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DATA SOURCES FOR THE CREDIT-CARD AUGMENTED DIVISIA MONETARY AGGREGATES

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Abstract:

In 2013, the Center for Financial Stability (CFS) initiated its Divisia monetary aggregates database, maintained within the CFS program called Advances in Monetary and Financial Measurement (AMFM), in accordance with Barnett (1980, 2012). The CFS is now making available Divisia monetary aggregates extended to include the transactions services of credit cards. The extended aggregates are called the augmented Divisia monetary aggregates and are available to the public in monthly releases. The new aggregates are also available to Bloomberg terminal users. The theory on which the new aggregates is based is provided in Barnett and Su (2014).³ In this paper, we provide detailed information on the data sources used in producing the new augmented Divisia monetary aggregates.

Keywords: monetary aggregates; credit cards; aggregation theory; index number theory; data; Divisia index.

Classifications: G, C8, E4.

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³ A revised and extended version of that theory can be found in Barnett, Chauvet, Leiva-Leon, and Su (2016).



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1. Introduction

The Center for Financial Stability (CFS) is now making available Divisia monetary aggregates extended to include the transactions services of credit cards, in accordance with Barnett and Su (2014) and Barnett, Chauvet, Leiva-Leon, and Su (2016). To construct the resulting “augmented Divisia monetary aggregates,” we extensively explored relevant sources for the needed credit card variables. Since the credit card transactions volumes data are not publicly available from federal government agencies or the Federal Reserve System, our search took over a year. In this paper we make available the results of our search, not only to document the sources for the new CFS augmented Divisia monetary aggregates, but also for reference by future researchers who might want to work in this area and therefore be confronted with similar data search challenges. In this paper, we focus entirely on the credit card components of the new aggregates, since the sources for the other components have been documented by Barnett, Liu, Mattson, and Noort (2013), as was needed for construction of the original CFS aggregates.

The most difficult part of this search was the need to find data for credit card transactions volumes. To be consistent with the theory in Barnett and Su (2014) and Barnett, Chauvet, Leiva-Leon, and Su (2016), the credit card quantities to include in the augmented Divisia index formula are the monthly credit card transactions volumes, not the credit card balances. The balances include revolving debt used to pay for transactions in prior periods. To include those funds again in a subsequent period would produce double counting of transactions services. But only the total balances are available from governmental sources, such as the Federal Reserve. Those credit card balances can be used as related indicator variables within the Chow-Lin method to interpolate the transactions volumes monthly. Those volumes are only available quarterly, while the total balances are available monthly from the Federal Reserve. But the credit card debt balances should not themselves be entered into the Divisia index formula to measure contemporaneous credit card transactions services.



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The data search process was long and arduous. For the benefit of future researchers, who might be confronted with similar data needs, this paper not only documents our successful location of relevant sources but also makes public the many dead ends we encountered.

2. Adopted Data Sources

2.1. Data Sources for Credit Card Transactions Volumes

As observed by Barnett and Su (2014) and Barnett, Chauvet, Leiva-Leon, and Su (2016), implementing the theory using credit card transactions volumes has heavy data requirements. Numerous sources were extensively explored, as discussed in section 3. In this subsection, we introduce in detail where to find the ultimate sources we adopted and how to locate the specific data from the financial reports.

Our primary sources are the quarterly financial reports of the four credit card companies, Visa, MasterCard, Discover, and American Express. The total payment volume each period is summed over the four. According to trade jargon, the word “credit card” applies only to those four. Charge cards and store cards (called “private label” cards), are not credit cards. To be a credit card, it must be accepted for all goods and services not requiring cash-only payment. That rules out store cards, such as gasoline cards or department store cards. In addition, the card must provide a line of credit. That rules out charge cards for which payment is required in full at the end of the period. To model consumer charge cards decisions, we would need to include an inequality constraint requiring credit card debt to be paid off at the end of the period. Our model does not have such a constraint. Our representative consumer model assumes that the representative consumer has access to a line of credit, if the debt is not paid off during the same period.⁴

For Visa cards, the quarterly reports can be found in their investor relations site:

<http://investor.visa.com/financial-information/quarterly-earnings/>

- Select the period of interest.
- Go to “Operational Data.”
- Page 1, first table.
- “Visa Credit Programs” section.
- Locate the row for “US.”
- Locate the column for “Payments Volume.”

⁴ Historically, most American Express cards were charge cards, but in recent years even the former charge cards issued by American Express provide access to a line of credit. As a result, the distinction between charge cards and credit cards issued by American Express is not relevant to our model.



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For example, for the 3 months ending December 31, 2015, the Visa credit card transactions volume in the United States is 358 billion dollars. The release date each quarter is about 4 weeks after the quarter ends.

Similarly, for MasterCard, the quarterly reports can be found in their investor relations site:

<http://investor.mastercard.com/investor-relations/financials-and-sec-filings/quarterly-results/default.aspx>

- ➔ Select the period of interest.
- ➔ Go to “Supplemental Materials.”
- ➔ Page 1, first table.
- ➔ “MasterCard Credit and Charge Programs” section.
- ➔ Locate the row for “United States.”
- ➔ Locate the column for “Purchase Volume.”

For example, for the 3 months ending December 31, 2015, MasterCard transactions volume in the United States was 174 billion dollars. The release date is about 4 weeks after the quarter ends.

For Discover Cards, the quarterly reports are researched by:

<http://investorrelations.discoverfinancial.com/phoenix.zhtml?c=204177&p=irol-quarterlyresults>

- ➔ Locate “Earnings” for the relevant quarter and year.
- ➔ Go to “Financial Supplement (PDF).”
- ➔ Search for the row for “Discover Card Sales Volume.”
- ➔ Locate the column for the relevant quarter and year.

For example, Discover credit card transactions volume in 2015 quarter 4 was 31.672 billion dollars. The release date is about 3 to 4 weeks after the quarter ends.

Lastly the quarterly reports for American Express can be found at:

<http://ir.americanexpress.com/Earnings-and-Events>

- ➔ Select the tab for “Past Events” and the period of interest.
- ➔ Go to “American Express Earnings Conference Call.”
- ➔ Go to “Financial Tables.”
- ➔ Search for “Card billed business (F).”
- ➔ Locate the row for United States,
- ➔ Locate the column for the relevant quarter and year.



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For example, American Express credit card transactions volume in 2015 quarter 4 was 189.9 billion dollars. The release date is about 2 to 3 weeks after the quarter ends.

Another relevant source of credit card transactions volumes is a spreadsheet in the statistics site of PaymentsSource.com:

<http://www.paymentsource.com/statistics/>

→ “US Quarterly Credit and Charge Card Payment Volumes: 3Q 2006 – Current.”

The spreadsheet contains payment volumes from 2006 Q2 to 2013 Q2. It confirmed that the transactions volumes found from the above-mentioned financial reports were correctly located in those reports. In addition, that spreadsheet improved the efficiency and accuracy of our collection of transactions volume series. As data up to the second quarter of 2013 were all included in the spreadsheet, we only needed to check the precision of those data and to update to the current period based on the four companies’ financial reports. From both of our sources, credit card transactions volumes are available only since 2006 quarter 3, which is when the firms went public.⁵

The data from both sources are seasonally unadjusted. We adopted the latest Census X-13 ARIMA-SEATS program to adjust the level data of credit card transactions volumes. A detailed description of the methods and theory of X-13 ARIMA-SEATS can be found at the US Census Bureau website.⁶ In addition, its reference manual, theoretical background, and empirical applications are also available on the US Census Bureau website.⁷

2.2. Data Sources for Chow-Lin Interpolation

Since the credit card transactions volumes are released only on a quarterly basis, we need to interpolate the quarterly data monthly to permit monthly publication and release of the augmented Divisia monetary aggregates. For this purpose, we selected the well known and widely respected Chow-Lin (1971) procedure, which provides a unified approach to interpolation, distribution, and extrapolation.⁸ The procedure requires

⁵ An exception is American Express, which has been a public company for a much longer time. But during the earlier years, American Express issued only charge cards, not credit cards.

⁶ <https://www.census.gov/srd/www/x13as/>.

⁷ <https://www.census.gov/srd/www/x13as/papers4newusers.html>.

⁸ According to Chow-Lin (1971), interpolation and distribution are respectively defined as follows. (a) Given the value of a time series at the beginning of each quarter for n quarters, and given the value of a related series at the beginning of each month for these $3n$ months, the problem of interpolation is to estimate the first series for the remaining $2n$ months. (b) Given the value of a series of flows during each quarter for n quarters, and the value of a related series for each month, the problem of distribution is to estimate the first series for the $3n$ months.



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regression on a related indicator series to obtain best linear unbiased estimates (BLUE) of the monthly series.

To implement the Chow-Lin procedure, at least one highly correlated series needs to be chosen as an indicator. Five potential candidates were selected for that purpose and their merits compared for the interpolation:

- Total consumer credit outstanding.

The Federal Reserve Board provides Total Consumer Credit Outstanding, with unique identifier “G19/CCOUT/DTCTL.M,” on a monthly basis through the G.19 survey by the Data Download Program.⁹ This seasonally adjusted series covers most credit extended to individuals, excluding loans secured by real estate. The release date is on the fifth business day of each month. Those data are also available in the St. Louis Federal Reserve Bank’s database, FRED, under the tag TOTALSL. This series is available beginning on January 1943.

- Revolving consumer credit outstanding.

This seasonally adjusted series, with unique identifier “G19/CCOUT/DTCTLR.M,” is from the same source as Total Consumer Credit Outstanding and is a component of it, while the other component is “non-revolving credit.” Credit card outstanding balance contains revolving consumer credit outstanding as a major component. Revolving Consumer Credit Outstanding is available beginning on January 1968.

- Credit card interest rate (all accounts).

This series is provided in the Federal Reserve Board’s G.19 release. The release provides two such interest rates. One is the interest rate on only those credit card accounts that pay interest to the bank issuing the account. The other interest rate, which is lower, includes those accounts that are not paying interest to the banks. The noninterest yielding accounts are paid off within the month. Our model is for the representative consumer, aggregated over both those consumers paying interest on credit card accounts and those that are not. Hence, the interest rate we use is the lower one, which accounts for the fact that not all credit card transactions volumes are being charged interest. This series is called Commercial Bank Interest Rate on Credit Card Plans, All Accounts, with unique identifier “G19/TERMS/RIFSPBICC_N.M.” It is not seasonally adjusted, which is consistent with the convention at the Center for Financial Stability (CFS) and also at the Federal Reserve for interest rates. This series is available since 1994 Q4.

Note that this interest rate is also the choice used in the user cost formula for the credit card transactions services. At the present time in the United States, 58.7% of active credit

⁹ <http://www.federalreserve.gov/datadownload/Choose.aspx?rel=G19>.



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card accounts pay interest.¹⁰ Since the interest rate paid on those accounts is high, the lower average credit card interest rate in the G.19 survey, averaged over both groups, is still much higher than our benchmark rate. As a result, the user cost is always positive – in fact very positive. Although the benchmark rate is higher than the interest rates paid to consumers on secured assets, the rate of interest on credit card debt is not on a consumer asset and is not secured to the issuing firms. For the issuing firms, those accounts are assets. Credit card debt is not secured and subject to fraud risk.¹¹

- Nominal user cost of credit card services

The following formula for the nominal user cost of credit card services was derived in Barnett and Su (2014) and subsequently in Barnett, Chauvet, Leiva-Leon, and Su (2016):

$$\tilde{\pi}_{jt} = \frac{p_t^*(e_{jt} - R_t)}{1 + R_t},$$

where p_t^* is the true cost of living index, e_{jt} is credit card interest rate, and R_t is the yield on the benchmark asset during period t . We use the Labor Department's Consumer Price Index (CPI) to represent the true cost of living index, p_t^* , since the CPI is used as the "cost of living" in wage contracts. For the credit card interest rate, e_{jt} , we use the series discussed above. For the yield on the benchmark asset adopted by the CFS and used by us, see Barnett, Liu, Mattson, and van den Noort (2013). Restricted by the credit card interest rate's availability, the nominal user cost of credit card services is available since October 1994.

- Real user cost of credit card services.

The formula for the real user cost of credit card services is as follows:

$$\tilde{\pi}_{jt}^* = \frac{\tilde{\pi}_{jt}}{p_t^*} = \frac{e_{jt} - R_t}{1 + R_t}.$$

As with the nominal user cost of credit card services, the real user cost is available since October 1994.

¹⁰ See the proportion of "revolvers," "transactors," and "dormants" on the following document provided by American Bankers Association: www.federalreserve.gov/datadownload/Choose.aspx?rel=G19.

¹¹ Even if credit card debt were secured and not subject to fraud risk, there would be no internal contradiction in assuming that the maximum interest rate available to one category of economic agents (consumers) is lower than that available to another category of economic agents (credit card companies), although the risk born by credit card companies is the primary reason for the high interest rate on credit card debt. The greatest source of risk is credit risk (called Net Credit Loss), but fraud risk along with high operating costs all play a role in the high interest rates on credit card debt.



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To implement the Chow-Lin procedure, we used the statistical software, R. We used the temporal disaggregation package provided by R, and the descriptive links are below.

<https://cran.r-project.org/web/packages/tempdisagg/index.html> (download link)

<https://cran.r-project.org/web/packages/tempdisagg/tempdisagg.pdf> (manual)

<https://journal.r-project.org/archive/2013-2/sax-steiner.pdf> (tutorial article)

As the data are limited by the availability of the credit card interest rate, which is available only after 1994 Q4, we extrapolated and interpolated the data from October 1994 to the present, with all possible combinations of the above indicator series. The resulting table for the Chow-Lin procedure is in the Appendix table 1. Statistical significance tests determined that the best model with Chow-Lin uses only one indicator as a related series: total consumer credit outstanding.

Since credit card transactions volumes start in 2006 Q3, while all the indicator series start from October 1994, we investigate extrapolation backwards from 2006 Q3 to October 1994. We found that the backwards extrapolation of transactions volumes was highly nonrobust to the choice of indicators, since the extrapolation has no anchor in October 1994 without availability of transactions volumes data before 2006 Q3. As a result, we have forgone backwards extrapolation, and used Chow-Lin only for interpolation beginning in 2006 Q3.

To summarize all the adopted data sources to construct the augmented Divisia Index, we provided table 2 in the Appendix, following the tradition of Barnett, Liu, Mattson, and Van Den Noort (2013) and Anderson and Jones (2011). In addition, a graphical demonstration of the Chow-Lin interpolation is provided in Appendix Figure 1.

3. Other Potentially Relevant Sources

While searching for our chosen sources of credit card transactions volumes, we encountered numerous dead ends. We provide a summary for researchers interested in replicating our work or pursuing relevant extensions and alternatives to our approach.

3.1. Federal Reserve Board G.19 Release

The Federal Reserve Board G.19 release, “Consumer Credit,” reports outstanding credit extended to individuals for household, family, and other personal expenditures, excluding loans secured by real estate.¹² It was one of the first sources that we searched for credit card transactions volumes. Unfortunately, the Federal Reserve does not provide those transactions volumes. But this is where we acquired the total consumer credit outstanding, used as indicator for the Chow-Lin monthly volume interpolation procedure,

¹² <http://www.federalreserve.gov/Releases/G19/current/>.



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and the credit card interest rate for all accounts to calculate the user costs of the credit card transactions services.

3.2. Consumer Credit Snapshot by Federal Reserve Bank of Philadelphia

This source provides updated statistics related to consumer credit and consumer payments.¹³ The most relevant data are at the “Consumer Debt” tab, which is a mirror of the G.19 statistics mentioned above.

3.3. Federal Reserve Payment Study, 2013

This document provides an overview of the aggregate trends in noncash payments in the United States.¹⁴ It does provide a few annual transactions volumes. For example, it reports that the total value of 2012 private label (store) card transactions in the U.S. was \$2.21 trillion, which is consistent with the data sources we mentioned above. However, it is far from a detailed and systematic source providing historical data at adequate frequency.

The Electronic Payments Study was performed by Blueflame Consulting. According to Ed Bachelder, the Director of Research and Analytics at Blueflame Consulting, “the credit card data was collected on annual total basis, not monthly as is described in the methodology documents. It was also gathered on a confidential basis and cannot be shared beyond what was publicly released due to a number of legal restrictions.”

3.4. Credit Card Market Monitor by American Bankers Association

The Credit Card Market Monitor does not provide transactions volumes, but does provide an informative figure: Distribution of Accounts by Behavior Type.¹⁵ This gives us information about how many credit card accounts are active. That data source, from the American Bankers’ Association, also provides information about how many active accounts are carrying credit card debt into the next period and are thereby paying credit card interest.

3.5. Call Reports Processed by FFIEC Central Data Repository

This file contains data from Call Reports received and processed by the FFIEC (Federal Financial Institutions Examination Council) Central Data Repository (CDR) as of 2016-01-14.¹⁶ The file is intended to provide an integrated view of financial data across those financial institutions filing Call Reports in a format that could facilitate analysis of such

¹³ <http://www.philadelphiafed.org/consumer-credit-and-payments/statistics/>.

¹⁴ https://www.frbservices.org/files/communications/pdf/research/2013_payments_study_summary.pdf.

¹⁵ <http://www.aba.com/Press/Documents/12.16.14ABACreditCardMonitorFAQ.pdf>.

¹⁶ <https://cdr.ffiec.gov/public/PWS/DownloadBulkData.aspx>.



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data by the public. The file does not necessarily provide the most recent Call Report and financial institutions data available in FFIEC CDR. In this source, we failed to find the credit card transactions volumes we need.

3.6. Creditcards.com

This site contains much informative data about credit card usage trends in the United States. For example, the transactors versus revolvers trend from 2009 to 2014 indicates that the percent of American households carrying rotating credit card debt from month to month (revolvers) have decreased from 44% in 2009 to 34% in 2014.¹⁷

Meanwhile, the site's credit card market share statistics page provides some payment volume data, but only the 2013 and 2014 annual purchase volumes for each card network.¹⁸ Although those volumes are inadequate for our use, the site's footnotes reveal the sources of purchase volumes: the financial reports for the four card companies. However, the footnote does not provide instructions on how to locate those data from within those financial reports.

3.7. The Nilson Report

The Nilson report purports to publish the US credit card purchase volumes quarterly and the global figures every six months. However, this requires a subscription to all the issues of the Nilson reports. The cost is currently \$1495 for each year (23 issues per year). New subscribers also receive a USB flash drive containing the last five years of issues. The cost for previous years extending back to 1997 is \$295 for each year, supplied on a CD ROM or flash drive, while the cost for the years of 1996-1990 is \$300 each year, supplied only in a hard copy format. Considering the cost versus the amount of information we need, and our inability to determine whether their reports provide exactly what we need, we decided instead to look further into the sources from which Nilson acquires those figures.

3.8. The 2015 Consumer Financial Literacy Survey

This survey was conducted online within the United States by Harris Poll on behalf of the NFCC (National Foundation for Credit Counseling) between March 11 and March 13, 2015 among 2017 adults age 18+.¹⁹ Though it does not contain the credit card transactions volumes, it does provide an overview of the credit card expenditure trend in the US. For

¹⁷ <http://www.creditcards.com/credit-card-news/credit-card-debt-statistics-1276.php>. But the following statement is from www.motherjones.com/kevin-drum/2011/10/americans-are-clueless-about-their-credit-card-debt. "In the four working age categories, about 50% of households think they have outstanding credit card debt, but the credit card companies themselves think about 80% of households have outstanding balances." Since these percentages are of total households, including those having no credit cards, the percent of credit card holders paying interest can be even higher.

¹⁸ <http://www.creditcards.com/credit-card-news/credit-card-market-share-statistics-1264.php>.

¹⁹ https://www.nfcc.org/wpcontent/uploads/2015/04/NFCC_2015_Financial_Literacy_Survey_FINAL.pdf.



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example, according to this report, one in three U.S. adults (33%) indicate their household carries rotating credit card debt from month to month, with about one in ten adults (11%) saying they roll over \$2500 or more in credit card debt each month.

3.9. SEC Filings of the Four Card Companies

We found the same figures for transactions volumes in the SEC filings of the four credit card companies as in their financial reports. The SEC filings share the same release dates as their annual reports.

For Visa, the SEC filings can be found here:

<http://investor.visa.com/sec-filings/>

- ➔ Select the “8-K” filing of the relevant period.
- ➔ Look for “Operational Performance Data” section.
- ➔ First table, under the title “Visa Credit Programs.”
- ➔ Locate the row of “US.”
- ➔ Locate the column of “Payments Volume.”

That 8-K Filing is usually released four weeks after the quarter ends.

The SEC filings for MasterCard are available from:

<http://investor.mastercard.com/investor-relations/financials-and-sec-filings/sec-filings/default.aspx>

- ➔ Select the “8-K” filing of the relevant period.
- ➔ “MasterCard Incorporated Operating Performance” table.
- ➔ “MasterCard Credit and Charge Programs” section.
- ➔ Locate the row for “United States.”
- ➔ Locate the column for “Purchase Volume.”

That 8-K Filing is usually released four weeks after the quarter ends.

For Discover cards, the SEC filings are posted at:

<http://investorrelations.discoverfinancial.com/phoenix.zhtml?c=204177&p=irol-sec>

- ➔ Select the “8-K” filing of the relevant period.
- ➔ Search for the row for “Discover Card Sales Volume.”
- ➔ Locate the column for the quarter and year.

That 8-K Filing is usually released about 3 to 4 weeks after the quarter ends.



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Finally, the American Express SEC filings are posted on:

<http://ir.americanexpress.com/docs.aspx?iid=102700>

- ➔ Select the “8-K” filing of the relevant period.
- ➔ Search for “Card billed business (F).”
- ➔ Locate to the row for the United States.
- ➔ Locate the column for the quarter and year.

That 8-K Filing is usually released about 2 to 3 weeks after the quarter ends.

There are numerous types of other files apart from 8-K Filings on the SEC filings webpage. As a result, the needed files are very scattered. Moreover, there usually are several files called “8-K Filings” in a single period and only one of them contains the relevant spreadsheet. Therefore, we do not recommend acquiring the transactions volumes through this channel. Those data are more conveniently acquired from credit card companies’ annual reports.

3.10. Credit Bureaus

We have also looked into credit bureaus such as Equifax, Experian, and TransUnion for credit card transactions volumes data. However, providing this kind of data is not primarily what they do, they can be missing some relevant information. Researchers would need to acquire information from all of them, with some overlap. Following this path would be very time consuming, with possibly inadequate results.

3.11. FirstData

FirstData has a product called SpendTrend, which we originally thought could be helpful. However, FirstData only has information about the card volumes processed through FirstData, so is missing a huge chunk of the relevant data. Furthermore, they would not provide any additional information they have privately.

3.12. First Annapolis

First Annapolis responded to our data requests by informing us of two other possible sources: the Federal Reserve Payment Study and the Philadelphia Federal Reserve Consumer Credit Snapshot. We acquired no positive results from those two sources.

3.13. CardHub

This website contains an annual purchase volume table, based on the SEC filings from Visa, MasterCard, American Express, and Discover. The table is provided only for the year



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2014 and contains only annual data.²⁰ The Communications Manager of CardHub replied that they do not have any data other than those listed in that one report.

CardHub.com contains a table providing the Consumer Credit Card Debt from 2008 Q4.²¹ That reported debt is the total outstanding credit card debt in each quarter, not the needed transactions volumes.

But these data help to confirm a comment mentioned by an expert on the Federal Reserve G.19 statistics team, when we contacted that team for relevant information. What he mentioned was that the G.19 statistics of revolving credit outstanding is mainly credit card debt outstanding, which comprises more than 90% of revolving credit. Comparing the two series in each quarter, we found this to be the case. This information was relevant to our choice of indicator variables in the Chow-Lin interpolation of transactions volumes from quarterly to monthly.

Another table on CardHub contains total credit card debt balance. The source is the Federal Reserve Bank of New York consumer credit panel.²²

3.14. Investor Relations Departments of Credit Card Companies

The Investor Relations Departments of Visa, MasterCard, American Express, and Discover were very helpful in our search to locate the transactions volumes, both via email and phone calls. The contact information is listed below:

- A. Visa
Phone: 650-432-7644
Email: ir@visa.com

- B. MasterCard
Phone: 914-249-4565
Email: Investor_Relations@mastercard.com

- C. Discover
Phone: 224-405-4555
Email: investorrelations@discover.com

- D. American Express
Phone: 212-640-6348
Email: ir@aexp.com

²⁰ <http://www.cardhub.com/edu/market-share-by-credit-card-network/>.

²¹ <http://www.cardhub.com/edu/credit-card-debt-study/#data-and-graphs>.

²² <http://www.cardhub.com/edu/credit-card-debt/#card-debt>.



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3.15. Statista

This source claims to contain credit card purchase volume in the United States for the years 2000-2014 by type of credit card.²³ The report costs \$325. Upon contacting the support team, we were sent the report for free. However, the report only contains a snapshot of purchase volumes in the years of 2000, 2010, and 2014 by each credit card company.

3.16. Consumer Finance Monthly, Ohio State University

According to Professor Randall Olsen from the Ohio State University, they have stopped collecting the Consumer Finance Monthly survey, but are allowing people to access the past data they did collect. However, that survey did not include the amounts charged on credit cards. The survey focused on stocks, including asset quantities, liabilities, and net worth, rather than spending flows.

3.17. CPRC Presentation

The Federal Reserve Bank of Boston publishes its Consumer Payment Research Center (CPRC) Events and Presentations. This site has preliminary monthly figures for average value of credit card purchases and average number of credit card purchases for U.S. adults.²⁴ One way to estimate the average purchase volume per month is to calculate the product of the two series and divide by the number of U.S. adults.

But if the number of transactions and the transactions values are highly correlated, then the product of the averages will not be an accurate estimate of the average of the products. As a result, we did not adopt that approach.

3.18. Diary of Consumer Payment Choice (DCPC)

This source offers consumers-only data. But the DCPC had not been released officially at the time we were looking for the data. We had signed up on the email list of the Consumer Payment Research Center to receive news about new data releases.²⁵ However, we have so far received no helpful information from this source.

3.19. Federal Reserve Survey of Consumer Finances

This survey based report is available only every three years, with the most recent being for 2013.²⁶ We have not found that source to be helpful.

²³ <http://www.statista.com/study/12118/credit-cards-in-the-united-states-statista-dossier/>.

²⁴ <http://www.bostonfed.org/economic/cprc/presentations/index.htm>.

²⁵ <http://www.bostonfed.org/economic/cprc/contact/contact.htm>.

²⁶ <http://www.federalreserve.gov/econresdata/scf/scfindex.htm>.



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3.20. Bankrate Monitor Survey

The Bankrate Monitor Survey provides fixed and variable credit card interest rates in its weekly report.²⁷ The “fixed” column refers to fixed-rate credit cards, and “variable” column refers to variable-rate credit cards.²⁸ In fact, there are only five fixed-rate credit cards in Bankrate’s weekly survey or rates, including none from a major bank. As we are concerned with all the accounts rather than specific group categories, we did not adopt the data from Bankrate Monitor Survey.

Conclusion

To implement the theory originated by Barnett and Su (2015) and Barnett, Chauvet, Leiva-Leon, and Su (2016), we extensively explored relevant sources for the needed credit card variables. As the relevant credit card data are not available from governmental sources, the search for level and rate data took over a year. We detail the results of this search in this paper as reference for future researchers confronted with a similar problem. Our focus in this paper is limited to the credit card data, since the other components for the CFS aggregates have been explained in Barnett, Liu, Mattson, and van den Noort (2013). The most difficult part of the search was to acquire credit card transactions volumes, as needed by the theory, since those volumes are not provided by any governmental sources. In our search, we encountered many “dead ends,” revealed in this paper for the benefit of future researchers on this subject. We primarily focus on our chosen best sources.

The theory and data have been integrated and applied by Barnett, Chauvet, Leiva-Leon, and Su (2016) to produce the new augmented Divisia monetary aggregates, which are now available to the public in regular monthly releases by the Center for Financial Stability in NY City and to Bloomberg terminal users. Barnett, Chauvet, Leiva-Leon, and Su (2016) have found the new aggregates to be highly informative. The construction of the augmented Divisia monetary aggregates has opened up a new branch and direction for our future research and for the research of others interested in the role of monetary services in the macroeconomy.

References

American Banker Association, Credit Card Market Monitor, from
<http://www.aba.com/Press/Documents/12.16.14ABACreditCardMonitorFAQ.pdf>

²⁷ <http://www.bankrate.com/finance/credit-cards/current-interest-rates.aspx>.

²⁸ <http://www.bankrate.com/finance/credit-cards/fixed-rate-cards-going-away.aspx>



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American Express Investor Relations Department, American Express Company Earnings Conference Call Financial Tables. Retrieved from

<http://ir.americanexpress.com/Earnings-and-Events>

Anderson, R., and B. Jones (2011). "A Comprehensive Revision of the U.S. Monetary Services (Divisia) Indexes," *Federal Reserve Bank of St. Louis Review*, September/October **93**(5): 325-59.

Barnett, W. (1980). Economic Monetary Aggregates: An Application of Index Number and Aggregation Theory. *Journal of Econometrics*, 14, 11-48. Reprinted in W. Barnett and A. Serletis (2000), *The Theory of Monetary Aggregation*, Elsevier, Amsterdam, Chapter 2, pp.11-48.

Barnett, W. (2012). *Getting it Wrong: How Faulty Monetary Statistics Undermine the Fed, the Financial System, and the Economy*. Cambridge, MA: MIT Press.

Barnett, W., Liu, J., Mattson, R., and J. van den Noort (2013): "The New CFS Divisia Monetary Aggregates: Design, Construction, and Data Sources," *Open Economies Review* **24**: 101-124.

Barnett, W. and L. Su (2014). "The Joint Services of Money and Credit." *Johns Hopkins Studies in Applied Economics*, Working Paper No. 21, December.

Barnett, W., Chauvet, M., Leiva-Leon, D., and Su, L. (2016), "Nowcasting Nominal GDP with the Credit-Card Augmented Divisia Monetary Aggregates," University of Kansas, working paper.

Chow, G., and A. Lin, "Best Linear Unbiased Interpolation, Distribution, and Extrapolation of Time Series by Related Series," *Review of Economics and Statistics*, Volume 53, Issue 4 (1971), 372-375.

Chen, T., American Household Credit Card Debt Statistics: 2015. Retrieved from <http://www.nerdwallet.com/blog/credit-card-data/average-credit-card-debt-household/>

Discover Investor Relations Department, Discover Quarterly Financial Supplement.

Retrieved from

<http://investorrelations.discoverfinancial.com/phoenix.zhtml?c=204177&p=irol-quarterlyresults>



CENTER FOR FINANCIAL STABILITY

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Federal Reserve Board, (2015), Federal Reserve Statistical Release: G.19 – Consumer Credit. Retrieved from <http://www.federalreserve.gov/Releases/G19/current/>

Federal Reserve System. (2013). The 2013 Federal Reserve Payments Study: Recent and Long-Term Payment Trends in the United States: 2003 – 2012 Summary Report and Initial Data Release.

https://www.frbservices.org/files/communications/pdf/research/2013_payments_study_summary.pdf

Friedman M. (1962). The Interpolation of Time Series by Related Series. NBER volume ISBN: 0-87014-422-7.

Hubrich, K., and Tetlow, R. (2014). “Financial Stress and Economic Dynamics – The Transmission of Crisis,” ECB Working Paper No. 1728.

<https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1728.pdf?75ab219a8db60c6f37e5be0de21aa829>

John S. Chipman, J., and Lapham, B.,(1995). *Interpolation of Economic Time Series, with Application to German and Swedish Data*. Springer Verlag, Heidelberg, Chapter 6, pp. 89-139.

MasterCard Investor Relations Department, MasterCard Supplemental Operational Performance Data. Retrieved from <http://investor.mastercard.com/investor-relations/financials-and-sec-filings/quarterly-results/default.aspx>

Papadimitriou, O., Market Share by Credit Card Network, retrieved from <http://www.cardhub.com/edu/market-share-by-credit-card-network/>

Ray, D., and Ghahremani, Y. Credit card statistics, industry facts, debt statistics.

<http://www.creditcards.com/credit-card-news/credit-card-industry-facts-personal-debt-statistics-1276.php>

Sax, C., and Steiner, P., “Temporal Disaggregation of Time Series,” *The R Journal*, vol 5(2), December, pp. 80-87. See <http://journal.r-project.org/archive/2013-2/sax-steiner.pdf>

United States Census Bureau (2015). X-13ARIMA-SEATS, from

<https://www.census.gov/srd/www/x13as/>

US Quarterly Credit and Charge Card Payment Volumes: 3Q 2006 – Current. Retrieved from <http://www.paymentssource.com/statistics/>



CENTER FOR FINANCIAL STABILITY

Bold • Innovative • Practical

Visa Investor Relations Department, Visa Inc. Operational Performance Data. Retrieved from <http://investor.visa.com/financial-information/quarterly-earnings/>



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Appendix

Table 1. Point estimates of the coefficients of indicators in the Chow-Lin procedure to interpolate and extrapolate credit card transactions volumes with combinations of indicator series (1994 Q4 - 2015 Q2).

	Total credit	Revolving credit	Credit card interest rate	Nominal user cost	Real user cost
(1)	0.06039 (***) (3.907)				
(2)		0.1003 (*) (2.211)			
(3)			-2.301 (-1.123)		
(4)				7.79E-04 (0.002)	
(5)					-34.01 (-0.393)
(6)	0.11866 (*) (2.619)	-0.15811 (-1.398)			
(7)	0.05953 (***) (3.924)		-2.27779 (-1.174)		
(8)	0.06259 (***) (3.965)			-0.19457 (-0.504)	
(9)	0.06323 (***) (4.116)				-68.5469 (-0.832)
(10)		0.09995 (*) (2.221)	-2.28782 (-1.132)		
(11)		0.10110 (*) (2.177)		-0.06671 (-0.167)	
(12)		0.10213 (*) (2.215)			-45.29199 (-0.529)
(13)			-3.6347 (-1.409)	0.4256 (0.855)	
(14)			-2.939 (-1.108)		42.473 (0.384)
(15)				18.809 (***) (6.273)	-4073.196 (***) (-6.288)



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(16)	0.11665 (*) (2.592)	-0.15555 (-1.383)	-2.20313 (-1.157)		
(17)	0.12425 (*) (2.683)	-0.16644 (-1.449)		-0.2519 (-0.661)	
(18)	0.12489 (**) (2.739)	-0.16754 (-1.473)			-77.80956 (-0.961)
(19)	0.05792 (**) (3.536)		-2.67904 (-1.074)	0.12967 (0.265)	
(20)	0.06014 (***) (3.777)		-2.08534 (-0.821)		-12.98218 (-0.122)
(21)	2.04E-02 (1.341)			16.97 (***) (4.925)	-3691 (***) (-4.995)
(22)		0.09577 (*) (2.08)	-3.30413 (-1.287)	0.32298 (0.648)	
(23)		0.09889 (*) (2.144)	-2.6484 (-1.007)		23.93598 (0.218)
(24)		0.03451 (0.978)		18.01 (***) (5.566)	-3906 (***) (-5.608)
(25)			-0.1693 (-0.086)	18.7412 (***) (5.94)	-4054.17 (***) (-5.821)
(26)	0.11587 (*) (2.447)	-0.15441 (-1.333)	-2.30039 (-0.932)	0.03107 (0.064)	
(27)	0.11954 (*) (2.561)	-0.15982 (-1.387)	-1.73876 (-0.694)		-30.99516 (-0.293)
(28)	0.04094 (0.996)	-0.05095 (-0.545)		16.41 (***) (4.525)	-3574 (***) (-4.608)
(29)	0.02037 (1.316)		-0.06286 (-0.032)	16.95 (***) (4.729)	-3684 (***) (-4.715)
(30)		0.03444 (0.96)	-0.1317 (-0.066)	17.95 (***) (5.299)	-3891 (***) (-5.233)
(31)	0.04092 (0.978)	-0.05091 (-0.535)	-0.02285 (-0.011)	16.40 (***) (4.364)	-3572 (***) (-4.376)

Notes: We use *** to denote significance at the 0.1% level, ** at the 1% level, and * at the 5% level. The t-ratios are in parentheses below the point estimates.



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Table 2. A summary of adopted data sources for the augmented Divisia Index:

Monetary Asset	Level Source	Sample Period	Rate	Rate Source
Credit Card Transactions Volumes	Financial Reports from Visa, MasterCard, American Express, and Discover	Since 2006 Q3 (quarterly data interpolated into monthly by Chow-Lin method)	Interest rates of Credit Card Plans – All Accounts	FRED / G.19
Indicator Series for Chow-Lin Interpolation	Level Source	Sample Period	Rate	Rate Source
Total Consumer Credit Outstanding	FRED / G.19	Since 2006.07	N.A.	N.A.



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Figure 1a. Demonstration of Chow-Lin Interpolation, before interpolation.

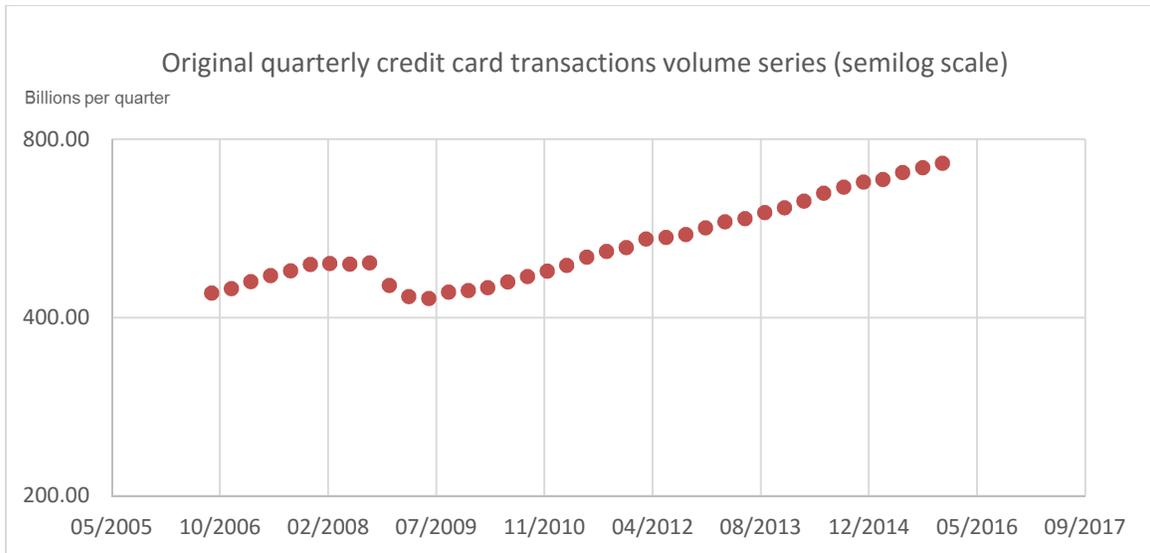


Figure 1b. Demonstration of Chow-Lin Interpolation, after interpolation.

