



BANK OF THAILAND

Uplifting the Usability of Financial Statement Data to Leverage the Quality of the Sectoral Balance Sheet Estimates

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Importance of Sectoral Balance Sheet (SBS)

Components and structure of SBS

Challenges and Constraints

Addressing Constraints

Case study: Other Non-Financial Corporations (ONFC)

Impute Missing data

Increasing the Frequency

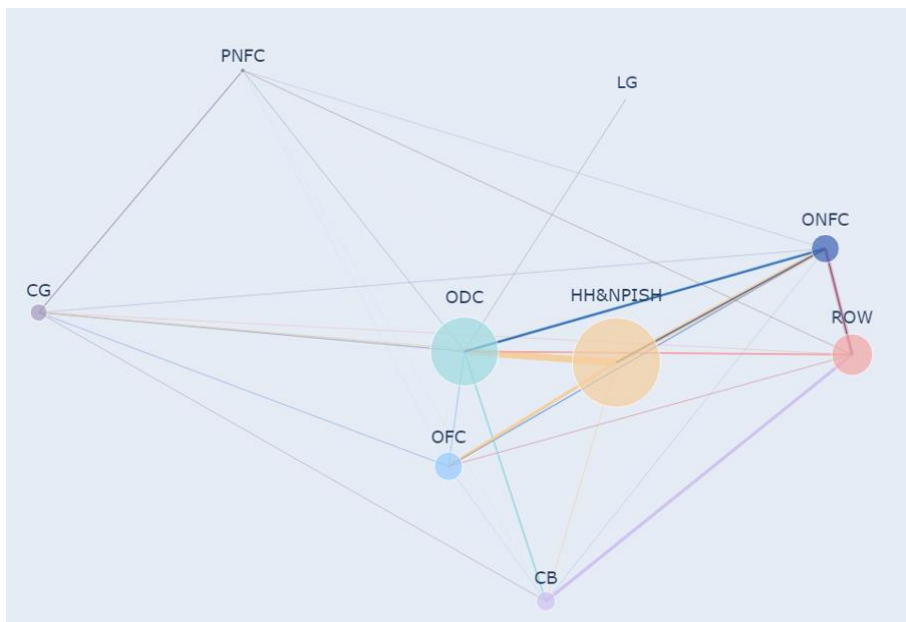
Extrapolating Forward Data

Conclusion and Way Forward

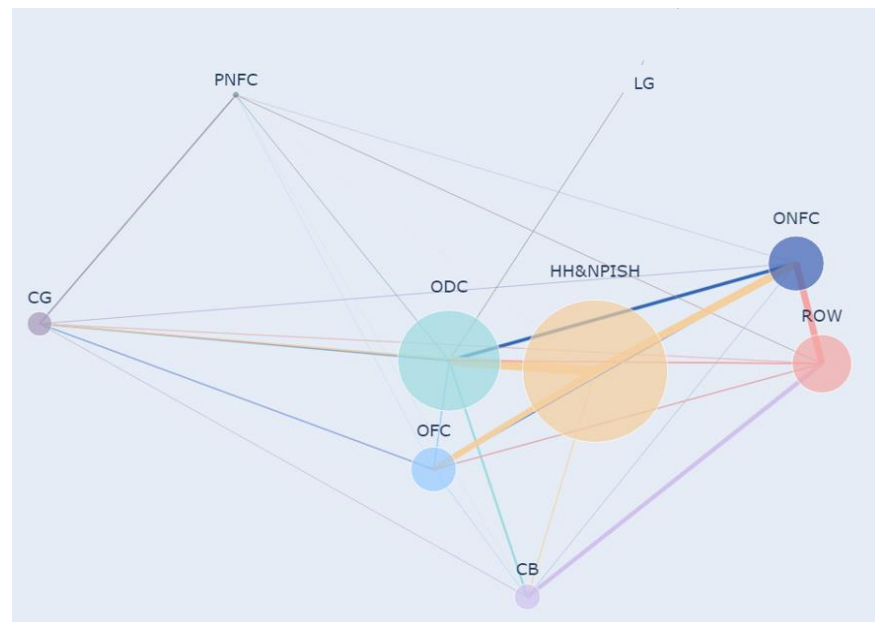


Intersectoral Asset and Liability Network

Q4/2013



Q4/2023





Maturity Mismatch

- High Short-term Liabilities
- Illiquid Assets
- Ability to roll-over

Capital Structure Mismatch

- High Liabilities
- Low Equity
- Lead to higher expenses

Currency Mismatch

- High Foreign Currency Liabilities
- Low Foreign Assets
- Vulnerable to changes in FX rate

Solvency Problem

- Unable to repay debt
- Credit risk
- Spill-over effects



Economic Sector

- Central Bank (**CB**)
- Other Depository Corporations (**ODCs**)
- Other Financial Corporations (**OFCs**)
- Non-Financial Corporations (**NFCs**)
 - Other Non-Financial Corporations (**ONFC**)
 - Public Non-Financial Corporations (**PNFC**)
- General Government (**GG**)
 - Central Government (**CG**)
 - Local Government (**LG**)
- Households and Nonprofit Institutions Serving Households (**HH & NPISH**)
- Rest of the World (**ROW**)

Financial Instrument

- Monetary gold and Special Drawing Rights (SDRs)
- Currency and deposits
- Debt securities
- Loans
- Equity and investment fund shares
- Insurance, pensions, and standardized guarantees
- Financial derivatives and employee stock options
- Other accounts receivable/payable



Coverage assessment of Thailand's SBS

	CB	ODC	OFC	PNFC	ONFC	HH&NPISH	CG	LG	ROW
Monetary gold & SDRs	Complete data (direct reports)	Complete data (direct reports)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)
Currency & Deposits	Complete data (direct reports)	Complete data (direct reports)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)
Debt securities	Complete data (direct reports)	Complete data (direct reports)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)
Loans	Complete data (direct reports)	Complete data (direct reports)	Complete data (Counterpart data)	Incomplete data	Incomplete data	Incomplete data	Incomplete data	Incomplete data	Incomplete data
Equity	Complete data (direct reports)	Complete data (direct reports)	Complete data (Counterpart data)	Incomplete data	Incomplete data	Incomplete data	Incomplete data	Incomplete data	Incomplete data
Insurance	Complete data (direct reports)	Complete data (direct reports)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)
Fin derivatives	Complete data (direct reports)	Complete data (direct reports)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)	Complete data (Counterpart data)
Other accounts	Complete data (direct reports)	Complete data (direct reports)	Complete data (Counterpart data)	Incomplete data	Incomplete data	Incomplete data	Incomplete data	Incomplete data	Incomplete data





Case study : ONFC's equity + trade credits & other accounts receivable/payable

Data source for ONFC

- **Listed companies:** Securities database called “*Financial Market Instrument (FMI) System*”
Financial statements disclosed by SET
- **Non-listed companies :** Financial statements submitted to Ministry of Commerce's (MOC)
“*Corporate Profile and Financial Statement (CPFS) database*”

CPFS data constraints

1. Completeness :

- Missing data for some years/some companies for trade credits receivable/payable (TCR, TCP)
- Complete data for equity

2. Frequency :

- Annual

3. Timeliness :

- 7-month lag (i.e., available in July of the following year)



A framework for improving the quality of CPFS data

- I. **Impute missing values** for TCR, TCP in the financial statement data which registered companies nationwide reported to the MOC annually
- II. **Derive quarterly estimates** of the SBS from annual financial statement data
- III. **Produce nowcasting estimates** for SBS of recent quarters for which annual financial statements are not yet reported to the authorities



Data Preparation

- I. Use company-level financial statement data for 3 years.
- II. Segregating non-listed ONFCs by
 - Excluding financial corporations (ISIC = K)
 - Excluding State-Owned Enterprises (SOEs), following GFS' list of SOE
 - Excluding companies listed in SET & MAI
- III. Exclude companies which were no longer operated

And randomly remove data to cover all possible cases in order to create a test dataset for data imputation.



Statistical techniques adopted to impute missing values for TCR/TCP:

1. Overall Growth Method:

- Calculate %YoY of reported data at aggregate level
- Applying this % to estimate missing data for non-reporting companies in each of the 3 years tested

2. Cluster-wise Growth Method:

- Calculate %YoY of reported data at 1-digit ISIC level
- Applying these % to estimate missing data for non-reporting companies in each ISIC section for each of the 3 years tested

3. Hybrid Method:

- Applying Method 2 for 'manufacturing and wholesale-retail trade' (ISIC C & G sections)
- Applying Method 1 for other ISIC sections

4. Time-based Method :

- Applying "linear growth" for companies not reporting data for only 1 year
- Applying Method 2 for companies with missing data for 2 years or more



Method 1 : Overall Growth Method

Example: Assuming 2020 - 2022 %YoY were 15.5%, 12.4%, and 17.9%, respectively

Company	2019	2020	2021	2022
Company A	1,306	$1,306 * (15.5\% + 1)$	1,500	1,713
Company B	1,306	1,231	$1,231 * (12.4\% + 1)$	1,713
Company C	1,306	$1,306 * (15.5\% + 1)$	$(1,306 * (15.5\% + 1)) * (12.4\% + 1)$	1,713
Company D	1,306	1,231	$1,231 * (12.4\% + 1)$	$(1,231 * (12.4\% + 1)) * (17.9\% + 1)$



Method 2 : Cluster-wise Growth Method

Example: Assuming 2020 - 2022 %YoY for ISIC J were 10.8%, 14.2%, and 15.9%, respectively and %YoY for ISIC A & B were 5.3%, 4.7%, and 5.6%, respectively

Company	ISIC	2019	2020	2021	2022
Company A	J	1,306	$1,306 * (10.8\% + 1)$	1,500	1,713
Company B	B	1,306	1,231	$1,231 * (4.7\% + 1)$	1,713
Company C	J	1,306	$1,306 * (10.8\% + 1)$	$(1,306 * (10.8\% + 1)) * (14.2\% + 1)$	1,713
Company D	A	1,306	1,231	$1,231 * (4.7\% + 1)$	$(1,231 * (4.7\% + 1)) * (5.6\% + 1)$



Method 3 : Hybrid Method

Example: Assuming 2020 - 2022 %YoY were 15.5%, 12.4%, and 17.9%, respectively
and for ISIC C were 10.8%, 14.2%, and 15.9%, respectively

Company	ISIC	2019	2020	2021	2022
Company A	C	1,306	$1,306 * (10.8\% + 1)$	1,500	1,713
Company B	A	1,306	1,231	$1,231 * (12.4\% + 1)$	1,713
Company C	C	1,306	$1,306 * (10.8\% + 1)$	$(1,306 * (10.8\% + 1)) * (14.2\% + 1)$	1,713
Company D	A	1,306	1,231	$1,231 * (12.4\% + 1)$	$(1,231 * (12.4\% + 1)) * (17.9\% + 1)$



Method 4 : Time-Based Method

Example: Assuming 2020 - 2022 %YoY for ISIC J were 10.8%, 14.2%, and 15.9%, respectively

Company	2020	2021	2022
Company A	$1,500 + (1,500 - 1,713)$	1,500	1,713
Company B	1,231	$1,231 + ((1,713 - 1,231)/2)$	1,713
Company C	1,231	1,500	$1,500 + (1,500 - 1,231)$
Company D (ISIC = J)	$1,306 * (10.8\% + 1)$	$(1,306 * (10.8\% + 1)) * (14.2\% + 1)$	1,713
Company E (ISIC = J)	$1,500 * (10.8\% + 1)$	1,500	$1,500 * (15.9\% + 1)$
Company F (ISIC = J)	1,231	$1,231 * (14.2\% + 1)$	$(1,231 * (14.2\% + 1)) * (15.9\% + 1)$

Missing value :
1 year

Missing value :
2 years



Statistical Testing :

- **MSE:** Mean Square Error
- **RMSE:** Root Mean Square Error
- **MAE:** Mean Absolute Error
- **MAPE:** Mean Absolute Percentage Error

The method which yields the lowest value for all (or most of the) four statistics is deemed to have highest efficacy and would be chosen as preferred method, to be applied in actual compilation of the SBS.

Results :

Trade Credits Receivable : Method 3

“Hybrid Method”

Trade Credits Payable : Method 1

“Overall Growth Method”



Convert Annual data to Quarterly data

- In compiling SBS, inputs for most sectors & instruments sourcing from MFS, IIP, GFS, FMI system are available quarterly.
- Only the positions of NFC's selected instruments where CPFS is the sole data source are available only on an annual basis.
- Derive quarterly from annual positions, assuming that changes to the annual positions occurred at a constant rate and distributed evenly across the four quarters.

Q4/2021	Q1/2022	Q2/2022	Q3/2022	Q4/2022
1,000	1,000 + ((1,400 – 1,000) / 4)	Q1/2022 + ((1,400 – 1,000) / 4)	Q2/2022 + ((1,400 – 1,000) / 4)	1,400



Statistical Tests to Develop Nowcasting Models for SBS

- CPFS data are available with long time lag
- Need to develop a method to nowcast positions for NFC's selected items for more timely compilation/dissemination of SBS

Target : Nowcasting trade credits receivable & payable

Trade Credits Receivable

Variables tested: total sales or income
(from SET, VAT database)

Trade Credits Payable

Variables tested: production volume,
inventory, sales
(from SET, MPI, VAT database)



Trade Credits Receivable :

“Total sales (aggregate level)” was highly correlated with trade credits receivable.

Cross-correlation analysis results :

Trade credits receivable

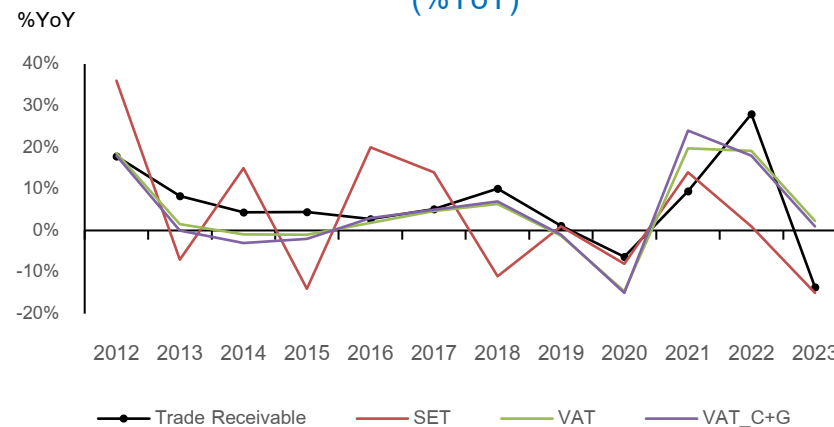
	Variables' Value	Variables' %YoY
SET	0.66	0.40
VAT	0.90	0.75
VAT C+G	0.88	0.70

Remark : Test period was 2011-2023 (for variables' value), and 2012-2023 (for %YoY)

C = manufacturing sector G = wholesale and retail sector

Source: SET, Revenue Department, calculated by the BOT

Trade Credits Receivable vs Determining Variables (%YoY)





Trade Credits Payable :

“Sales of manufacturing and wholesale/retail sectors” exhibits highest correlation with trade credits payable.

Cross-correlation analysis results :
Trade credits payable

	Variables' Value	Variables' %YoY
SET	0.66	0.39
Production (MPI)	0.87	0.38
VAT_C	0.90	0.70
VAT_C+G	0.88	0.77

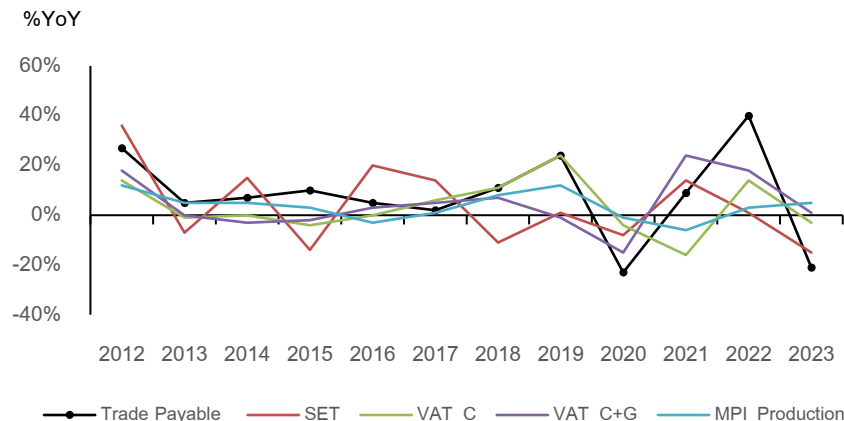
Remark : Test period was 2011-2023 (for variables' value), and 2012-2023 (for %YoY)

C = manufacturing sector G = wholesale and retail sector

MPI = manufacturing production index

Source: SET, Revenue Department, Ministry of Industry, calculated by the BOT

Trade Credits Payable vs Determining Variables
(%YoY)





Conclusion : Addressing 3 constraints to improve quality of CPFS and SBS

	Equity	Trade Credits & Other Accounts Receivable/Payable	
		Trade Credits Receivable	Trade Credits Payable
Impute missing values	No missing values	Method 3 : Hybrid Method	Method 1 : Overall Growth Method
Derive quarterly estimates	Assuming that changes to the annual positions occurred at a constant rate and distributed evenly across the four quarters		
Produce nowcasting estimates	CPFS : Equity (carry forward)	Total sales from VAT database (%YoY)	Sales (C+G) from VAT database (%YoY)



Conclusion

Limitations in quality and timeliness of financial statement data can be overcome by means of statistical techniques, thereby leveraging their usability for SBS compilation

Way Forward

- **The BOT plans to disseminate SBS in the near future**
- **Promote the use of SBS for improved policymaking, enhanced risk assessment, greater transparency and strengthened economic resilience**
- **Regularly review statistical methods for nowcasting to further improve the quality of the estimates**



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Thank you

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