The Effect of COVID-19 on the Service Sector Performance

the role of the persistency of the impact of the shock on the service sector

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Catalog

Part 1 :Introduction

Background

In mid January, the COVID-19 broke out in Wuhan and Hubei and spread to the whole country. Compared with SARS in 2003, the spread of the epidemic is larger and the number of cases is greater. It is expected that the short-term impact on the economy will be greater than during SARS.

- Supply Side: industrial production will be significantly under pressure;
- Demand Side: consumption growth will drop significantly, and investment in real estate development and manufacturing will be impacted.

Background

Due to measures such as closing cities and restricting travel, the service industry has been hit the hardest by the epidemic.

- The catering and accommodation industry was the hardest hit, with a growth rate of -45.7% expected in the first quarter, and about 70% of hotels in China closed in February.
- The transportation industry has also been hit hard, with an expected growth of -1% in the first quarter. From January 25 to February 14, 2020, a total of 283 million passengers were sent, with an average daily rate of 13.48 million, a year-on-year decrease of 82.3%.

Introduction

In this project, we aim to study the effect of the COVID-19 on Chinese service sector based on the evidence from a modified Overlapping Generation Model.

- Firstly, we shall estimate the share of capital and labor in three different industries using structral approaches.
- Then we will introduce the exogenous shock of the COVID-19 into the original economic growth model and discuss how industry economy will fluctuate accordingly.

Part 2 :Literature Review

Literature Review

Covid-19 and the macroeconomic effects of costly disasters.(Sydney C. Ludvigson et al,2020)

- This paper attempts to quantify the macroeconomic impact of Covid-19 in recent US.
- They found that the impact of this shock could last from six months to several years.

Literature Review

An Impact Path Analysis of COVID-19 Outbreak in China and Policy Response(Liu Shijin et al. May 2020)

- This paper analyzes the impact of the epidemic among different provinces.
- They discusses the impact on different industries, such as transportation and construction.

Literature Review

Georgieva, President of the International Monetary Fund, says that the most likely pattern in China's economy is "V-shaped" growth.

- The so-called "V-shaped" growth refers to the rapid recovery of economic activity after the decline.
- The overall impact of the epidemic on the Chinese economy is relatively controllable.

Question: Is our result consistent with the IMF's inference?

Part 3 :Model

Model: Utility

For each consumer at time period t, he or she considers the following utility maximization problem:

$$\begin{aligned} U_t &= ln(c_{1,t}) + \ ln(e_t) + \frac{1}{1+\rho}(ln(c_{2,t+1}) + ln(e_{t+1})) \\ \text{s.t.} \quad & c_{1,t} + p_t \ e_t + \frac{c_{2,t+1} + p_{t+1} \ e_{t+1}}{1+r_{t+1}} = w_t \end{aligned} \tag{1}$$

- $e_t(c_{1,t})$: consumption for service(non-service) goods at time period t
- p_t: price for service goods at time period t

Model:Three Production Sectors

Agricultural Sector(land and labor):

$$Y_{1,t} = (A_{1,t}N_{1,t})^{1-\alpha} L_{1,t}^{\alpha} \tag{2}$$

Solow Sector(labor and capital):

$$Y_{2,t} = (A_{2,t}N_{2,t})^{1-\beta} K_{2,t}^{\beta} \tag{3}$$

Service Sector(labor and capital):

$$Y_{3,t} = (A_{3,t}N_{3,t})^{1-\gamma} K_{3,t}^{\gamma} \tag{4}$$

Assumption

- Here, we assume the depreciation rate of capital is $\delta \in (0, 1)$.
- Growth of productivity level:

$$\frac{A_{1,t+1}}{A_{1,t}} = \frac{A_{2,t+1}}{A_{2,t}} = \frac{A_{3,t+1}}{A_{3,t}} = 1 + g \tag{5}$$

- Growth of population:

$$N_{t+1} = (1 + n)N_t \tag{6}$$

Competitive Equilibrium

- Utility maximization
- Profit maximization
- Market equilibrium

Utility Maximization

To solve (1), we construct Lagrange multiplier function and use first order condition:

$$c_{1,t} = \frac{1+\rho}{2(2+\rho)} w_t, \tag{7}$$

$$p_t e_{1,t} = \frac{1+\rho}{2(2+\rho)} w_t \tag{8}$$

$$\frac{c_{2,t+1}}{1+r_{t+1}} = \frac{1}{2(2+\rho)} w_t \tag{9}$$

$$\frac{p_{t+1} e_{2,t+1}}{1+r_{t+1}} = \frac{1}{2(2+\rho)} w_t, \quad S_t = \frac{1}{1+\rho} w_t \tag{10}$$

Profit Maximization in Agricultural Sector

To solve (2), we use first order condition:

$$Y_{1,t} = (A_{1,t}N_{1,t})^{1-\alpha}L_{1,t}^{\alpha}$$

$$(1-\alpha)A_{1,t}^{1-\alpha}N_{1,t}^{-\alpha}L^{\alpha} = w_t \tag{11}$$

$$\alpha(A_{1,t}N_{1,t})^{1-\alpha}L_{1,t}^{\alpha-1} = r_{Land} \tag{12}$$

Profit Maximization in Industrial Sector

To solve (3), we use first order condition:

$$Y_{2,t} = (A_{2,t}N_{2,t})^{1-\beta}K_{2,t}^{\beta}$$

$$(1-\beta)A_{2,t}^{1-\beta}N_{2,t}^{-\beta}K_{2,t}^{\beta} = w_t \tag{13}$$

$$\beta A_{2,t}^{1-\beta}N_{2,t}^{1-\beta}K_{2,t}^{\beta-1} = \delta + r_t \tag{14}$$

Profit Maximization in Service Sector

To solve (4), we use first order condition:

$$Y_{3,t} = (A_{3,t}N_{3,t})^{1-\gamma}K_{3,t}^{\gamma}$$

$$\text{Profit} = p_t(A_{3,t}N_{3,t})^{1-\gamma}K_{3,t}^{\gamma} - (\delta + r_t)K_{3,t} - w_t N_{3,t}$$

$$p_t\gamma(A_{3,t}N_{3,t})^{1-\gamma} \times K_{3,t}^{\gamma-1} = \delta + r_t \tag{15}$$

$$p_t(1-\gamma)A_{3,t}^{1-\gamma}N_{3,t}^{-\gamma}K_{3,t}^{\gamma} = w_t \tag{16}$$

Market Equilibrium Condition

- Labor market

$$N_t = N_{1,t} + N_{2,t} + N_{3,t} \tag{17}$$

- Capital market

$$K_t = K_{2,t} + K_{3,t} \tag{18}$$

$$K_{t+1} = S_t N_t = N_t \frac{1}{2+\rho} w_t \tag{19}$$

- Service market

$$N_t e_t = Y_{3,t} \tag{20}$$

Part 4 :Estimation & Results

Estimation Results

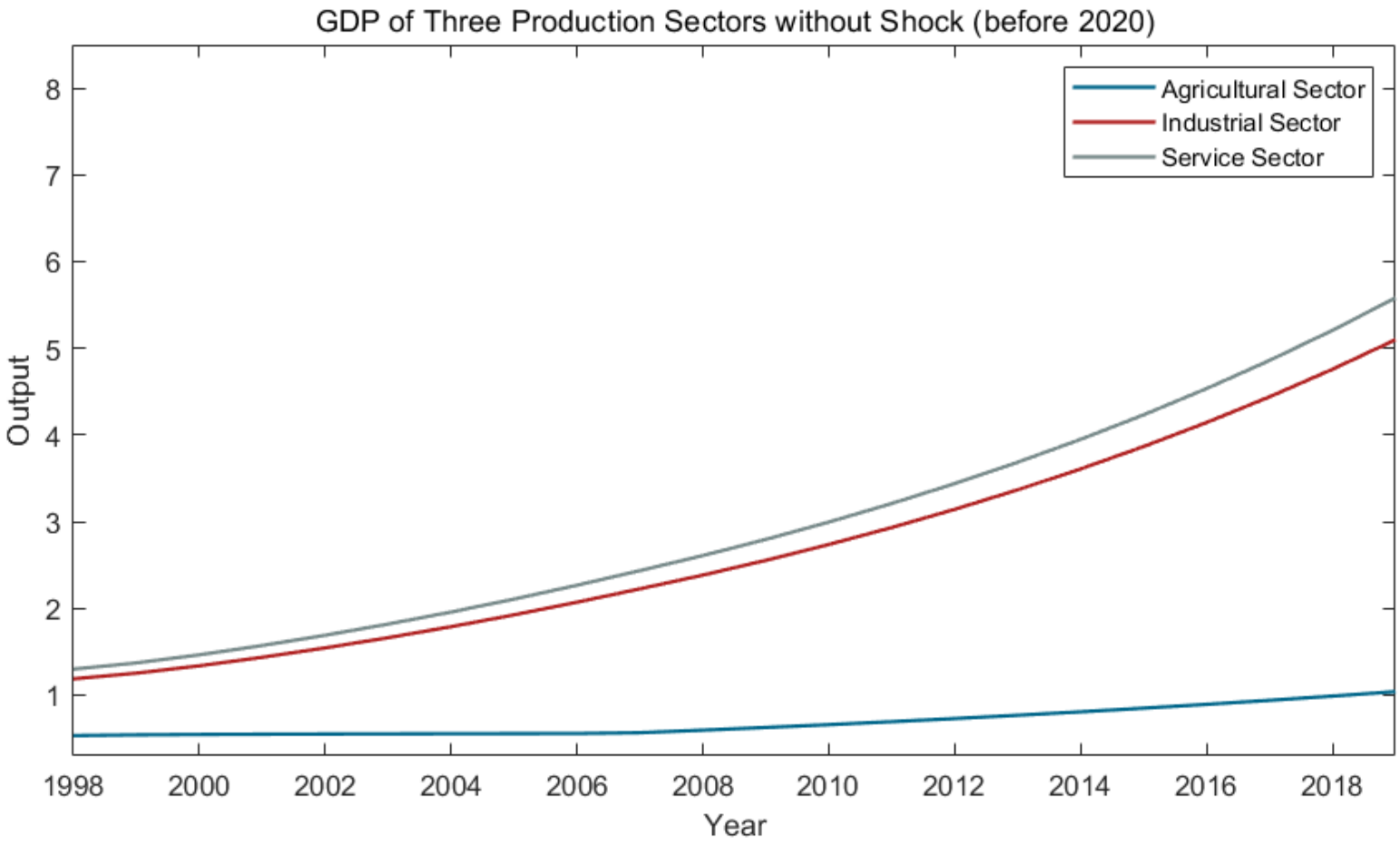
Our estimation strategy is to use the average percentages of the output of three sectors in a period to match the real data.
The estimates of α, β, and γ are:

```
param_estimated =

    0.2672    0.1420    0.5837
```

Estimation Results

Then we use the estimated parameters to simulate the growth model:



Estimation Results

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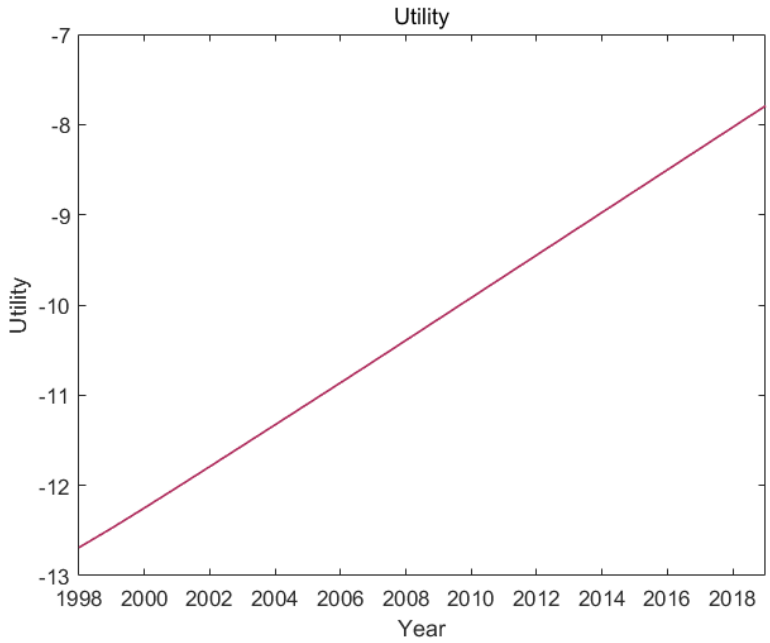
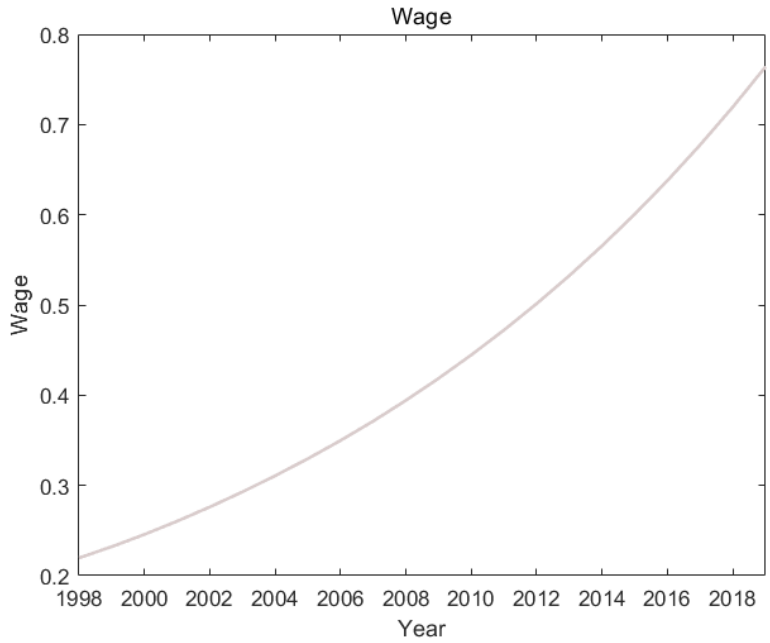


(a)



(b)

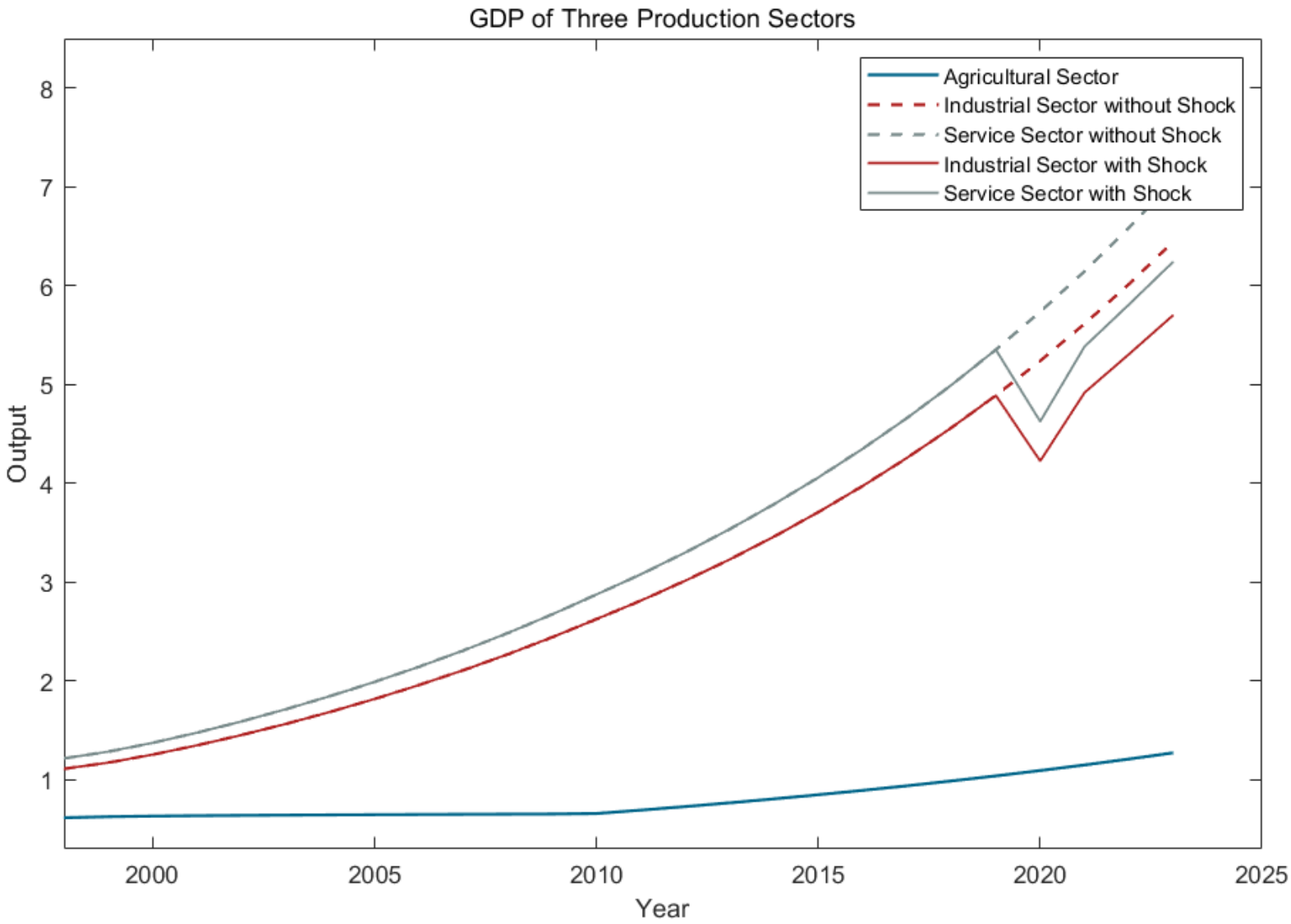
External shock on service and industrial sector

We aim to analyze the impact of the COVID-19 shock on economy, and we will discuss the effect under three different circumstances.

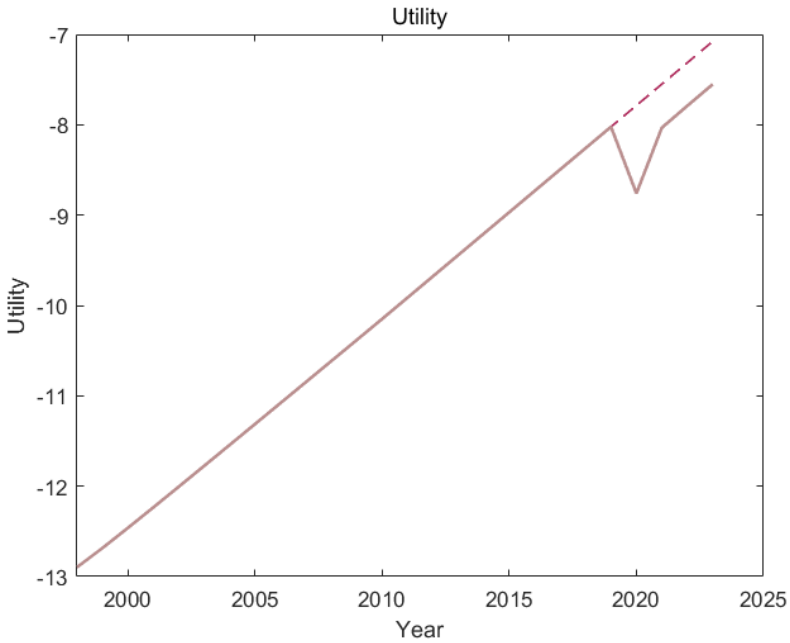
- The effect lasts for ONE year.
- The effect lasts for TWO years.
- The effect lasts for THREE years.

We introduce the external shock to the technololy productivity of service sector and industrial sector. The shock on service sector is heavier than that on industrial sector.

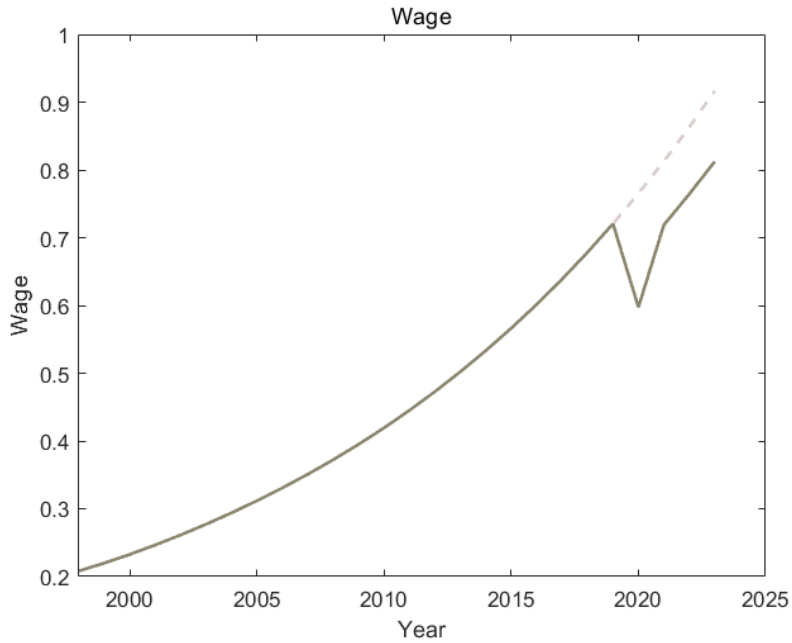
The effect lasts for ONE year.



The effect lasts for ONE year.

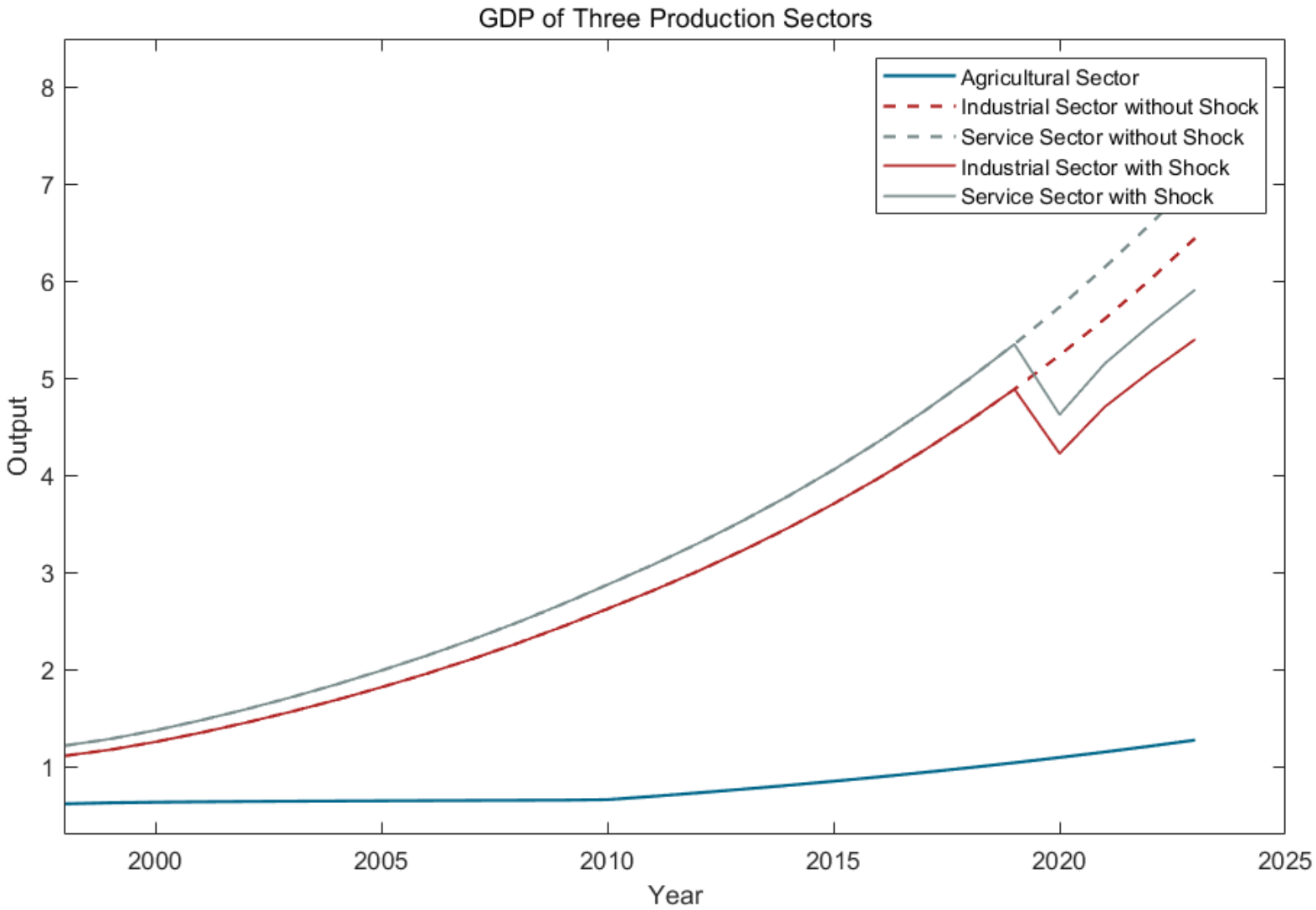


(c)

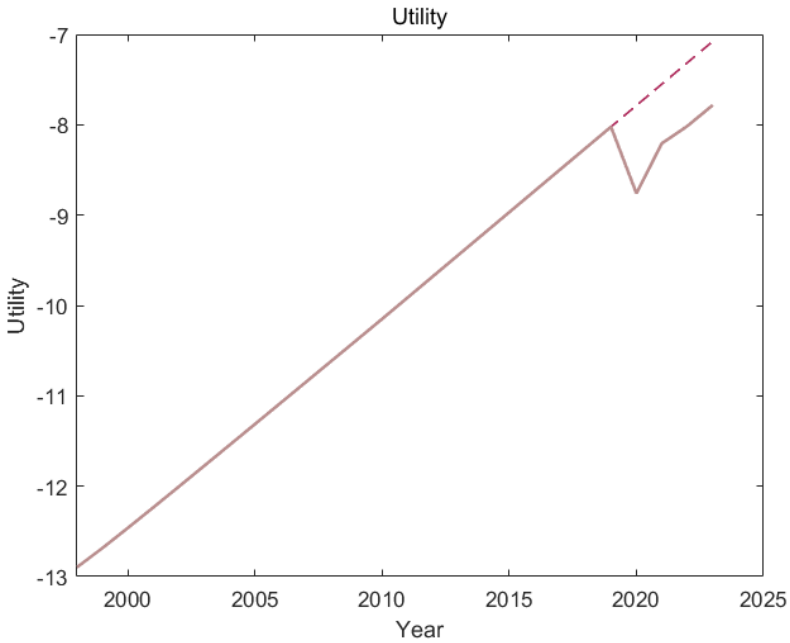


(d)

The effect lasts for TWO years.



The effect lasts for TWO years.



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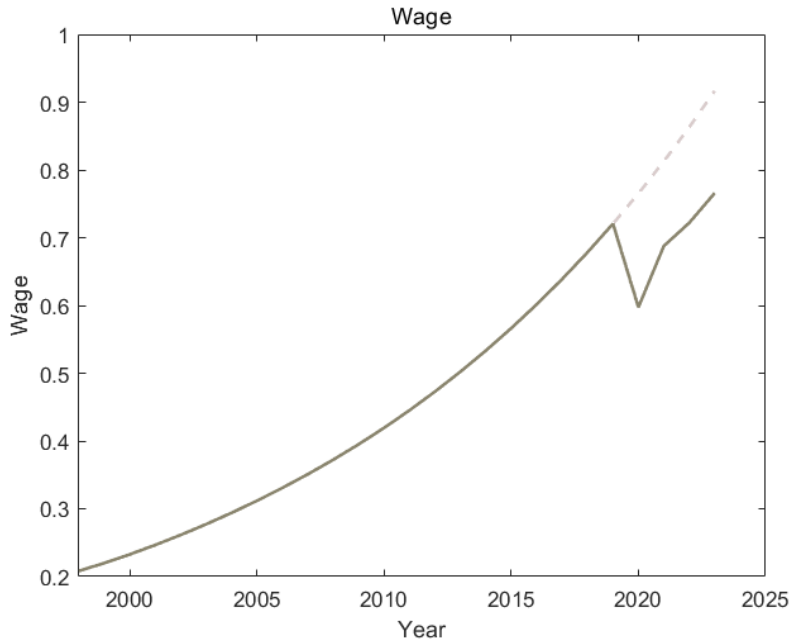
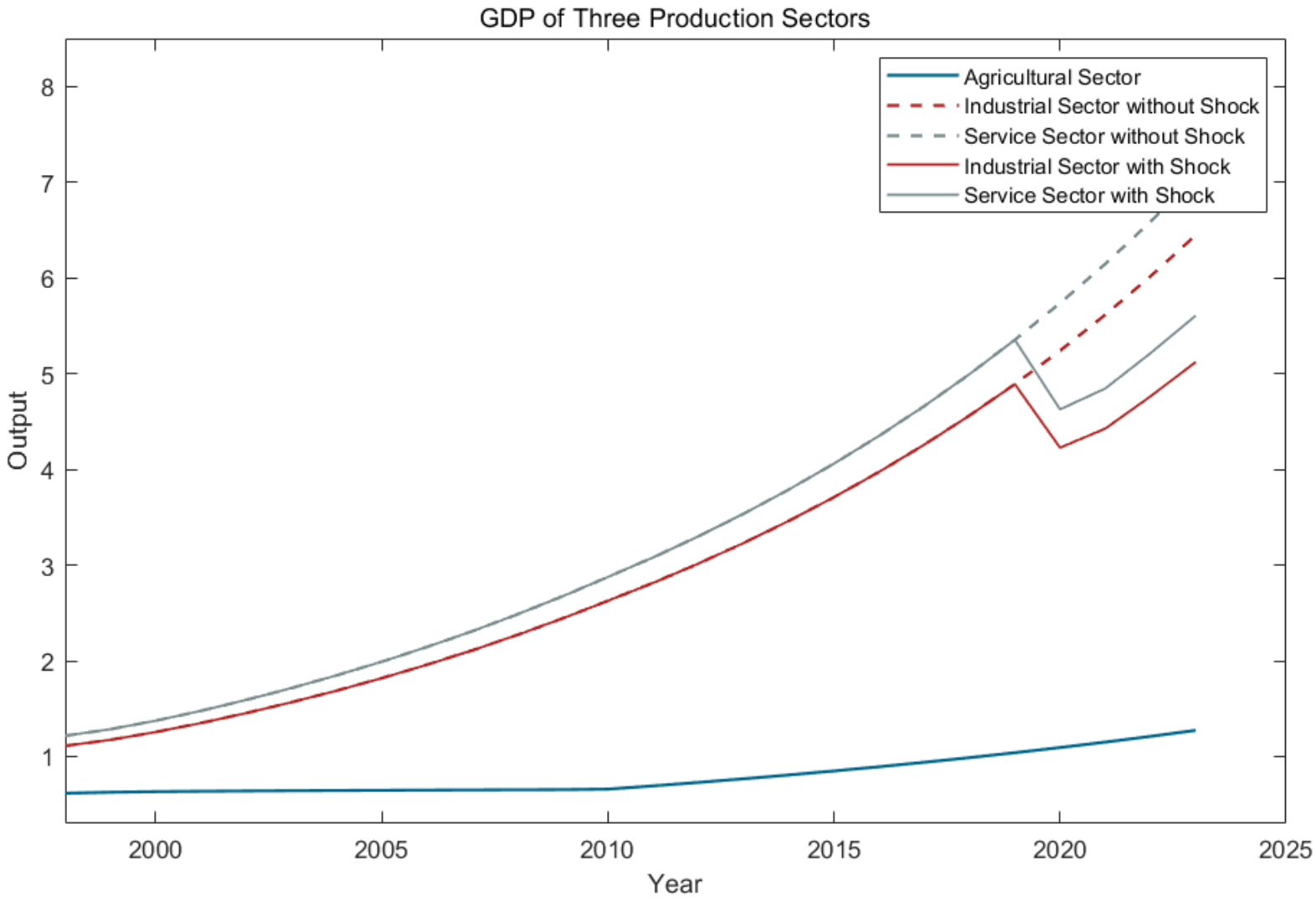
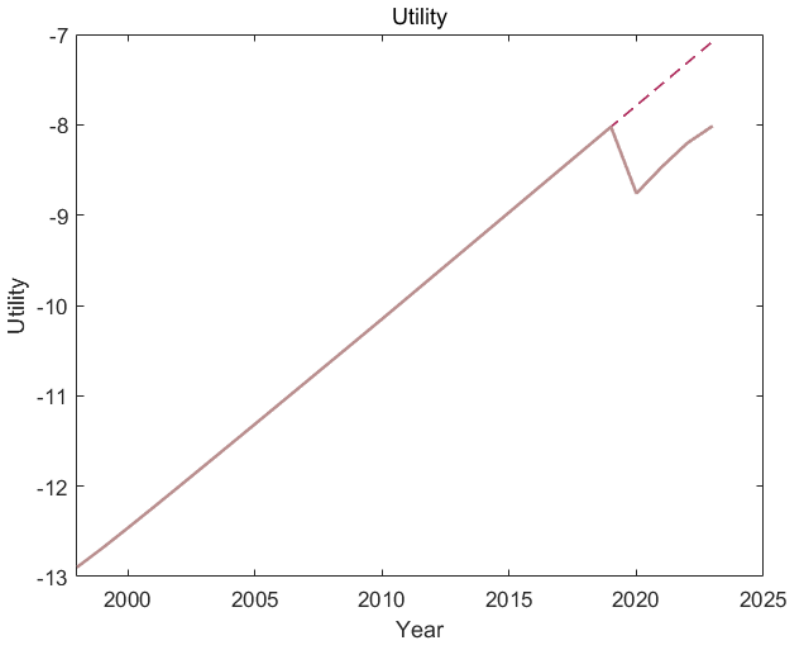


(f)

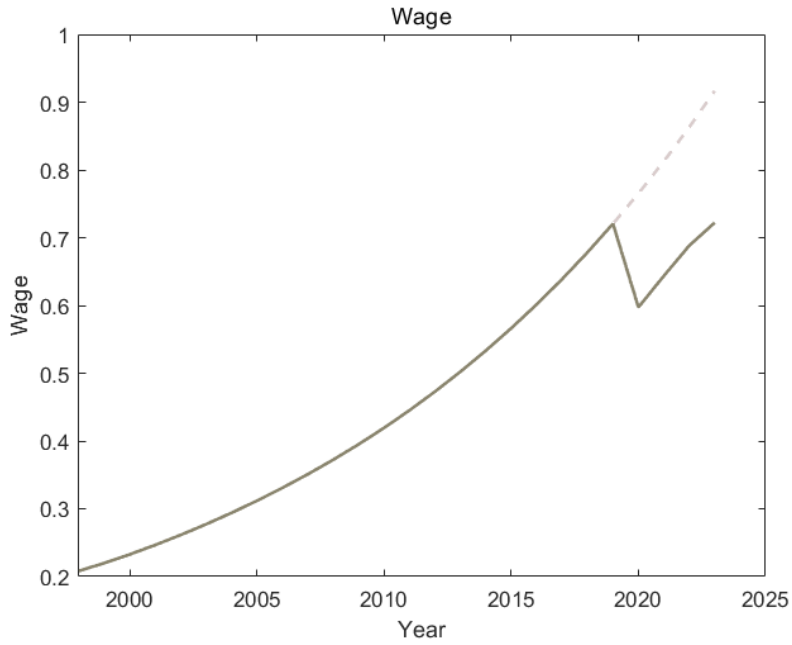
The effect lasts for THREE years.



The effect lasts for THREE years.



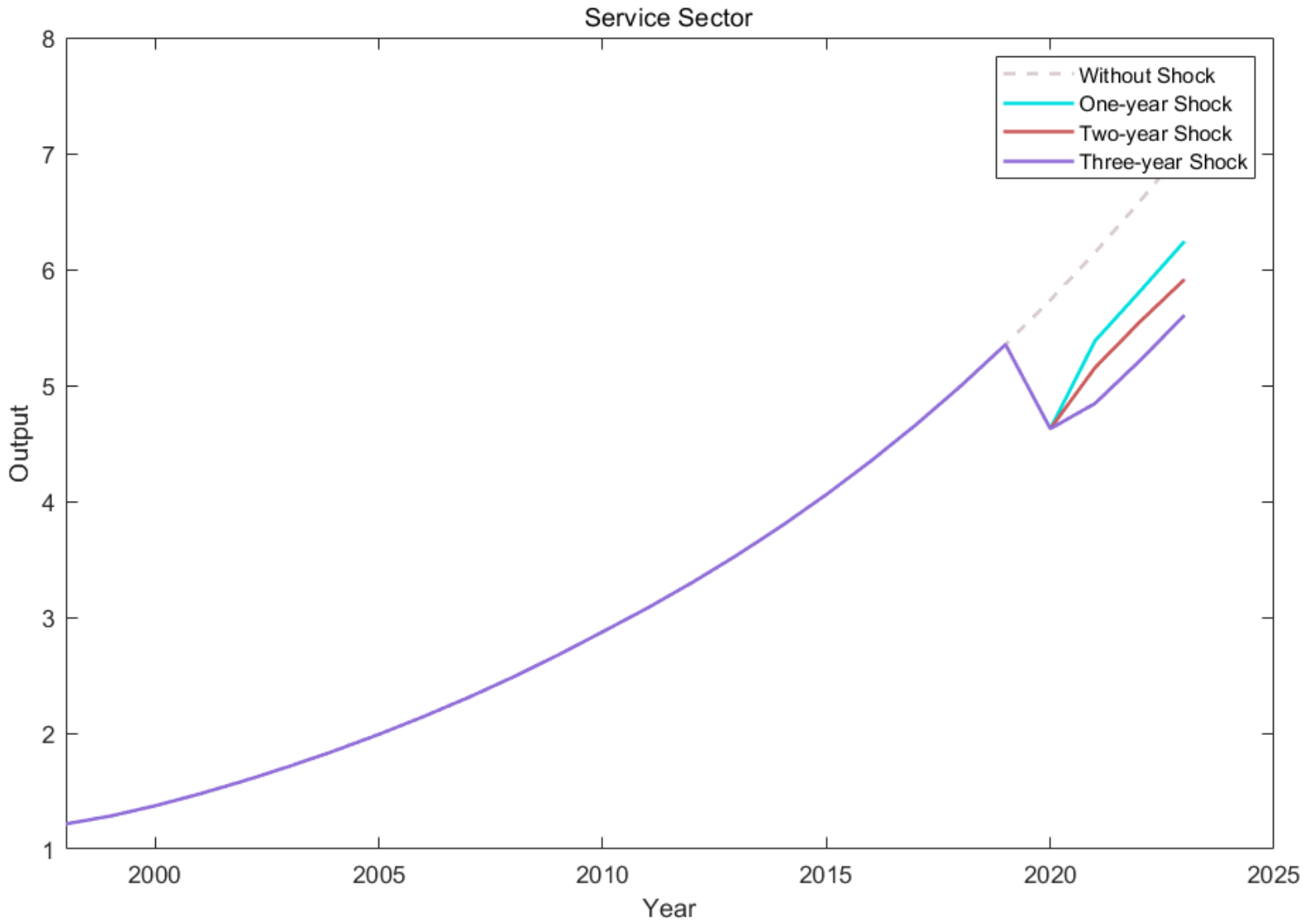
(g)



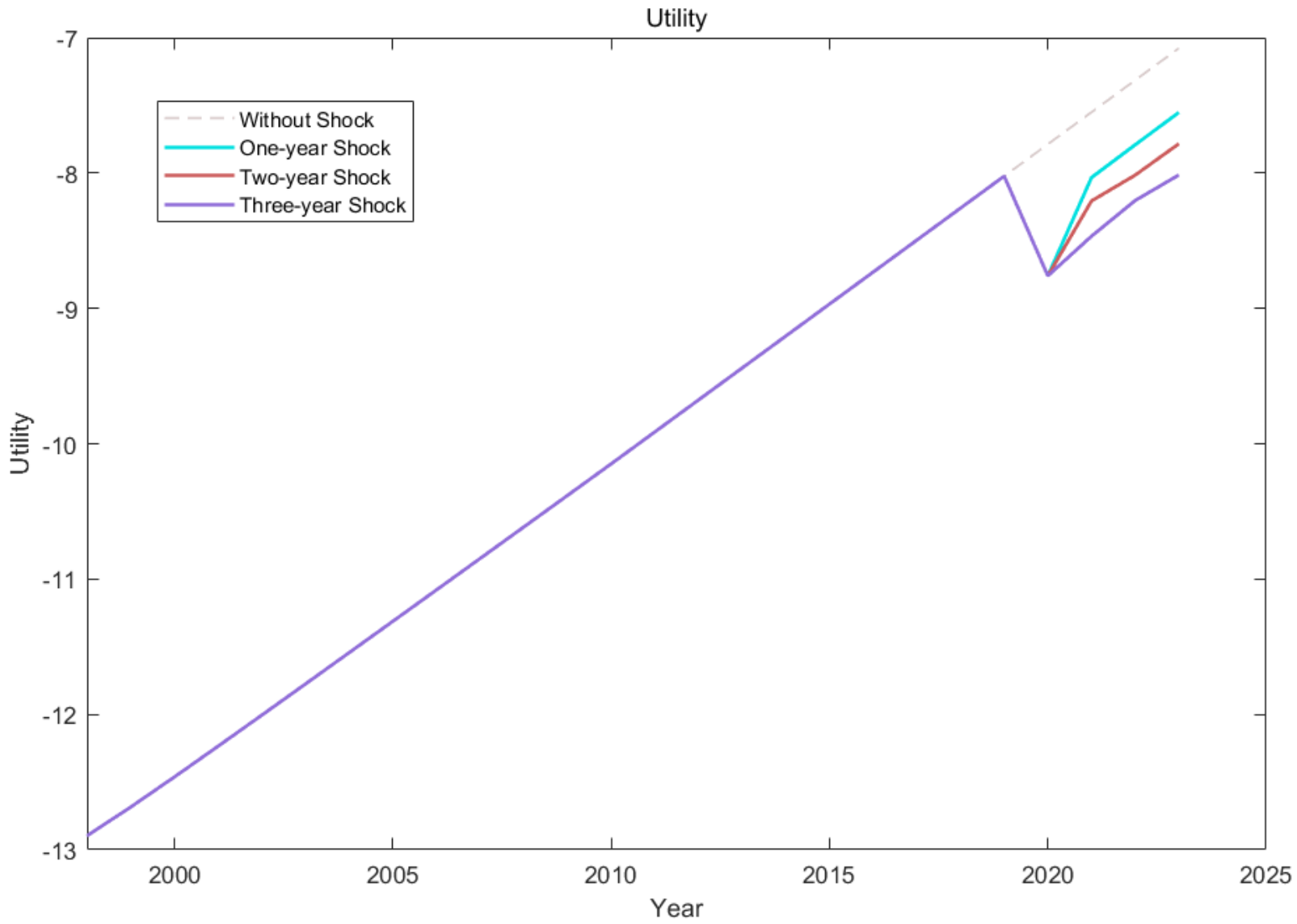
(h)

Part 5 :Conclusion

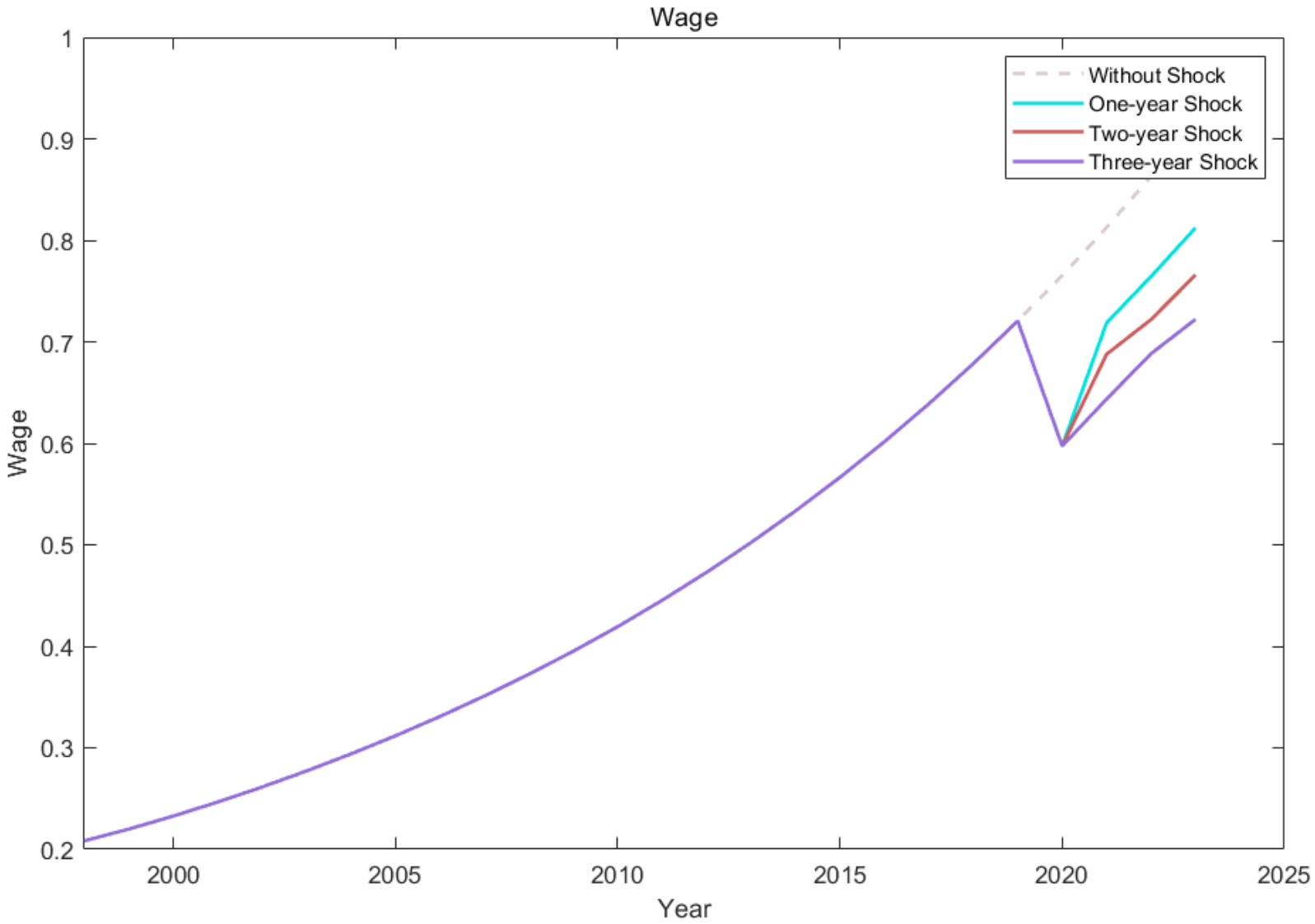
Comparison of Three Circumstances: Service Sector



Comparison of Three Circumstances: Utility



Comparison of Three Circumstances: Wage



Conclusion

- The epidemic has an impact on the economy, causing negative effects not only on production, but also on utility and wage.
- The severity of the epidemic depends on the persistency of the shock on economy.
- No matter how long the impact of the epidemic lasts, China's economy will follow its growth pattern before epidemic.

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Thank You.