A Scenario Analysis of the Growth Factors on the Supply Side and Demand Side of Shanghai's Economy in the Next Stage (2021-2025)

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Abstract

This study uses a regional computable general equilibrium (CGE) model to conduct a scenario simulation analysis on the factors of Shanghai's economic growth from 2021 to 2025. The growth factors of analysis include labor, capital factor input, and total factor productivity on the supply side; household consumption, investment, export to ROW (the Rest of World) and transfer to ROC (the Rest of China) on the demand side, and import from ROW and transfer from ROC. Our results indicate that on the supply-side, the most effective driving factor for Shanghai's economic growth is to improve total factor productivity, labor input is still sufficient, and fixed capital investment scale expansion has limited effect. On the demand side, the pulling effect of household consumption and investment is little, export to ROW tends to be neutral, and transfer to ROC is negative. The impact of import from ROW is weak, and the effect of transfer from ROC is greater than that of import. The research results' policy significance shows that Shanghai should increase the introduction and investment of human resources, gradually abandon the growth path relying on investment, and further play a leading role in the national economy on the premise of enhancing Shanghai's industrial competitiveness.

Keywords: Shanghai Economy, Factor of Economic Growth, CGE Model

1. Introduction

The research on Shanghai's economic growth factors is one of the government's bases to formulate economic development plans and policies. The empirical research literature on Shanghai's economic growth factors mainly includes Gao (2010), Guan and Li (2013), Yang et al. (2015). These studies mainly focus on the measurement of total factor productivity and its contribution to economic growth. Predictive research literature mainly includes the following related research around the "13th Five-Year Plan". The first is "Research on the Characteristics of Shanghai's Economic Development Stages and the Dynamics of Economic Growth during the 13th Five-Year Plan" (Shanghai Municipal Bureau of Statistics Research Group, 2015). The research method is mainly based on the econometric analysis of the production function and has carried out a scenario analysis of the factor input and total factor productivity on the supply side. This research focuses on the four stages of Shanghai's economy since the reform and opening up. It analyzes the economic growth dynamics pattern and its evolution in each stage and studies the macro-environment and growth dynamics factors that Shanghai's economy will face during the "13th Five-Year Plan" period, and predicts the economic growth rate.

The second is "Research on Shanghai's Economic Growth Potential and Dynamic Mechanism under the New Normal" (Ma Haiqing, 2015). The research method mainly bases on statistical analysis and analysis of the supply, demand, and energy constraints. The study predicts Shanghai's economy's growth rate during the "13th Five-Year Plan" period and believes that the transformation of Shanghai's economic growth power mechanism during the "13th Five-Year Plan" period has significant characteristics of linking the past.

The third is the "New Normal and Shanghai Economic Growth Potential Research" (Quan Hen et al. 2016). The research uses the typical Solow residual method to analyze the contribution of factor input and total factor productivity on the supply side. It conducts econometric regression analysis on investment, consumption, and export on the demand side. Based on the analysis of the two-sided power sources of supply and demand, the study believes that Shanghai's economy has entered a slowdown channel during the 13th Five-Year Plan period.

The studies mentioned above use econometric regression or statistical methods to study the influencing factors of Shanghai's economic growth from the supply side or the demand side and predict the economic growth rate during the "13th Five-Year Plan" period. Because the research methods mentioned above are based on the analysis framework of partial equilibrium, they cannot describe the correlation between the driving force and pulling force of regional economic growth. Simultaneously, the studies mentioned above lack a description of the relationship between Shanghai's economy and the domestic market.

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 with each other. 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 have an impact on regional economic growth. Third, the supply side's driving force and the pulling force on the demand side are also mutually restrictive. Therefore, studying the factors affecting regional economic growth requires an analysis framework that incorporates the correlations mentioned above as much as possible. This research aims to make up for the limitations of the research method of partial equilibrium. It constructs a general equilibrium framework that incorporates supply-side driving forces and demand-side pulling forces, includes transfers to or from the rest of China, and studies Shanghai economic growth factors.

Thus, the paper uses a dynamic computable general equilibrium model (DCGE) based on the input-output data for 2017 and distinguishes fourteen sectors, and simulations are conducted for 2021 to 2025. The paper is organized as follows. Section 2 describes the Dynamic CGE model constructed and used for the analysis, including model structure, database, and benchmark scenarios. Section 3 presents the scenario designs and simulation results. Section 4 concludes.

2. A regional CGE model for the Shanghai economy

2.1 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. We also developed a single region model of Shanghai to study the effect of Yuan exchange rate, value-add tax reform, energy price, and Shanghai's economic relationships with the rest of China and the world (Sun and Islam, 2017). The model used in this paper is a further application to the Shanghai economy.

2.2 Regional CGE model for Shanghai

Unlike national CGE models, regional CGE models have a more complex structure allowing for cross-region flows of products, factors, and funds. These cross-region flows can be endogenous, exogenous, or both, depending on the model construction, which depends on the model's purpose. 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 assumed to follow CES (Constant Elasticity of Substitution) functions to combine labor and capital to produce the value-added. The intermediate input requirement is determined by using Leontief type fixed coefficients applied to the gross output. On the supply side, the constant elasticity of transformation (CET) functions are used to allow for substitution possibilities at two levels. At the initial level, the CET specification is used to enable substitution between exports and the domestically disposed of part of the output. The latter is disaggregated at the next level using the CET specification between the part marketed within Shanghai and the part marketed in ROC.

On the demand side, CES specifications are used to conduct a similar two-level disaggregation with substitution possibilities. At the first level, the CES specification is used to aggregate 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. So far as prices of exports and imports are concerned, Shanghai is assumed to a small-economy, both ROC and ROW, making these prices exogenous to the Shanghai economy. 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, fewer taxes imposed on factor income (in the form of personal and property taxes). 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. There are 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. It is solved separately with updating equations connecting the model for one period with the one for the next period. The updating equations furnish the values (mostly through extrapolation) of the exogenous variables, such as the supply of labor, nominal wage of labor, real investment, capital stock, and also the values of the parameters such as the total factor productivity of each industry. Extrapolations are made based on specific growth rates and changes assumed for the pertinent variables and parameters. As already mentioned, total capital stock is obtained by adding investment to the previous period's capital stock and subtracting the depreciation. The predetermined capital stock is then allocated among industries according to the return rate to capital prevailing in them.

2.3 Dataset and Baseline

The baseline information is summarized in the Social Accounting Matrix (SAM) form presented in Table 1 and Table 2. The parameters of the model 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 presented in Table 1 is based on Shanghai's input-output table of 2017 and other macroeconomic and sectoral information of that year obtained from various other publications.

The first task in using the CGE model is to establish the baseline scenario (for 2017-2025) against which the scenarios can be compared. The baseline needs to be reasonable, reflecting what would have happened if the recent trends by and large continued and parameter values did not change too much. For constructing such a baseline, it is assumed that during 2017-2025 labor, nominal wage, real investment, and TFP of each industry, respectively. These values accord well with the recent experience. The scale parameter of exports in each sector is extrapolated based on exports' growth performance in the past. The exchange rate is fixed at the 2017 level, and the coefficients of intermediate inputs are assumed to remain the same as in the 2017 input-output table.

Table 2 presents the baseline scenario in terms of average growth rates of key macroeconomic variables and gross value added by industry during 2017-2025. As we can see, under the baseline scenario, Shanghai's real GDP is to grow at an annual average rate of 6.9 to 5.6 percent. The baseline scenario reflects the current trend of increasing Shanghai's dependence on ROW as a source of consumption and ROC as a source of demand for her output.

Table 1:   Shanghai Social Accounting Matrix (SAM), 2017 in 10 Million Yuan

Expenditures / Receipts	Activities	Commodities	Capital	Labor	Enterprises	Households	Government	Investment	Export to ROC	Export to World	Total
Activities		31351							49270	13493	94114
Commodities	63420					12970	4642	12193			93225
Capital	11770										11770
Labor	13607										13607
Enterprises			11770								11770
Households				11876	8162		6014				26052
Government	5316			1731	3608		5862				16517
Savings						13082			-13459	12570	12193
Import from ROC		35812									35812
Import from World		26063									26063
Total	94114	93225	11770	13607	11770	26052	16518	12193	35812	26063	

Table 2:   Baseline of Shanghai Economy, 2017-2025 in 100 Million Yuan

	2017	2018	2019	2020	2021	2022	2023	2024	2025
Real GDP Growth rate	6.9%	6.7%	6.1%	6.0%	6.0%	5.9%	5.8%	5.7%	5.6%
Real GDP	30694	32737	34740	36822	39030	41349	43753	46240	48810
Nominal GDP	30694	33405	36279	39599	43290	47394	51943	56983	62562
GDP deflator	1.00	1.02	1.04	1.08	1.11	1.15	1.19	1.23	1.28
Real household consumption	12970	14107	15276	16630	18128	19786	21610	23615	25817
Real gov. consumption	4642	4926	5204	5500	5804	6119	6446	6785	7136
Real investment	12193	12751	13313	13898	14501	15123	15762	16419	17092
Real export to ROC	49270	52359	55325	58432	61744	65227	68859	72641	76578
Real export to ROW	13493	14110	14457	14823	15202	15577	15947	16312	16672
Real import from ROC	35812	37889	40015	42221	44589	47110	49792	52645	55682
Real import from ROW	26063	27627	28820	30239	31760	33373	35080	36887	38803
Agriculture	115	116	116	116	116	116	116	115	114
Manufacturing	7977	8306	8506	8712	8926	9137	9345	9550	9753
Water, power & gas	416	442	464	488	512	537	562	588	614
Construction	971	1011	1050	1090	1131	1173	1216	1258	1302
Wholesale & retail	4393	4676	5023	5384	5763	6158	6568	6992	7432
Transportation	1345	1448	1596	1756	1930	2117	2316	2530	2757
Hotel and Catering	412	482	517	553	590	627	665	702	740
Information &software	1862	2045	2235	2434	2658	2907	3174	3460	3768
Finance & insurance	5331	5808	6303	6827	7415	8065	8764	9513	10316
Real estate	1873	1985	2099	2214	2333	2456	2583	2714	2849
Leasing &business services	1788	1923	2061	2207	2360	2522	2691	2866	3048
Residential services	347	367	387	406	424	442	460	477	494
Social services	3151	3409	3663	3924	4189	4458	4732	5010	5289
Public service	713	749	785	821	856	891	925	960	995

3. The Simulations and their results

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 during the "14th Five-Year Plan" period (021-2025). The following four simulation scenarios are designed to analyze the factors affecting economic growth (Table 3).

Table 3: Simulation Scenarios of Shanghai's Economic Growth Factors

Simulation scenario number		Simulation content
A: New baseline corrected by 2020 COVID-19 epidemic		Reflects the economy shrink in the first quarter of 2020
Supply-side factors	B1: Impact of labor supply	1% increase of labor supply
	B2: Impact of fixed capital	1% increase of fixed capital scale
	B3: Impact of technological progress	1% increase of TFP
Demand-side factors	C1: Impact of household consumption	1% increase of consumption scale
	C2: Impact of investment	1% increase of investment scale
	C3: Impact of export	1% increase of export scale
	C4: Impact of transfer to ROC	1% increase of transfer to ROC scale
D1: Impact of import		1% increase of import demand scale
D2: Impact of transfer from ROC		1% increase of transfer from ROC scale

Note: 1% means an average annual increase of 1 percentage point for each factor based on the baseline scenario.

The first is Scenario A, reflecting the sudden impact of the COVID-19 outbreak 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. Therefore, firstly, the output shrinkage scenario A of Shanghai's major industries in 2020 is designed (see below for details). The state formed by the impact of the epidemic is used as the baseline scenario for subsequent simulations. Secondly, the simulation scenarios of labor force change B1, fixed investment change B2, and technological progress change B3 on the supply side during 2021-2025 are designed.

Thirdly, the simulation scenarios of household consumption change C1, investment change C2, export change C3, and transfer to ROC change C4 on the demand side during 2021-2025 are designed. Fourthly, simulation scenarios such as import change D1 and transfer from ROC change D2 during 2021-2025 are designed.

3.2 Simulation Results

3.2.1 Scenario A: Impact of the COVID-19 epidemic in 2020 (new baseline for simulation analysis)

The sudden outbreak of COVID-19 at the end of January 2020 caused the suspension of large-scale economic activities nationwide and globally, and the Shanghai economy is no exception. 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 industry 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 the whole year of 2020 will drop to 2.8%. The revised simulation scenario A is based on the 2020 outbreak and serves as the new benchmark scenario for subsequent analysis (the main indicators are shown in Table 4).

Table 4: New Baseline of Shanghai's Economy under the Impact of COVID-9 (100 million yuan)

	2017	2018	2019	2020	2021	2022	2023	2024	2025
Real GDP Growth rate	6.9%	6.7%	6.1%	2.8%	5.9%	5.9%	5.7%	5.62%	5.49%
Real GDP	30694	32737	34740	35704	37817	40038	42339	44719	47176
Nominal GDP	30694	33405	36279	39971	43655	47747	52278	57293	62837
GDP deflator	1.00	1.02	1.04	1.12	1.15	1.19	1.23	1.28	1.33
Real household consumption	12970	14107	15276	16828	18328	19986	21807	23808	26002
Real gove. consumption	4642	4926	5204	5427	5726	6037	6358	6692	7037
Real Investment	12193	12751	13313	13521	14088	14669	15264	15873	16494
Real export to ROC	49270	52359	55325	55927	59049	62332	65755	69318	73024
Real export to ROW	13493	14110	14457	14177	14526	14869	15207	15540	15867
Real import from ROC	35812	37889	40015	40833	43097	45508	48071	50799	53703
Real import from ROW	26063	27627	28820	29344	30801	32346	33981	35711	37545
Agriculture	115	116	116	111	111	111	110	110	109
Manufacturing	7977	8306	8506	8326	8522	8714	8903	9089	9272
Water, power & gas	416	442	464	486	510	535	560	586	612
Construction	971	1011	1050	1025	1061	1096	1131	1167	1202
Wholesale & retail	4393	4676	5023	5045	5395	5760	6139	6532	6939
Transportation	1345	1448	1596	1644	1804	1976	2160	2356	2565
Hotel and Catering	412	482	517	494	526	559	592	624	656
Information &software	1862	2045	2235	2472	2699	2951	3222	3513	3825
Finance & insurance	5331	5808	6303	6820	7401	8044	8735	9476	10269
Real estate	1873	1985	2099	2147	2259	2375	2494	2617	2743
Leasing &business services	1788	1923	2061	2133	2280	2435	2597	2766	2940
Residential services	347	367	387	392	410	428	445	461	477
Social services	3151	3409	3663	3803	4058	4318	4582	4849	5118
Public service	713	749	785	806	840	875	909	943	977

The simulation results of scenario A (epidemic shock) show that compared with the original baseline scenario without the occurrence of COVID-19, the annual GDP reduction during 2021-2025 will exceed 3% (from 3.11 to 3.35 percentage points).

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 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, increasing by about 1.5% every year (2021-2025). The accommodation and catering industry saw the largest decrease in added value, with a reduction of 10.72 to 11.28 percentage points. 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. See appendix table 1(Scenario A) for changes in GDP expenditure items and added value of each industry.

3.2.2 Scenario B: A simulation analysis of influencing factors on the supply side

The simulation results of scenario B1 (increasing labor input) show that compared with the baseline scenario after the outbreak, the driving force of labor input on real GDP growth is positive. From 2021 to 2025, labor input will promote GDP growth, and the effect will increase year by year. From the perspective of GDP expenditure, labor input has contributed to the year-on-year increase in all expenditure items. Although imports and transfers from ROC have also increased, the actual GDP is increasing year by year.

From the perspective of industrial added-value, increasing labor input positively affects the added-value of all industries. Among them, the promotion effect on the residential service industry, social service industry, and agriculture is relatively large. In contrast, the promotion effect on the manufacturing industry, the primary industry that creates added-value, is relatively low. That means that Shanghai's manufacturing industry is no longer a labor-intensive industry. The driving effect of increasing labor input in the service industry on Shanghai's GDP growth is still useful. Please refer to appendix table 1(Scenario B1) for specific GDP expenditure items and certain changes in the value-added of each industry.

The simulation results of scenario B2 (increasing fixed capital investment) show that compared with the baseline scenario after the outbreak, the driving effect of increasing fixed capital investment on real GDP growth is limited. From 2021 to 2025, the role of fixed capital investment in promoting GDP growth will gradually change from the initial weak negative effect to the weak positive impact. From the perspective of GDP expenditure, although the increase in fixed capital investment has a more significant driving effect on the growth of investment demand, it also drives the year-on-year increase in import and transfer from ROC, which hedges the positive effect of GDP increase. Therefore, the driving effect on GDP growth is limited.

From the perspective of industrial added value, increasing fixed capital investment has a weak driving impact on the manufacturing industry, which is the primary industry that creates added value. The driving effect on the construction industry and real estate industry that rely on investment is more significant. Due to capital investment's diminishing utility, it may not be easy to drive GDP growth by increasing investment only in quantity effectively. Please refer to appendix table 2 (Scenario B2) for specific GDP expenditure items and specific changes in each industry's added value.

The simulation results of scenario B3 (improving total factor productivity) show that compared with the baseline scenario after the outbreak, total factor productivity significantly affects real GDP growth. From 2021 to 2025, the driving influence of increasing total factor productivity in promoting GDP growth will increase year by year, and the increase will be enormous. From the GDP expenditure perspective, improving total factor productivity promotes all GDP expenditure items, including import demand and transfer demand from ROC (negative GDP accounting items). However, due to the more significant increase in the transfer to ROC and export (the positive term of GDP accounting), real GDP growth remains relatively high. The increase in total factor productivity has a relatively sizeable driving effect on all industrial added value growth. It can be found that increasing the total factor productivity of various industries having a significant impact on GDP growth. Of course, improving the total factor productivity of multiple industries requires an ongoing human resource strategy and a series of specific policy measures to promote innovation (Sun et al., 2019). Please refer to Appendix table 2(Scenario B3) for specific GDP expenditure items and specific changes in the value-added of each industry.

3.2.3 Scenario C: A simulation analysis of influencing factors on the demand side

The simulation results of scenario C1 (increasing consumer) show that, compared with the baseline scenario after the outbreak, from 2021 to 2025, increasing household consumption has a slightly negative effect on real GDP growth. From the perspective of GDP expenditure, increasing household consumption has led to a decrease in export and transfer to ROC year by year, while imports and transfers from ROC have increased year by year. In the end, the total addition effect of GDP accounting is less than the full reduction effect, and GDP decreases. From the perspective of industrial added value, the increase in consumer demand for households mainly drives the increase in the added value of the residential service industry, leasing service industry, real estate service industry, and financial and insurance industries. For industries such as manufacturing, wholesale and retail, accommodation and catering, transportation, and software services that rely on transfers from ROC and imports, the effect is negative.

As household consumption structure is relatively dependent on the domestic market and the international market, its increase has a negative impact on Shanghai's GDP. Please refer to appendix table 3 (Scenario C1) for specific GDP expenditure items and specific changes in each industry's added value.

The simulation results of scenario C2 (increasing investment) show that compared with the baseline scenario after the outbreak, the increase in investment demand will have a weak positive effect on real GDP growth from 2021 to 2025. From the perspective of GDP expenditure, similar to increasing household consumption, increasing investment has a more significant stimulating effect on investment demand. Still, at the same time, it reduces exports and transfers to ROC.

It makes imports and transfers from ROC increase year by year, eventually leading to the total effect of the positive term of GDP accounting is only slightly more significant than the full effect of the subtractive term, resulting in a slight increase in GDP. From the perspective of industrial added value, increased investment mainly spurred the growth of the added value of the real estate industry, finance and insurance industry, software services, water, electricity and gas industry, and construction industry, with a slightly negative effect on other industries. Investment demand is relatively dependent on domestic market transfers and international market imports, resulting in a weak pull effect on Shanghai's GDP. Please refer to appendix table 3(Scenario C2) for specific GDP expenditure items and specific changes in each industry's added value.

The simulation results of scenario C3 (increasing export) show that, compared with the baseline scenario, from 2021 to 2025, the effect of growing export on real GDP growth is almost zero. From the perspective of GDP expenditure, increasing export, on the one hand, leads to a rise in prices, which has a weak pull on GDP accounting, and on the other hand, it drives imports and transfers from ROC as a deduction for GDP accounting. The positive aggregate effect offsets the subtract aggregate effect, and its effect on real GDP growth is close to zero.

From industrial added value, increasing export demand drives the manufacturing industry's growth and hurts most other industries. Since Shanghai's export relies on the import and transfer from ROC of intermediate products in the international market and the domestic market, its stimulating effect on Shanghai's GDP is offset. Please refer to appendix table 4 (Scenario C3) for specific GDP expenditure items and specific changes in each industry's added value.

The simulation results of scenario C4 (increased transfer to ROC) show that compared with the baseline scenario after the outbreak, from 2021 to 2025, the increase in transfer to ROC will hurt real GDP growth. From the perspective of GDP expenditure, the increase in export leads to the rise in prices on the one hand, and on the other hand, it stimulates an increase in import and transfer from ROC year by year and ultimately hurts real GDP growth.

From the perspective of industrial added value, the increased demand for transfers to ROC mainly drove the growth of manufacturing, accommodation and catering, transportation, and hydropower and coal industries, with adverse effects on other industries. Since Shanghai's export relies on the import and transfer from ROC of intermediate products in the international market and the domestic market, it hurts Shanghai's GDP. Please refer to appendix table 4(Scenario C4) for specific GDP expenditure items and specific changes in each industry's added value.

3.2.4 Scenario D: A simulation analysis of the impact of import and transfer from ROC

The simulation results of scenario D1 (increasing import) show that, compared with the baseline scenario after the outbreak, from 2021 to 2025, the effect of increasing import on real GDP growth is weak. From the perspective of GDP expenditure, there is a substitution relationship between imports and transfers from ROC. An increase in imports leads to a decrease in transfer from ROC, which ultimately leads to the offset of the total effect of adding items and the full impact of subtracting items in GDP accounting, which has a weak effect on actual GDP growth.

From the perspective of industrial added value, the impact of increased imports on major industries is relatively weak. Due to the substitution relationship between Shanghai's imports and transfers from ROC, its impact on Shanghai's GDP was offset. Please refer to appendix table 5(Scenario D1) for specific GDP expenditure items and specific changes in the added value o each industry.

The simulation results of scenario D2 (increased transfer from ROC) show that compared with the baseline scenario after the outbreak, the effect of increasing transfer from ROC on real GDP growth is positive. The simulation results of scenario D2 (increased transfer from ROC) show that compared with the baseline scenario after the outbreak, the effect of increased transfer from ROC on real GDP growth from 2021 to 2025 is positive, and it will increase year by year.

From the perspective of GDP expenditure, on the one hand, increased transfer from ROCpositively impacts other GDP growth items. On the other hand, there is a substitution relationship with imports. Increased transfers from ROC lead to a decrease in imports, and the impact on real GDP growth is a positive effect. From the perspective of industrial added value, the increase in transfer from ROC has a positive and negative impact on primary industries, and the magnitude is small. There is a substitution relationship between import and transfer from ROC, but the transfer from ROC has a more significant impact on Shanghai's GDP than import.

Please refer to appendix table 5(Scenario D2) for specific GDP expenditure items and specific changes in each industry's added value.

4. Conclusions

The outbreak of Covid-19 in 2020 has led to the stagnation of economic activities in China and worldwide to a certain extent and has had a significant impact on Shanghai's economy. This study constructs a CGE model for the Shanghai economy. It analyzes the effects of the supply-side driving forces and the demand-side pulling forces, the import and the transfer from ROC on Shanghai's economic growth from 2021 to 2025.

The impact of supply-side driving forces on Shanghai's economy. Increasing labor input promotes an increase in all GDP expenditure items, which means labor input can drive economic growth. Increasing labor input has a positive effect on all industries, but the promotion effect on manufacturing is relatively low.

In other words that Shanghai's manufacturing industry is no longer a labor-intensive industry. In the future, Shanghai needs to increase labor input in the service industry to promote the continuous growth of Shanghai's GDP. Increasing fixed capital investment is not as good as before in driving economic growth because it leads to an increase in import and transfer from ROC, so its role in boosting GDP is limited. At the industrial level, increasing fixed capital investment has a weaker driving force for the manufacturing industry. If only increasing the amount of investment, it may no longer be possible to promote Shanghai's economic growth effectively. Improvement of TFP has a significant driving effect on Shanghai's economic growth. It drives the growth of all GDP expenditure items, leading to a relatively high level of real GDP growth. TFP generally has a more significant driving effect on the growth of various industries' added value at the industrial level. Improvement TFP of various industries indeed requires continuous human resource strategies and other specific policies to promote innovation.

The impact of demand-side pulling power on Shanghai's economy. Because household consumption is relatively dependent on the ROC and international markets, it has a limited adverse effect on Shanghai's economic growth. Increasing household consumption reduces exports and transfers to ROC. It stimulates the increase in imports and transfers from ROC, resulting in the GDP increase being smaller than the deduction effect and GDP reduction. At the industrial level, increasing consumer demand hurts industries such as manufacturing that rely on imports and transfers from ROC. Investment demand is relatively dependent on transfers from ROC and imports and reduces exports and transfers to ROC. As a result, the GDP increase effect is only slightly more significant than the deduction effect, and GDP increases somewhat. Increasing export will stimulate the increase in import and transfer from ROC, resulting in the GDP increase effect offsetting the reduction effect, and the effect on real GDP growth is close to zero. At the industrial level, it mainly drives the growth of manufacturing. Since Shanghai's export relies on the import and transfer from ROC of intermediate products in the international market and the domestic market, its stimulating effect on Shanghai's GDP is offset. Increasing transfer to ROC will negatively affect because Shanghai's transfer to ROC relies on the imports and transfers from ROC of intermediate products in the international and domestic markets. Increasing the transfer to ROC stimulates the increase in imports and transfers from ROC, resulting in the GDP increase effect being smaller than the reduction effect.

The substitution relationship between Shanghai's import demand and transfer from ROC has led to a weak effect of increasing import on Shanghai's economic growth. Increasing import leads to a decrease in transfers from ROC, and the impact of GDP increase and decrease is hedged, and the effect on real GDP growth is weak. The impact of increased imports on major industries is relatively weak. Shanghai's transfer from ROC has a substitution relationship with import demand, but the transfer from ROC has a more significant impact on Shanghai's GDP than import. Increasing the transfer from ROC has a positive effect on other GDP items. It leads to a decrease in imports, resulting in a GDP increase effect more significant than a decreasing impact and a positive impact on real GDP growth.

In conclusion, from the perspective of supply-side driving forces from 2021 to 2015, increasing total factor productivity is the most influential driving force for Shanghai's economic growth, followed by increasing labor input, and third, increasing fixed capital input. From the perspective of demand-side pulling power, the order of the role of pulling Shanghai's economic growth is the transfer from ROC, investment, import, and export. In contrast, the role of transfer to ROC and household consumption is harmful. Due to the substitution relationship between Shanghai's export to ROW and transfer to ROC, import from ROW, and transfer from ROC, the export to ROC and household consumption that hurts Shanghai's economic growth but have a positive effect on ROC and driving the economic growth of ROC.

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Appendix Table 1(%)

	Scenario A: Impact of COVID-9					ScenarioB1: Impact of Labour Input				
	2021	2022	2023	2024	2025	2021	2022	2023	2024	2025
Real GDP	-3.11	-3.17	-3.23	-3.29	-3.35	0.51	1.02	1.55	2.08	2.63
Nominal GDP	0.84	0.75	0.65	0.54	0.44	-0.07	-0.11	-0.13	-0.13	-0.09
GDP deflator	4.08	4.04	4.01	3.96	3.92	-0.57	-1.13	-1.66	-2.16	-2.65
Real household consumption	-1.10	-1.01	-0.91	-0.82	-0.72	0.01	0.05	0.11	0.20	0.30
Real gov. consumption	-1.33	-1.35	-1.37	-1.38	-1.39	0.37	0.74	1.13	1.52	1.92
Real investment	-2.85	-3.00	-3.16	-3.33	-3.50	0.12	0.25	0.37	0.50	0.63
Real export to ROC	-4.37	-4.44	-4.51	-4.58	-4.64	0.47	0.95	1.45	1.95	2.46
Real export to ROW	-4.45	-4.55	-4.64	-4.74	-4.83	0.38	0.76	1.15	1.54	1.93
Real import from ROC	-3.35	-3.40	-3.46	-3.51	-3.56	0.25	0.51	0.78	1.05	1.33
Real import from ROW	-3.02	-3.08	-3.13	-3.19	-3.24	0.24	0.48	0.73	0.98	1.24
Agriculture	-4.42	-4.51	-4.60	-4.68	-4.77	0.80	1.63	2.47	3.34	4.22
Manufacturing	-4.53	-4.63	-4.73	-4.83	-4.93	0.32	0.64	0.96	1.28	1.60
Water, power & gas	-0.39	-0.37	-0.35	-0.33	-0.30	0.37	0.74	1.13	1.52	1.91
Construction	-6.24	-6.57	-6.92	-7.30	-7.69	0.23	0.48	0.73	1.00	1.28
Wholesale & retail	-6.39	-6.46	-6.52	-6.58	-6.63	0.66	1.32	1.99	2.65	3.31
Transportation	-6.53	-6.64	-6.75	-6.86	-6.96	0.50	1.02	1.55	2.10	2.66
Hotel and Catering	-10.72	-10.85	-10.98	-11.13	-11.28	0.56	1.13	1.71	2.30	2.91
Information & software	1.52	1.51	1.51	1.51	1.51	0.70	1.41	2.11	2.81	3.50
Finance & insurance	-0.18	-0.26	-0.33	-0.39	-0.45	0.50	0.99	1.49	1.97	2.46
Real estate	-3.15	-3.30	-3.45	-3.59	-3.73	0.39	0.78	1.17	1.55	1.93
Leasing & business services	-3.40	-3.45	-3.49	-3.52	-3.55	0.63	1.27	1.92	2.58	3.26
Residential services	-3.31	-3.34	-3.37	-3.40	-3.43	0.88	1.79	2.71	3.65	4.62
Social services	-3.12	-3.15	-3.18	-3.21	-3.23	0.80	1.61	2.43	3.27	4.12
Public service	-1.78	-1.78	-1.78	-1.78	-1.78	0.65	1.31	1.98	2.65	3.33

Appendix Table 2(%)

	ScenarioB2: Impact of Fixed Capital					Scenario B3: Impact of TFP				
	2021	2022	2023	2024	2025	2021	2022	2023	2024	2025
Real GDP	-0.04	-0.04	-0.01	0.06	0.16	0.95	1.91	2.90	3.92	4.96
Nominal GDP	0.08	0.16	0.23	0.30	0.37	-0.10	-0.16	-0.18	-0.15	-0.07
GDP deflator	0.12	0.20	0.24	0.24	0.21	-1.04	-2.04	-2.99	-3.91	-4.79
Real household consumption	0.04	0.07	0.12	0.17	0.22	0.06	0.16	0.30	0.48	0.70
Real gov. consumption	-0.04	-0.06	-0.07	-0.07	-0.05	0.51	1.03	1.56	2.10	2.65

Real investment	0.95	1.91	2.88	3.86	4.85	0.24	0.48	0.71	0.96	1.20
Real export to ROC	-0.02	-0.01	0.04	0.11	0.22	0.86	1.74	2.65	3.57	4.52
Real export to ROW	-0.06	-0.08	-0.07	-0.02	0.04	0.71	1.44	2.19	2.95	3.73
Real import from ROC	0.24	0.50	0.77	1.06	1.36	0.44	0.89	1.35	1.82	2.30
Real import from ROW	0.11	0.23	0.37	0.54	0.71	0.45	0.91	1.39	1.87	2.36
Agriculture	-0.06	-0.10	-0.11	-0.09	-0.04	1.11	2.24	3.41	4.61	5.85
Manufacturing	-0.05	-0.07	-0.07	-0.03	0.04	0.64	1.29	1.95	2.63	3.31
Water, power & gas	-0.01	0.02	0.11	0.25	0.42	0.91	1.85	2.84	3.86	4.92
Construction	0.74	1.50	2.28	3.07	3.87	0.40	0.81	1.24	1.69	2.16
Wholesale & retail	-0.08	-0.11	-0.08	-0.01	0.09	1.20	2.41	3.63	4.86	6.09
Transportation	-0.07	-0.10	-0.11	-0.10	-0.06	0.81	1.64	2.49	3.36	4.26
Hotel and Catering	-0.12	-0.21	-0.26	-0.29	-0.30	0.88	1.78	2.68	3.61	4.55
Information & software	0.01	0.07	0.16	0.28	0.43	1.21	2.42	3.63	4.84	6.05
Finance & insurance	-0.04	-0.01	0.07	0.21	0.39	1.16	2.32	3.49	4.67	5.85
Real estate	0.18	0.43	0.73	1.08	1.47	1.13	2.27	3.43	4.61	5.80
Leasing & business services	-0.05	-0.07	-0.04	0.02	0.12	1.07	2.16	3.27	4.40	5.55
Residential services	-0.09	-0.15	-0.18	-0.17	-0.15	1.24	2.51	3.80	5.12	6.47
Social services	-0.04	-0.04	-0.03	0.01	0.07	1.12	2.25	3.39	4.55	5.73
Public service	-0.05	-0.07	-0.08	-0.06	-0.03	0.86	1.73	2.60	3.49	4.38

Appendix Table 3(%)

	Scenario C1: Impact of Household Consumption					Scenario C2: Impact of Investment				
	2021	2022	2023	2024	2025	2021	2022	2023	2024	2025
Real GDP	-0.02	-0.05	-0.07	-0.10	-0.13	0.03	0.03	0.05	0.07	0.15
Nominal GDP	-0.36	-0.72	-1.09	-1.46	-1.84	0.07	0.13	0.18	0.24	0.29
GDP deflator	-0.33	-0.67	-1.02	-1.36	-1.71	0.10	0.15	0.18	0.17	0.14
Real household consumption	0.97	1.95	2.93	3.92	4.91	0.03	0.05	0.09	0.12	0.16
Real gov. consumption	-0.06	-0.13	-0.19	-0.26	-0.33	-0.03	-0.05	-0.06	-0.05	-0.04
Real investment	0.00	0.00	0.00	0.00	0.00	0.79	1.60	2.43	3.27	4.13
Real export to ROC	-0.04	-0.08	-0.12	-0.16	-0.20	-0.02	-0.01	0.03	0.10	0.19
Real export to ROW	-0.06	-0.11	-0.17	-0.23	-0.29	-0.04	-0.06	-0.05	-0.01	0.04
Real import from ROC	0.21	0.43	0.68	0.94	1.22	0.19	0.40	0.61	0.84	1.08
Real import from ROW	0.20	0.42	0.65	0.91	1.19	0.08	0.18	0.30	0.43	0.57
Agriculture	0.32	0.66	1.02	1.40	1.80	-0.05	-0.08	-0.08	-0.06	-0.02
Manufacturing	-0.06	-0.11	-0.17	-0.23	-0.29	-0.04	-0.06	-0.05	-0.02	0.04
Water, power & gas	0.12	0.24	0.36	0.48	0.60	-0.01	0.02	0.09	0.20	0.35
Construction	0.02	0.04	0.06	0.09	0.11	0.61	1.25	1.90	2.56	3.24
Wholesale & retail	-0.08	-0.15	-0.23	-0.30	-0.37	-0.06	-0.08	-0.06	0.00	0.09
Transportation	-0.06	-0.12	-0.19	-0.26	-0.33	-0.05	-0.08	-0.08	-0.07	-0.04
Hotel and Catering	-0.08	-0.16	-0.24	-0.33	-0.42	-0.10	-0.16	-0.21	-0.23	-0.23
Information & software	-0.05	-0.10	-0.15	-0.20	-0.25	0.01	0.06	0.13	0.23	0.35
Finance & insurance	0.07	0.14	0.21	0.27	0.33	-0.03	-0.01	0.06	0.17	0.32
Real estate	0.03	0.07	0.10	0.14	0.18	0.15	0.35	0.60	0.88	1.21
Leasing & business services	0.09	0.18	0.27	0.36	0.45	-0.04	-0.05	-0.03	0.02	0.10
Residential services	0.14	0.28	0.44	0.60	0.78	-0.07	-0.12	-0.14	-0.13	-0.11
Social services	0.03	0.06	0.09	0.12	0.14	-0.03	-0.03	-0.02	0.02	0.07
Public service	-0.03	-0.05	-0.07	-0.09	-0.10	-0.04	-0.06	-0.06	-0.05	-0.02

Appendix Table 4(%)

	Scenario C3: Impact of Export to ROW					Scenario C4: Impact of Transfer to ROC				
	2021	2022	2023	2024	2025	2021	2022	2023	2024	2025
Real GDP	0.00	0.00	0.00	0.00	0.00	-0.03	-0.07	-0.11	-0.17	-0.24
Nominal GDP	0.13	0.24	0.33	0.42	0.49	0.62	1.24	1.84	2.44	3.03
GDP deflator	0.13	0.24	0.34	0.42	0.48	0.65	1.30	1.96	2.62	3.28

Real household consumption	0.09	0.17	0.24	0.30	0.35	0.49	0.97	1.45	1.91	2.37
Real gov. consumption	0.00	0.00	0.01	0.01	0.02	0.00	0.01	0.03	0.04	0.07
Real investment	-0.03	-0.05	-0.07	-0.09	-0.11	-0.07	-0.15	-0.23	-0.32	-0.41
Real export to ROC	0.02	0.03	0.04	0.05	0.05	0.12	0.23	0.33	0.42	0.50
Real export to ROW	0.25	0.49	0.74	0.97	1.21	0.05	0.09	0.13	0.16	0.18
Real import from ROC	0.07	0.14	0.20	0.26	0.30	0.23	0.47	0.70	0.94	1.18
Real import from ROW	0.09	0.17	0.24	0.31	0.37	0.22	0.45	0.68	0.91	1.14
Agriculture	0.03	0.06	0.09	0.12	0.15	-0.06	-0.13	-0.22	-0.33	-0.46
Manufacturing	0.16	0.32	0.47	0.62	0.75	0.20	0.39	0.58	0.77	0.96
Water, power & gas	0.01	0.02	0.02	0.02	0.02	0.06	0.10	0.13	0.14	0.14
Construction	-0.04	-0.07	-0.10	-0.13	-0.16	-0.02	-0.06	-0.12	-0.19	-0.27
Wholesale & retail	-0.02	-0.04	-0.05	-0.06	-0.07	-0.07	-0.14	-0.21	-0.28	-0.34
Transportation	-0.05	-0.09	-0.14	-0.17	-0.21	0.23	0.44	0.63	0.81	0.97
Hotel and Catering	-0.08	-0.16	-0.22	-0.28	-0.33	0.28	0.54	0.78	1.01	1.22
Information & software	-0.09	-0.18	-0.25	-0.31	-0.37	-0.09	-0.17	-0.24	-0.31	-0.37
Finance & insurance	-0.05	-0.09	-0.13	-0.17	-0.20	-0.07	-0.14	-0.20	-0.26	-0.32
Real estate	-0.05	-0.09	-0.12	-0.15	-0.18	-0.19	-0.38	-0.56	-0.74	-0.91
Leasing & business services	-0.02	-0.05	-0.07	-0.09	-0.10	-0.01	-0.03	-0.06	-0.09	-0.13
Residential services	-0.04	-0.09	-0.12	-0.15	-0.18	-0.21	-0.43	-0.65	-0.87	-1.10
Social services	-0.05	-0.09	-0.12	-0.15	-0.17	-0.10	-0.21	-0.31	-0.40	-0.50
Public service	-0.03	-0.06	-0.09	-0.11	-0.12	-0.19	-0.36	-0.53	-0.70	-0.85

Appendix Table 5(%)

	Scenario D1: Impact of Import from ROW					Scenario D2: Impact of Transfer from ROC				
	2021	2022	2023	2024	2025	2021	2022	2023	2024	2025
Real GDP	0.00	0.01	0.01	0.01	0.01	0.10	0.19	0.29	0.39	0.49
Nominal GDP	0.04	0.07	0.10	0.13	0.15	0.13	0.25	0.35	0.46	0.55
GDP deflator	0.03	0.07	0.09	0.12	0.14	0.03	0.05	0.06	0.07	0.06
Real household consumption	0.06	0.12	0.17	0.22	0.27	0.08	0.15	0.22	0.29	0.36
Real gov. consumption	0.02	0.05	0.07	0.09	0.12	0.02	0.04	0.06	0.08	0.10
Real investment	0.01	0.02	0.04	0.05	0.06	0.04	0.09	0.13	0.18	0.22
Real export to ROC	0.01	0.02	0.03	0.04	0.04	0.01	0.03	0.04	0.06	0.07
Real export to ROW	0.02	0.05	0.07	0.10	0.12	0.02	0.05	0.08	0.10	0.13
Real import from ROC	-0.03	-0.05	-0.08	-0.10	-0.13	0.02	0.03	0.05	0.06	0.08
Real import from ROW	0.11	0.22	0.33	0.43	0.54	-0.03	-0.07	-0.10	-0.13	-0.16
Agriculture	-0.01	-0.02	-0.03	-0.04	-0.05	-0.01	-0.02	-0.03	-0.03	-0.04
Manufacturing	0.03	0.06	0.10	0.13	0.16	0.03	0.06	0.09	0.12	0.15
Water, power & gas	0.02	0.03	0.05	0.06	0.08	0.00	-0.01	-0.01	-0.01	-0.01
Construction	0.02	0.04	0.06	0.08	0.10	0.02	0.05	0.07	0.09	0.11
Wholesale & retail	-0.02	-0.04	-0.06	-0.08	-0.09	0.00	0.00	0.00	0.00	0.00
Transportation	0.01	0.01	0.02	0.02	0.03	0.03	0.06	0.09	0.12	0.14
Hotel and Catering	0.00	0.00	0.01	0.01	0.01	0.03	0.05	0.08	0.11	0.14
Information & software	-0.02	-0.03	-0.04	-0.05	-0.06	-0.02	-0.04	-0.05	-0.06	-0.06
Finance & insurance	-0.01	-0.02	-0.02	-0.03	-0.03	-0.02	-0.03	-0.04	-0.04	-0.04
Real estate	-0.01	-0.01	-0.01	-0.01	-0.01	-0.03	-0.05	-0.08	-0.09	-0.10
Leasing & business services	0.00	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.03	-0.03	-0.04
Residential services	0.00	0.01	0.01	0.02	0.03	-0.05	-0.10	-0.15	-0.20	-0.25
Social services	-0.01	-0.03	-0.04	-0.05	-0.06	-0.01	-0.02	-0.03	-0.03	-0.04
Public service	-0.01	-0.02	-0.03	-0.03	-0.04	0.00	0.00	0.00	0.01	0.01