Analysis of the Influence of the Tax Cuts and Jobs Act on Electricity Demand in China and the United States: based on GTAP-Dyn Model

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Abstract. The GTAP-Dyn model was used to study the impact of the tax cuts and jobs act on the economic structure and electricity demand in China and the United States. According to the main content of the Tax Cuts and Jobs Act, the main products of trade friction, and the major countries participating in the tax cuts, three policy scenarios including US tax reform, trade barriers, and competitive tax cuts were designed. The results show that Countries competing for tax reduction benefit China's economic growth, industrial structure optimization and electricity intensity enhancement.

1. Introduction

On December 22, 2017, US President Trump signed the "Deduction of Taxes and Employment Act" program. This is the largest tax reduction legislation in the United States since the 1986 Tax Reform Act. The main means of this tax reform is to simplify the tax system, reduce household and corporate taxation, prevent the loss of capital and profits overseas, and expand the tax base and promote fairness. As the world's largest economy, the US's substantial tax cuts will have far-reaching effects on its homeland and other countries. It is of great significance to study the impact of the Trump tax reform and the possible global tax cuts on China's economy and electricity demand.

In terms of the impact of the Trump tax reform on China's economy, most studies believe that the negative impact is greater than the positive impact. First, it has a negative impact on Chinese investment. Trump's tax reduction policy will lead to changes in corporate investment decisions, not only stimulate local capital investment, but also attract a lot of international capital inflows, while taking employment opportunities, affecting the economic growth and government taxation[1]; Second, it will increase China's economic and financial risks, and increase the expectation of RMB depreciation due to China's capital outflow pressure [2]; Third, the border tax adjustment plan and high tariffs have a certain negative impact on China's foreign trade surplus [3]; Fourth, it brings greater uncertainty to the international trading system and the recovery of the world economy[4]. In terms of positive impact, income tax exemption stimulates US consumer demand and has a certain positive impact on China's goods exports to the US. However, considering Trump's policy of countering globalization, it is possible to reduce trade deficits through trade protection.

In response to the above different views and disputes, this paper uses quantitative analysis to measure the impact of Trump tax reform on economic growth, industrial structure and electricity demand in China and the US. We use the dynamic GTAP model and scenario analysis method to
measure effects of Trump tax reform, trade barrier and competing tax reduction scenario.

2. Data processing and GTAP simulation solution

In order to have a more scientific quantitative analysis of Trump's tax reform policy, this section builds three different policy simulation scenarios using a dynamic global trade analysis model (GTAP-Dyn model).

2.1 Research methods

The GTAP-Dyn model[5] is a general equilibrium model for dynamic recursive application of the world economy. It is extended from the standard GTAP model, a multi-country multi-sector general equilibrium model developed by Purdue University. In the GTAP model, a sub-model describing the behaviors of production, consumption, government expenditure in each country (or region) is first established, and then the sub-models are connected into a multi-country general equilibrium model by using the international trade flow relationship. When conducting policy simulations in this model structure, the impact of this policy on production, foreign trade, prices, factor remuneration, gross domestic product, and social welfare levels of various sectors of the country can be explored at the same time. The GTAP-Dyn model performs long-term policy simulation analysis by processing time variables of the standard GTAP model. This paper uses the GTAP-Dyn model to quantitatively analyze the impact of Trump's tax reform policy.

2.2 Data processing

This paper uses the latest GTAP-Dyn model and the ninth edition database, which is based on the social accounting matrix of each country in 2011, and contains 57 industrial sectors in 140 countries (regions). According to the research needs, 140 countries were divided into 7 regions using GTAPAgg9 software developed by Purdue University's Global Trade Research Center, and 57 industrial sectors were aggregated into 12 industrial sectors.

2.3 Policy simulation scenario design

According to the research purpose of this paper, four simulation scenarios are designed: baseline scenario, Trump tax reform scenario, trade barrier scenario and global tax reduction scenario. Considering that the effective period of corporate income tax in the Trump Tax Reform Act is permanent, the personal income tax is valid for 2018-2025, and the sample interval for dynamic simulation is set to 2018-2025.

1. Baseline scenario: The baseline scenario assumes that the original policies of all countries will continue to be implemented. The GTAP database is updated using a dynamic recursive method as follows: Since GDP is an endogenous variable in the model, the GDP is first converted to an exogenous variable; Secondly, according to the GDP and population growth assumptions under the autonomous emission reduction scenario in the 2018 Global Energy Analysis and Outlook published by the State Grid Energy Research Institute Co. Ltd., the exogenous variables such as GDP and population will be impacted year by year. The data will be calibrated by 2025 and a baseline scenario will be formed.

2. Trump tax change scenario: The focus of the Trump tax reform is to reduce corporate tax rates and personal income taxes. Under this scenario, the corporate income tax rate has dropped from 35% to 21%; the personal income tax rate has changed from the original seven-rate tax rate to the new seven-rate. Since the personal income tax rate of seven taxes is difficult to describe in detail, it is appropriately simplified. According to the tax reform plan, the average annual personal income tax reduction in 2018-2025 is about $30 billion, which means personal income tax rate is lowered by 2%.

3. US raises trade barriers scenario: The Trump tax reform will curb US exports and promote its imports, causing the trade deficit to widen, which is contrary to the US government's policy goal of reducing trade deficits. The US tends to increase trade barriers. This scenario is a superposition of Trump tax reform and trade barriers. Since China is the largest source of imports for the US and the
country with the largest deficit, the US trade barriers are mainly targeted at China's steel, chemical, metal products, paper products, rubber products, wood products, electromechanical, textile and clothing industries. On the basis of the Trump tax reform scenario, the tariffs on US imports of heavy industry, light industry and textile and apparel products from China are raised by 20%.

4. The global tax reduction scenario: Based on the Trump tax reform scenario, consider other countries competing for tax cuts. Under this scenario, Japan, the European Union, and China all adopt tax reduction measures. Considering the differences in tax structure between different countries, it is assumed that the Japanese corporate income tax rate will be lowered by 40%, the EU corporate income tax rate will be lowered by 20%, and the Chinese corporate income tax rate will be lowered by 10%, and consumption tax rate is lowered by 20%.

3. Policy simulation results and analysis

3.1 Impact on economy of China and the US

Trump tax change scenario: The Trump tax reform policy has a certain pulling effect on US economic growth. By 2025, the Trump tax reform will boost the US GDP growth rate by 0.50%. The cumulative pulling effect of US investment is 4.98%. The cumulative pulling effect of US imports is 1.09%. The Trump tax reform policy has a slight negative impact on China's economic growth. By 2025, it will reduce China's GDP growth rate by 0.09%. US will attract more investment, and Chinese investment will suffer. According to the results of the model, the growth rate of China's investment has dropped by 0.34% by 2025. The decline in domestic investment has caused China's imports to fall by 0.15%.

Trade barrier scenario: Compared with the Trump tax reform scenario, the policy scenarios in which the Trump tax reform and trade barriers are superimposed have weakened the US economic growth. By 2025, the superposition policy will boost the US GDP growth rate by 0.13%. Compared with the Trump tax reform scenario, the negative impact of the Trump tax reform and trade barrier superposition policy scenarios on the Chinese economy has increased. By 2025, China's GDP growth rate has dropped by 0.81%.

Competing tax reduction scenario: Compared with the Trump tax reform scenario, the global tax cuts will stimulate the global tax-reduction countries' investment, thus weakening the US tax reform's pulling effect. By 2025, the US GDP growth rate has increased by 0.21%, China's GDP growth rate has increased by 0.31%.

Table 1. The impact of the Trump tax reform scenario on the Sino-US economy (according to the cumulative change in the growth rate of the baseline scenario)

| 2025       | Trump tax reform scenario | Trade barrier scenario | Competing tax reduction scenario |
|------------|---------------------------|------------------------|---------------------------------|
|            | US    | China | US    | China | US    | China |
| GDP        | 0.50  | -0.09 | 0.13  | -0.81 | 0.21  | 0.31  |
| Consumption| 0.06  | 0.02  | -0.09 | -0.61 | 0.06  | 5.73  |
| Investment | 4.98  | -0.34 | 1.26  | -3.82 | 1.63  | 0.94  |
| Export     | -0.64 | 0.02  | -6.12 | -1.09 | -0.42 | -3.75 |
| Import     | 1.09  | -0.15 | -5.12 | -5.78 | 0.07  | 0.84  |

aData source: GTAP-Dyn model simulation results, the same below

3.2 Impact on China and the US industrial structure

Under the Trump tax reform scenario, the growth rate of heavy industry in the US will increase by 0.88 % from the baseline scenario by 2025 due to the impact of investment promotion and industrial resettlement policies. Due to the high energy consumption of heavy industry, the US electricity industry and public utilities are growing rapidly. By 2025, they will increase by 0.65 and 2.93 % respectively compared with the baseline scenario. Due to the suppression of domestic investment in China and the impact of the US industry's relocation, China's heavy industry and resources industry
are negatively affected, but the impact is relatively small. By 2025, they will decrease by 0.12% and 0.15% respectively. Due to the decline in the growth rate of high-energy industries, the growth rate of the electricity industry and utilities has been reduced. By 2025, the cumulative decline have been 0.08% and 0.32% respectively.

Under the trade barrier scenario, trade barriers have affected the export of US cereals and crops, livestock and meat products, and light industry, resulting in a decline in output growth in these industries. By 2025, they have decreased by 1.78%, 0.90%, and 0.86% respectively. As trade barriers have a greater impact on China's heavy industry and light industry, their output growth rate have declined. By 2025, they have decreased by 1.26% and 1.27% respectively. The drag of trade barriers on Chinese investment has led to a decline in the growth rate of utility output, which has fallen by 3.93%.

Under competing tax reduction scenario, the effect of the US tax reform policy has been weakened to a certain extent, and the pulling effect on US heavy industry has weakened. By 2025, it has fallen by 0.12% from the baseline scenario. China's industrial structure is optimized and upgraded. The growth rate of output of heavy industry, textile and garment industry, mining industry and light industry declined. The growth rate of output of food processing industry, transportation industry and public utilities increased by 1.48%, 1.32%, and 1.03% respectively.

Table 2. Changes in industrial structure between China and the US under the three policy scenarios (accumulated percentage points of cumulative growth rate relative to the baseline scenario)

| Number | Department                  | 2025 US | 2025 China | 2025 US | 2025 China | 2025 US | 2025 China |
|--------|-----------------------------|---------|------------|---------|------------|---------|------------|
| 1      | Grains and crops            | -0.54   | -0.01      | -1.78   | 1.16       | -0.38   | 0.38       |
| 2      | Livestock and meat products | -0.28   | -0.05      | -0.90   | 0.03       | -0.21   | 0.96       |
| 3      | mining industry             | 0.20    | -0.02      | 0.04    | 0.17       | -0.10   | -0.26      |
| 4      | Resource industry           | 0.60    | -0.15      | -0.33   | -0.20      | -0.28   | -0.75      |
| 5      | Food processing industry    | -0.11   | -0.03      | -0.66   | 0.41       | -0.19   | 1.48       |
| 6      | Textile and garment industry| -0.41   | -0.03      | 5.31    | 0.79       | 0.10    | -0.92      |
| 7      | light industry              | 0.14    | -0.03      | -0.86   | -1.26      | -0.46   | -0.12      |
| 8      | Heavy industry              | 0.88    | -0.12      | 0.80    | -1.27      | -0.12   | -1.13      |
| 9      | Electricity industry        | 0.65    | -0.08      | 0.44    | -1.02      | 0.46    | 0.32       |
| 10     | Utilities                   | 2.93    | -0.32      | 0.71    | -3.93      | 0.97    | 1.03       |
| 11     | Transportation industry     | 0.43    | -0.09      | -0.01   | -0.65      | 0.17    | 1.32       |
| 12     | Other service industry      | 0.34    | -0.05      | 0.23    | -0.64      | 0.31    | 0.46       |

3.3 Impact on electricity demand of China and the United States

Under the Trump tax reform scenario, the US's utilities, heavy industry, electricity industry, and resource industry have developed better and electricity demand has risen. By 2025, the growth rate of US electricity demand has increased by 0.65%. China's heavy industry and mineral resources industry have been negatively affected, which has a negative impact on China's electricity demand, but the impact is relatively small. By 2025, China's electricity demand growth rate has dropped by 0.08%.

Under the trade barrier scenario, output growth in the US cereals and crops, livestock and meat products, and light industry is affected. Under the overlapping situation of Trump tax reform and trade barriers, the pulling effect on heavy industry and public utilities is weaker than the Trump tax reform scenario. Therefore, the pulling effect on electricity consumption in the US has been weakened. By
2025, the growth rate of US electricity demand has increased by 0.44%. As trade barriers have a large negative impact on China's heavy industry and light industry, the growth rate of electricity demand has dropped significantly. By 2025, China's electricity demand growth rate has dropped by 1.02%.

Under competing tax reduction scenario, the pull on US heavy industry output has weakened. By 2025, the US electricity demand growth rate has increased by 0.46%. China's industrial structure optimization has accelerated, output growth has increased, and demand for electricity has increased. By 2025, China's electricity demand growth rate has increased by 0.32%.

### Table 3. Cumulative changes in the growth rate of China-US electricity demand under the three policy scenarios

| Time | Trump tax reform scenario | Trade barrier scenario | Competing tax reduction scenario |
|------|---------------------------|------------------------|---------------------------------|
| US   | US                        | US                     | US                              |
| 2019 | 0.17                      | 0.01                   | 0.20                            |
| 2020 | 0.27                      | -0.01                  | 0.25                            |
| 2021 | 0.36                      | -0.03                  | 0.30                            |
| 2022 | 0.45                      | -0.04                  | 0.35                            |
| 2023 | 0.53                      | -0.06                  | 0.38                            |
| 2024 | 0.59                      | -0.07                  | 0.41                            |
| 2025 | 0.65                      | -0.08                  | 0.44                            |

3.4 Impact on electricity consumption intensity of China and the US

### Table 4. Changes of electricity consumption intensity under three policy scenarios

| Time | Trump tax reform scenario | Trade barrier scenario | Competing tax reduction scenario |
|------|---------------------------|------------------------|---------------------------------|
| US   | US                        | US                     | US                              |
| 2019 | 0.00                      | 0.01                   | 0.04                            |
| 2020 | -0.02                     | 0.01                   | 0.03                            |
| 2021 | -0.03                     | 0.02                   | 0.02                            |
| 2022 | -0.03                     | 0.02                   | 0.02                            |
| 2023 | -0.03                     | 0.01                   | 0.02                            |
| 2024 | -0.02                     | 0.01                   | 0.02                            |
| 2025 | -0.02                     | 0.01                   | 0.01                            |

The US has entered into the post-industrialization stage. The electricity demand and economic growth were gradually decoupled. China is still in the late stage of industrialization. With the transformation and upgrading of China's economic structure, the intensity of electricity consumption is declining.

Under the Trump tax reform scenario, the US electricity consumption intensity has slightly decreased, with an average annual reduction of 0.02% from the baseline scenario. Under the Trump tax reform scenario, China's electricity consumption intensity has increased slightly, with an average annual increase of 0.01% over the baseline scenario.

Under the trade barrier scenario, the tax reform has weakened the US output and electricity demand. The intensity of US electricity consumption has increased slightly, with an average annual increase of 0.03% over the baseline scenario. There is a large negative impact on China's output and electricity consumption, and the electricity consumption intensity has increased slightly, with an average annual increase of 0.2% compared with the baseline scenario.

Under competing tax reduction scenario, the intensity of US electricity consumption has remained basically stable. China's economic structure has been optimized and upgraded, and the electricity consumption intensity has declined slightly, with an average annual decrease of 0.07% compared with the baseline scenario.
4. Main conclusions and implications
According to the scenario simulation results of the GTAP model, the following conclusions are summarized:
China's increased tax cuts are conducive to industrial structure optimization and electricity intensity reduction. Under competing tax reduction scenario, China's industrial structure has been optimized and upgraded. The output growth of heavy industry, textile and garment industry, mining industry and light industry decline, while the output growth of food processing industry, public utilities, transportation industry and other service industries increased. Affected by the optimization and adjustment of industrial structure, the electricity demand structure also changes accordingly. The lower electricity consumption growth rate can support higher economic growth.

Acknowledgments
This article is supported by 2018 Science and Technology Project of State Grid Corporation of China (Research and Application of Quantitative Evolution Model of New Energy Industry Format Development Based on New Consumption Pattern, No. SGHE0000KXJS1800549).

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