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A method to measure bank output while excluding credit risk and retaining liquidity effects

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ABSTRACT

The current method of calculating nominal bank output in the national accounts has significant shortcomings. Discussions to remedy this have been ongoing for several years. We propose a new method that addresses the flaws of the current approach of the System of National Accounts. We implement a simple model-free method that removes the 'pure' credit risk premium from the production of banks while keeping the liquidity provision as part of the total nominal bank output. Using both local projections and autoregressive distributed lag models, we show that our method produces nominal bank output estimates that are consistent with the evolution of the economic activity and that remain always positive including during periods of financial stress. This method satisfies the four conditions set by the Inter-Secretariat Working Group on National Accounts. Furthermore, our method reveals that the nominal banking output of the eurozone is overestimated by approximately 40% over the period 2003–2017.

1. Introduction

The financial sector has a central place in both developing and developed economies. The share of finance in Gross Domestic Product (GDP) has experienced a continuous growth over the past 60 years as depicted in Philippon and Reshef (2013). For instance, the share of the financial sector in the United States' GDP has risen from 4% in 1970 to around 8% in 2019. A similar trend can be observed for the United Kingdom (4% to 9%) and Canada (4% to 7%). In Japan and the European Union, the increase is less pronounced, but the share of the financial industry is also significant (5% in France, 4% in Germany and 3% in Japan).[1] Among the financial sector, the role of financial intermediaries is important in promoting economic growth (Rajan & Zingales, 1998), as bank profitability impact economic growth both in the short and long-run (Klein & Weill, 2022). Indeed, they pool funds, produce information, transfer resources and share risks which directly benefits to both lenders and borrowers (Philippon, 2015). These services are compensated as they create value added.

Nevertheless, measuring this valued added remains a huge challenge (Athanasoglou et al., 2009; Hagino & Sonoda, 2010). Indeed, the remuneration for these financial intermediation services are not directly charged to the customers. Instead, they come from the spread between interest rates receivable on financial assets and interest rates payable on financial liabilities. They are known in national accounting under the acronym FISIM (financial intermediation services indirectly measured). The problem revolves around the estimation of the reference rate used to estimate the spreads on loans and deposits. During the financial crisis, the production of FISIM as measured by the method of the 2008 System of National Accounts (SNA) grew substantially (Akritidis & Francis, 2017). For instance, the banking value added estimated by the 2008 SNA has increased by 21% in Germany and 63% in France between 2007 and 2010.[2] This estimation has been considered implausible by most national accountants (Davies, 2010), and made this issue even more acute. Since then, an intense debate has flourished to provide a more accurate method to estimate bank output (Zieschang, 2016). With no clear consensus emerging, the Task Force of the InterSecretariat Working

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[1] Source: OECD STAN database.

[2] Source: Eurostat database.

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Group on National Accounts (ISWGNA, 2013, p. 5) recommended that: "research continues in this area [.] to develop methods and data that can support estimation in the future".

On one side of the debate, scholars such as Diewert et al. (2012), Diewert (2014), Zieschang (2016) and Fixler and Zieschang (2019) favour a reference rate specific to each bank and based on the bank's cost of capital. Using this type of reference rates implies that the value added of banks contains some elements of risk remuneration. However, critics of this approach contend that compensation for assuming credit default risk should not be part of the banks' value added. On the other side, Wang et al. (2010), Basu et al. (2011) and Colangelo and Inklaar (2012) advocate using a series of reference rates specific to the risk and maturity of each type of deposit and loan instruments. This alternative approach has the merit of removing the credit risk-related remuneration from the banking output but has the disadvantage of eliminating all liquidity-related services from the SNA account, which goes against the consensus reached by the community (ISWGNA, 2013). Borrowing from both sides of the debate, we introduce a new method that excludes the compensation for bearing credit risk in the spirit of Wang et al. (2010) and Colangelo and Inklaar (2012), but also includes the liquidity transformation services as advocated by Fixler and Zieschang (2019) and recommended by the United Nations Statistics Division, European Central Bank (2014).

The impact of illiquidity on the price of bonds and on credit spread has been widely evidenced. Bao et al. (2011) underline that in times of financial stress, liquidity effects are the dominant driver of credit spread and take over the credit risk component. Using several alternative liquidity measures proposed in the literature, Friewald et al. (2012) found that liquidity proxies account for approximately 14% of the explained time-series variation of the yield spread changes over time for individual bonds. The COVID-19 crisis is a clear illustration of this, as established in O'Hara and Zhou (2021) or Kargar et al. (2021). However, these liquidity effects on the value of credit spread do not reflect the fundamental level of credit risk. They are due to the microstructure financial market or to the reallocation of portfolios in times of financial stress.

In this paper, we propose a new way to measure nominal bank output based on a simple model-free method that removes the 'pure' credit risk premium from the production of banks while keeping the liquidity provision as part of the total bank output. We use the spread between the yields of Kreditanstalt für Wiederaufbau (KfW) government-guaranteed agency bonds and German government bonds to estimate the liquidity premium over the term structure in the euro area. Then, we compute the adjusted liquidity-free reference rate for each maturity, and we use this new reference rate to estimate banking output of the eurozone during the period 2003–2017. We assess the performance of our method using the four criteria established by the ISWGNA (2013) (p. 20, §49) for producing reasonable reference rates and sensible FISIM:

1. Strong connection to underlying economic conditions as measured by volatility.
2. No sustained periods of negative FISIM.
3. Sensible changes in FISIM near economic turning points.
4. Data is observable.

We compare the new method with (1) the current 2008 SNA and (2) the full risk premia-excluded method (based on Colangelo and Inklaar, 2012's method) and find that our proposed method is the only one that satisfies all four ISWGNA criteria. Indeed, using both local projections (LP) and autoregressive distributed lag (ARDL) models, we show that our method and the full risk premia-excluded method fulfil the first and third criteria, contrary to the current 2008 SNA method. On the second criteria, only our method and the current 2008 SNA method do not generate sustained periods of negative FISIM. Finally, regarding the fourth criteria, we show that we can find data to replicate the new method at the international level in Japan, the United Kingdom and the United States.

The main contribution of this paper is to provide a method that remains within the framework of the 2008 SNA, and that produces coherent and stable banking output even during periods of financial stress, including during times of volatile movements in reference rates and when liquidity markets are dysfunctional. The method eliminates the occurrence of negative outputs and generates reliable output estimates. It improves the consistency of the current 2008 SNA, without requiring any drastic change in its architecture. Furthermore, the method relies on an opportunity cost approach to funds following the ISWGNA recommendations. It allows keeping the term premium and the remuneration linked to liquidity services and satisfies the four ISWGNA criteria. Putting the new method to work, we also show that the nominal banking output estimate in the eurozone, over the period 2003–2017, is, on average, 46% lower than the current method predicts and 22% higher than the approach that adjusts for default risk premium only states. Therefore, this research adds to the literature on the measurement of the financial intermediation services starting with Fixler (1993) and Fixler and Zieschang (1999) and followed by Basu et al. (2011) and Inklaar and Wang (2013). This study also relates to the stream of research examining the size and efficiency of the banking industry including Greenwood and Scharfstein (2013), Philippon (2015) and Bazot (2018).

The remainder of the paper is organized as follows: Section 2 presents the database and the new method we propose to estimate bank output. Section 3 describes and discusses our main results, and Section 4 concludes.

2. Data and methodology

The current 2008 SNA method uses a single reference rate, r_f, which is determined according national circumstances, usually an interbank rate. Then, it computes the total indirectly measured banking output (FISIM) as the sum between the FISIM on deposits and the FISIM on loans. FISIM on deposits are calculated as the difference between the reference rate, r_f, and the rate actually paid to depositors, r_D, multiplied by the amounts of deposits. FISIM on loans are given by the difference between the rate paid to banks by borrowers, r_L, and the reference rate, r_f, multiplied by the amounts of loans.

$$\mathrm{FISIM} = (\mathrm{r_f} - \mathrm{r_D}) \times \mathrm{Deposits} + (\mathrm{r_L} - \mathrm{r_f}) \times \mathrm{Loans} \tag{1}$$

We basically follow the same approach as the 2008 SNA except that we chose different reference rates in lieu of a single r_f. We use the data provided by the ECB Statistical Data Warehouse for series on loans and deposits.[3] Interest rates on market debt security come from the ECB database, Bloomberg and Markit iBoxx. Our dataset covers the period 2003–2017 and includes the 2008–2009 subprime crisis and 2010–2013 European sovereign debt crisis periods, when liquidity dried up dramatically on the bonds market. In our analysis, we focus on the two most important institutional sectors—namely, non-financial corporations (S11) and households and non-profit institutions serving households (NPISH) (S14 and S15). These represents approximately 80% of the total outstanding amounts.

2.1. Deposits

ISWGNA (2013) concluded that liquidity transformation services are part of the nominal banking output, and it found that the current method for computing FISIM on deposits is correct and does not require any changes. Consequently, we follow the 2008 SNA and keep a single reference rate that reflects the average of short-term interbank lending rates (Euribor). To determine the FISIM on deposits, we need the outstanding amounts and outstanding amount rates for each of the sectors, categories and maturities of deposits as described in Table 1.

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[3] See http://sdw.ecb.europa.eu/.

Table 1
Characteristics of deposits.

Sector	Category	Maturity
Non-financial corporations (S11)	Overnight	-
	With agreed maturity	Less than two years
		More than two years
Households and NPISH (S14 +S15)	Overnight	-
	With agreed maturity	Less than two years
		More than two years
	Redeemable at notice	Less than three months

2.2. Loans - credit risk

Considering risk-bearing as a non-productive activity, we aim to remove any risk remuneration from the nominal banking output. In a first step, we calculate a series of reference rates, including the risk of default and any term premium in the spirit of Wang et al. (2010), Basu et al. (2011) and Colangelo and Inklaar (2012). We do so for each institutional sector, each type of loan and each maturity. Using the European Central Bank (ECB) database enables us to categorize the statistical series presented in Table 2. For each type of loan, we need the quantity and the price of the financial intermediation services.

The price of the financial intermediation services is represented by the margins on loans, which corresponds to the spreads between some reference rates and the actual interest rates on loans. For the actual interest rate, it is necessary to choose between 'new business' rates and 'outstanding amount' rates. Because the spread between the reference rate and the actual interest rate applies to the stock of loans in the relevant instrument category, the SNA proposes using the outstanding amount rates. We follow this recommendation.

For each type of loan, a corresponding reference rate is selected from the same systematic risk and maturity profiles. Then we need to find a corresponding bond index for which systematic risk is as close as possible to each type of bonds. For non-financial corporations, we use the iBoxx € non-financials. This index comprises 1000 firms and is split by maturities 1 to 3 years, 3 to 5 years, 5 to 7 years, 7 to 10 years and more than 10 years. For households and NPISH, there are no such comparable bond indices, because they do not raise money directly from the markets. However, we can estimate their risk by assessing the covered bond rates. The latter are issued by financial institutions and backed by mortgage loans to pay interests on the covered bonds. The interests paid by households are passed on to the covered bond investors. The iBoxx € Covered tracks the evolution of this market. It comprises approximately 700 bonds split along the maturities 1 to 3 years, 3 to 5 years, 5 to 7 years, 7 to 10 years and more than 10 years. We retain this index for measuring the households and NPISH systematic risk. This gives us for each type of loan i of maturity t a market reference rate r_{it}^{M} based on the yields on market securities with the same systematic risk. In opposition to the single reference rate currently used in the 2008 SNA, this rate reflects the credit default risk and allows removing the remuneration related to the credit risk premium from the banking output, as recommended by the Task Force of the ISWGNA (2013, p. 22, §60).

$$r_{it}^{M} = \begin{cases} Corporate \quad bond \quad index_{it} \text{if non} - \text{financial corporations} \\ Covered \quad bond \quad index_{it} \quad if \quad households \quad NPISH \end{cases}$$

2.3. Loans – liquidity risk

In a second step, we estimate the liquidity risk premium, which we subtract from the reference rates r_{it}^{M} calculated previously. The liquidity risk reflects the potential difficulty that may be encountered when buying or selling an asset due to the deterioration of trading conditions. This risk has been studied by Brunnermeier (2009) and Acharya and Skeie (2011), and its importance was highlighted during the financial crisis (Gianfelice et al., 2015). The ISWGNA (2013) concluded that the liquidity transformation services should be part of the banking output therefore, the reference rate must be free of any liquidity risk and we need to adjust the market reference rate by removing the liquidity premium. To do so, in the spirit of Amihud and Mendelson (1991) and Warga (1992), we follow the literature that decomposes yields into liquidity and credit risk and computes the liquidity premium as the spread between bonds with the same credit quality but with different liquidity.

We implement a model-free measure of market liquidity, directly calculated from asset prices, and borrow the methodology from Longstaff (2004). Longstaff extracts the yield differential between U.S. Treasury bonds and same maturity bonds issued by RefCorp (Resolution Funding Corporation), which is a U.S. government agency, guaranteed by the U.S. Treasury. Ejsing et al. (2015) and Schwarz (2019) adopted a similar approach for the euro area, and this is the path that we follow. More specifically, we examine the yields of highly liquid German government bonds and some less liquid German government-guaranteed agency bonds, namely the KfW agency bonds. KfW bonds are fully and explicitly guaranteed by the government and have the same credit risk as the German government bonds, they also have the same tax treatment.

Schestag et al. (2016) evaluated a comprehensive list of measures of liquidity and found that most of them perform well. Monfort and Renne

Table 2
Characteristics of loans.

Sector	**Category**	**Maturity**
Non-financial corporations (S11)	Loans	Less than one year
		Between one and five years
		More than five years
Households and NPISH (S14 +S15)	Loans for house purchases	Less than one year
		Between one and five years
		Between five and ten years
		More than ten years
	Consumer credit	Less than one year
		Between one and five years
		More than five years
	Other loans	Less than one year
		Between one and five years
		More than five years

Table 3
Summary statistics for KfW bonds and German government bonds.

	KfW	German government bonds
Number of bonds	124	204
Average time to maturity at issue date (in years)	6.28	7.45
Average coupon (in %)	2.08	2.69
Average issuing volume (in bn euros)	4.59	15.54
Total amount issued (in bn euros)	569	3170

(2014) proposed an alternative method to that of Longstaff (2004), which does not directly consider the German government bonds but subtracts German CDS from maturity-matched German bonds to neutralize any credit risk premium. However, taking into account the ISWGNA (2013)'s concern about the feasibility of new methods, we prefer the simplicity of the Longstaff (2004) model-free approach, which relies only on the assumptions that both issuers share exactly the same credit risk. We recover daily prices from Bloomberg from January 1st, 2003 to Dec 31st, 2017. We select fixed annual coupon, euro-denominated, bullet KfW bonds comparable to the German government bonds. Our dataset consists of 124 KfW bonds maturing between 2003 and 2037 and 204 German government bonds maturing between 2003 and 2048. Table 3 provides the summary statistics of the dataset.

From these baskets, we create generic historical series of 1-year up to 15-year maturity. As the maturities do not match perfectly, we need to interpolate the yield curves, and we use the Svensson (1994) method for recovering monthly yield curves of each issuer. Then we subtract the yields on KfW bonds from the yields on German government bonds with corresponding maturities and find the liquidity premium for each maturity t ranging from 1 year to 15 years.

$\textit{Liquidity premium}_t = \textit{Yield Agency}_t - \textit{Yield governement}_t.$

Next, we compute the adjusted liquidity-free reference rate:(2).

$$r_{it}^{M*} = r_{it}^{M} - \text{Liquidity Premium}_t \qquad (3)$$

We calculate the liquidity premium as the spread between bond yields of the same credit quality but of different liquidity.

Schwarz (2019) and Monfort and Renne (2014) established the existence of a commonality in market liquidity in the cross-section of countries, implying that the KfW liquidity premium carries European-wide liquidity-pricing effects. For example, Fig. 1 shows the liquidity premium extracted from the 6-year German government bonds and the 6-year KfW bonds. Until the second quarter of 2007, the liquidity premium is less than 0.1%. Then, it gradually increases and reaches a maximum of almost 1% at the height of the subprime crisis in the fourth quarter of 2008. It recedes rapidly until the first quarter of 2010 and then increases again rapidly with the onset of the euro crisis. It reaches a second peak at 0.84% in the fourth quarter of 2011 corresponding to the most acute time of the euro crisis. Then, after the arrival of Mario Draghi as head of the European Central Bank and the resulting change in its policy, the liquidity premium decreases almost continuously and reaches a pre-crisis level from mid-2014 to mid-2015. From that date, it rises again but remains well below the level reached during the subprime and euro crisis and fluctuates around 0.2%. In Fig. 2, we take the spread between the 6-year French and German government

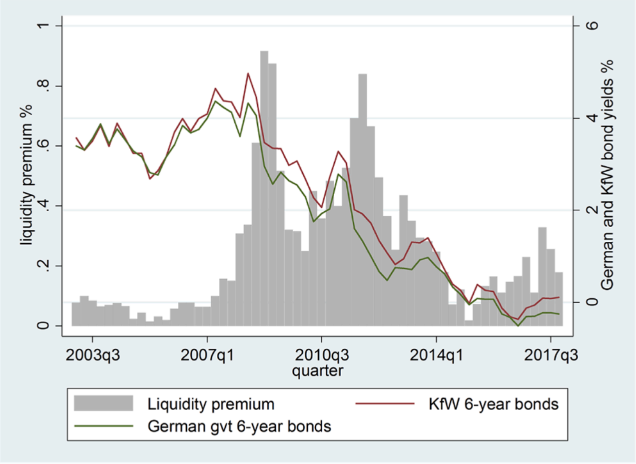

Fig. 1. Liquidity premium KfW 6-year. This figure shows the 6-year German government and KfW bond yields and the resulting liquidity premium.

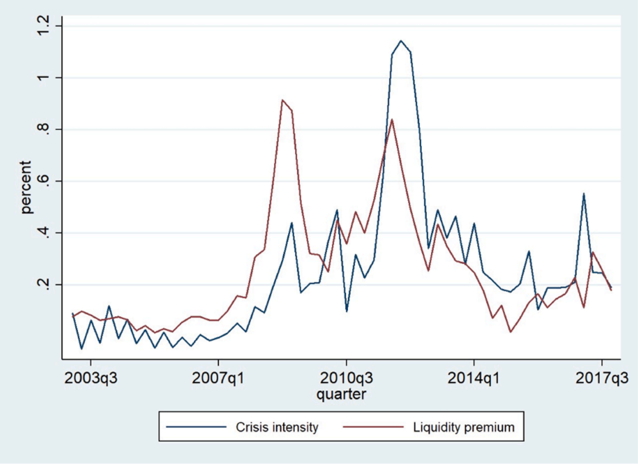

Fig. 2. Financial crisis intensity and liquidity premium. This figure shows the evolution of the financial crisis intensity measured by the spread between the 6-year French government bond yields and the 6-year German government bond yields and the evolution of the liquidity premium (6-year).

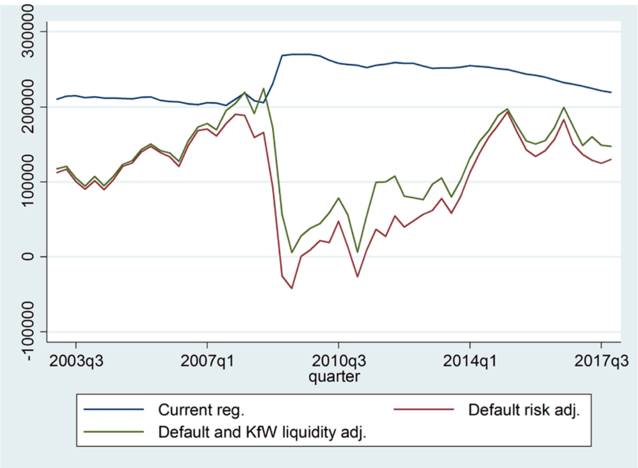

Fig. 3. Quarterly FISIM under various methods. This figure shows the quarterly production of FISIM under the current regulation (2008 SNA), the default risk adjusted method as suggested in ISWGNA (2013) and the method that adjusts for both default risk and liquidity premium. All figures are in million euros.

bonds as a crude measure of the financial crisis intensity and find a strong correlation between the evolution of the liquidity premium and the crisis intensity. Our measure of liquidity premium reflects the flight to quality that occurs in times of crisis when investors prefer to hold highly liquid securities and widen the spread between assets of same credit quality. Fig. 3.

2.4. Empirical methods to investigate the link between FISIM and macroeconomic conditions

To test the relevance of the different methods with regard to the first and third ISWGNA criteria, we adopt two different tests.

2.4.1. On the short run

First, we investigate the short-run relationship between estimated FISIM and economic cycle of the euro area, proxied by its Gross Domestic Product (GDP) or the Economic Sentiment Index (ESI) of the area. For that, we rely on the general method proposed by Jordà (2005) and Jordà (2009) to estimate impulse response functions (IRF) from local projections. Indeed, this method is robust to the misspecification representation of the data generating process (DGP), which is not represented by a VAR. This method does not impose any underlying dynamics on the variables in the system, contrary to VAR models. In its basic form, local projection consists of a sequence of regressions of the endogenous variable shifted several steps ahead. As a result, the approach consists in estimating the following equation:

$$\Delta_h Y_{t+h} = \beta_h EC_t + \epsilon_{ht} \tag{4}$$

where $\Delta_h Y_{t+h} = Y_{t+h} - Y_{t-1}$ and corresponds to the log change in the FISIM estimated from base quarter t up to quarter $t+h$, using the different methods,[4] and EC_t is the measure of the euro area economic cycle (euro area GDP or euro area ESI) at time t. Each step of the accumulated IRF is obtained from a different equation and directly corresponds to the estimates of β^h.

2.4.2. On the long-run

In a second step, we run a cointegration analysis to test the long-term relationship between the computed FISIM and the economic cycle (first criterion) but also the adjustment speed towards this equilibrium relationship in the short run (third criterion). For this purpose, we employ the ARDL bounds testing procedure developed by Pesaran and Shin (1998) and Pesaran et al. (2001). We prefer this method to standard cointegration tests such as those of Johansen (1991) or Engle and Granger (1987) for several reasons.

First, one important feature of the bound testing procedure proposed by Pesaran et al. (2001) is that it can be applied to a set of regressors that are a mixture of I(0) and I(1) variables. However, Cheung and Lai (1993) put forth evidence that standard unit root tests suffer from size distortion and low power in the case of small samples, as is the case in our analysis. Second, the bound testing procedure is robust in case of small samples whereas others could be biased in this case. Finally, the method provides robust t-statistics and, thus, unbiased long-term estimates even if one or more regressors are potentially endogenous.

Following Pesaran et al. (2001), we estimate the conditional error correction model presented in Eq. (5) to obtain the bound tests:

$$\Delta Y_t = \mu + \delta Y_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta Y_{t-i} + \theta EC_{t-1} + \sum_{j=1}^{l} \tau_j \Delta EC_{t-j} + \epsilon_t, \tag{5}$$

where Y_t is the logarithm of FISIM estimated using the different methods proposed herein at time t. EC_t is the measure of the euro area economic cycle (euro area GDP or euro area ESI) at time t. k and l are the lags of the ARDL model selected according to the Schwartz information criterion and ϵ_t are the errors of the model assumed to be independent and identically distributed.

The bound test, testing the null hypothesis of no cointegration, developed by Pesaran et al. (2001) is based on an F-test statistics, as follows:

$$H_0\colon \delta = \theta = 0 \tag{6}$$

Pesaran et al. (2001) provided two sets of critical values for their bound test. The first set is computed assuming that all variables in the ARDL model are stationary. For the second set, all variables of the ARDL model are supposed to be I(1). These two sets of critical values provide bounds for all regressors. The decision procedure is as follows: if the F-statistic is lower than the lower bound, the null hypothesis cannot be rejected and there is no long-term relationship between the two studied variables. The reverse is true if the F-statistic is higher than the upper bound. However, the test is inconclusive if the F-statistic falls between the two bounds. In this case, standard unit root tests must be computed.

3. Results

3.1. Estimated FISIM

We compute FISIM under respectively (1) the current regulation, (2) the default risk adjusted, and (3) the default and liquidity risk adjusted for the eurozone. Table 4 presents these results split by sector and averaged over the period 2003–2017. As expected, FISIM adjusted for default risk and FISIM adjusted for default and liquidity risk are much lower than those obtained by the current method, especially from 2008 to 2015, which is consistent with the economic intuition. The method we propose (column 3) reduces the nominal banking output estimate of the eurozone by a significant 46% compared with the current regulation (column 1). This reduction is more pronounced for the non-financial corporation sector with 52% than for the household sector with 42%. Our method generates on average 22% more than the approach that adjusts for default risk premium only (column 2).[5] Fig. 5 shows the quarterly production of FISIM under these different approaches.

The difference between the banking output under the current regulation and the risk-adjusted methods varies over time. It was at its maximum during the subprime crisis and the euro crisis. The current method leads to paradoxical results because FISIM dramatically increased during the financial crisis of 2008 and the eurozone crisis of 2012. Thereafter FISIM initiated a declining trend with low volatility. Conversely, the risk-adjusted methods resulted in a sharp decline of the banking output in the first quarter of 2009, and again at the end of 2010 and the beginning of 2011. Since then, they have gradually recovered and have been fluctuating at the pre-crisis levels since 2014. At first glance, the risk-adjusted methods present a picture more consistent with the evolution of the business cycle.

Then, we examine separately the FISIM on loans and the FISIM on deposits. We find that except in 2011, the FISIM on deposits have been negative every quarter since 2009 (Fig. 4). This is due to the emergence of negative interest margins on deposits when the reference rate falls below the interest rates on deposits. This result, which may seem paradoxical, is most likely explained by the existence of cash and retail depositors' option to hold cash. It could also result from a change in banks' behavior towards deposits (Ravets, and Groslambert et al., 2011,

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[4] The three methods are: the current method developed by the 2008 SNA, the method adjusted for the credit risk premium, and the method adjusted for both credit risk and liquidity premium. As the method adjusted for the risk premium provides negative FISIM, we compute the logarithm of this variable using the following transformation: $ln(Y_t - Min(Y_t) + 1)$.

[5] Colangelo and Inklaar (2012) use a slightly different method that adjusts for both default risk and term premium. The results adjusted for default risk premium (column 2) are in line with theirs.

Table 4

Imputed banking sector output (FISIM) in eurozone by sector, current regulation, and modified approaches (average January 2003–December 2017, million euros).

	(1) Current regulation 2008 SNA	(2) Adjusted for default risk premium only	(3) Adjusted for default risk premium and liquidity premium
Total	234,251	103,36	125,911
Non-financial corporations	91,21	33,769	43,604
Households	143,04	69,591	82,308

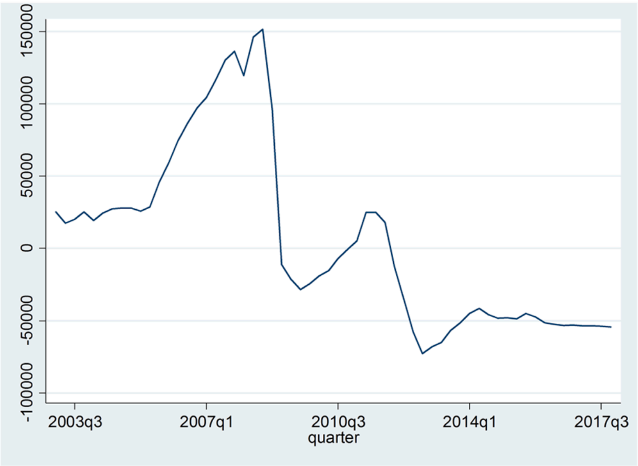

Fig. 4. FISIM on deposits (million euros).

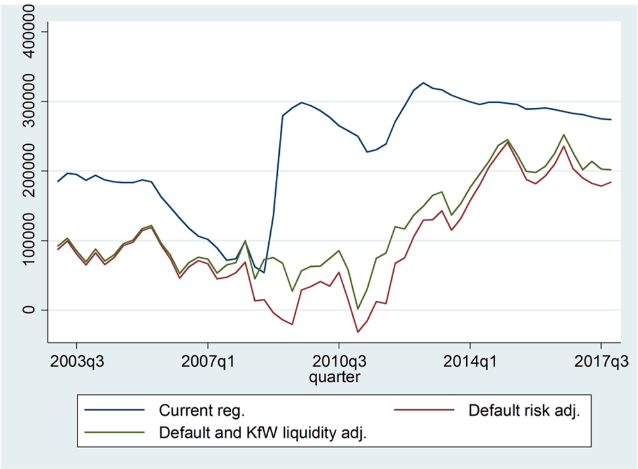

Fig. 5. FISIM on loans (million euros).

2016) and indicate that deposits have become an important liquidity resource for banks that would be willing to remunerate them. Furthermore, as explained by ISWGNA (2013): "it is not difficult for example to defend occurrences of negative FISIM for certain groups of depositors/borrowers if these implicit charges are outweighed by explicit intermediation fees ". This is the case for example in France, where the share of FISIM in bank output has decreased from 55% in 1995 to 33% in 2017.[6] Overall, this suggests that there is an important methodological gap in the current method for FISIM, but this is beyond the scope of our paper.

For FISIM on loans (Fig. 5), we find roughly the same patterns as for total FISIM. The current method exhibits a threefold increase in banking output at the time of the crisis and then stabilize around 300 billion euros per quarter. Because the growth rate of the outstanding amount of loans has been flat since 2009, these variations are mostly explained by the evolution of the interest rate margin. This huge increase was caused by the plummeting of the 2008 SNA reference rate due to an accommodating monetary policy by the ECB from 2008. Both alternative methods show a very different evolution of the banking output. They dropped during the subprime crisis and again during the eurozone crisis but then recovered dramatically from a low in the first quarter of 2011 until 2014. Since then, they have fluctuated around 200 billion euros at about 25% less that the current method.

3.2. Discussion on the performance of the different methods

In this section, we compare the respective merits of each method by using the four criteria established by the ISWGNA (2013) for producing reasonable reference rates and sensible FISIM estimates which are described in the part 1.

3.2.1. Connection with underlying economic conditions and sensible changes near turning points

The ISWGNA (2013) requires that any new method have a strong link to underlying economic conditions, as measured by volatility, and have significant changes in FISIM near economic turning points. To test these conditions, we perform a short-run analysis and a long-run analysis.

3.2.2. Short run analysis

First, we test the time series properties of our different variables using both the Augmented Dickey-Fuller (ADF) test and the stationarity test developed by Kwiatkowski et al. (1992). Table A.1. in the Appendix reports the results of the unit root tests. All variables seems to be I(0) or I (1). Figs. 6 and 7 displays impulse responses of estimated FISIM to one standard deviation innovations of the explanatory variables (ESI or current GDP) in a 95% marginal confidence band using the LP method. Note that estimation of impulse response coefficients can lead to wider marginal error bands in case of serial correlation. The use of conditional error bands allows to remove the variability caused by serial correlation.

Fig. 6 reveals that a positive shock on euro area GDP has a significant negative impact on FISIM estimated using the current method, which seems counterintuitive. When FISM are computed using the full risk premia-excluded method and the credit risk premia only-excluded method, results are different. Indeed, Fig. 6 shows that a one standard deviation innovations of euro area leads to an increase in FISIM. FISIM estimated using the full risk premia-excluded method increase by 0.28% points, while FISIM computed using the credit risk premia only-excluded method increase by 0.6% points two quarters following the shock. These results put forth the evidence that FISIM computed using the current method seems to be disconnected from macroeconomic conditions on the short-run, while FISIM estimated using the two other methods are not. Fig. 7 confirms this conclusion by using the ESI rather than the euro area GDP to proxy for macroeconomic conditions.

3.2.3. Long run analysis

The Schwartz information criterion is used to select the optimal number of lags for the estimation of the ARDL models. We also correct

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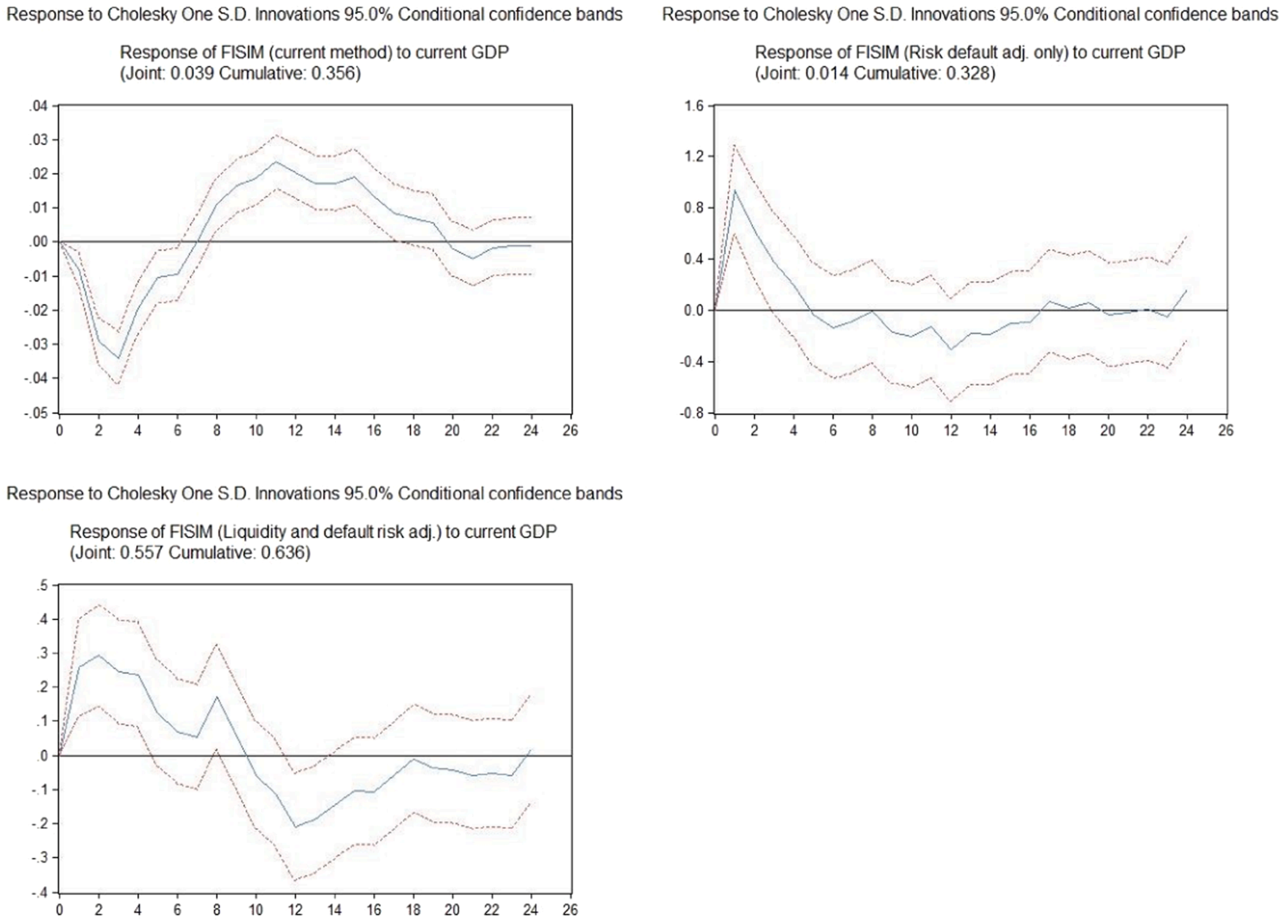
[6] Source; INSEE and Banque de France.


Response to Cholesky One S.D. Innovations 95.0% Conditional confidence bands

Response of FISIM (current method) to current GDP
(Joint: 0.039 Cumulative: 0.356)

Response to Cholesky One S.D. Innovations 95.0% Conditional confidence bands

Response of FISIM (Risk default adj. only) to current GDP
(Joint: 0.014 Cumulative: 0.328)

Response to Cholesky One S.D. Innovations 95.0% Conditional confidence bands

Response of FISIM (Liquidity and default risk adj.) to current GDP
(Joint: 0.557 Cumulative: 0.636)

Fig. 6. FISIM local projection responses to a positive current GDP shock.

standard errors for autocorrelation and heteroscedasticity using the Newey-West transformation. Table 5 summarizes results of the bound tests and presents the long-term relationship between the estimated FISIM and the eurozone's GDP, as long as the error correction term is based on the estimation of the ARDL models. Table 5 also displays autocorrelation and heteroscedasticity tests to check the accuracy of estimations. Note that ARDL models are estimated without an intercept and a trend, as both intercept and trend are not significant at the 5% level.

Column (1) of Table 5 depicts the current method for the computation of FISIM, column (2) provides the results for the full risk premia-excluded method and column (3) presents the results for the credit risk premia only-excluded method. The results indicate that the null hypothesis of no cointegration between FISIM estimated by the current SNA method and the euro's area current GDP cannot be rejected at the 5% level. Therefore, the current method fails to satisfy the criterion established by the ISWGNA. By contrast, FISIM adjusted for credit risk and liquidity premia and for credit risk premium only are related to eurozone's economic cycle, as the null hypothesis of no cointegration with the eurozone's GDP is rejected at the 1% level. Consequently, the first criterion proposed by the ISWGNA (2013) is only fulfilled by these two methods.

Then, we evaluate the third criterion proposed by the ISWGNA, which means that FISIM exhibit sensible changes near economic turning points, using the adjustment speed estimated in the error correction model. The results in Table 5 show that the coefficient associated with the error correction term is significant at the 1% level only in the last two estimations. This indicates that deviations from the long-term relationship are eliminated more quickly in the case of the method adjusted for default risk premium only and in the case of the method adjusted for both default risk and liquidity premium. Therefore, the volatility of FISIM from factors not connected with the economic cycle is much lower with the latter two methods. Consequently, the method adjusted for default risk premium only and the method adjusted for both default risk and liquidity premium are more in line with the third criterion proposed by the ISWGNA (2013), contrary to the current method. Note that we observe a strong difference between the adjustment speed estimated for the method adjusted for the default risk only and the one estimated for the method adjusted for both risk and liquidity premia. At first glance, we could conclude that the method adjusted for the default risk only produces better results because the adjustment speed towards long-term equilibrium is higher. However, we find that the discrepancy in adjustment speed between the two methods is only linked to the logarithmic transformation applied to the method adjusted for default risk, as it entails negative values.[7] Indeed, if we apply the same transformation to the method adjusted for both liquidity and default risk premia, we obtain a similar coefficient for the adjustment speed as shown in Table A.2. of the Appendix.

To test the robustness of our results, we also conduct the ARDL cointegration testing procedure of Pesaran et al. (2001) on the ESI of this area. Table 6 reports the results and confirms our previous conclusions.

In summary, our results provide evidence that the method adjusted for the default risk premium and the method adjusted for both the default risk and liquidity premia outperform the current method in terms of the first and third criteria proposed by the ISWGNA (2013). They are more connected with the economic cycle and minimize the part of volatility due to factors not related to this economic cycle. It is

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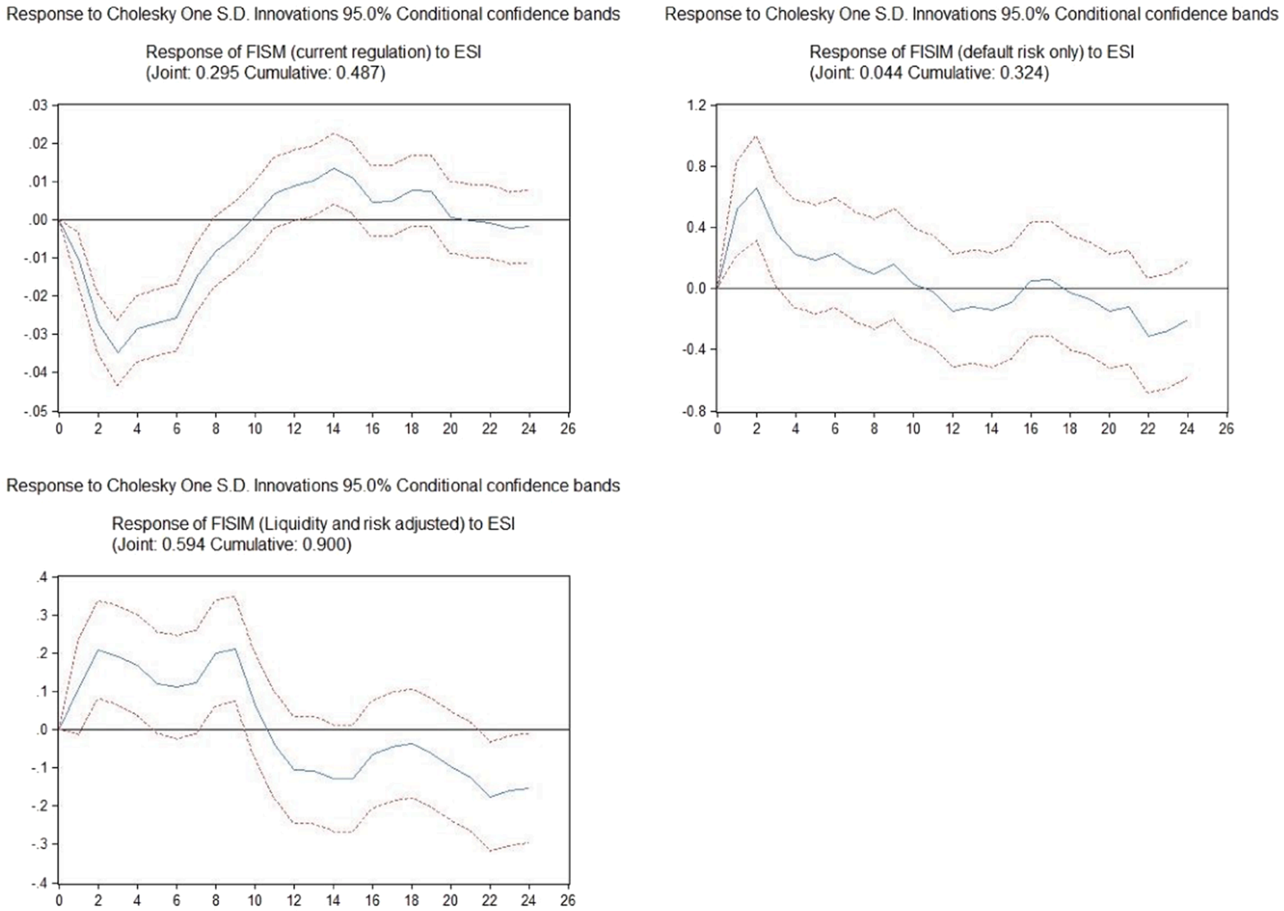
[7] See footnote 4 for a presentation of the applied transformation.


Response to Cholesky One S.D. Innovations 95.0% Conditional confidence bands

Response of FISM (current regulation) to ESI
(Joint: 0.295 Cumulative: 0.487)

Response to Cholesky One S.D. Innovations 95.0% Conditional confidence bands

Response of FISM (default risk only) to ESI
(Joint: 0.044 Cumulative: 0.324)

Response to Cholesky One S.D. Innovations 95.0% Conditional confidence bands

Response of FISIM (Liquidity and risk adjusted) to ESI
(Joint: 0.594 Cumulative: 0.900)

Fig. 7. FISIM local projection responses to a positive ESI shock.

Table 5
Results of bound tests with current eurozone's GDP (case no intercept).

	(1) Current regulation 2008 SNA	(2) Adjusted for default risk premium only	(3) Adjusted for default risk premium and liquidity premium
Model	ARDL (4,4)	ARDL (1,2)	ARDL (1,2)
Cointegrating vector	0.858***	0.720***	0.755***
	(0.010)	(0.020)	(0.013)
ECT_{t-1}	-0.043	-0.969***	-0.461***
	(0.026)	(0.154)	(0.098)
Diagnostic tests QLB (1)	1.588	0.003	0.001
QLB (5)	4.063	1.944	0.987
QLB (10)	6.602	5.578	16.764*
ARCH-LM test	0.091	0.011	0.300
Bound tests F-statistics	2.186	60.684	15.114
I(0) critical value (5%)	3.15	3.15	3.15
I(1) critical value (5%)	4.11	4.11	4.11
I(0) critical value (1%)	4.81	4.81	4.81
I(1) critical value (1%)	6.02	6.02	6.02

Note: Number in parentheses are standard errors. The model includes no intercept and no trend (Case I). Critical values for bound test come from Pesaran et al. (2001). ECTt–1 represents the coefficient associated with the adjustment speed in the error correction model. QLB represents the Ljung-Box statistic. ARCH-LM represents the ARCH-LM statistic to test for heteroscedasticity. Significance level: * ** $p < 0.01$, * * $p < 0.05$, * $p < 0.1$.

Table 6
Results of Bound tests for eurozone's ESI (Case no intercept).

	(1) Current regulation 2008 SNA	(2) Adjusted for default risk premium only	(3) Adjusted for default risk premium and liquidity premium
Model	ARDL (4,1)	ARDL (1,2)	ARDL (1,2)
Cointegrating vector	2.679***	2.519***	2.526***
	(0.033)	(0.042)	(0.029)
ECT_{t-1}	0.014	-0.924***	-0.458***
	(0.013)	(0.214)	(0.107)
Diagnostic tests QLB (1)	0.110	0.130	0.041
QLB (5)	4.355	6.686	1.286
QLB (10)	7.075	9.054	10.225
ARCH-LM test	0.417	6.141	0.195
Bound tests F-statistics	0.923	29.037	8.165
I(0) critical value (5%)	3.15	3.15	3.15
I(1) critical value (5%)	4.11	4.11	4.11
I(0) critical value (1%)	4.81	4.81	4.81
I(1) critical value (1%)	6.02	6.02	6.02

Note: Number in parentheses are standard errors. The model includes no intercept and no trend (Case I). Critical values for bound test come from Pesaran et al. (2001). ECTt–1 represents the coefficient associated with the adjustment speed in the error correction model. QLB represents the Ljung-Box statistic. ARCH-LM represents the ARCH-LM statistic to test for heteroscedasticity. Significance level: * ** $p < 0.01$, * * $p < 0.05$, * $p < 0.1$.

Table 7

Number of negative quarters of banking output on loans from Q1–2003 to Q4–2017.

	(1) Current regulation 2008 SNA	(2) Adjusted for default risk premium only	(3) Adjusted for default risk premium and liquidity premium
Total FISIM	0	3	0
FISIM on loans	0	5	0
FISIM on deposits*	32	32	32

* FISIM on deposits are calculated in the same way for all three methods.

important to note that our results are robust to the use of another method to measure the liquidity premium. Indeed, if we rely on the spread between the iBoxx euro non-financial corporate bond index and its subset, the iBoxx euro liquid non-financial corporate bond index, we obtain very similar results, as shown in Table A.3. of the Appendix.

3.2.4. No sustained periods of negative FISIM

The ISWGNA debated the notion of negative FISIM and their theoretical meaning (Ahmad, 2012) and concluded that negative FISIM was not conceptually possible and recommended that any method for computing FISIM should not produce sustained periods of negative FISIM. Table 7 gives the number of occurrences of negative quarterly FISIM in the period 2003–2017. The current regulation method does not generate any quarter of total negative FISIM (column 1). Conversely, the method adjusted for the default risk premium generates three quarters of negative total output in the first half of 2009 and the first quarter of 2011. This comes from the overestimation of the reference rate during a period of financial stress, which dramatically decreases the FISIM on loans. The method generates five quarters of negative FISIM on loans in the last quarter of 2008, the two first quarters of 2009 and in the first two quarters of 2011 (column 2). The method adjusting for default risk and liquidity premium corrects this flaw and does not generate any negative quarterly output, contrary to the default risk only method.

The current regulation method and our proposed method adjusted for risk and liquidity premia comply with the second criterion of the ISWGNA of no sustained periods of negative FISIM. This is not the case for the method adjusted for default risk premium only. This raises the question of the consistency of this approach during periods of financial stress, as it is difficult to explain sustained negative output on loans.

3.2.5. Observable data

The ISWGNA (2013)'s fourth criterion for validating any new method is the availability of observable data. Compared with the current regulation, the new proposed methods require additional data to compute the default risk premium and the liquidity risk premium. For the default risk, it is necessary to find a non-financial corporate bond index and a covered bond index. These types of data are easily accessible through third party vendors such as Markit Iboxx, Bank of America Merrill Lynch or Bloomberg Barclays. For the liquidity risk, one needs to have both liquid and non-liquid credit riskless bond issuers with a sufficient number of bonds in all maturity segments. In the eurozone, KfW bonds are good candidates (Monfort & Renne, 2014; Schwarz, 2019). For the United States, one can use RefCorp bonds as shown by Longstaff (2004). Hattori (2019) developed a similar approach with Japanese government-guaranteed bonds. In the United Kingdom, one can use the bonds issued by the Network Rail Infrastructure Finance PLC, which benefits from the British government guarantee in full and carries the same credit ratings as the UK sovereign. Thus, we can estimate the liquidity risk premium across many countries directly from asset prices without relying on a specific model. Consequently, we can conclude that data are observable and the method we propose to correct for credit risk and liquidity premium can be easily implemented in the countries that have a large banking sector.

4. Removing term and credit risk premium from FISIM on deposits: robustness checks

Although the ISWGNA (2013) concluded that the current method for computing FISIM on deposits is correct, it can be argued that the use of a single short-term reference rate could include some elements of credit risk and other risks in the bank output on deposits. For consistency with the treatment on loans, these elements should be removed from the FISIM on deposits. Therefore, in this section we present two alternative choices of reference interest rates for calculating FISIM on deposits, and check whether our previous results are robust to this new approach. The first alternative method distinguishes between fully insured and non-fully insured deposits, and removes the credit risk premium from the insured deposits. The second alternative method removes the term and credit risk premium by using maturity and credit-matched reference rates for insured and non-fully insured deposits with maturities greater than overnight.

4.1. Credit risk premium

It can be argued that depositors should not receive any compensation for bearing credit risk, if the deposit is fully insured. Consequently, using a single reference rate for both fully insured and non-fully insured deposits can introduce an overestimation of the value of bank liquidity services, especially during financial stress. To overcome this issue and ensure the consistency of the measured liquidity services over time, we select different reference rates for insured deposits and for non-fully insured deposits. For fully insured deposits, we retain the euro Repo-Funds rate, which by design does not contain credit risk. For deposits that are not fully insured, we choose the Euribor. We have estimated the share of fully insured and non-fully insured deposits in total deposits using the International Association of Deposit Insurers (IADI) database.

4.2. Term and credit risk premium

The use of a single reference could also pose some problems because deposits under scrutiny in this analysis have different maturities. If during normal times, the nominal yield curve is generally upward sloping, the slope can change rapidly at times when the central bank is actively tightening or easing monetary policy. Thus, to test the sensitivity of our results to the choice of different maturities for the reference rates used in the computation of FISIM on deposits, we rely on an interest-pass-through methodology as in Colangelo and Inklaar (2012) and Groslambert et al. (2016). We consider the cointegrated relationship between market (mr_t) and deposit interest rates (r_t) If both series are I (1), the following relationship is obtained:

$$r_t = \gamma_1 + \gamma_2 mr_t + \epsilon_t$$

Then, we can model the short-run relationship using an Error Correction Model (ECM) following Engle and Granger (1987) and rewrite it as follows (De Bondt, 2005):

$$\Delta r_t = \beta_1 + \beta_2 \Delta mr_t - \delta_1 (r_{t-1} - \delta_2 mr_{t-1}) + u_t$$

Where the parameter β_2 represents the short-term pass-through, δ_2 re-

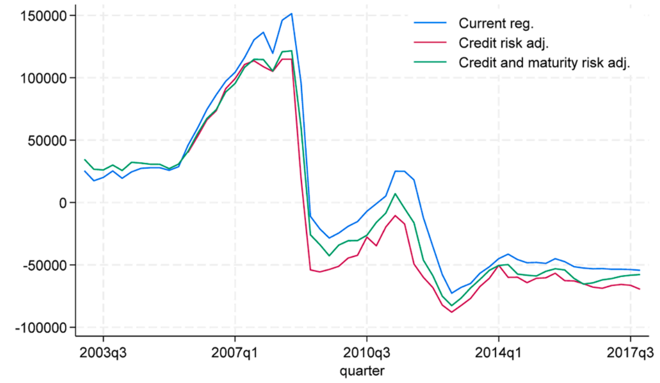


Fig. 8. FISIM on deposits (million euros). This figure shows the quarterly production of FISIM on deposits under the current regulation (2008 SNA), the credit risk adjusted method, and the credit and maturity risk adjusted method.

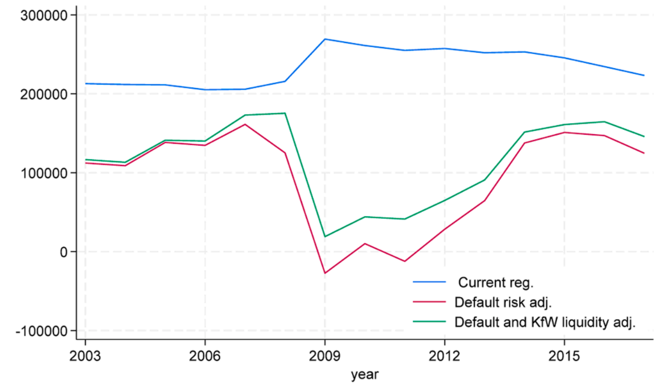


Fig. 9. Total FISIM (million euros). This figure shows the annual production of total FISIM under the current regulation (2008 SNA), the credit risk adjusted method, and the credit and maturity risk adjusted method.

flects the long run pass-through, and δ_1 captures the speed of adjustment.

To ensure that all rates under scrutiny are I(1), we apply the augmented Dickey–Fuller (ADF) test. Then, we estimate Eq. (8) for each interest rate on deposits to match them with the relevant market interest rate. As such, we regress each interest rate on several market rates reflecting a maturity corresponding to the rate's spectrum of maturity or period of rate fixation. Finally, we chose the reference market rate using the Schwartz Bayesian Information Criterion (BIC) for the different versions of Eq. (8). Results of the selection process are summarized in Table A.4.

4.3. Results

The results shown in Fig. 8 reveal that the FISIM on deposits are very similar to those previously estimated. Compared with the current regulation, these two alternative methods (credit risk adjusted, and credit and maturity risk adjusted) amplify the decline in FISIM on deposits following the great financial crisis and the euro crisis. The difference with the current regulation is at its maximum between 2009 and 2012. The decrease is more important for the credit risk adjusted method. However, these methods exhibit the same pattern over time as the current regulation.

After calculating total FISIM with these alternative methods, the conclusions are similar to those obtained in Section 3. Removing the 'pure' credit risk premium from the production of banks while keeping the liquidity provision as part of the total bank output, we show that our method produces nominal bank output estimates that are consistent with the evolution of the economic activity and that remain always positive on an annual basis, including during periods of financial stress (see Fig. 9). Thus, our results are robust to the selection of different interest rates for the computation of FISIM.

5. Conclusion

Following the criteria established by the group of experts on FISIM (ISWGNA, 2013), we aimed to develop a method for calculating nominal banking output that excludes the credit risk premium. Our approach differs from Colangelo and Inklaar (2012)'s as it removes the liquidity risk premium that may greatly affect the evolution of interest rates in times of financial crisis. The method that we propose corrects the problems raised by both the current SNA method and by the full risk premia-excluded method. First, our method generates less volatile banking output than that obtained with the alternative methods. Our results are more in accordance with the changes in the economic cycle between 2003 and 2017. Second, while considering the credit risk, our method does not lead to negative banking output, even during periods of financial stress. This indicates that the liquidity premium plays a major role in the rise of credit spread during the subprime and the eurozone crises, when the two other methods led to diverging results. Third, the method proposed herein relies on data available for most developed economies and therefore can be applicable for Japan, the United Kingdom, and the United States. Finally, we show that the current SNA method overestimates nominal banking output, while the full risk premia-excluded method underestimates it. Therefore, we recommend using our proposed method as it better reflects the economic reality while being relatively easy to implement. Not only is measuring precisely financial intermediation services important for national accounting, but it is also a sensitive question for the research on the productivity of the banking industry (Philippon, 2015) and the study of possible rent-seeking activity (Greenwood & Scharfstein, 2013; Zingales, 2015).

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Table A1
Standard unit root tests.

	ADF			
	Level		First Diff.	
	Intercept	Intercept and trend	Intercept	Intercept and trend
FISIM(current method)	-1.7700	-1.4621	-3.0447**	-3.1890*
FISIM (Default risk adj. only)	-5.4956 ***	-5.4560***	-11.0817***	-10.9855***

(*continued on next page*)

Table A1 (*continued*)

	ADF			
	Level		First Diff.	
FISIM (Liquidity and Default risk adj.)	-3.4168 **	-3.4110*	-8.6530***	-8.5803***
ESI	-2.3932	-2.4003	-4.8924***	-4.8749***
GDP	-1.1065	-2.7711	-3.2638**	-3.2597*
	KPSS			
	Level		First Diff.	
	Intercept	Intercept and trend	Intercept	Intercept and trend
FISIM(current method)	0.4664**	0.1711**	0.3207	0.0932
FISIM (Default risk adj. only)	0.1549	0.1547**	0.0908	0.0913
FISIM (Liquidity and Default risk adj.)	0.1578	0.1523**	0.1514	0.1391
ESI	0.1242	0.1170	0.0627	0.0523
GDP	0.9139***	0.1317*	0.1525	0.1217

Note: Lag length based on the Schwartz information criteria (SIC). Significance level: * ** $p < 0.01$, * * $p < 0.05$, * $p < 0.1$.

Table A2
Results of bound tests using transformation for FISIM (liquidity and risk adjusted).

	With current GDP	With ESI
Model	ARDL (1,2)	ARDL (1,2)
Cointegrating vector	0.715***	2.474***
	(0.021)	(0.046)
ECT_{t-1}	-0.920***	-0.934***
	(0.145)	(0.198)
Diagnostic tests QLB (1)	0.013	0.123
QLB (5)	0.920	5.184
QLB (10)	10.576	13.225
ARCH-LM test	0.000	0.053
Bound tests F-statistics	47.403	28.027
I(0) critical value (5%)	3.15	3.15
I(1) critical value (5%)	4.11	4.11
I(0) critical value (1%)	4.81	4.81
I(1) critical value (1%)	6.02	6.02

Note: Number in parentheses are standard errors. The model includes no intercept and no trend (Case I). Critical values for bound test are taken from Pesaran et al. (2001). ECTt–1 represents the coefficient associated with the adjustment speed in the error correction model. QLB represents the Ljung-Box statistic. ARCH-LM represents the ARCH-LM statistic to test for heteroscedasticity. Significance level: * ** $p < 0.01$, * * $p < 0.05$, * $p < 0.1$.

Table A3
Results of bound tests using the iBoxx euro liquid non-financial corporate bond index to measure the liquidity premium.

	With current GDP	With ESI
Model	ARDL (1,2)	ARDL (1,0)
Cointegrating vector	0.755***	2.533***
	(0.014)	(0.029)
ECT_{t-1}	-0.323***	-0.320***
	(0.103)	(0.103)
Diagnostic tests QLB (1)	0.534	0.641
QLB (5)	4.772	4.698
QLB (10)	18.032*	18.278*
ARCH-LM test	3.409*	7.425***
Bound tests F-statistics	10.495	7.309
I(0) critical value (5%)	3.15	3.15
I(1) critical value (5%)	4.11	4.11

(*continued on next page*)

Table A3 (*continued*)

	With current GDP	With ESI
I(0) critical value (1%)	4.81	4.81
I(1) critical value (1%)	6.02	6.02

Note: Number in parentheses are standard errors. The model includes no intercept and no trend (Case I). Critical values for bound test are taken from Pesaran et al. (2001). ECTt–1 represents the coefficient associated with the adjustment speed in the error correction model. QLB represents the Ljung-Box statistic. ARCH-LM represents the ARCH-LM statistic to test for heteroscedasticity. Significance level: * ** $p < 0.01$, * * $p < 0.05$, * $p < 0.1$.

Table A4

Value of the BIC from the error correction estimations (model selection) for deposits. Selected interest rates are in bold.

	Non-financial corporations			Households			
	Overnight	WAM < 2 years	WAM > 2 years	Overnight	WAM < 2years	WAM> 2 years	RAN < 3 months
Eonia	**-239.0**	-517.2		**-950,446**	-561.5		-573.7
euribor1m		-577.3			-583.5		-584.2
euribor3m		**-590.2**			-593.0		**-584.6**
euribor6m		-579.3			-594.1		
euribor12m		-561.3			**-599.4**		
gb1y		-432.2			-527.2		
gb2y		-400.3	**-591.5**		-510.2	-733.9	
gb3y			-586.4			-734.3	
gb4y			-580.9			-735.2	
gb5y			-575.2			-735.3	
gb6y			-570.3			**-735.8**	
gb7y			-566.3			-735.5	
gb8y			-562.8			-735.1	
gb9y			-560.1			-734.5	
gb10y			-558.0			-733.7	
gb15y			-546.0			-720.5	
gb20y			-551.7			-729.7	
gb30y			-554.4			-730.7	
Obs.	181	181	181	181	181	181	181

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