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Developing a Producer Price Index for Banking Services

Solutions for Mitigating the Incidence of Negative Prices in an SPPI for Banking Based on Administrative Data

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1. Introduction

Statistics Canada is currently developing a services producer price index (SPPI) for banking services. The purpose of this index is to deflate Financial Intermediation Services Indirectly Measured (FISIM)[1]. The Banking program, which covers the five-digit North American Industry Classification System (NAICS) industry 52211, comprises establishments primarily engaged in accepting deposits and issuing loans. Examples of establishments in this industry are chartered banks, trust companies and deposit-accepting mortgage companies. However, credit unions are excluded.

The experimental work includes only chartered banks and focuses on traditional loan and deposit products offered by federally regulated banks that report to Canada's regulatory agency for financial institutions, the Office of the Superintendent of Financial Institutions (OSFI). Administrative data reported to OSFI and some financial market data are used to estimate the SPPI and to test alternative assumptions in order to inform the final data collection and SPPI estimation strategy for this industry.

The previous presentation regarding the Banking SPPI, which was delivered to the 24th Voorburg Group (Statistics Canada 2009), concluded with a list of challenges regarding the choice of reference rate[2] as well as negative prices and high levels of volatility. While these issues remain as significant challenges, over the last year substantial progress has been made in identifying strategies that will improve the overall quality of the Banking SPPI. This paper will discuss those strategies and their consequences without making specific recommendations. The paper will conclude with a brief introduction to the challenges to our methodology caused by dramatic changes in monetary policy and market conditions following the recent financial crisis.

2. Methodology

Since the price of banking services is not observable, it must be derived. The Banking SPPI uses the user-cost of money approach to establish prices. The user cost for a financial service is the difference between its revenue and cost, both implicit and explicit[3]. To measure implicit costs, interest is allocated between loans and deposits by means of reference rates.

In the simplest form, the price of a unit of deposit is the difference between the reference rate and the effective rate banks pay on deposits, plus explicit fees per unit of deposit. The price of a unit of lending is the spread between the effective loan rate and the reference rate, plus explicit fees. To calculate the effective rate, interest income (expenditure) is divided by the outstanding balance. In order to keep the unit of measure

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[1] FISIM is the difference between interest income and interest expense. It is the largest component of bank output.

[2] Reference rates are defined in Section 2. For examples of experimental reference rates, see Appendix A.

[3] Though explicit fees are a component of the user-cost of money approach, the primary purpose of the banking SPPI is to deflate FISIM. Therefore, experiments have been run both including and excluding explicit fees.

constant, we discount[4] the outstanding balance by the reference rate, which is assumed to be the opportunity cost for the banks.

> *Effective Rate: Interest income (expense) per dollar of loan (deposit)*
> *Reference Rate: Opportunity cost of money i.e. what the bank could have earned (paid) by investing (borrowing) in a similar but service free asset (liability).*

3. Data

The SPPI Banking methodology uses two sources of data to derive the index: quarterly income statements and balance sheets of chartered banks booked worldwide and booked in Canada. The booked worldwide financial statements are submitted to OSFI as per the banks' regulatory requirements whereas the booked in Canada data is obtained by Statistics Canada's Industrial Organization and Finance Division (IOFD). However, "in order to minimize reporting burden Statistics Canada has adopted similar formats to data provided to the Office of the Superintendent of Financial Institutions."(Vella 2009) These financial statements are used to calculate effective rates. There is however, a mismatch in terms of the calenderization of the financial statements since income statements follow the fiscal year while balance sheets follow the calendar year. This means that the first quarter income statement covers the months of November, December, and January, while the first quarter balance sheet covers the months of January, February, and March. Methods to correct for this mismatch are discussed later on.

Six product lines are identifiable from the financial statements: Personal Loans for Non-Business Purposes, Other Non-Mortgage Loans, Residential Mortgages, Non-Residential Mortgages, Demand and Notice Deposits, and Term Deposits. Since the Canadian banking industry is highly concentrated with the nine largest banks accounting for over 90 percent of total assets and profits and 90 percent or more of loan and deposit activity in 2009, the coverage is limited to these 9 largest banks. Also, data obtained from large banks tend produce less volatile estimates.

The reference rates used are obtained mostly from the Bank of Canada[5] and the banks' financial statements. Since interest income or expenditure reported this period reflects interest rates set in the previous period, we lag the market reference rates obtained from CANSIM by one period in order to produce more appropriate results.

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[4] Present value discounting is required in order to maintain a constant unit of measure. Since the outstanding balances are period-end values and since the real value of money is eroded over time, the nominal balances must be reduced so that they are reflective of their real value in the base period. The nominal values are discounted through multiplication by a discount factor $[1/(1+r)]$; where r is the discount rate, which is the opportunity cost of capital. For the purpose of the Banking SPPI, the discount rate has been primarily the relevant reference rate.

[5] Statistics Canada. No Date. Table 176-0043 Financial market statistics, last Wednesday unless otherwise stated, monthly (percent unless otherwise noted). CANSIM (database). Last updated July 27, 2010. http://cansim2.statcan.gc.ca/cgi-win/cnsmcgi.exe?CANSIMFile=CII/CII_1_E.HTM&RootDir=CII/ (accessed July 28, 2010).

4. Negative Prices

The choice of reference rate can have a significant impact on the value and volatility of the index and it is essential that an appropriate reference rate be used in order for the results to be meaningful and interpretable. As well it is important to ensure that in selecting a reference rate, the occurrence of negative prices is minimized because negative prices are problematic for price index making. Negative prices for implicit charges arise when the effective rate on a loan (deposit) is lower (higher) than the relevant reference rate. The following sections discuss the practical causes of negative prices and the various methods utilized to attempt to eliminate them.

4.1 Causes of negative prices

Negative prices may occur for several reasons including but not limited to the following:
- The inappropriate choice of the reference rate.
- Mismatches in the timing between interest income (expenditure) and outstanding balances.
- Anomalies in the data caused by accounting irregularities due to tax purposes, M & A activities and securitization, or simple errors in the data collection process (typos, extra zeros etc.).
- Lags between changes in the reference rate and changes in the effective interest rate. These lags become more pronounced during times of rapid interest rate fluctuation such as during the recent financial crisis.
- Recently, it may be the case that reference rates are artificially low since the Bank of Canada target rate is near zero.
- Volatility in effective rates and reference rates
- Some products can be used as loss-leaders in order to promote the sale of other products.
- The bank may be making up for negative implicit fees with higher explicit fees.

In constructing the Banking SPPI, several methods were considered for dealing with negative prices. These are explained in detail in the next sections. Despite the efforts to minimize the occurrence of negative prices, it is not possible to completely eliminate all occurrences of negative prices. In practice, remaining negative prices are imputed with positive values if they appear occasionally, but the series are removed from the sample if negative prices persist.

4.2 Possible solutions for mitigating negative prices

The obvious issue of finding appropriate reference rates is presented first, followed by solutions to problems that may be encountered depending on the data source and environment, such as possible administrative data issues and timing.

4.2.1 Using a different reference rate

Since the choice of reference rate has the largest impact on prices, an appropriate reference rate can help to reduce negative prices while being, at the same time, more relevant to the specific product. Take term deposit as one example. Except for the period from 2002 to 2005, the effective rates banks paid for term deposits is comparable to the 10-year government bond. However, it is unlikely that the average maturity of term deposits would be that long. Therefore, it seems that banks pay, on average, effective interest rates on term-deposits that are higher than equivalent-maturity government bonds. Because of this, it has been a significant challenge to determine the proper reference rate for term deposits. Partly in order to eliminate negative prices, the rate on banks' subordinated debt is considered as the reference rate. Issuing subordinated debt is an alternative for banks to obtain funds and the yield is usually high compared to other financing vehicles. While this reference rate helps to eliminate all negative prices in this case, we should be aware that this spread over effective rates contains the aggregated credit risk specific to those banks. The issue as to whether the assumption of risk is, in and of itself, a service, remains to be settled academically. However, unlike the term deposit rates, this reference rate is barely affected by the level of short-term market interest rates.

In the case of demand and notice deposits, the limitations of our data sources and the challenges to our methodology caused by extraordinary monetary policy conditions coupled with the complication of determining an appropriate reference rate present considerable obstacles to price estimation for this product line.

Demand and notice deposits consist primarily of ordinary savings accounts and checking accounts. Typically, these accounts pay very low levels of interest, or none at all in the case of most checking accounts. However, some banks offer relatively high levels of interest on their savings accounts, but the relative proportions of the different types of accounts are unknown to us and they may vary widely between banks. Therefore, certain banks may face negative prices when a certain reference rate is used while another will not. Finally, when yields on short-term treasury bills approached zero during the height of the financial crisis, negative prices became very common since it was unlikely that banks paid zero interest on all of their demand and notice deposits. In order to correct for this, a longer-maturity reference rate, namely the 2-year government bond rate was used. The use of this reference rate has resulted in the elimination of most negative prices for demand and notice deposits which had occurred primarily during the period of the financial crisis.

4.2.2 Correcting for the mismatch in calenderization between the financial statements

One major source of volatility in the index is the mismatch in calenderization between the income statements and the balance sheets. The balance sheets follow the calendar year which begins in January while the income statements follow the fiscal year which begins in November. Since effective rates are calculated by dividing interest income (expense) by the loan (deposit) balance, the fact that two of the three months in the quarter do not match in any given quarter makes this method inappropriate. Theoretically, if a bank

were to write-down an asset, the income from that asset should decline, but since the income statement is two months behind this does not occur in the same quarter causing a sudden change in the effective rate which is often corrected in the following quarter. One method to correct for this mismatch is to lag the balance sheet by one quarter, which means that only one month is now mismatched. Simultaneously, one could take a weighted average of the current quarter income statement and the last quarter income statement where the weights are two-thirds for the current quarter and one-third for the previous quarter. The results have shown that these methods reduce the rate of volatility in the data as well as the occurrence of negative prices. However, there still remains significant volatility and the occurrence of negative prices, neither of which can be completely removed without the effect of reference rates being taken into account.

4.2.3 Taking a moving average of effective rates or reference rates

Another method for reducing the volatility in any data is to take a moving average. Taking a moving average as opposed to using a point estimate reduces the impact of individual anomalous data points on the direction of the data. For the purpose of our index, the moving average is calculated over four periods (quarters). This transforms the quarterly rate into a year-to-date average. This eliminates the seasonal swings that might occur in the data as well as any temporary factors such as a sudden market panic, or a temporary mismatch between interest income (expenditure) and asset (liability) balance that might occur due to the securitization of an asset, or the down-writing of an asset.

When taking a moving average of the reference rate, the change in price given by a single-period change in the reference rate is reduced. This method is particularly effective in smoothing out data fluctuations when financial market reference rates are moving rapidly such as during the recent financial crisis. Also, since most of the loans on a bank's balance sheet are previously existing loans made under different market conditions, using a moving average for the reference rates helps to smooth the spread between effective rates and reference rates since they reflect reference rates that have occurred in the past as well as those currently prevalent. Finally, taking a moving average of the reference rate has the added benefit of reducing the occurrence of negative prices, since those are often caused by changes in the effective rate that lag changes in the reference rate and therefore result in a temporary period of negative prices.

Another option for reducing volatility and the occurrence of negative prices is to take a moving average of the effective rates. Taking the moving average of the effective rates helps to partly correct the mismatch in calenderization between the income statements and the balance sheets and could be used as an alternative or in addition to the methods discussed in section 4.2.2. However, it is not clear if a four-period moving average of the effective rates is more appropriate than the methods discussed in the previous section for correcting the mismatch between the financial statements. Our experiments show that while taking a moving average of the reference rates significantly reduces volatility, simultaneously taking a moving average of the effective rates makes the data only slightly smoother.

4.2.4 Using annual data as opposed to quarterly data in order to lower volatility

Some of the volatility inherent in the data is due to temporary and/or sudden changes in asset or liability balances that are not matched immediately by changes in the relevant interest income or expense. Also, the occurrence of anomalous microdata points in a particular quarter are sometimes corrected in the following quarter through accounting adjustments. By producing annual instead of quarterly estimates, we can eliminate significant period-to-period volatility. However, unlike taking moving averages, annualizing is only effective for smoothing the mismatch between interest income (expenditure) and outstanding balances when the mismatch happens in the same calendar year. In our experiments, we have found that the relative occurrence of negative prices can be reduced by as much as one-fifth for some banks by producing annual as opposed to quarterly estimates.

4.2.5 Aggregating the products together

Modern banks offer a wide variety of services. The purpose of this product diversification is to achieve synergies across product lines. This is done by taking advantage of cross-promotional opportunities. For example, checking account holders are offered savings accounts, and mortgage holders are offered lines of credit. Since the total value of FISIM is the difference between interest income and interest expense, changes in the relative margins charged for different products can change the distribution of FISIM across products. This is a source of volatility that can emanate directly from changes in the way that banks choose to bundle their services. For example, banks can choose to use one of their products as a loss-leader, like paying a high interest rate for a term deposit, in order to sell a mortgage at a higher rate of interest. If the lower price of a product is made up for by a higher price for another product, no change occurs to global FISIM but a significant change occurs to the output of the individual FISIM products. This service bundling may also be a cause of negative prices if it is the case that banks are using a particular service to subsidize another. By aggregating across products, these effects can be reduced significantly. This may be particularly useful for one of our problematic products, demand and notice deposit,[6] which when combined with term deposit makes for a less volatile index with fewer instances of negative prices.

4.2.6 Using the mid-point rate as a reference rate

Using the mid-point rate to allocate interest income between loans and deposits has been Canadian System of National Accounts (CSNA) practice for many years. At the aggregate level, this approach will eliminate negative prices (or negative output for CSNA), but applying the aggregated mid-point rate to specific product lines at the firm level may still cause negative prices due to the significant differences between products (risk profile, maturity etc.). We have noticed that usually this reference rate causes a

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[6] We record a large number of negative prices for demand and notice deposits due to the near-zero short-term interest rates, which are used as reference rates for this product.

smaller number of occurrences of negative prices compared to a volatile market reference rate. Since the prices thus calculated are assumed to be the same for deposits and loans each period, at the aggregated level, instead of reflecting the margin over the true opportunity cost, this approach is not ideal from price measurement perspective.

5. Conclusion

By applying the methods explained above, most of the negative prices are eliminated and meaningful price indexes are produced. However, some smaller banks (or certain products of large banks) still present persistent negative prices due to apparent accounting anomalies. Ideally, a price survey for loans and deposits would be tested in order to have better control on what data is collected, such as targeting certain products with large weight. By asking specific questions, the results are likely to be more relevant to price measurement and they would potentially be less prone to accounting anomalies and biases. Finally, recent extreme market conditions and unusually lax monetary policy still raise challenges to the current approach. A steepening of the yield curve increases the imputed service output while services provided may not actually change. How to adjust for this effect on prices is still under consideration.

Appendix A

Category	Maturity	Source
Banker's Acceptance	Short-term	CANSIM
Government Bonds (2-year, 5-year, 10-year)	Medium/long term	CANSIM
Capital Market (Mortgage Backed Securities, Corporate Bonds)	Medium/long term	Bloomberg
Bank's Portfolio (Securities holdings, Subordinated Debt)	Medium/long term	Bank Financial statements

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