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**THE CORRESPONDENCE
BETWEEN ANNUAL AND
HIGH-FREQUENCY DATA FOR
SELECT CURRENCY BOARDS**

Currency Board Working Paper

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Global Health, and Study of Business Enterprise



The Correspondence between Annual and High-Frequency Data for Select Currency Boards

By Benjamin Tsoi and Nikolaos Kotoulas

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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 for the Currency Board Project. 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 who have conducted their work at the Institute as undergraduate researchers.

About the Authors

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Summary

The following analysis uses annual and high-frequency data for currency boards in select countries (Iraq, Kenya, Palestine, and West Africa) to determine if the high-frequency balance sheet values such as assets, liabilities, and notes and coins in circulation can be used to approximate the corresponding annual balance sheet values. Each currency board existed at different periods of time and utilized slightly different accounting techniques to determine what was included or excluded from the annual and high-frequency statements; hence it is necessary to evaluate each currency board individually. Overall, high-frequency data do provide consistent estimators for annual data because high-frequency statements tend to only omit items of relatively small value, and at-cost values of the items included do not vary greatly from their market values in the short run.

Acknowledgments

We thank Nicholas Krus and Dr. Kurt Schuler for comments.

Introduction

Purpose

Under the guidance of Professor Steve H. Hanke and with additional advice from Dr. Kurt Schuler, student researchers at The Johns Hopkins University have compiled an extensive collection of primary source material on currency board systems from libraries and government institutions all over the world. The material includes currency board annual reports, abbreviated monthly or quarterly financial statements, government gazettes, statistical abstracts, annual reports of government operations, and other publications. The primary source material has been or is being transcribed onto spreadsheets in order to better organize and analyze the data.

For many currency boards, student researchers have collected both annual data and high-frequency data (usually monthly or quarterly). Annual data, often issued in individually published annual reports, are typically quite detailed, accounting for all assets and liabilities and going so far as to list individual securities held on the asset side and a breakdown of currency by denomination on the liability side. High-frequency data, almost always published in government gazettes, are typically less detailed, perhaps omitting some assets and omitting liabilities other than notes and coins in circulation. Therefore, in the high-frequency data, assets may not equal liabilities because certain items may be excluded. In addition, each currency board uses its own accounting method to determine what is included in accounting items such as assets and liabilities so it is important to comment on each currency board individually. The stylized balance sheet below illustrates the typical differences between annual and high-frequency data.

Assets	Liabilities and Net Worth
Foreign assets	Foreign liabilities*
—Precious metals	Domestic liabilities
—Securities	—Monetary base: notes in circulation
—Deposits*	—Monetary base: coins in circulation (if issued by currency board rather than treasury)
—Other*	—Monetary base: deposits or other (if any)*
Domestic assets	—Other*
—Securities	Net worth*
—Deposits*	
—Other*	

* These items are included in annual balance sheets or “estimated general positions,” but are often excluded from higher-frequency financial statements.

Also, note that securities may be stated at cost or at market value. For currency boards that published both a balance sheet and an “estimated general position,” the balance sheet typically evaluates securities at cost while the estimated general position evaluates them at market value. Higher-frequency financial statements sometimes list securities only at cost, while other times they list both at cost and at market value, and these distinctions will be clarified in the analyses of each currency board.

Our goal here is to utilize the annual and the high-frequency data as complements, using each kind of data to give highly accurate estimates of the other where figures are missing or incomplete. Comparing balance sheets will determine if sufficient evidence exists to claim that it is possible to relate the two data sets and determine what percentage of the assets and liabilities in the balance sheet for the annual

data of the currency board is included in the high-frequency data. This paper will provide guidelines and outline assumptions made on how to estimate annual data for each currency board. For countries where there are full sets of annual and high frequency data, the guide will precisely quantify the relationship and explain the causes for discrepancies between the two data sets. Not only can missing data be properly estimated, but studying the relationship between annual and high-frequency data will also yield insights into the data collection methods and the different components of the balance sheets for each currency board.

Format

The paper consists of two parts. The **Guide to Relating High-Frequency Data to Annual Data** provides analyses for the currency boards that have annual data and high-frequency data collected so far and draws conclusions on whether each currency board has sufficient data to make estimations. The **References** cites sources of the data (mostly annual and high-frequency reports) and indicates that the calculations and analyses of the data can be found in the spreadsheet “Annual and High-Frequency Data Analysis.”

In the **Guide to Relating High-Frequency Data to Annual Data**, the analysis for each country will have three sections:

- **Source of Data:** Lists and explains the years studied and the sources of the annual and high-frequency data used in the analysis.
- **Relationship:** For each year where annual and high-frequency data exist, determines the percentage of the assets recorded in the annual data that is also in the high-frequency data. The annual data are for the year ending in a specific month (such as March 31), so we use the high-frequency data for that month as the point of comparison. We use the same method to determine if differences exist on the liabilities side of the balance sheet. These calculations are summarized as the average total high-frequency assets and liabilities as a percentage of annual assets and liabilities. We use this average as the estimate for the assets and liabilities for missing annual data if the corresponding high-frequency data exist. The estimate is more accurate in determining data for years in-between years where the data derive from (or very near those years given that no known major events occurred that would have caused substantial changes in the values of the assets and liabilities or the way they are recorded). In addition, notes and coins in circulation values in the annual and high-frequency data will be juxtaposed in order to establish that the monetary base values are consistent.
- **Causes of Differences:** Determines what accounting values have been omitted or included in the high-frequency data of the assets and liabilities do not match those in the annual data. Oftentimes, the balance sheets will give detailed summaries of what selected items are included in the assets and liabilities. The differences in assets, liabilities, and notes and coins in circulation are separately explained.

In the **References**, each source is listed with the following information, if available:

- Name of document.
- Publisher.
- Name of publication that the document is found in.
- Copyright information.

Guide to Relating High-Frequency Data to Annual Data

IRAQ

I. Data

Years studied: 1933-1949 (annual data for the year ending on March 31 and high-frequency data for the month of March ending on March 31). The Iraq Currency Board existed from late 1932 until 1949 and its financial data are available for all those years.

Sources: The Iraq Currency Board issued its annual report as a separate publication. The high-frequency statements appear in the government gazette. We compare the Estimated General Position in the annual report to the statements provided in the gazettes (high-frequency data). We used the Estimated General Position because it provides the most accurate picture of assets and liabilities. It values assets and liabilities at market value, whereas the balance sheet values them at cost.

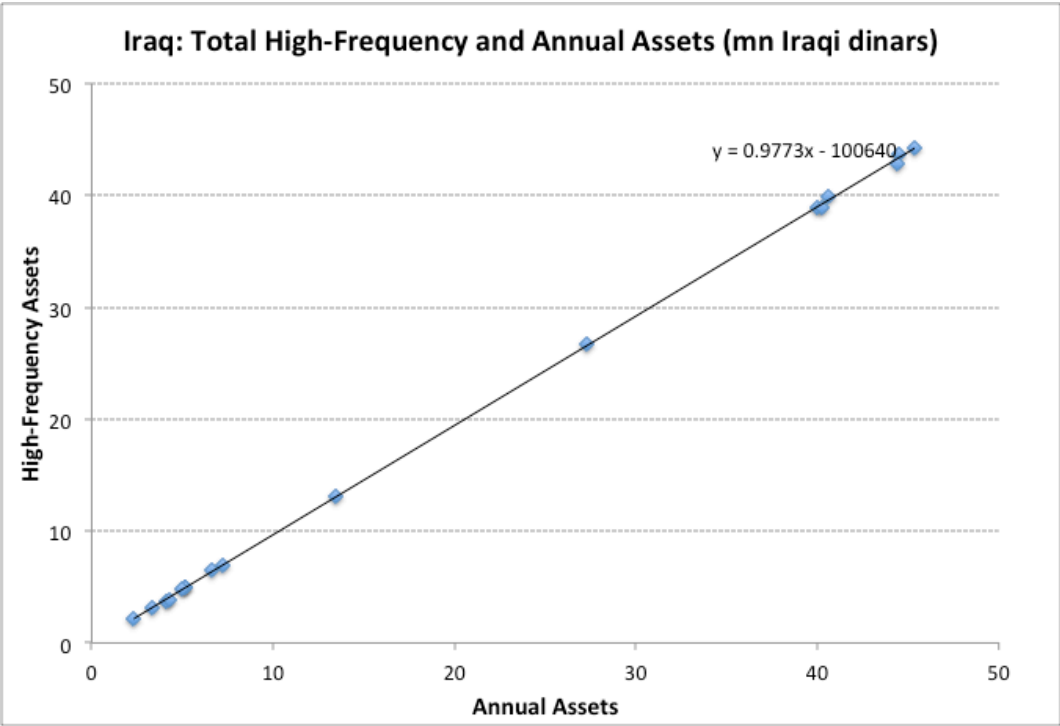
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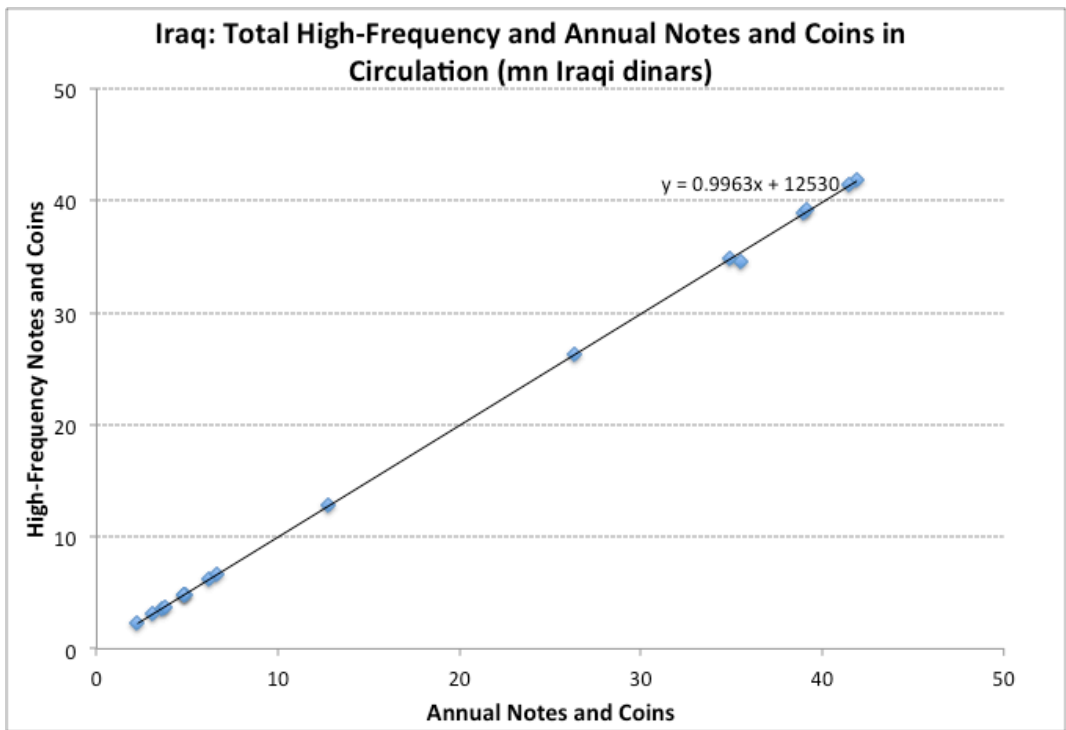
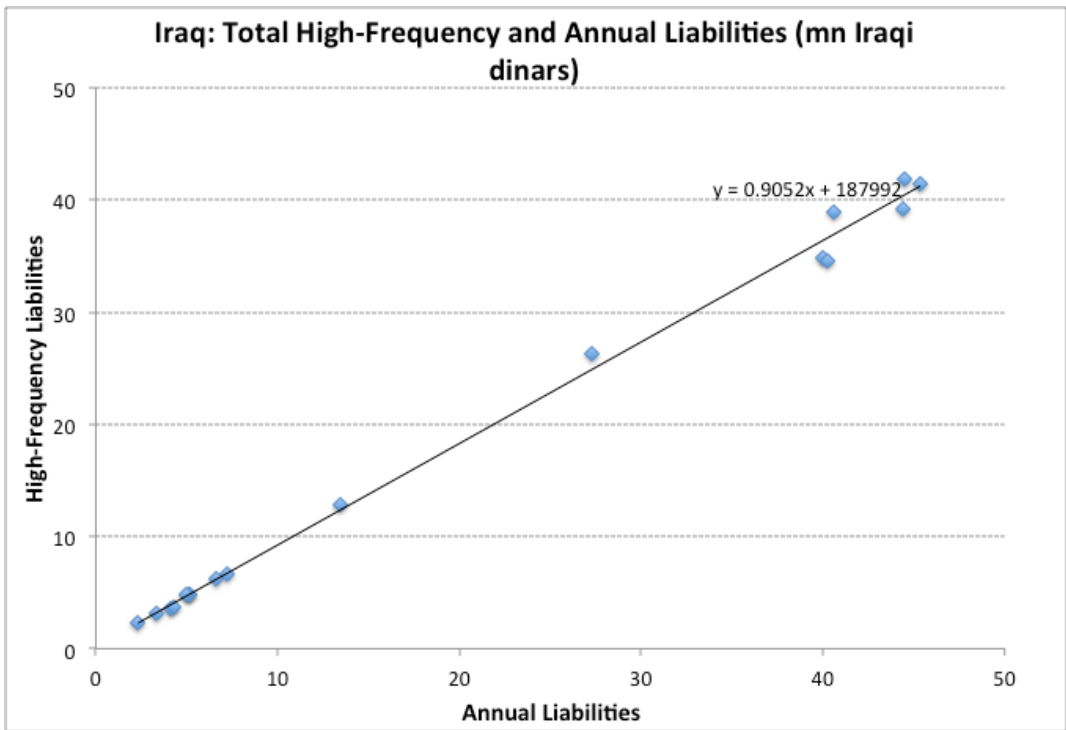
Average total high-frequency assets as a share of total annual assets: 96.17%.

Average total high-frequency liabilities as a share of total annual liabilities: 92.39%.

Average total high-frequency notes and coins in circulation as a share of total annual notes and coins in circulation: 99.84%.

* See the full data sets in the spreadsheet titled "Annual and High-Frequency Analysis."





III. Causes of Differences

Assets

The high-frequency data on the asset side only include the Currency Reserve Fund, which contains securities and omits bank deposits. For the month of March every year only the at-cost values of the assets are available, so they are the values used in the analysis. However, the annual data provide an Estimated General Position balance sheet that values assets at market value, which leads to discrepancies between the high-frequency and annual balance sheets on the asset side. In addition, the assets in the Estimated General Position not only include investments in securities (at mean market price), but also dividends accrued on the investments, cash at banks and on hand, and the estimated value in silver in coin in stock and in circulation. Even though these additional items in the annual assets data are relatively small in value in comparison to the investments in securities, they are part of the reason why the average total high-frequency assets as a share of total annual assets is only 96.17%.

Liabilities

On the liability side, the high-frequency data only include notes and coins in circulation. However, the liability side of the Expected General Position balance sheet in the annual data also includes a “balance” that makes annual assets equal annual liabilities. Therefore, this additional accounting item is a source of inconsistency between the annual and high-frequency liability values. (The “balance” may include money transferred from other accounts. It is in effect net worth.)

Notes and Coins in Circulation

The average total high-frequency notes and coins in circulation as a share of total annual notes and coins in circulation is 99.84%, which means that both data sets agree with one another on a consistent basis. All the years except for 1949 had the same value for total notes and coins in circulation in both the annual and high-frequency data, so the data for 1949 should be viewed as an unexplainable outlier that may be the result of a human accounting error.

KENYA

I. Data

Years studied: 1908-1920 (annual data for the year ending on March 31 and high-frequency data for the month of March ending on March 10). We have most of the annual and monthly high-frequency data for the episode from 1906-1920, but start the analysis in 1908 since that is the first year that we have high-frequency data for the month of March.

Sources: Both the annual reports and the high-frequency statements were published in the government gazette.

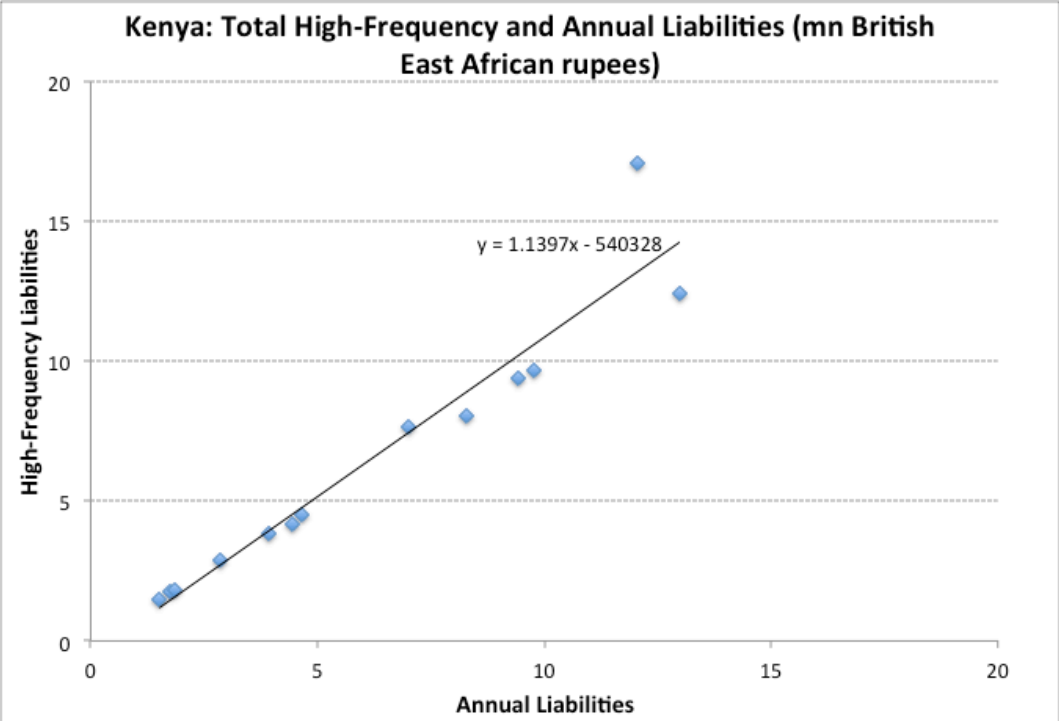
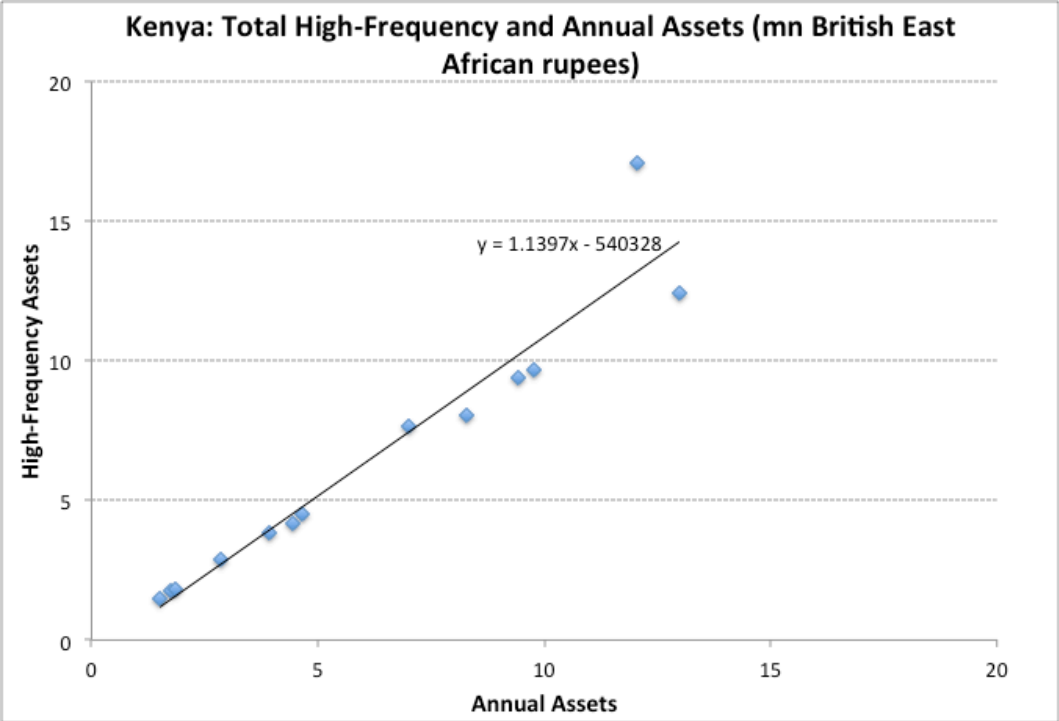
II. Relationship

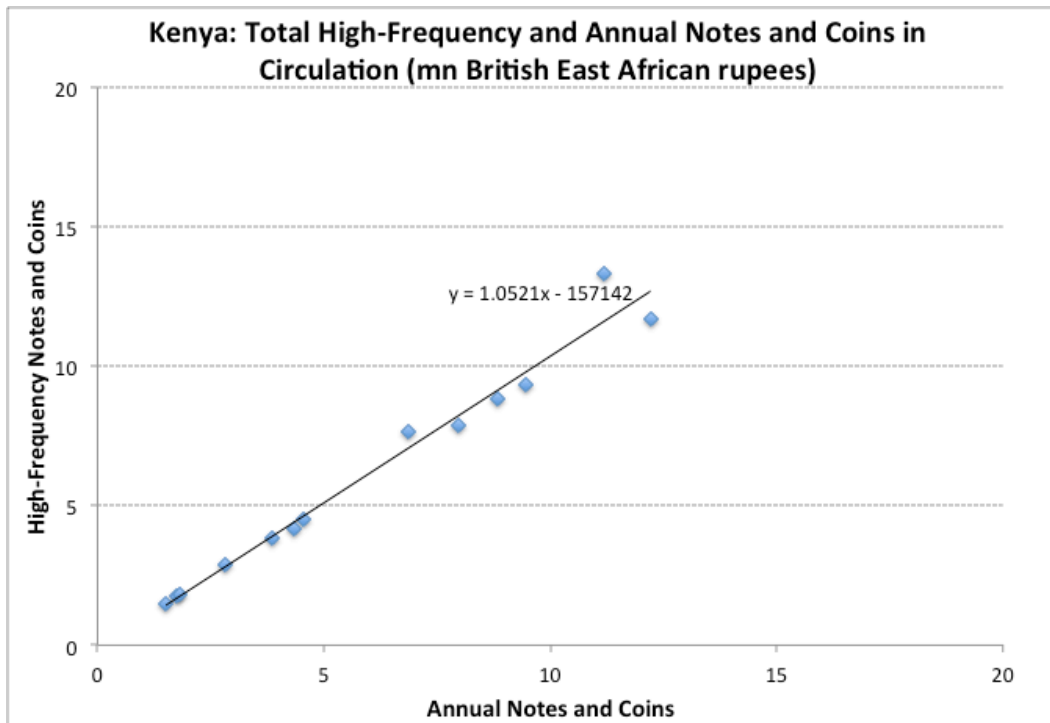
Average total high-frequency assets as a share of total annual assets: 102.17%.

Average total high-frequency liabilities as a share of total annual liabilities: 102.17%.

Average total high-frequency notes and coins in circulation as a share of total annual notes and coins in circulation: 101.35%.

* See the full data sets in the spreadsheet titled "Annual and High-Frequency Analysis."





III. Causes of Differences

Assets

Annual reports use data ending March 31, but high-frequency statements use data from March 10, which is a potential source of discrepancies. The annual and high-frequency balance sheets list the same items and are only different because the corresponding values slightly vary (off by 2.17% on average for both assets and liabilities). Therefore, it can be deduced that the different measurement methodologies were the main causes of discrepancies between the two balance sheets.

Liabilities

(See the explanation under Assets.)

Notes and Coins in Circulation

(See the explanation under Assets.)

PALESTINE

I. Data

Years studied: 1928-1948 (annual data for the year ending in March 31 data and high-frequency data for the month of March ending on March 31). The Palestine Currency Board existed from 1927 to 1951 and the first annual report was issued in March 1928. However, high-frequency data exist only from 1928 to 1948, so it was only possible to analyze the data from these years.

Sources: The Palestine Currency Board issued its annual report as a separate publication. The high-frequency statements appear in the government gazette. We are missing a small amount of the high-frequency data.

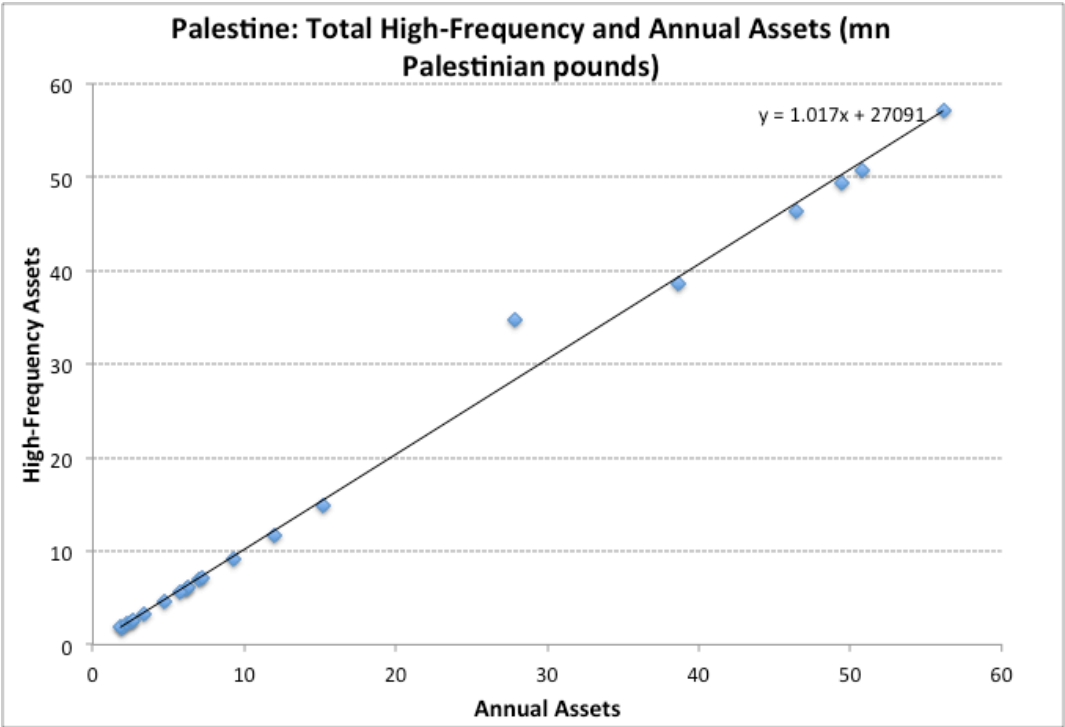
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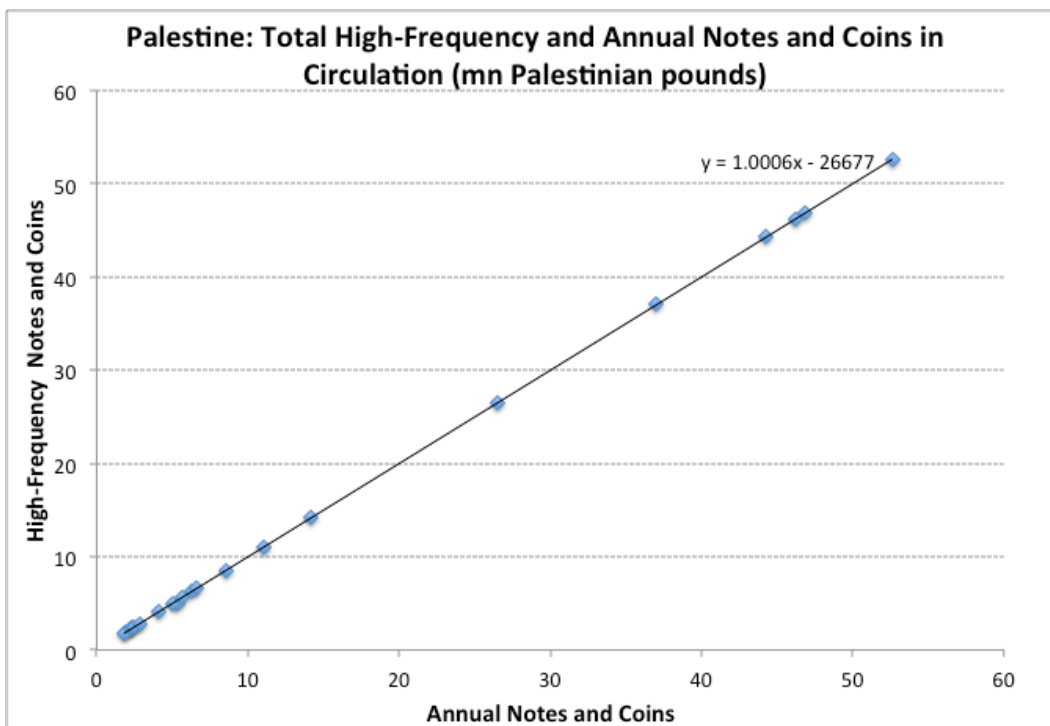
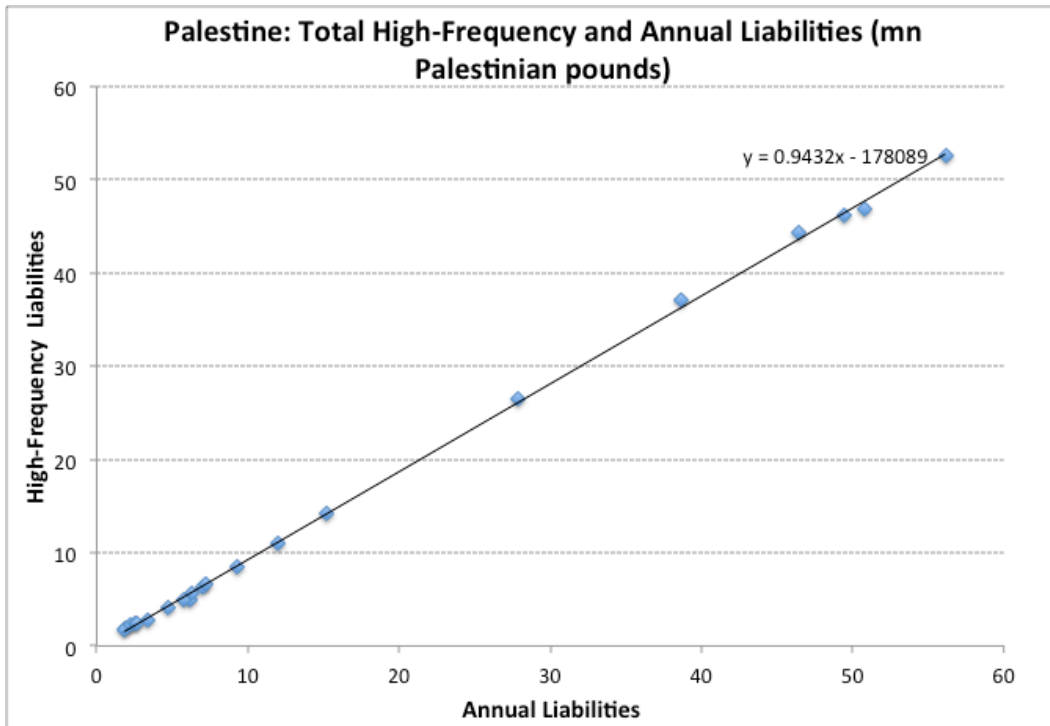
Average total high-frequency assets as a share of total annual assets: 100.42%.

Average total high-frequency liabilities as a share of total annual liabilities: 92.07%.

Average total high-frequency notes and coins in circulation as a share of total annual notes and coins in circulation: 99.68%.

* See the full data sets in the spreadsheet titled "Annual and High-Frequency Analysis."





III. Causes of Differences

Assets

On average, total high-frequency assets are 100.42 % of total annual assets, but the data show that the

value of high-frequency assets either slightly exceed or slightly fall below the annual assets unpredictably. The small differences may be due to the high-frequency data using at-cost values and the annual data using market values. In addition, assets recorded in high-frequency data are referred to as net foreign assets, which are the sum of the Currency Reserve Fund and the Investment Reserve Account, while assets in the annual data are calculated as the sum of foreign and domestic assets. Subtle accounting differences may exist between these two methods of calculating total assets where small-value items are included in only one of the two balance sheets.

Liabilities

The high-frequency balance sheet consistently has liabilities substantially lower than annual liabilities because the high-frequency data only include notes and coins in circulation while the annual data include notes and coins in circulation plus “deposits” or “unspecified” items. (No *foreign* liabilities were ever listed for the years studied, so can assume that they do not exist.)

Notes and Coins in Circulation

The average total high-frequency notes and coins in circulation as a share of total annual notes and coins in circulation is 99.68%, which means that both data sets agree with one another on a consistent basis. All the years except for 1935 had the same value for total notes and coins in circulation in both the annual and high-frequency data, so the data for 1935 should be viewed as an unexplainable outlier that may be the result of a human accounting error.

WEST AFRICA

I. Data

Years studied: 1924-1959 (annual data for the year ending in June 30 data and high-frequency data for the month of June ending on June 30). The West African Currency Board existed from 1913 to 1964, and while we were able to collect all the annual data from these years, we were only able to collect the high-frequency data for the years 1916-1959. The collection methodology for the high-frequency data from 1916-1923 is inconsistent with the method used in the data reported from 1924-1959 because the total currency in circulation and Currency Reserve Fund data are not available. Therefore, only the years 1924-1959 were used in this analysis.

Sources: The West African Currency Board issued its annual report as a separate publication. High-frequency statements appear in the Nigerian government gazette. We are missing some of the high-frequency data.

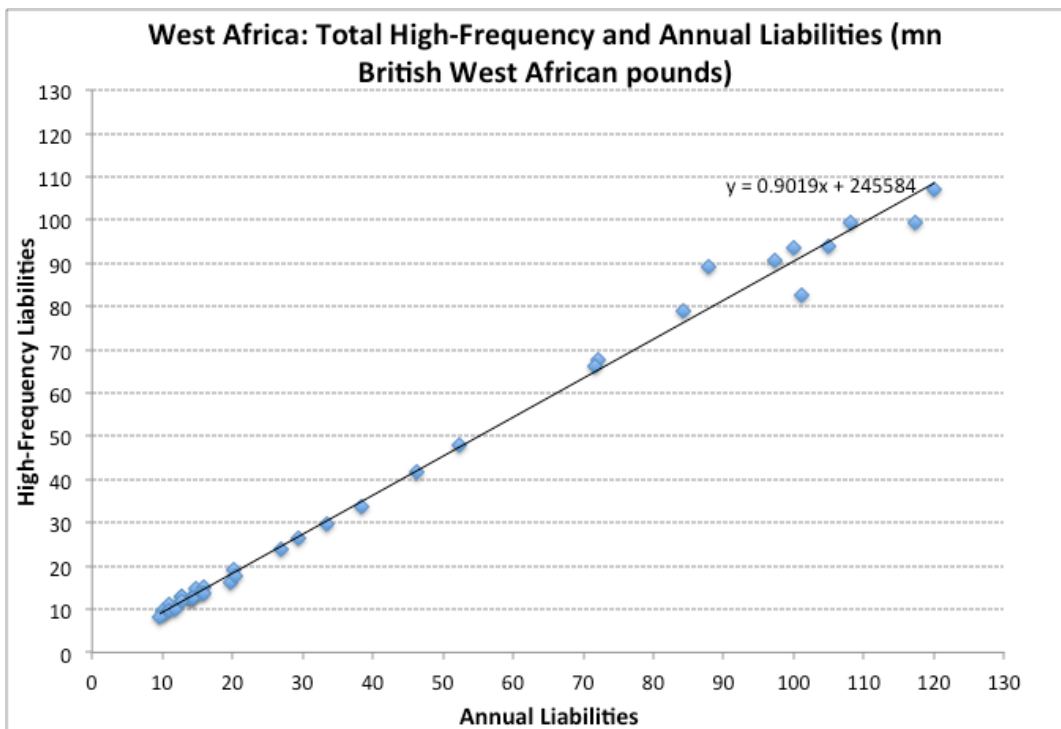
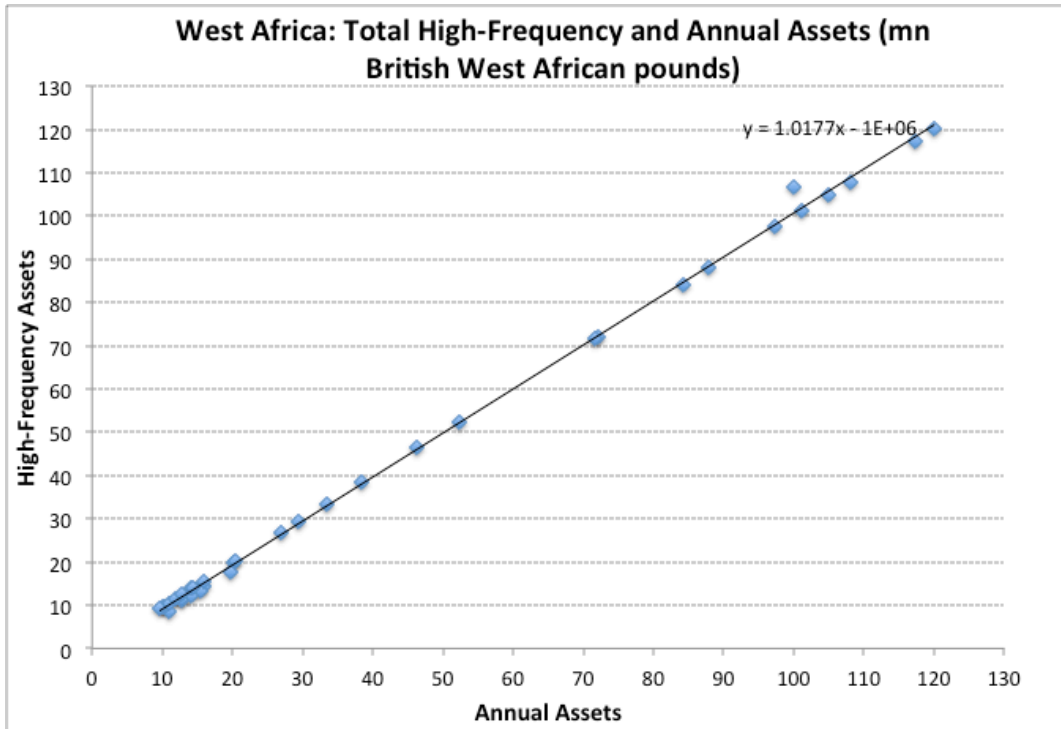
II. Relationship

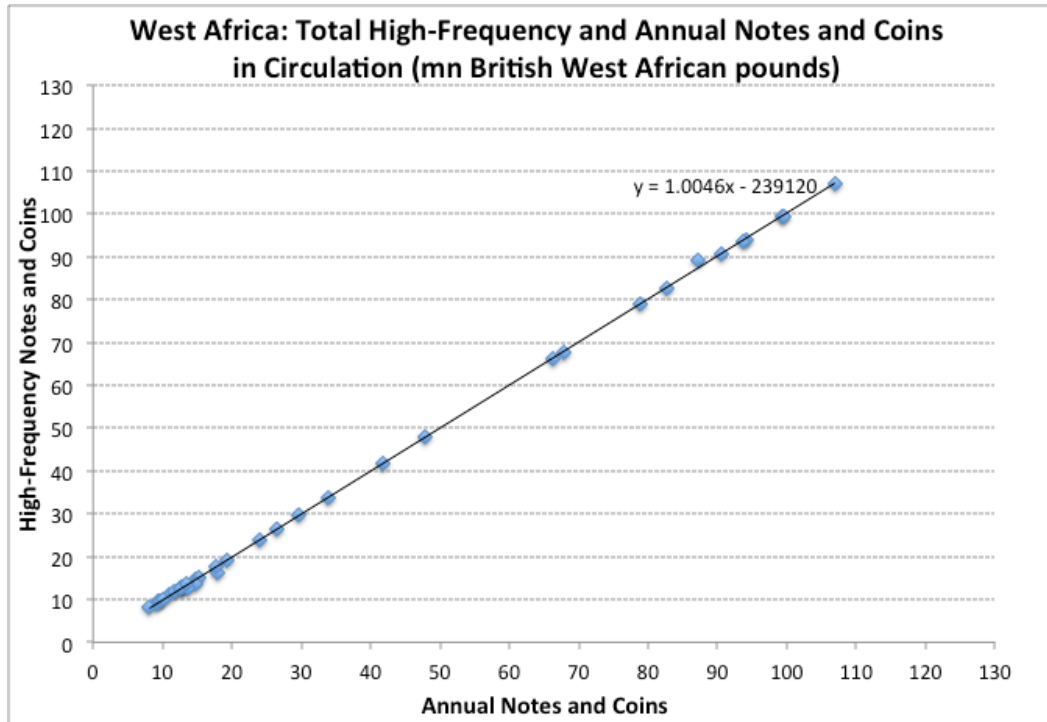
Average total high-frequency assets as a share of total annual assets: 96.44%.

Average total high-frequency liabilities as a share of total annual liabilities: 90.71%.

Average total high-frequency notes and coins in circulation as a share of total annual notes and coins in circulation: 99.34%.

* See the full data sets in the spreadsheet titled "Annual and High-Frequency Analysis."





III. Causes of Differences

Assets

On average, total high-frequency assets are 96.44% of total annual assets, but the data show that the value of high-frequency assets either slightly exceed or slightly fall below the annual assets unpredictably. The small differences may be due to the high-frequency data using at-cost values and the annual data using market values. In addition, assets recorded in high frequency data are referred to as net foreign assets, which are the sum of the Currency Reserve Fund and the Investment Reserve Account, while assets in the annual data are calculated as the sum of foreign and domestic assets. Even though the average is 96.44% for the years 1924-1959, the total high-frequency assets present in the total annual assets has been close to 100% in the later years of the analysis. Total high-frequency assets as a share of total annual assets were less than 1% away from 100% for the years 1944-1959. The convergence between the two values for total assets may be due to more standardized accounting techniques where previously excluded items are now included as subcategories of the existing labels such as the Currency Reserve Fund or the Investment Reserve Account.

Liabilities

The high-frequency balance sheet consistently has liabilities lower than annual liabilities (except for the year 1924) because the high-frequency data only include notes and coins in circulation, while the annual data include notes and coins in circulation plus “deposits” or “unspecified” items. The annual data also include foreign liabilities, which begin to accumulate in 1944. However, the values of foreign liabilities (for the years that they do exist) are so small compared to the overall value of total liabilities that their impact is minimal, but they nonetheless must be accounted for as a cause of discrepancy between the annual and high-frequency balance sheets. The greatest source of difference between the two data sets comes from the inclusion of “net worth” in the annual data because it becomes a significant percentage

of the total liabilities in the annual data which is not included in the high-frequency data. Therefore, the value 90.71% value for average high-frequency liabilities as a share of total annual liabilities is not a good estimator for annual liabilities because by 1975 the value for the year has dropped to 81.71% from 100.70% in 1924 due to the rise in “net worth” in the balance sheet.

Notes and Coins in Circulation

The average total high-frequency notes and coins in circulation as a share of total annual notes and coins in circulation is 99.34%, which means that both data sets agree with one another on a consistent basis. All the years except for 1929, 1930, 1938, and 1952 had the same values for total notes and coins in circulation in both the annual and high-frequency data, so the data for 1929, 1930, 1938, and 1952 should be viewed as unexplainable outliers that may be the result of human accounting errors.

Conclusion

Our analysis of the annual and high-frequency data for the currency boards that existed in Iraq, Kenya, Palestine, and West Africa shows that for all, the items included in high-frequency data account for at least 90% of the value of the corresponding annual data for assets, liabilities, and notes and coins in circulation. Even though 90% is a relatively high number (which is a good sign, as it suggests that most of the balance sheet items are accounted for), data for individual years may vary significantly from the average. Therefore, let us analyze each currency board individually and determine if it seems reasonable to use high-frequency data, adjusted by appropriate expansion factors, as good estimators of total assets, liabilities, and currency circulation for months in between annual reports.

For Iraq, the high-frequency assets average of 96.17% is a good estimator for annual assets because the average total high-frequency assets as a share of total annual assets from the years 1933 to 1949 is consistently between 90.44% and 98.38%. The same can be said for liabilities, because total high-frequency liabilities as a share of total annual liabilities is consistently between 85.82% and 96.87% and averages 92.39%. High-frequency notes and coins in circulation averaged 99.84% of the annual values, so we can be highly confident in that the high-frequency values are accurate.

Kenya stands out from the other currency boards in this analysis because its annual and high-frequency balance sheets include the same items but are measured on different days (March 31 for the annual data and March 10 for the high-frequency data). Despite this difference, the high-frequency data provide fairly accurate estimators for the annual data because they contain a full balance sheet where assets equal liabilities so each year the total high-frequency assets (or liabilities) as a share of total annual assets (or liabilities) are the same. The averages for both assets and liabilities are 102.17%. Most importantly, the values each year are consistently between 95.84% and 100.00% except for the year 1920 when the value is 141.81%. In 1919 and 1920 the exchange rate of the British East African (Kenyan) rupee was adjusted several times against the pound sterling to reflect that use of rupee silver coins was widespread, and if the rupee became worth less as a coin than as silver, rupee coins would be melted down, resulting in a currency shortage that the government wished to avoid. The fluctuations in the exchange rate affected the rupee value of sterling assets. Total high-frequency notes and coins in circulation averaged 101.35% of the annual values. The discrepancy is almost surely the result of the different dates in which the two types of data were collected, and since the ratio is so close to 100%, there is no reason to question the validity of the high-frequency values.

The high-frequency assets for the Palestine Currency Board average 100.42% of the annual assets, being

always between 96.22% and 107.50% for the years 1928-1948 except for the year 1943 when they were 125.05%. To determine the cause of this outlying data point would take further research that we will not undertake. High-frequency liabilities as a share of annual liabilities vary greatly, from 80.39% to 100%, with multiple values near the extremes. The available data cannot accurately predict the percentage year to year. The “deposits” or “unspecified” items included in the annual data play a significant role in determining annual liabilities, so the high-frequency data inevitably stand a large chance of being off by a wide margin. The total notes and coins in circulation averaged at 99.68%, which supports that the two data series are nearly identical.

For the West African Currency Board, the average total high-frequency assets (or liabilities) as a share of total annual assets (or liabilities) are poor overall estimators of annual values for assets and liabilities for certain years. The West African Currency Board existed for a relatively long time (1913 to 1964), and the values of the excluded items in the high-frequency balance sheets significantly fluctuated over the course of this period. The average total high-frequency assets as a share of total annual assets was 80.15% in 1924 and rose to 99.99% in 1959, while the average total high-frequency liabilities as a share of total annual liabilities was 100.70% in 1924 and shrank to 81.71% in 1959. The total notes and coins in circulation between 1924 and 1959 remained very consistent (average was 99.34%), but other values such as “deposits” and “unspecified” items took up a smaller percentage of the annual assets and “net worth” took up a larger percentage of the annual liabilities as the years passed. These changes caused the convergence and divergence of assets and liabilities respectively between the annual and high-frequency data. Therefore, it is more appropriate to use the data from a few years before and after the year of potential missing annual data and find their average to estimate the annual data.

In conclusion, we remark that total notes and coins in circulation should be the same in high-frequency and annual balance sheets if they are measured on the same date because the measurement standard is fairly straightforward and there is not much room for reinterpretation of the concept. In addition, high-frequency data tend to only include total notes and coins in circulation as liabilities, so if annual data include items such as “foreign liabilities” and “unspecified” items or “net worth” and they have relatively large values compared to total notes and coins in circulation, the differences between the annual and high-frequency data for those years will be significant. On the asset side, high-frequency balance sheets typically only include securities, so “deposits” and “other” items are not included, and will determine the closeness of the total values of annual and high-frequency assets. In addition, in high-frequency data securities are usually listed at cost while in annual data they are usually listed at market value. Despite many possible sources of discrepancies, for the currency boards here, high-frequency data tend to provide reasonable bases for estimates as long as they are calculated for years close to one another and major economic trends or events occur that greatly affect items excluded from high-frequency data.

References

Please refer to the accompanying spreadsheet “Annual and High-Frequency Data Analysis” to view all the data and calculations used in the analyses and graphs.

The following annual reports, gazettes, and other printed material were consulted to create the spreadsheet “Annual and High-Frequency Data Analysis”:

IRAQ

Report of the Iraq Currency Board For the Year Ended 31st March, (1933-1949). London and Dunstable: Waterlow & Sons Limited.

Located in *Iraq Annual Report 1933-1948*.

Copyright protection has expired for all documents.

Iraq Government Gazette (1932-1949). Baghdad.

Located in *Iraq Gazette 1932-1949*.

Copyright protection has expired for all documents.

KENYA

Hardinge, Sir A. *Report by Sir A. Hardinge on the British East Africa Protectorate for the year (1897-1918)*. London: His/Her Majesty’s Stationery Office.

Located in *Kenya Colonial Report 1897-1918*.

Crown and Parliamentary copyright protection has expired for all documents.

Colonial Reports--Annual, Kenya, Report for (1918-1938). London: His/Her Majesty’s Stationery Office.

Located in *Kenya Colonial Report 1918-1938*.

Copyright protection has expired for all documents.

The Official Gazette of the Colony and Protectorate of Kenya; later renamed The Kenya Gazette (1909-1971). Nairobi: Government Press.

Located in *Kenya Gazette 1909-1971*.

1963-1971 under copyright restriction; for 1909-1962 copyright protection has expired.

PALESTINE

Report of the Palestine Currency Board for the period ended 31st March, (1928-1952). London, Dunstable & Watford: Waterlow & Sons Limited.

Located in *Palestine Annual Report 1928-1952*.

1943-1952 under copyright restriction; for 1928-1942 copyright protection has expired.

Palestine Blue Book (1928-1938). Alexandria: Whitehead Morris Limited in Egypt.

Located in *Palestine Blue Book 1928-1938*.

Copyright protection has expired for all documents.

The Palestine Gazette 1935. Jerusalem: Published by Authority.

Located in *Palestine Gazette 1935*.

Copyright protection has expired for all documents.

WEST AFRICA

Report of the West African Currency Board For the Year Ended 30th June, (1914-1937). London: His/Her Majesty's Stationery Office.

Located in *West Africa/West Africa Annual Reports/ 1914-1937 Annual Reports.*
Crown and Parliamentary copyright expired for all documents.

Report of the West African Currency Board For the Year Ended 30th June, (1938-1964). London: Waterlow & Sons Limited.

Located in *West Africa/West Africa Annual Reports/ 1938-1964 Annual Reports.*
Under copyright restriction for 1963-1964; for 1938-1962 copyright protection has expired.