

# The Impact of Fintech on Economic Growth in Singapore

Jiarong Huang<sup>1</sup>, Yinggang Jie<sup>2</sup>, Song Wu<sup>3</sup>

<sup>1</sup> Faculty of Business and Economics, University of Malaya, Kuala Lumpur, 50603, Malaysia

<sup>2</sup> Faculty of Computer Science and Information Technology, University of Malaya, Kuala Lumpur, 50603, Malaysia

<sup>3</sup> Faculty of Business Management, City University Malaysia, Selangor, 46100, Malaysia

**Abstract:** The study examines the impact of financial technology on economic growth in Singapore. Using time-series data on Singapore's financial technology from 2010 to 2022, The study constructs a financial technology index based on a comprehensive set of indicators. Through VAR modeling, the study assesses the effects of financial technology on the interest rate market, consumer market, and investment market, as well as its role in driving economic growth. The results indicate that financial technology has a positive impact on Singapore's economic growth. The calculation of the Fintech Index reveals a continuous improvement in Singapore's level of financial technology. The VAR analysis demonstrates that the development of financial technology has significant impacts on the interest rate market, consumer market, and investment market in Singapore. This suggests that the advancement of financial technology helps lower market interest rates, enhances the experiences of consumers and investors, and promotes consumption and investment growth. These findings highlight the significant role of financial technology in driving economic growth in Singapore.

**Keywords:** Financial technology, Financial technology index, Economic growth, Entropy, VAR model.

## 1. Introduction

Despite the thriving Fintech industry globally, its specific impact on economies, particularly Singapore's, remains under-studied. This study aims to elucidate this relationship. With Singapore being a global financial hub and a leader in both traditional finance and Fintech innovation, examining its Fintech advancement offers invaluable local and international implications. Coupled with its high digital transformation acceptance, demonstrated by widespread digital payment and e-commerce usage, and a developed economy with extensive international financial connections, Singapore provides an ideal research setting. This research investigates Fintech's impact on Singapore's economic growth from 2010 to 2022 by constructing a Fintech indicator framework and utilizing a VAR model. It explores the state of Fintech in Singapore and its impact on interest rates, consumption, and investment markets, probing the mechanisms through which Fintech influences economic growth. The goal is to analyze Fintech's direct and indirect influence on Singapore's economic sectors, thereby guiding policy recommendations to further enhance Fintech development and economic growth. By examining Fintech's actual influence, this research strives to reveal its potential applications, stimulate efficient financial resource allocation, and contribute to Singapore's emergence as a global Fintech hub.

## 2. Literature Review

"Fintech," a portmanteau of "finance" and "technology," represents a transformative sector leveraging innovative software to deliver on-demand services, primarily in finance (Gomber, Koch, and Siering, 2017; Shin and Choi, 2019). With the sector's genesis in the United States, it has flourished notably in Britain and Singapore, with significant global financial investments made year-on-year. Singapore has proven itself a technological powerhouse, with advancements in artificial intelligence, Internet of Things, and Fintech,

making it an attractive destination for Fintech-related companies and investors. Its surge in the Global Financial Centre Index (GFCI) 2022 is testimony to its strategic advantages and Fintech development, fostering its global standing and economic growth.

The inherent value of Fintech lies in its ability to enrich financial functions, optimize resource allocation, and foster green economic growth (Leckow, Haksar, 2017; Junhua Han, Quan Zhou, Hongchang Wang, 2019). However, while the interplay of Fintech and economic growth is evident, literature gaps exist, with most analysis being qualitative or theoretical (Luo, Sun, Yang, Zhou, 2022). Key questions remain unanswered: How does Fintech affect economic growth? Is its effect promoting or inhibiting? What pathways does Fintech utilize to influence economic growth?

This study attempts to bridge this gap by quantitatively examining the relationship between Fintech and economic growth, particularly in Singapore, from 2010 to 2022. The research process includes conceptual definition, theoretical analysis, and empirical methodology. It assesses the direct and indirect impact of Fintech on interest rates, consumer markets, investment markets, and economic output. The findings will enhance understanding and inform policy recommendations, fostering Fintech innovation and driving Singapore's economic development.

## 3. Methodology

### 3.1. Introduction

Exploring financial technology measurement, this research employs qualitative and quantitative analysis, constructing a financial technology index via the entropy method to measure regional fintech development. It provides a comprehensive assessment of fintech's influence on interest rates, consumer and investment markets, and overall economic output. Qualitative analysis allows for a detailed study of fintech trends, policy environment, and market dynamics, while

quantitative analysis improves the study's scientific validity and reliability through data and econometric analysis.

### 3.2. Intrinsic Principles

1) The Mechanism of Fintech's Effect on Economic Growth

Fintech expands financial development, improving its efficiency and enhancing capital's marginal productivity. It bolsters economic growth quality through increased capital liquidity, investment enthusiasm, and through asset portfolio management that raises investment returns, mitigates liquidity risks, and promotes investment specialization.

2) The Mechanism of Fintech's Effect on the Interest Rate Market

Fintech aids in achieving balanced interest rates within a fair, reasonable, and transparent market framework, impacting investment and savings, which are economic growth drivers.

3) The Mechanism of Fintech's Impact on the Consumer Market

Fintech provides technical basis for banks to manage long tail customer groups. With its rapid development, financial services are no longer limited by time and space, extending their reach, reducing operational costs, and enhancing customer relationship management efficiency.

4) The Mechanism of Fintech's Impact on the Investment Market

Fintech's advantages include swift information processing, simplified methods, and low costs. It introduces new financial products, enriching individual investment choices. Also, it provides diverse financing methods for small and medium-sized enterprises, such as Internet P2P loans, crowdfunding,

and supply chain finance, improving financing efficiency and promoting physical project investments.

### 3.3. Conceptual framework

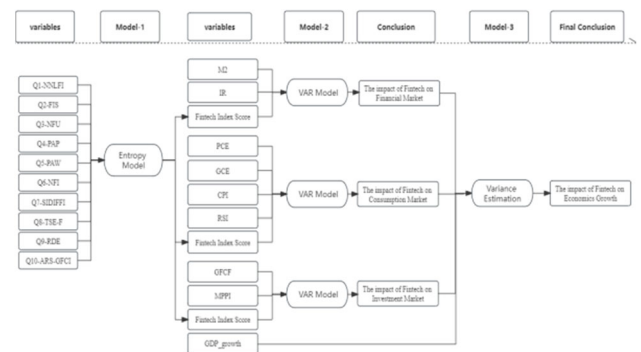


Figure 1. Conceptual framework

### 3.4. Index Calculation

#### 3.4.1. Introduction

Various regulators, including FCA, PBOC, FSOC, FINMA, ASIC, and FSA use unique approaches to calculate the Fintech index. Absence of unified standards adds complexity to cross-border comparisons and comprehensive analyses. Machine learning algorithms like Random forest and gradient lifting tree suffer from randomness and inexplicability, leading us to prefer the entropy method for the Singapore Fintech Index. This method, offering comprehensive, objective results and high flexibility, adapts to different scenarios and ensures comparability across different regions or timeframes.

Table 1. Variable Statement

Number	General Indicators	Effect	Specific Indicators	Variable	Code	Unit
1	Fintech Micro Indicators	Positive	Number of newly listed Fintech institutions	NNLFI	Q1	Count
2		Positive	Number Of Financial And Insurance Services Talents	FIS	Q2	Count
3		Positive	Number of Fintech users	NFU	Q3	Count
4		Positive	Number Of Patents Applied	PAP	Q4	Count
5		Positive	Number Of Patents Awarded	PAW	Q5	Count
6		Positive	Number Of Financial Institutions	NFI	Q6	Count
7	Fintech Macro Indicators	Positive	Singapore's Inward Direct Investment Flows By Finance Industry	SIDIFFI	Q7	Millions Of Singapore Dollars
8		Positive	Turnover On The Singapore Exchange (Equities) - Finance (Value)	TSE-F	Q8	Million Dollars
9		Positive	R&D Expenditure	RDE	Q9	Million Dollars
10	External Evaluation Indicators	Negative	Annual ranking of Singapore in GFCI	ARS-GFCI	Q10	Rank

Data sources include Monetary Authority of Singapore, Ministry of Manpower, Agency for Science, Technology and

Research, and Singapore Department of Statistics. The Fintech development measurement considers three

dimensions: Micro, Macro, and External Evaluations with several indicators. We use the Global Financial Centres Index (GFCI) for the external evaluation, offering a relative comparison and trend analysis of global financial centers.

### 3.4.2. Data Collection

Indicator data, ranging from 2010-2022, are selected from the Singapore region, and are mainly sourced from reliable institutions like the Singapore Department of Statistics, Monetary Authority of Singapore, Ministry of Manpower of Singapore, and Science, Technology and Research Bureau of Singapore.

### 3.4.3. Data cleaning

To ensure the model's stability and reliability, the collected data undergo standardization, converting different indicator values into Z-scores or mapping them within the range of 0 to 1, facilitating cross-indicator comparison and analysis. The Min-Max normalization method is utilized in this study.

$$\text{Positive indicators: } x'_{ij} = \frac{x_{ij} - \min\{x_{1j}, \dots, x_{nj}\}}{\max\{x_{1j}, \dots, x_{nj}\} - \min\{x_{1j}, \dots, x_{nj}\}}$$

$$\text{Negative indicator: } x'_{ij} = \frac{\max\{x_{1j}, \dots, x_{nj}\} - x_{ij}}{\max\{x_{1j}, \dots, x_{nj}\} - \min\{x_{1j}, \dots, x_{nj}\}}$$

### 3.4.4. Establishing Model

Step 1, calculating the proportion of the i-th sample value to the j-th indicator:

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^n x_{ij}}, i = 1, \dots, n, j = 1, \dots, m$$

Step 2, calculating the entropy value for each standardized indicator. Entropy  $e_j$  is used to judge the Statistical dispersion of an indicator. The greater the Statistical dispersion, the greater the impact of the indicator on the comprehensive evaluation. The formula is as follows:

$$e_j = -k \sum_{i=1}^n p_{ij} \ln(p_{ij}), j=1, \dots, m$$

Where  $k=1/\ln(n) > 0$ , satisfies  $e_j \geq 0$ .

Step 3, calculating the information entropy redundancy (difference):

$$d_j = 1 - e_j, j = 1, \dots, m$$

Step 4, considering the importance of each indicator, calculate the corresponding weights assigned to each indicator. The weight represents the relative importance of each indicator in the comprehensive evaluation. The formula is as follows:

$$\omega_j = \frac{d_j}{\sum_{j=1}^m d_j}, j=1, \dots, m$$

Step 5, summing up all weighted entropy values to obtain the comprehensive score of the Fintech index. The formula is as follows:

$$s_i = \sum_{j=1}^m \omega_j x_{ij}, i = 1, \dots, m$$

Where  $x_{ij}$  is the standardized data.

### 3.4.5. Calculation results

#### 3.4.5.1 Weight calculation results

**Table 2.** Weight Distribution

Variable	Entropy weight method		Weight(%)
	Information entropy value e	Information utility value d	
Q1-NNELFI	0.799	0.201	14.232
Q2-FIS	0.909	0.091	6.419
Q3-NFU	0.839	0.161	11.405
Q4-PAP	0.827	0.173	12.218
Q5-PAW	0.874	0.126	8.936
Q6-NFI	0.856	0.144	10.179
Q7-RDE	0.885	0.115	8.150
Q8-SIDIFFI	0.848	0.152	10.739
Q9-TSE-F	0.836	0.164	11.633
Q10-ARS-GFCI	0.914	0.086	6.088

The weight calculation results of the entropy method show that the weights of Q1-NNELFI standardization are 14.232%, Q2-FIS standardization is 6.419%, Q3-NFU standardization is 11.405%, Q4-PAP standardization is 12.218%, Q5-PAW standardization is 8.936%, Q6-NFI standardization is 10.179%, Q10-RDE standardization is 8.15%, Q7-SIDIFFI standardization is 10.739%, and Q9-TSE-F standardization is 11.633%. The weight of Q12-ARS-GFCI standardization is 6.088%, with the maximum value of indicator weight being Q1-NNELFI standardization (14.232%) and the minimum value being Q12-ARS-GFCI standardization (6.088%).

#### 3.4.5.2 Variable Weight Histogram

Q1-NNELFI has a relatively high weight in the Fintech

index, while Q1-NNELFI has a relatively low weight in the Fintech index. In the calculation of the weight of the Fintech index, the proportion of Micro indicators in Fintech is the highest, accounting for 63%, as it better reflects the actual situation of Fintech in the industry and institutions. The proportion of Macro indicators in Fintech is 31%, but a single indicator of R&D funding from government departments has a relatively significant impact on the Fintech index. External evaluation selection is an authoritative international evaluation that serves as a reference and has a low weight. It can indirectly reflect the gathering center of financial technology.

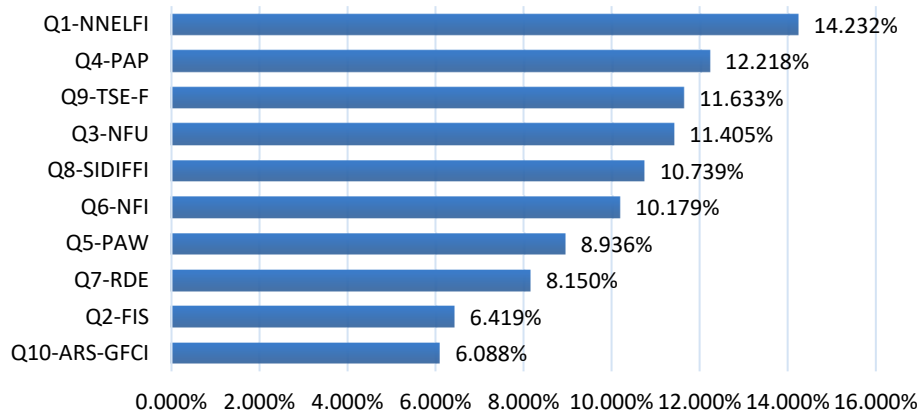


Figure 2. Variable Weight Histogram

### 3.4.6. Result analysis

From 2010 to 2014, the Singapore Financial Technology Index experienced rapid growth. During this period, the Fintech index gradually increased from 0.028 to 0.410, indicating a clear growth trend. Next, from 2014 to 2016, the Fintech index continued to grow, but the growth rate slowed down. From 2017 to 2020, the Fintech index once again showed rapid growth overall. During this period, the Fintech index increased from 0.519 to 0.619, indicating another

significant growth trend. However, from 2020 to 2022, the growth trend of the Fintech index seems to have slowed down. Although the Fintech index has increased from 0.619 to 0.674, the growth rate has slightly slowed down compared to the previous period.

Overall, it can be said that the Singapore Fintech index has shown a growth trend, but the growth rate may fluctuate over different time periods. From 2010 to 2022, the index gradually increased, but the rate of growth varied over different time periods.

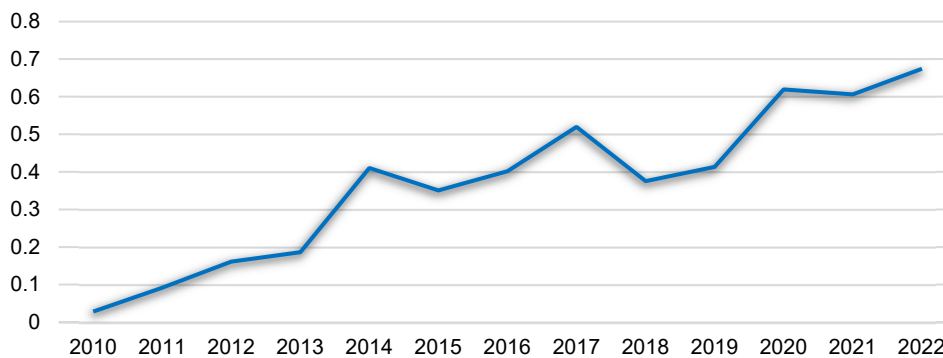


Figure 3. Trends in Fintech Index

## 3.5. Empirical Analysis

### 3.5.1. Research Assumptions

H1: The improvement of financial technology has led to an increase in social consumption levels.

H2: The improvement of financial technology has promoted the improvement of social investment level.

H3: The enhancement of financial technology development level positively influences economic growth.

H4: Financial technology affects the corresponding changes in the consumption and investment markets with the fluctuation of IR, thereby promoting the growth of consumption and investment.

### 3.5.2. Model Settings

Given the assumptions, Fintech enhances market efficiency and service levels, reflected in lower IR and higher PCE/GCE/RSI/GFCF/MPPI. This leads to boosted market consumption and investment, indirectly influencing economic growth. Our model reflects this, where Y represents economic growth, C reflects social consumption, and I represents social investment.

$$\begin{cases} Y = f(C, I, \text{Fintechindex}) \\ C = f(\text{PCE}, \text{GCE}, \text{CPI}, \text{RSI}, \text{IR}) \end{cases}$$

$$I = f(\text{GFCF}, \text{MPPI}, \text{IR})$$

$$Y = (\text{GDP\_growth}, \text{Fintechindex})$$

### 3.5.3. Data Collection and Variable Statement

Quarterly economic data from Singapore (2010-2022) were selected for analysis, obtained from trusted authorities. The model calculations were performed using SPSS software. The data sources are as follows:

- Singapore Department of Statistics
- <https://www.singstat.gov.sg/publications/reference/singapore-in-figures/trade-and-investment>
- Singapore-Ministry-of-Manpower
- <https://stats.mom.gov.sg/Statistics/Pages/labourforce.aspx>
- Monetary Authority of Singapore
- <https://eservices.mas.gov.sg/Statistics/msb/ExchangeRates.aspx>
- The Association of Banks in Singapore

**Table 3. Variable Description**

Number	Economics Indicator	Code	variable	Unit
1	Measures of the money supply	I1	M2	Million Singapore dollars
2	Singapore Inter Bank Offered Rate	I2	IR	%
3	Private Consumption Expenditure	C1	PCE	Million Dollars
4	Government Consumption Expenditure	C2	GCE	Million Dollars
5	CPI	C3	CPI	Index
6	Retail Sales Index	C4	RSI	Index
7	Gross Fixed Capital Formation	IV1	GFCF	Million Dollars
8	Manufactured Products Price Index	IV2	MPPI	Index
9	GDP Year On Year Growth Rate	Y1	GDP_growth	%
10	Fintech Index Score	-	Fintechindex	Score

To ensure the objectivity and scientificity of the empirical results, the collected data is processed as follows (See Table 3): the GDP deflator of some data is used to eliminate the impact of price fluctuations. Since the logarithmic processing of data is conducive to better discovering the relationship between data, this study will conduct logarithmic processing of index data to eliminate the interference of

homoscedasticity and heteroscedasticity.

**3.5.4. Descriptive Statistics**

This study will conduct statistical analysis on the data of all indicators, and measure the mean, median, maximum, minimum, skewness, and kurtosis. The results obtained are shown as Table 4.

**Table 4. Descriptive Statistics**

Variable	Sample size	Mean	Median	Maximum	Minimum	Kurtosis	Skewness
LnFintechindex	52	0.305	0.338	0.515	0.028	-0.934	-0.406
LnM2	52	13.233	13.199	13.541	12.983	-1.081	0.349
LnIR	52	0.521	0.345	1.545	0.223	0.814	1.172
LnPCE	52	10.565	10.586	10.834	10.275	-0.579	-0.366
LnGCE	52	9.306	9.328	9.901	8.626	-0.279	-0.296
LnCPI	52	4.598	4.607	4.716	4.465	1.747	-0.625
LnRSI	52	4.555	4.566	4.698	4.049	19.933	-3.594
LnGFCF	52	10.209	10.241	10.449	9.908	-0.32	-0.704
LnMPPI	52	4.64	4.617	4.79	4.49	-1.364	0.018
LnGDP growth	52	0.064	0.06	0.259	-0.159	2.694	-0.028

**3.5.5. Empirical Testing Based on VAR Model**

**3.5.5.1 Stationarity test**

The stationarity test, ADF test and Root of unity test of time series data are the preconditions for establishing VAR model (Li et al.,2022). The test results are shown as Table 5. The

results indicate that LnRSI and LnGDP\_ The original sequence of growth is stationary, while the first-order differential sequence of Fintechindex, LnM2, LnIR, LnPCE, LnGCE, LnGFCF, LnMPPI is stationary, and the second-order differential sequence of LnCPI is stationary.

**Table 5. Stationary Test**

ADF	t	Original sequence			Result	First Order Difference			t	Second Order Difference		
		P	AIC	Result		P	AIC	Result		P	AIC	Result
LnRSI	-4.767	0.000***	-73.348	Stationary								
LnGDP_growth	-3.348	0.013**	-	Stationary								
LnFintechindex	-1.339	0.611	149.446		-7.390	0.000***	-	Stationary				
			140.883				133.323					
LnM2	1.060	0.995	-		-3.596	0.006***	-	Stationary				
			228.055				224.035					
LnIR	-2.046	0.267	-58.93		-3.651	0.005***	-56.097	Stationary				
LnPCE	-1.764	0.399	-		9.013	0.000***	-96.405	Stationary				
			101.566									
LnGCE	-0.413	0.908	-		-5.027	0.000***	-	Stationary				
			133.194				125.748					
LnGFCF	-2.349	0.157	-90.33		-5.747	0.000***	-81.232	Stationary				
LnMPPI	-1.734	0.414	-		-3.680	0.004***	-	Stationary				
			177.425				172.047					
LnCPI	-1.413	0.576	-		-1.958	0.305	-		-	0.000***	-	Stationary
			300.093				289.914		7.637		299.898	

**3.5.5.2 Testing the Impact of Fintech on the Interest Rate Market**

**1) Determination of Lag Order**

The optimal lag order is determined based on the optimal

lag criterion (AIC, SC, LR), and is generally determined based on the principle of minimizing AIC and SC values. According to Table 6, the optimal lag order is 11 orders, but due to a sample size of 52, an excessive lag order can lead to

a sharp decrease in sample size, which is not conducive to model calculation. Therefore, this article chooses the second best lag order, which is 1 order.

With the results of stationarity test and lag order, perform differential treatment on the corresponding order of variables LnFintechindex, LnM2, and LnIR.

**Table 6.** Determination of Lag Order

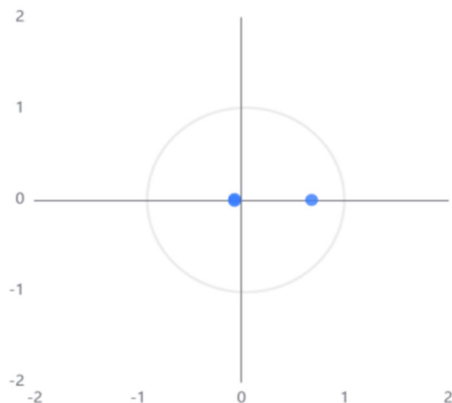
Lag Order	logL	AIC	SC	HQ	FPE
0	245.357	-18.208	-18.093	-18.164	0
1	257.286	-18.525	-18.062	-18.35	0
2	257.332	-18.361	-17.542	-18.051	0
3	256.302	-18.144	-16.963	-17.699	0
4	253.81	-17.853	-16.303	-17.272	0
5	284.191	-19.011	-17.084	-18.293	0
6	283.1	-18.791	-16.48	-17.934	0
7	286.308	-18.761	-16.057	-17.764	0
8	298.86	-19.174	-16.071	-18.036	0
9	311.146	-19.594	-16.083	-18.316	0
10	331.734	-20.45	-16.524	-19.031	0
11	384.75	-23.014*	-18.663*	-21.453*	0.0*

2) VAR model estimation

$$\text{LnIR} = -0.934 * \text{LnFintechindex}(-1) + 0.545 * \text{LnM2}(-1) + 0.698 * \text{LnIR}(-1) + 0.016$$

3) Root of unity inspection

It can be seen from Figure 4 that the non characteristic root is outside the Unit circle, and the regression residual sequence obtained is characterized by Normal distribution, no heteroscedasticity and correlation, so the model established is stable, and then the VAR model can be continued to be established.



**Figure 4.** Root of unity Test Results

4) Granger Test

Since the Root of unity test variables are all stationary variables of the same order, Granger Test is conducted.

Table 7 shows the results of Granger Test, including paired

samples, sample size, F statistics, and significant P values. By analyzing the significance of F statistics, if it is significant ( $P < 0.05$ ), it indicates that the original hypothesis is rejected (one group of time series is not the reason for the other group of time series), that is, the left variable can cause the change of the right variable, with Granger causality, otherwise there is no Granger causality. The inspection results are as follows:

Based on the variables LnM2 and Fintechindex, the significance P-value is 0.940, which does not show significance and cannot reject the original hypothesis. LnM2 cannot cause changes in LnFintechindex. Based on the variables LnFintechindex and LnM2, the significance P-value is 0.677, which does not show significance and cannot reject the original hypothesis. LnFintechindex cannot cause a change in LnM2.

Based on the variables LnIR and LnFintechindex, the significance P-value is 0.776, which does not show significance and cannot reject the original hypothesis. LnIR cannot cause changes in LnFintechindex. Based on the variables LnFintechindex and LnIR, the significance P-value is 0.023\*\*, showing significance. Rejecting the original hypothesis, LnFintechindex can cause changes in LnIR.

Based on the variables LnIR and LnM2, the significance P-value is 0.047\*\*, showing significance. Rejecting the original hypothesis, LnIR can cause changes in LnM2. Based on the variables LnM2 and LnIR, the significance P-value is 0.750, which does not show significance and cannot reject the original hypothesis. LnM2 cannot cause changes in LnIR.

From the results, it can be seen that LnFintechindex can cause changes in LnIR and LnM2, indicating that the development of financial technology affects changes in the interest rate market.

**Table 7.** Granger Test

Paired sample	F	P
LnM2 LnFintechindex	0.006	0.940
LnFintechindex LnM2	0.175	0.677
LnIR LnFintechindex	0.082	0.776
LnFintechindex LnIR	5.56	0.023**
LnIR LnM2	4.159	0.047**
LnM2 LnIR	0.102	0.750

Note: \*\*\*, \*\*, \* represent significance levels of 1%, 5%, and 10%, respectively.

5) Impulse response analysis

The impulse response function measures the impact of

financial technology on the financial interest rate market. From Figure 5, it can be seen that when a positive impact of 1 unit is given to the financial technology index, the financial market interest rate will rapidly decrease in the first two periods, reach the minimum value, and then begin to rise and

gradually stabilize after a pullback. When there is a positive impact of 1 unit on market interest rates, the Fintech index will also rapidly decline in the first two periods, then begin to decline and gradually stabilize.



**Figure 5.** Analysis of LnFintechindex and LnPCE Pulse Response



**Figure 6.** Analysis of LnFintechindex and LnRSI pulse response

### 3.5.5.3 Impact Test of Financial Technology on the Investment Market

#### 1) Determination of Lag Order

According to the same principle for determining the lag

order, it can be seen from Table 8 that the optimal lag order is 11 orders. However, due to the sample size of 52 and the large lag order, it is not conducive to model calculation. Therefore, this article chooses the second best lag order, which is 1 order.

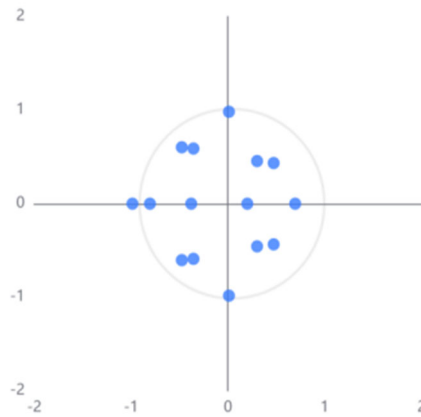
**Table 8.** Determination of Lag Order

Lag Order	logL	AIC	SC	HQ	FPE
0	258.309	-18.726	-18.611	-18.682	0
1	262.01	-18.718	-18.255*	-18.542	0.0*
2	261.549	-18.537	-17.718	-18.227	0
3	269.274	-18.696	-17.515	-18.251	0
4	264.618	-18.323	-16.773	-17.742	0
5	264.596	-18.14	-16.213	-17.422	0
6	261.358	-17.803	-15.491	-16.945	0
7	260.627	-17.566	-14.863	-16.569	0
8	279.271	-18.241	-15.138	-17.103	0
9	300.343	-19.067	-15.556	-17.789	0
10	302.317	-18.979	-15.053	-17.56	0
11	332.236	-20.321*	-15.97	-18.76*	0

2) VAR model estimation  
 $\text{LnGFCF} = -0.615 \cdot \text{LnFintechindex}(-1) - 0.283 \cdot \text{LnGFCF}(-1) + 0.327 \cdot \text{LnMPPI}(-1) + 0.018$   
 $\text{LnMPPI} = -0.198 \cdot \text{LnFintechindex}(-1) - 0.019 \cdot \text{LnGFCF}(-1) + 0.392 \cdot \text{LnMPPI}(-1) + 0.003$

is outside the Unit circle, and the regression residual sequence obtained is characterized by Normal distribution, no heteroscedasticity and correlation. Therefore, the established model is stable, and then the VAR model can be further established.

3) Root of unity inspection  
 It can be seen from Figure 7 that the non characteristic root



**Figure 7.** Root of unity Test Results

4) Granger Test variables of the same order, Granger Test is conducted (See Table 9).  
 Since the Root of unity test variables are all stationary

**Table 9.** Granger Test

Paired sample		F	P
LnGFCF	LnFintechindex	0.091	0.764
LnFintechindex	LnGFCF	4.652	0.036**
LnMPPI	LnFintechindex	0.173	0.679
LnFintechindex	LnMPPI	4.235	0.045**
LnMPPI	LnGFCF	0.357	0.553
LnGFCF	LnMPPI	0.08	0.779

Note: \*\*\*, \*\*, \* represent significance levels of 1%, 5%, and 10%, respectively.

This chapter only selects significant results related to the LnFintechindex variable for analysis. The results are as follows:

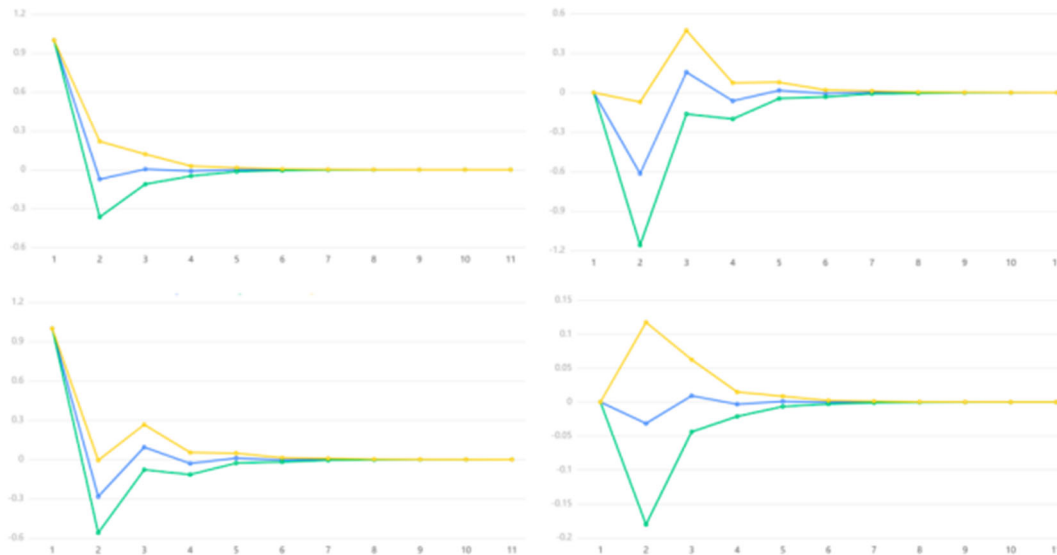
Based on the variables LnGFCF and LnFintechindex, the significance P-value is 0.764, which does not show significance and cannot reject the original hypothesis. LnGFCF cannot cause changes in LnFintechindex. Based on the variables LnFintechindex and LnGFCF, the significance P-value is 0.036\*\*, showing significance. Rejecting the original hypothesis, LnFintechindex can cause changes in LnGFCF.

Based on the variables LnMPPI and LnFintechindex, the significance P-value is 0.679, which does not show significance and cannot reject the original hypothesis. LnMPPI cannot cause changes in LnFintechindex. Based on the variables LnFintechindex and LnMPPI, the significance P-value is 0.045\*\*, showing significance. Rejecting the original hypothesis, LnFintechindex can cause changes in LnMPPI.

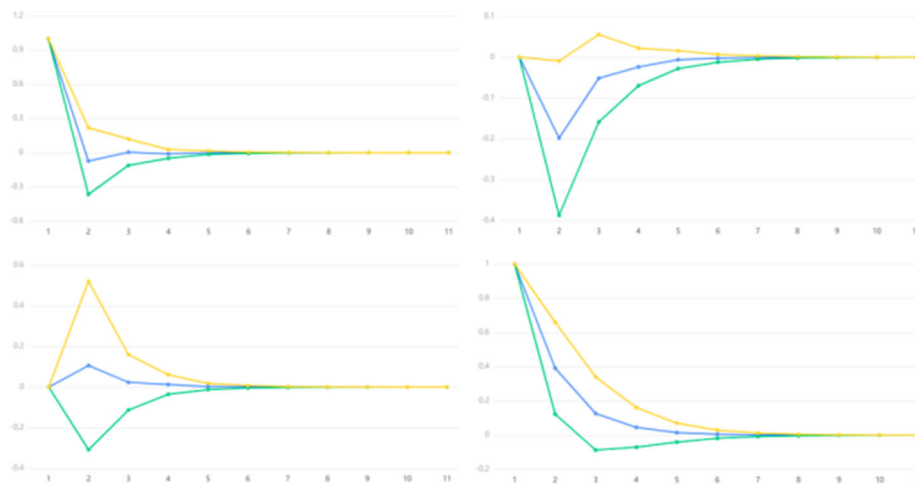
It can be seen that LnFintechindex can cause changes in LnGFCF and LnMPPI, indicating that the development level of Fintech affects the total fixed capital formation and changes in the price index of manufactured goods, thereby affecting the level of social investment in Singapore.

5) Impulse response analysis

The impulse response function measures the impact of Fintech on the investment market. From Figures 8 and 9, it can be seen that when a positive impact is given to the Fintech index of 1 unit, the total fixed capital formation is affected by this. The finished product price index will rapidly decline in the first two periods, and then begin to rise and have a positive impact. After reaching its peak in the third period, it will begin to decline and stabilize in the sixth period. When the total fixed capital formation is given a positive impact of 1 unit on the manufactured goods price index, the fluctuation of the Fintech index is significant in the early stage, but tends to stabilize after the fifth period.



**Figure 8.** Analysis of pulse response of LnFintechindex and LnGFCF



**Figure 9.** Analysis of LnFintechindex and LnMPPI Pulse Response

From the pulse response results, it can be seen that Fintech has a significant impact on the entire Singapore investment market. This is related to the large scale and active investment market of Singapore, which, as a global financial center, is enthusiastic about investing in the Fintech industry.

## 4. Results

### 4.1. Variance estimation

Based on the interest rate transmission mechanism, conduct a simple regression equation analysis on the impact of the consumer market and investment market on economic growth to verify whether it meets the research hypothesis.

**Table 10.** Variance estimation

	Non standardized coefficient		Standardized Coefficient Beta	t	P	VIF	R <sup>2</sup>	Adjust R <sup>2</sup>	F
	B	Standard error							
Constant	-1.102	0.531	-	-2.076	0.044**	-			
LnPCE	-0.154	0.207	-0.151	-0.742	0.462	3.111	0.4	0.348	F=7.546
LnRSI	0.255	0.117	0.357	2.184	0.034**	2.004	01		P=0.000***
LnGFCF	0.036	0.134	0.044	0.269	0.789	1.993			
LnMPPI	1.196	0.273	0.529	4.385	0.000***	1.095			

Dependent Variable: LnGDP\_growth

Note: \*\*\*, \*\*, \* represent significance levels of 1%, 5%, and 10%, respectively.

The results in Table 10 show that the analysis of the results of the F-test can get that the significance P value is 0.000\*\*\*, showing significance at the level, and rejecting the original assumption that the regression coefficient is 0, so the model

basically meets the requirements. For variable col-linearity, the VIF is all less than 10, so the model has no Multicollinearity problem, and the model is well constructed. The formula for the final model is:

$\text{LnGDP\_growth} = -1.102 - 0.154 \cdot C1 - \text{LnPCE} + 0.255 \cdot C4 - \text{LnRSI} + 0.036 \cdot \text{IV1} - \text{LnGFCF} + 1.196 \cdot \text{IV2} - \text{LnMPPI}$

The results further demonstrate that the year-on-year growth rate of GDP is LnGDP\_Growth is positively correlated with the retail sales index LnRSI and negatively correlated with the production price index LnMPPI. The P-values of both variables pass the test.

## 4.2. Empirical Results

Through empirical research, it has been found that Fintech has a local impact on the interest rate market and investment market. Among them, for the financial market, when a positive impact is given to Fintech, the efficiency of the financial market will decline in the early stage and then decline. It also means that financial technology has led to a decrease in market interest rates, thereby having an impact on the financial market. For the consumer market, when a positive impact of 1 unit is given to the Fintech index, the private consumption expenditure and retail sales index will reach their peak after the initial decline, then gradually decrease and stabilize. Financial technology can help improve consumption levels, and it has led to significant changes in the consumer market. For the investment market, when there is a positive impact of 1 unit on the Fintech index, the total fixed capital formation will be affected, and the manufactured goods price index will rapidly decline in the early stage and then decline after reaching its peak, gradually stabilizing. It indicates that financial technology can help improve investment levels, and financial technology leads to significant changes in the investment market.

From the variance estimation results, it can be seen that financial technology has led to a decrease in market interest rates, and changes in the interest rate market have had a certain impact on the consumer and investment markets. The positive changes in the consumer market and investment market will drive a positive change in the GDP growth rate. According to the equation estimation of each market and economic output growth, it can be seen that the consumer market and investment market have a positive impact on the total economic output. In short, financial technology has led to a decrease in market interest rates, improved financing efficiency, and, through the direct or indirect effects of interest rate mechanisms, increased consumer and investment markets, ultimately promoting economic growth (Lin, 2019)

## 5. Conclusion

The manuscript should include a conclusion. In this section, summarize what was described in your paper. Future directions may also be included in this section. Authors are strongly encouraged not to reference multiple figures or tables in the conclusion; these should be referenced in the body of the paper.

## 6. Discussion

Through research on Fintech in Singapore, this study has confirmed its positive impact on the nation's economic growth, thereby addressing the initial hypothesis and achieving set objectives. Fintech's influence is evident across interest rate markets, consumer markets, and investment arenas, driving growth by enhancing efficiency in financial institutions, altering consumer behaviors, fostering investments, and developing innovative financial products. These findings provide crucial policy insights for the

Singaporean government and associated entities, emphasizing the need for reinforced regulatory frameworks and increased research and innovation in Fintech for its sustainable growth and market stability. However, the study is confined to data from 2010-2022, limiting the assessment of Fintech's impact outside this period. Furthermore, the VAR model used imposes certain restrictions on the results. Hence, while generalizing the findings, cautious evaluation and adjustments are required. Future studies should expand data scope and employ more economic indicators and models to deepen the understanding of the relationship between Fintech and economic growth.

## 7. Conclusion

Financial technology (Fintech) plays an integral role in Singapore's contemporary financial system, contributing to operational efficiency, risk management, inclusive financial services, and market accessibility (Ankenbrand, T., Bieri, D., 2018). By fostering developments in consumer behavior, investment markets, and interest rates, Fintech advances Singapore's economic growth. Our study, conducted using time series data (2010-2022) and the VAR model, indicates a positive correlation between Fintech growth and overall economic growth. It highlights how Fintech, by enhancing transparency in financial product pricing, enables accurate risk and interest rate predictions, thus influencing market interest rates.

Given these findings, this paper suggests leveraging Fintech for economic growth by increasing capital investment, expanding Fintech infrastructure, and promoting Fintech innovation. Utilizing Fintech to bolster consumer markets is recommended by supporting businesses in building a digital consumption ecosystem, facilitating diverse, secure, and convenient payment methods, and innovating consumer finance products and services. Finally, enhancing Fintech's role in the real economy is crucial. This could be achieved through encouraging technological innovation and entrepreneurship, fostering collaboration between financial institutions and tech enterprises, and developing financial products that cater to the needs of the real economy. This comprehensive approach ensures Fintech's potential is harnessed to foster sustainable and inclusive economic growth in Singapore.

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