International Journal of Humanities and Social Science Invention (IJHSSI)
ISSN (Online): 2319 – 7722, ISSN (Print): 2319 – 7714
www.ijhssi.org ||Volume 11 Issue 4 Ser. II || April, 2022 || PP. 01-07

The Influence of the Financial Sector on the Regional Economy: A Case of Shanghai

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Abstract
This study constructs a CGE model for the Shanghai economy to analyze the effects of the supply side and the demand side of the finance sector on Shanghai's economy. The results show that On the supply side, the improvement of total factor productivity (TFP) of the finance sector has a positive effect on Shanghai's economic growth. It has the most significant positive impact on the financial sector itself, and the effect on other sectors is relatively tiny and harmful. On the demand side, the increase in household consumption of the financial sector hurts Shanghai's economic growth. It has the most significant positive impact on the financial sector itself, and the effects on the value-added of other sectors are all adverse. The increase in the demand for the finance sector from the ROC has a slightly negative impact on Shanghai's real GDP but a positive effect on nominal GDP. It has the most significant positive impact on the financial sector itself, and the effects on the value-added of other sectors are all adverse. The conclusion of the above simulation study is determined by Shanghai's industrial structure and its relationship with international and domestic markets.
Keywords: *Shanghai Economy, Economic Growth, Finance Industry, CGE Model*

Date of Submission: 04-04-2022 Date of Acceptance: 19-04-2022

I. Introduction

In October 1992, the Chinese government comprehensively studied and judged the international and domestic trends and fully grasped the overall situation of reform and development. In January 1996, the State Council held a special meeting on the construction of the Shanghai International Shipping Center and formally decided to accelerate the Shanghai International Shipping Center structure with Shanghai as the center and Jiangsu and Zhejiang as two wings. The Shanghai Master Plan in 2001 focused on "internationalization," clarified the practical orientation of the international "economic, financial, trade, and shipping center," and guided Shanghai to form a pattern of rapid development in recent years. In April 2009, the State Council officially issued the "Opinions on Promoting Shanghai to Accelerate the Development of Modern Service Industry and Advanced Manufacturing Industry to Build an International Financial Center and International Shipping Center," formally proposing that Shanghai build "four centers."

Shanghai has achieved substantial growth in population, goods, capital, and information by connecting with the world economy. By 2020, the Shanghai government claims that Shanghai will have become an international economic center, an international financial center, an international trade center, and an international shipping center, forming the basic framework of a scientific and technological innovation center with global influence. The construction of Shanghai International Financial Center is in a period of structural transformation from expanding scale to focusing on quality and a development and upgrading period from gathering resources to enhancing functions. As a pillar industry of Shanghai's economy, the financial industry's role in promoting Shanghai's economic development has been given high expectations. Therefore, the financial industry's role in promoting economic growth has also become a research hotspot.

At the national level, Chen & Zhang (2008) conducted a multiple regression analysis on the relationship between China's financial development and economic growth based on the theory of financial repression and financial structure. The conclusion shows a significant positive correlation between financial development and economic growth. Judging from the strength of the financial product in explaining economic fluctuations, the financial repression theory is weak in explaining the relationship between financial development and economic growth. In contrast, the financial structure theory is relatively strong in explaining economic growth.

Jin et al. (2013), Using the panel data of 31 provinces in China from 1997 to 2010, conducted an empirical analysis of the correlation between financial development and economic growth by constructing a Panel-VAR model using impulse response functions and variance decomposition methods. Research shows a significant cointegration relationship between economic growth, financial development, fixed asset investment,

and total employment. The story of the financial industry has a long-term positive impact on economic growth. Economic growth promotes the development of the financial sector. The result encourages the growth of fixed-asset investment and total employment. Fixed asset investment has a positive effect on the development of the financial industry, while total employment hurts the development of the financial sector.

Dong & Wang (2021) used the input-output table from 2002, discussed the development process of China's financial industry and its contribution to the national economy from a macro perspective, and studied the changes in the correlation effect between the financial sector and other sectors from a micro perspective. The financial industry's role in promoting economic growth has been studied all around. The study results show that the development of the financial industry has a positive correlation with economic growth. The added value of the financial industry has continued to grow steadily, and its proportion to GDP has continued to rise. The market size and growth contribution rate have continued to expand, maintaining a strong positive correlation with the high-speed growth of the economy. At the same time, the financial industry is an induction-related sector, and the increase in the output of the financial sector has a weak pulling effect on other industries but is easily pulled by other sectors.

At the regional level, Liu & Ye (2006), Starting from the endogenous economic growth model (AK model), theoretically deduce three possible ways for the development of the financial industry to promote economic growth and use the time series data in Shanghai to study the long-term relationship between the above three ways and economic growth. The results show that the development of Shanghai's financial industry mainly promotes economic growth by facilitating the conversion of savings into investment while increasing the savings rate and marginal capital productivity does not constitute the driving force for the development of the financial industry to promote economic growth.

Xie & Wang (2009) By constructing an Error Correction Model (ECM), this paper empirically studies the inherent logical connection between regional financial development and regional economic growth in Beijing and Shanghai. The main conclusion is that the regional financial development in Beijing and Shanghai has a positive driving effect on their regional economic growth. Shanghai's financial development has a more significant impact on economic growth. Beijing's financial development on economic growth is more reflected in the later period. There is a two-way causal relationship between financial development and economic growth in Beijing. At the same time, there is only a one-way causal relationship between financial development and economic growth in Shanghai. Both Beijing and Shanghai have intertemporal effects on economic growth. Ren et al. (2020) takes the added-value of the financial industry as an intermediate transmission factor, use the synthetic control method and multiple regression, and empirically analyze the contribution of financial innovation and opening-up in the Shanghai Free Trade Zone to Shanghai's economic growth in three steps. The study found that the monetary policies of the Shanghai Free Trade Zone have directly stimulated the added-value of Shanghai's financial industry, and the added-value of the financial sector has significantly boosted economic growth.

The studies mentioned above use econometric regression or statistical methods to study the financial industry's influence on Shanghai's economic growth. Because the research methods discussed above are based on the analysis framework of partial equilibrium, they cannot describe the correlation between regional economic growth's driving and pulling forces. Simultaneously, the studies mentioned above lack a description of the relationship between Shanghai's economy, international and domestic markets. Thus, to make up for the limitations of the research method of partial equilibrium, we will construct a dynamic computable general equilibrium model (DCGE) based on the input-output data for 2017 and distinguishes fourteen sectors. Simulations are conducted from 2021 to 2025. The paper is organized as follows. Section 2 describes the research method. Section 3 presents the scenario designs and simulation results. Section 4 concludes.

II. Research Method

The regional economy is a complex system, and there are correlations among the factors affecting regional economic growth. First of all, the supply-side driving forces, such as labor input, fixed capital input, and improvement in total factor productivity, impact economic growth, but they also interact. Second, the flow of factors between regions and industrial division has continuously strengthened economic relations between regions. On the demand side, export-related to the international market, transfer to ROC related to the domestic market, household consumption, and investment impact economic growth. At the same time, they impact each other. Imports from the international market and transfers from ROC also impact regional economic development. Third, the supply side's driving force and the demand side's pulling force are mutually restrictive. Therefore, studying the factors affecting regional economic growth requires an analysis framework that incorporates the correlations mentioned above as much as possible. We construct a dynamic computable general equilibrium model that includes supply-side driving forces and demand-side pulling forces, including transfers to or from the rest of China, and study the finance industry's relationship with the Shanghai economy.

2.1 Shanghai Regional CGE Models

CGE models designed to study development issues received considerable impetus from Dervis, de Melo, and Robinson (1982). This model was later extended to study regional economies within or based on other economies. Thus, Madden (1990) developed a dynamic regional CGE model with Tasmania and the rest of Australia as two regions of an economy. Over time, regional CGE models have become a popular tool to study regional economies and related policy issues. Unlike national CGE models, regional CGE models have a more complex structure allowing for cross-region flows of products, factors, and funds. The Shanghai regional CGE model presented in this paper distinguishes 14 industries, one type of household, one type of labor, and one government type.

On the production side, all industries are assumed to operate under constant returns to the scale and observe the cost minimization rule. Production processes are supposed to follow CES (Constant Elasticity of Substitution) functions to combine labor and capital to produce the value-added. The intermediate input requirement is determined using Leontief type fixed coefficients applied to the gross output. The constant elasticity of transformation (CET) functions allow for substitution possibilities at two levels on the supply side. The CET specification enables substitution between exports and the domestically disposed part of the output at the initial level. The latter is disaggregated at the next level using the CET specification between the part marketed within Shanghai and the regional market in ROC.

CES specifications are used to conduct a similar two-level disaggregation with substitution possibilities on the demand side. At the first level, the CES specification aggregates the demand for Shanghai-produced output and the demand for ROC-produced output into a combined demand for domestically produced output. At the second level, the CES specification is used again to aggregate the demand for domestic output and the import demand, following the Armington assumption. Utility functions of the Cobb-Douglas type are used to model the consumption demand of households and governments. On the other hand, investment demand is determined by fixed coefficients determined based on the input-output table. The private sector's income is determined by factor income, with fewer taxes imposed on factor income. The government's revenue consists of indirect taxes, tariffs, personal income tax, enterprise income tax. Households and the government split up their income into consumption and savings. The savings of these two actors add up to form the total saving, which is spent on investment.

A well-specified model should satisfy Walras Law, according to which in an *n*-variable system, the equilibrium in *n*-1 markets should ensure the equilibrium in the *n*-th market. Several popular ways to check whether Walras Law is satisfied in a CGE model. The model in this paper uses for this purpose the aggregate savings-investment equation. Leaving out this equation also makes the price of savings as the *numeraire*. The model is a dynamic recursive model. A detailed description of the structure of the Shanghai economic CGE model can be found in (Sun & Islam, 2017)

2.3 Dataset and Baseline

The baseline information is summarized in the Social Accounting Matrix (SAM) form (Sun, 2021, Table 1). The model parameters are calibrated based on the information contained in this SAM. It shows the balance between demand and supply in the output market, the balance between aggregate savings and investment, the budgetary balance of various actors, and the balance in the transactions with ROC and ROW. The SAM is based on Shanghai's input-output table of 2017 and other macroeconomic and sectoral information obtained from various other publications. The first task in using the CGE model is to establish the baseline scenario for 2017-2025 (see Sun, 2021, Table 2).

Before analyzing the influence of the finance industry, we need to consider the shock of the COVID-19 outbreak on the baseline scenario in the first quarter of 2020. The epidemic caused a large-scale stagnation of economic activity from the end of January to mid-April 2020, affecting all aspects of the supply and demand sides. The most obvious is the sudden decline in output and exports. According to data released by the Shanghai Municipal Bureau of Statistics, the economic growth in the first quarter of 2020 is -6.7%, of which the primary industry is -18.2%, the secondary sector is -18.1%, of which manufacturing is -18.5%, and the tertiary industry is -18.5%. -2.7%. We assume that in 2020, except for January to April (about three months), when economic activities are stagnant due to the outbreak of COVID-19, the original baseline scenario's growth rate will remain unchanged at 6% in other periods. A rough estimate of the economic growth rate for 2020 will drop to 2.8%. The revised simulation scenario is based on the 2020 outbreak and serves as the new benchmark scenario for subsequent analysis (see Sun, 2021, Table 3).

The new scenario (epidemic shock) shows that compared with the original baseline scenario without the occurrence of COVID-19, the annual GDP reduction during 2021-2025 will exceed 3%. From the perspective of GDP expenditure, the main reason is that exports and transfers to ROC have reduced significantly. Even if imports and transfers from ROC have also decreased, the actual GDP is still reduced. From the perspective of industry value-added, only the value-added of the information software service industry that can work at home has increased. The accommodation and catering industry saw the most significant decrease in

added value. The manufacturing industry, which accounts for more than a quarter (26%) of total GDP, also fell by 4.53 to 4.93 percentage points. The impact of the stagnation of production and consumption activities is significant.

III. The Simulations Scenario and results of the influence of the finance industry

3.1 Simulations Scenarios

Due to changes in the international and domestic economic environment and regional conditions, whether on the supply side or the demand side, there are many uncertainties in Shanghai's economic growth. The following three simulation scenarios are designed to analyze the finance industry affects economic growth from the supply-side and demand-side. Firstly, as the change of the finance industry is on the supply-side, the simulation scenarios of technological progress change during 2021-2025 are designed, that is, scenario A. Secondly, on the demand side, the simulation scenarios of household consumption change in the finance industry, named scenario B, and the demand of Shanghai's finance industry from the domestic market (transfer to ROC), called scenario C, are designed.

3.2 Simulation Results

3.2.1 Analysis on the supply side: the improvement of TFP of the finance industry

Scenario A is a 1% improvement in the finance industry's total factor productivity (TFP). The simulation results (Table 1) show that compared with the baseline scenario after the outbreak, the improvement of TFP in the financial industry positively affects Shanghai's economic growth. From 2021 to 2025, the influence of promoting real GDP growth will increase year by year, with 1.2 percentage points in 2025. The increase in nominal GDP is smaller than in real GDP, reaching 0.45 percentage points in 2025. This is because the improvement of TFP in the financial industry contributes to improving the Shanghai GDP price index. The GDP deflator is falling.

From the GDP expenditure perspective, the improvement of TFP in the financial industry has a more significant impact on household consumption. Still, it has little effect on government consumption and investment consumption. Among the real export to ROC (the demand for Shanghai's production from ROC), the real import from ROC, the real export to ROW, and the real import from ROW, the impact on the real export to ROC is the largest, while the effect on the real export to ROW is negative. Since the improvement of TFP in the financial industry has a positive impact on most items of GDP on the expenditure side, and the positive impact is more significant than the negative impact, it has a positive impact on real GDP.

From the perspective of the added value of various industries, the improvement of total factor productivity in the financial sector has the most significant positive impact on the financial sector itself and, followed by real estate and leasing & business services. The effect on other industries is relatively small, and the impact on agriculture, manufacturing, transportation, hotel and catering, information & software, and social services is negative.

Table 1: Scenario A: 1% improvement of TFP of the finance industry **(%)**

	2021	2022	2023	2024	2025
Real GDP	0.37	0.56	0.77	0.98	1.20
Nominal GDP	0.13	0.19	0.26	0.33	0.39
GDP deflator	-0.24	-0.37	-0.50	-0.65	-0.80
Real household consumption	0.31	0.47	0.63	0.80	0.97
Real gov. consumption	0.00	0.00	0.00	0.00	0.01
Real investment	0.01	0.02	0.03	0.05	0.07
Real export to ROC	0.20	0.31	0.43	0.55	0.68
Real export to ROW	-0.02	-0.03	-0.05	-0.07	-0.09
Real import from ROC	0.03	0.05	0.08	0.11	0.15
Real import from ROW	0.06	0.10	0.14	0.18	0.22
Agriculture	-0.06	-0.09	-0.12	-0.15	-0.19
Manufacturing	-0.03	-0.05	-0.07	-0.09	-0.11
Water, power & gas	0.06	0.09	0.12	0.14	0.17
Construction	0.04	0.06	0.08	0.09	0.11
Wholesale & Retail	0.08	0.11	0.13	0.14	0.14
Transportation	-0.03	-0.05	-0.08	-0.11	-0.15
Hotel and Catering	-0.03	-0.05	-0.08	-0.11	-0.15
Information & software	0.01	0.01	0.01	0.00	-0.01
Finance & insurance	1.80	2.72	3.66	4.62	5.60
Real estate	0.12	0.18	0.24	0.29	0.35

Leasing & business services	0.34	0.52	0.70	0.88	1.06
Residential services	0.04	0.06	0.07	0.09	0.10
Social services	-0.05	-0.08	-0.12	-0.15	-0.20
Public service	0.03	0.04	0.06	0.08	0.10

3.2.2 Analysis on the demand side: the influence of household consumption on the finance industry

Scenario B is a 10% increase in household consumption in the finance industry. The simulation results (Table 2) show that compared with the baseline scenario after the outbreak, the rise in household consumption of the financial sector hurts Shanghai's economic growth. From 2021 to 2025, the negative influence on real GDP growth will increase year by year, and -0.43 percentage points in 2025. The decrease in nominal GDP is more significant than real GDP, reaching -2.90 percentage points in 2025. This is because the increase in household consumption on the demand side of the financial industry has led to a decline in Shanghai's prices. The GDP deflator is falling.

From the GDP expenditure perspective, the increase in household consumption of the financial industry has a more significant impact on household consumption itself. Still, it has little effect on government consumption and investment consumption. Among the real export to ROC, the real import from ROC, the real export to ROW, and the real import from ROW, the impact on the real import from ROC is the largest. In contrast, the effect on the real export to ROW and the real export is negative since the increase in household consumption of the financial sector has a more significant impact on GDP deductions than GDP additions, both real GDP and nominal GDP decrease.

From the perspective of the added value of various industries, the increase in household consumption in the financial sector has the most significant positive impact on the financial sector itself. The effects on the value-added of other sectors are all adverse. Under the budgetary constraints of household income, the increase in consumer spending in the financial industry has had a crowding-out effect on demand in other sectors.

Table 2 Scenario B: 10% increase in household consumption in the finance industry (%)

	2021	2021	2021	2021	2021
Real GDP	-0.09	-0.15	-0.22	-0.31	-0.43
Nominal GDP	-0.74	-1.18	-1.68	-2.25	-2.90
GDP deflator	-0.65	-1.04	-1.47	-1.95	-2.48
Real household consumption	3.02	4.70	6.50	8.43	10.50
Real gov. consumption	-0.02	-0.02	-0.01	0.02	0.05
Real investment	0.35	0.54	0.74	0.96	1.19
Real export to ROC	-0.28	-0.43	-0.59	-0.77	-0.95
Real export to ROW	-0.38	-0.60	-0.83	-1.07	-1.34
Real import from ROC	0.80	1.31	1.90	2.61	3.43
Real import from ROW	0.06	0.11	0.18	0.28	0.39
Agriculture	-0.27	-0.42	-0.57	-0.73	-0.89
Manufacturing	-0.30	-0.47	-0.65	-0.85	-1.06
Water, power & gas	-0.17	-0.26	-0.36	-0.46	-0.55
Construction	-0.23	-0.37	-0.51	-0.66	-0.82
Wholesale & Retail	-1.03	-1.58	-2.14	-2.72	-3.31
Transportation	-0.47	-0.73	-1.01	-1.32	-1.65
Hotel and Catering	-0.66	-1.03	-1.42	-1.84	-2.29
Information & software	-0.57	-0.88	-1.22	-1.59	-1.97
Finance & insurance	1.95	2.98	4.04	5.15	6.29
Real estate	-0.40	-0.61	-0.83	-1.06	-1.29
Leasing & business services	-0.32	-0.49	-0.66	-0.85	-1.04
Residential services	-0.45	-0.70	-0.96	-1.24	-1.53
Social services	-0.49	-0.76	-1.05	-1.37	-1.71
Public service	-0.18	-0.27	-0.35	-0.42	-0.49

3.2.3 Analysis on the demand side: the influence of the demand of the finance industry from the ROC

Scenario C is a 10% increase in the demand of the finance industry from the ROC. The simulation results (Table 3) show that compared with the baseline scenario after the outbreak, the increase in the demand for the finance industry from the ROC has a slightly negative effect on Shanghai's real GDP but a positive effect on nominal GDP. From 2021 to 2025, the influence on real GDP is -0.36 percentage points and 6.67 percentage points on nominal GDP 2025. This opposite effect on real GDP and nominal GDP is because the increase in the demand of the finance industry from the ROC (export to ROC) to the financial sector has a significant impact on

Shanghai's prices. In 2025, the GDP deflator will increase to 7.6 percentage points.

From the GDP expenditure perspective, the increase in the demand of the finance industry from the ROC has a more significant positive impact on real household consumption. The following is a real investment and has little effect on government consumption. Among the real export to ROC, the real import from ROC, the real export to ROW, and the real import from ROW, the impact on the real export to ROW is negative and most significant, followed by the real export to ROC. In contrast, the effect on the real import from ROC and ROW are positive. Since the increase in the demand of the finance industry from the ROC has a more significant impact on GDP deductions than GDP additions, the real GDP decreased and had a more significant effect on the GDP deflator, the nominal GDP increased.

From the perspective of the added value of various industries, the increase in the demand of the finance industry from the ROC has the most significant positive impact on the financial sector itself. The effects on the value-added of other sectors are all adverse. This is because an increase in external demand will push up prices in Shanghai, which will reduce the added value of various industries and hurt Shanghai's real GDP growth. This is determined by Shanghai's industrial structure and Shanghai's relationship with international and domestic markets.

Table 3 Scenario C: 10% increase in demand from ROC of the finance industry (%)

	2021	2021	2021	2021	2021
Real GDP	-0.07	-0.12	-0.19	-0.26	-0.36
Nominal GDP	1.88	2.96	4.12	5.35	6.67
GDP deflator	1.96	3.09	4.31	5.63	7.05
Real household consumption	1.73	2.71	3.75	4.86	6.02
Real gov. consumption	-0.05	-0.06	-0.05	-0.02	0.04
Real investment	0.34	0.55	0.78	1.04	1.32
Real export to ROC	-0.26	-0.41	-0.57	-0.74	-0.91
Real export to ROW	-0.62	-0.98	-1.37	-1.78	-2.23
Real import from ROC	0.14	0.24	0.39	0.57	0.79
Real import from ROW	0.13	0.23	0.36	0.53	0.74
Agriculture	-0.68	-1.05	-1.44	-1.84	-2.26
Manufacturing	-0.56	-0.88	-1.23	-1.59	-1.98
Water, power & gas	-0.21	-0.33	-0.46	-0.60	-0.75
Construction	-0.10	-0.17	-0.26	-0.36	-0.48
Wholesale & Retail	-0.91	-1.43	-2.00	-2.61	-3.26
Transportation	-0.81	-1.29	-1.83	-2.42	-3.06
Hotel and Catering	-0.93	-1.48	-2.09	-2.75	-3.47
Information & software	-0.96	-1.51	-2.09	-2.71	-3.36
Finance & insurance	2.63	4.08	5.61	7.20	8.86
Real estate	-0.25	-0.39	-0.53	-0.67	-0.81
Leasing & business services	-0.13	-0.21	-0.31	-0.42	-0.55
Residential services	-0.73	-1.15	-1.60	-2.09	-2.60
Social services	-0.98	-1.55	-2.16	-2.82	-3.53
Public service	-0.36	-0.55	-0.72	-0.89	-1.05

IV. Conclusions

This study constructs a CGE model for the Shanghai economy. It analyzes the effects of the supply side, that is, the improvement of total factor productivity (TFP) of the finance industry, the effects of the demand side, that is, the increase of household consumption in the finance industry, and the demand of the finance industry from the ROC on Shanghai's economy from 2021 to 2025. The main conclusions are summarized as follows.

On the supply side, the finance industry's improvement of total factor productivity (TFP) positively affects Shanghai's economic growth. The increase in nominal GDP is smaller than in real GDP; this is because the improvement of TFP in the financial industry contributes to the progress of the Shanghai GDP price index. It also has a more significant impact on household consumption. The effect on the real export to ROC is the largest, while the real export to ROW is negative. Since it has a positive impact on most items of GDP on the expenditure side, and the positive impact is more significant than the negative impact, the total effect on real GDP is positive. It also has the most significant positive impact on the financial industry itself, and the impact on other sectors is relatively tiny and harmful.

On the demand side, the increase in household consumption of the financial industry hurts Shanghai's

economic growth. The decrease in nominal GDP is more significant than in real GDP. This is because it has led to a decline in Shanghai's prices. The GDP deflator is falling. The increase in household consumption in the financial industry has a more significant impact on household consumption itself. The effect on the real import from ROC is the largest, while the effect on the real export to ROW and the real export is negative. Since the increase in household consumption of the financial sector has a more significant effect on GDP deductions than GDP additions, both real GDP and nominal GDP decrease, it also has the most significant positive impact on the financial industry itself and the effects on the value-added of other sectors are all adverse. Under the budgetary constraints of household income, the increase in consumer spending in the financial industry has had a crowding-out effect on demand in other sectors.

The increase in the demand for the finance industry from the ROC has a slightly negative effect on Shanghai's real GDP but a positive effect on nominal GDP. This opposite effect on real GDP and nominal GDP is because the increase in the demand of the finance industry from the ROC to the financial industry has a significant impact on Shanghai's prices. It also has a more powerful positive impact on real household consumption, and the effect on the real export to ROW is negative and most influential. Since the increase in the demand of the finance industry from the ROC has a more significant impact on GDP deductions than GDP additions, the real GDP decreased and had a more substantial effect on the GDP deflator, the nominal GDP increased. It also has the most significant positive impact on the financial industry itself. The effects on the value-added of other sectors are all adverse. This is because an increase in external demand will push up prices in Shanghai, which will reduce the added value of various industries and hurt Shanghai's real GDP growth. The conclusion of the above simulation study is determined by Shanghai's industrial structure and its relationship with international and domestic markets.

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Lin Sun. "The Influence of the Financial Sector on the Regional Economy: A Case of Shanghai." *International Journal of Humanities and Social Science Invention (IJHSSI),* vol. 11(04), 2022, pp 01-07. Journal DOI- 10.35629/7722