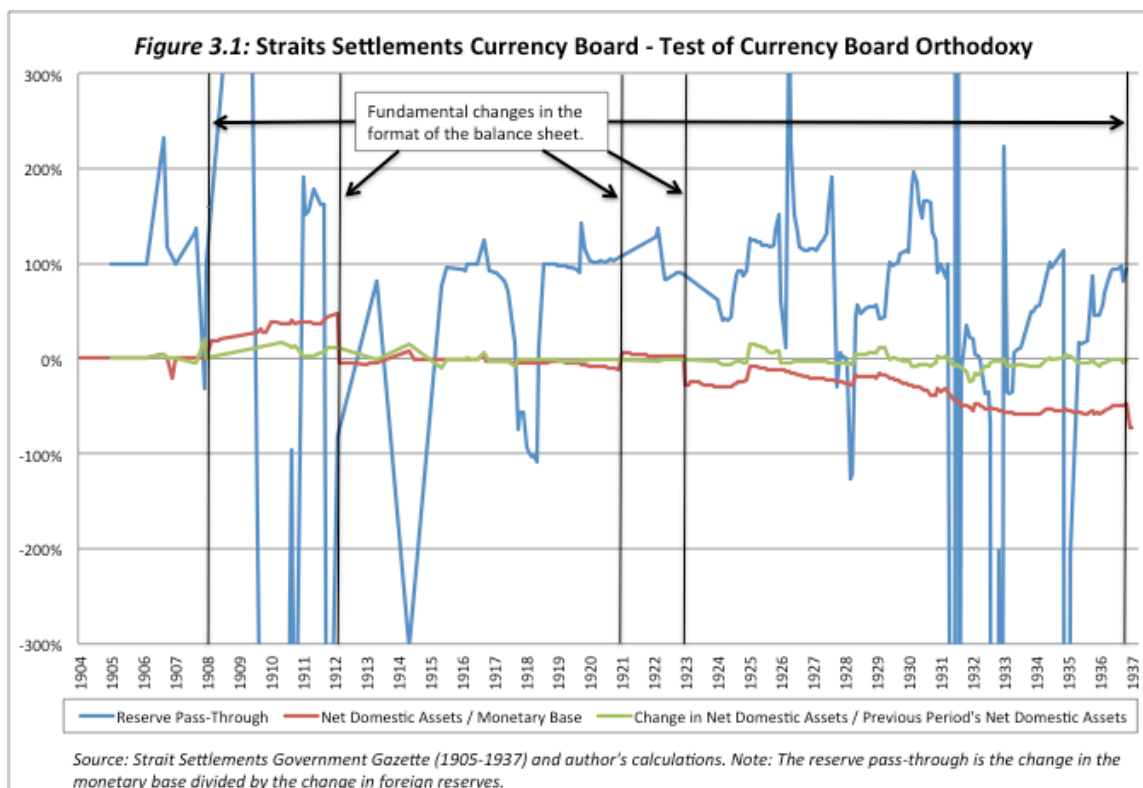


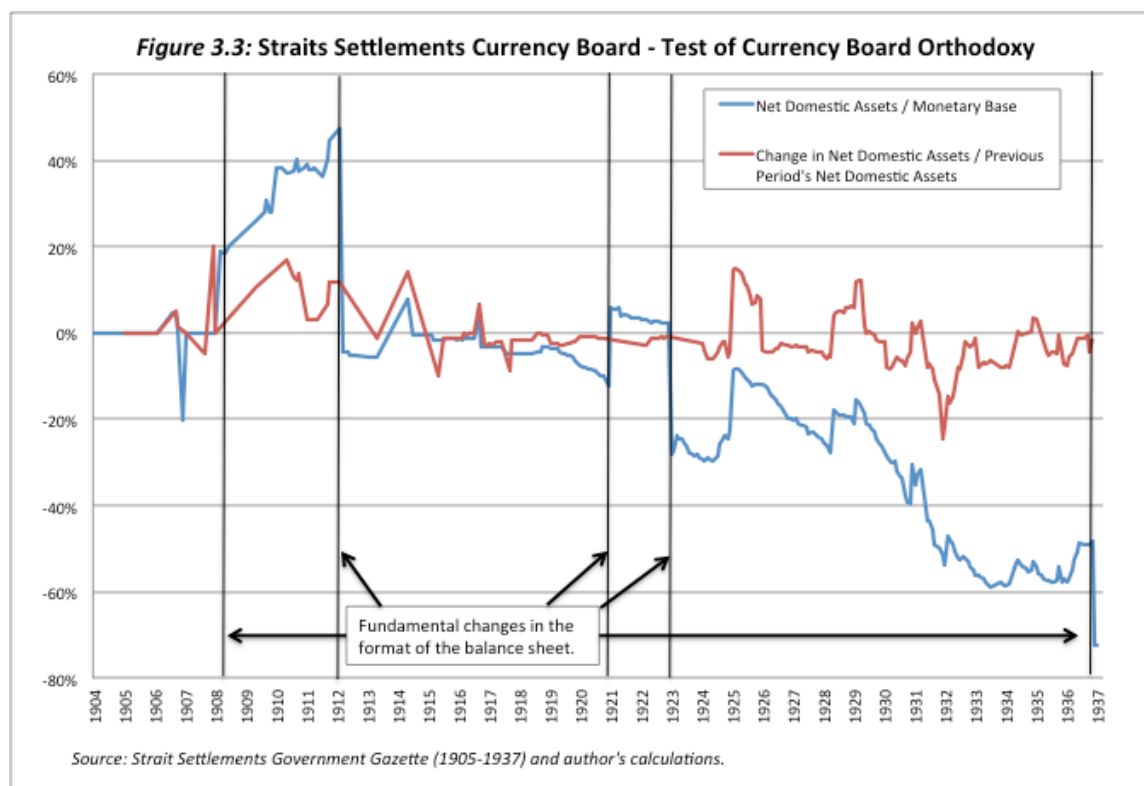
Source: Palestine Gazette (1928-1948) and author's calculations. Notes: The reserve pass-through is the change in the monetary base divided by the change in foreign reserves. This graph using definition #2 as explained in the text.



For the Straits Settlements currency board, I did not use these data previous to August 1908, because the board did not have any domestic assets. Thus, in the years from 1905 to 1907, the reserve pass through for the Straits Settlements currency board was exactly 100%—in other words, the change in monetary base matched the change in net foreign assets exactly. Moreover, the board had a fluctuating exchange rate from October 3, 1903 to January 28, 1906, during a period when the Straits Settlements were preparing to change from silver to a gold standard. On January 29, 1906, the governor of the Straits Settlements established an exchange rate that lasted through the end of the period of these data here, and beyond.

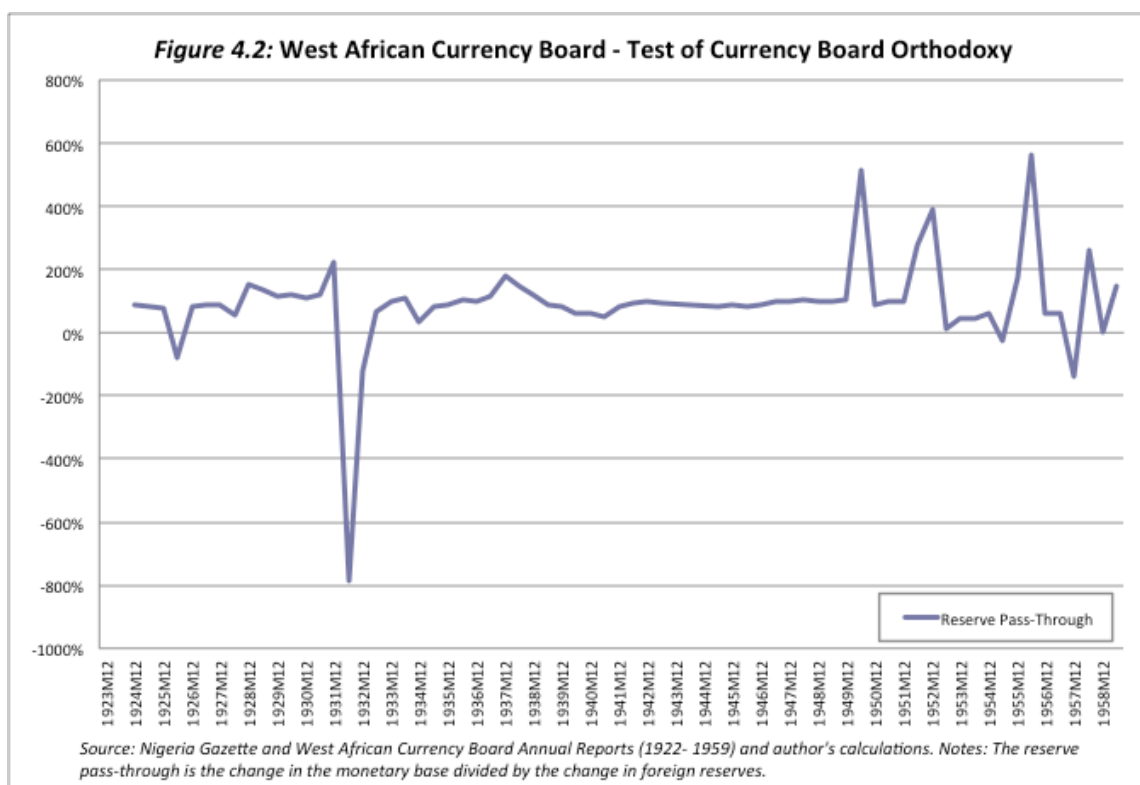
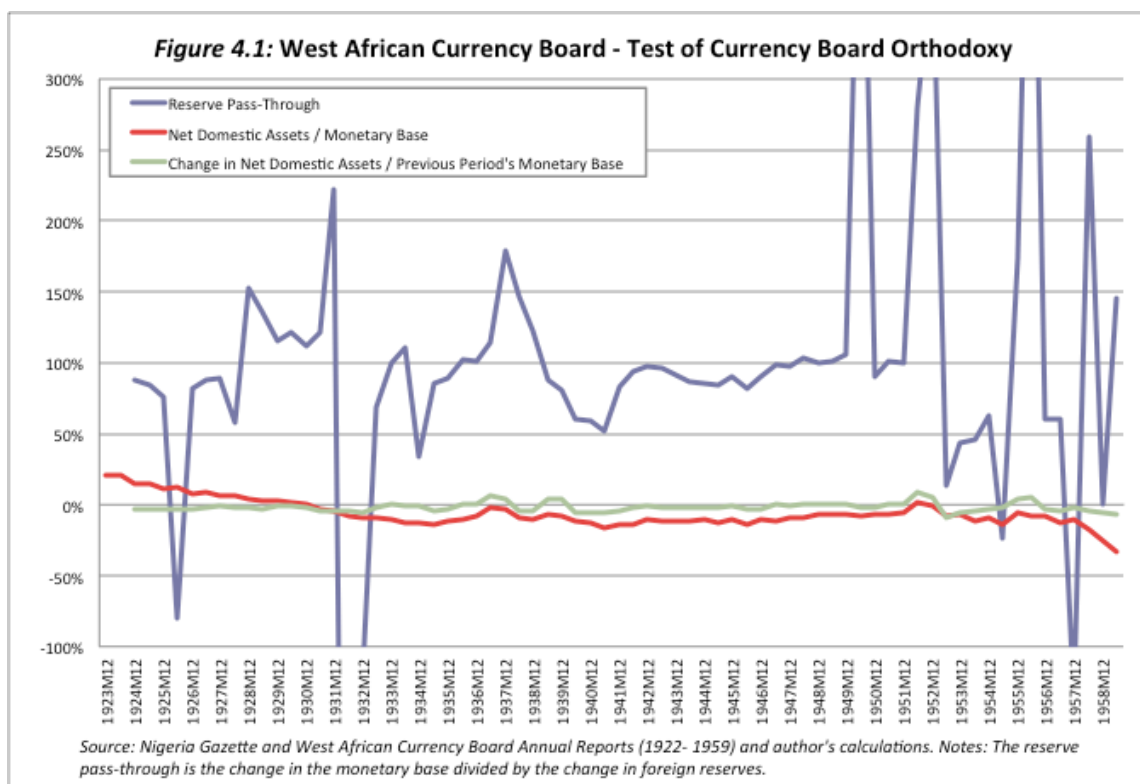
Further, I performed basic statistical analysis on these data up to 1937. However, there are annual reports for Straits Settlements up to the 1960s, and one can easily extrapolate these annual data to analyze more recent performance of Straits Settlements currency board. Nonetheless, the focus of this paper is to test the orthodoxy of particular currency boards with high-frequency data. Thus, I did not use the data beyond 1937. In 1938 the Straits Settlements currency board broadened its membership and governance to include what is now peninsular Malaysia. High-frequency data from 1941 to 1950 exist for the Board of Commissioners of Currency Malaya, the successor body, but it is not certain whether these data after 1950 exist. I have also indicated five instances in which changes in the format of the balance sheet fundamentally changed: Dec. 1908, Feb. 1913, Dec. 1921, Dec. 1923, and Nov. 1937. In each of these instances, line items were either added or removed which drastically changed the results of these tests.

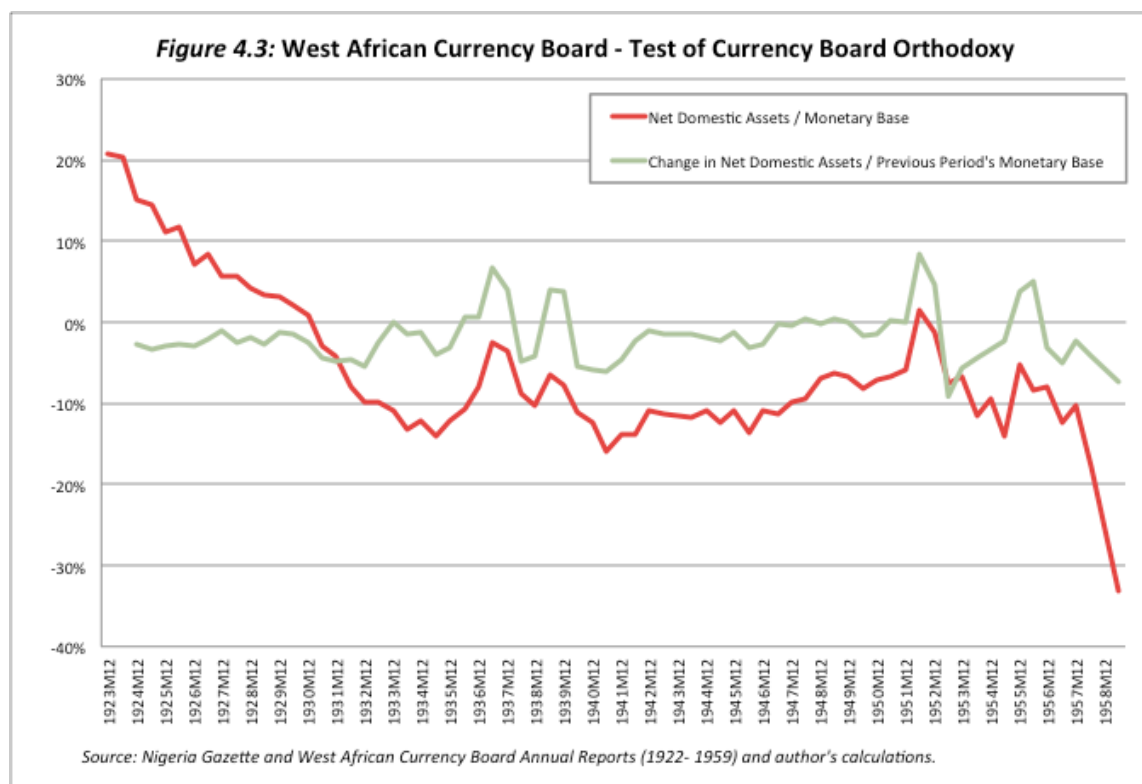




For the West African Currency Board, I began coverage in 1923 because that is when data in the *Nigeria Gazette* begin for the West African Currency Board as a whole rather than only for Nigeria. The first several years, which only cover the Note Fund, are not useful because they omit coin liabilities, which at that time greatly exceeded note liabilities. With these data from 1923, I calculated the reserve ratio (Total currency in circulation/Total of currency reserve fund and Investment reserve account), shown in Figure 1. I also sought to see whether securities varied in some fairly stable proportion to changes in the monetary base.

From the West African Currency Board data on Nigeria alone, there is not much information I could extract. However, I checked whether Nigerian currency outstanding (in circulation) seems to maintain a fairly stable proportion to the WACB's currency outstanding as a whole (every 6 months). Remember that these asset data are incomplete. Thus, the results might seem somewhat strange. As I mentioned above, I only provide the most basic data and analyses. I leave it to later investigators to utilize these data as they see fit.





Analysis and Conclusion

Palestine

There are two noticeable features from the Palestinian data: first, the drop in the change in NDA in 1931 (shown in Figure 1) and second, the bump of reserve pass through in 1939 (shown in Figure 2). The root of the problem is the NDA, which drops from £44,584.7 in 1929 to -£118,473.45 in 1931.

Negative net domestic assets means that net foreign assets exceeded 100% of the monetary base, and such a situation was pretty common for currency boards. Generally, they held some amount above 100% reserves, generally up to 10 or 15% extra, to guard against the depreciation of their assets and ensure that even in such a case net foreign reserves would be at least 100%.

Straits Settlements

Straits Settlements currency board's graph displays three aberrations: one in 1915, another one in 1928, and the other one in 1933. As the 1915 annual report for Straits Settlements currency board was not available, I could not find out the reason the monetary base increased so much relative to net foreign assets, which had barely changed.

In 1928, net foreign assets decreased by \$1,664,165.04 while the monetary base increased by \$18,575,741.88. In 1933, net foreign assets decreased by \$236,005.92 while the monetary base decreased by \$3,489,949.81. Since the 1928 and 1933 annual reports were at our disposal, and I quote the potential explanations below.

According to the *Report on the Working of the Currency Department for the Period 1st October, 1927—30th September, 1928*,

2. The value of notes in circulation on the 30th September, 1928, was \$115,563,157.70 and, as is shown in the above table, the Commissioners then had assets worth \$169,824,509.63; that is to say, for every \$100 liability on the note issue they had assets worth \$147.

3. This figure is appreciably higher than the corresponding figure of \$138 for the 30th September, 1927. The rise is due chiefly to the decrease in the amount of notes in circulation.

4. The liquid portion of the Currency Guarantee Fund, which was 55.6 per cent of the value of the notes in circulation on the 1st October, 1927, had risen to 58.1 of the note circulation on the 30th September, 1928. These figures are both far in advance of the statutory minimum, which is two-fifths of the amount of the notes for the time being in circulation.

5. The unlimited legal tender silver in the reserve at the beginning of the period represented 13.4 per centum of the value of the notes then in circulation, but this percentage had risen to 14.1 at the end of the period under review. The statutory minimum holding of silver is ten per centum of the notes in circulation, and there was therefore ample compliance with the law. If the gold held in the Colony is added to the silver reserve the percentage become 16.5.

CURRENCY NOTE CIRCULATION

6. There was a small deflation of the currency notes in circulation during the period under review. The amount in circulation on the 1st October, 1927, was \$117,395,954.70 and on 30th September, 1928 was \$155,563,157.70—a decrease of \$1,832,797 or 1.6 per cent. The deflation was mainly due to the fall in the prices of rubber and tin in the latter half of the year under review. There was a further deflation in January 1929, at the end of which month circulation had dropped to \$113,001,724.20.

According to the *Report on the Working of the Currency Department for the Period 1st October, 1932—30th September, 1933*,

2. The value of notes in circulation on the 30th September, 1933, was \$66,934,386.70 and, as is shown in the above table, the Commissioners then had dollar assets worth \$130,739,342.30; that is to say, for every \$100 liability on the note issue they had assets worth \$195. This figure is higher than the corresponding figure of \$191 for the 30th September, 1932, notwithstanding the transfer of \$5 millions to the General Revenue of the Colony. In view of the great interest which has been aroused in currency problems, it should be stated that the Straits Settlements dollar is linked to Sterling and is fixed at the value of 2/4d. in terms of that currency.

3. The liquid portion of the Currency Guarantee Fund, which was 60.9 per cent of the value of the notes in circulation on 1st October, 1932, had risen to 65.9 of the note circulation on the 30th September, 1933. These figures are both far in advance of the statutory minimum, which is two-fifths of the amount of the notes for the time being in circulation.

4. The unlimited legal tender silver in the reserve at the beginning of the period represented 28 per centum of the value of the notes then in circulation, but this percentage had risen to 29 at the end of the period under review. The statutory minimum holding of silver is ten per centum of the notes in circulation, and there was therefore ample compliance with the law.

In order to definitively pinpoint the cause of the unusually uncorrelated change in net foreign assets and monetary base in 1928, further investigation is necessary.

West Africa

Net domestic assets being negative means that net foreign assets exceeded 100% of the monetary base. That was pretty common for currency boards. Generally they held some amount above 100% reserves, generally up to 10 or 15% extra, to guard against the depreciation of their assets and ensure that even in such a case net foreign reserves would be at least 100%. In the first few years, apparently, the West African Currency Board did not hold 100% net foreign reserves, perhaps because of start-up costs. Thus, it would be easier to just consider net domestic assets to be zero for analytical purposes when they are less than zero.

The West African currency board's reserve ratio hovered around 0.98 with standard deviation 0.11, and its securities remained fairly stable in relation to the monetary base, as the average of the differences between the change in monetary and the change in securities was 12% with the standard deviation of 27%.

The Nigerian currency outstanding seems to be in a fairly stable proportion (49% on average with 3% standard deviation) to the WACB's currency outstanding. Also, the sharp increase in the change in NDA was probably an unusually large distribution of

profits to member countries of the West African Currency Board, which diminished assets by 2 million pounds. In 1953, the monetary base increased sharply with regard to a decline in net foreign assets. The cause of this phenomenon needs further scrutiny, but here I quote the *Report of the West African Currency Board for the year ended 30th June, 1954*.

“During the year ended 30th June, 1954, issues of currency in British West Africa against payment in sterling in London exceeded in total the amount of currency redeemed, for which the Board was called upon to pay sterling in London, by £3,644,000. This net increase of currency in circulation compared with a net increase of £3,329,000 during the previous year when the totals of issues and redemptions were similar ...”

“For a period of three months during the year the total recorded circulation of the Board’s currency exceeded £100,000,000 but it fell again and on the 30th June, 1954, the total recorded circulation was £94,059,641 compared with £90,536,321 at the 30th June, 1953.”

“During the early months of the year under review very substantial supplied of the notes of new design in the denominations 10s., 20s., and 100s. or £5 were shipped to West Africa and arrangements were completed for the issue of these notes early in October, 1953, throughout the four Territories. The new notes proved to be popular and within three or four months of their first issue much of the entire note circulation had been exchanged. The whole of this operation as carried out smoothly and the Board are pleased to record their appreciation of the excellent team work on the part of all concerned in this achievement.”

Aside from the sudden drop in the reserve ratio of the West African currency board in 1953, both the West African currency board and the Palestinian currency board followed the benchmark of the orthodox currency board fairly closely. However, these data still have some holes, and complete historical background was not incorporated in my interpretation. Thus, further investigation is needed to definitively prove the orthodoxy of the currency boards. It also bears remembering that statistical tests may need to be supplemented by narrative history for a full understanding of the extent to which a currency board was orthodox or not. What look like departures from orthodoxy may result from changes in accounting or management practices.

Companion Spreadsheet Workbooks

(All of these are in Microsoft Excel.)

Palestine Currency Board

Straits Settlements Board of Commissioners of Currency

West African Currency Board

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