The Short-, Medium- and Long-term Effects of Green Credit Policy Aimed at Energy-Intensive Industries in China Based on a Financial CGE Model

Jing-Yu Liu[a], Yan Xia[a], Jie Wu[a], Shih-Mo Lin[b], Ying Fan[a,*]

[a] Center for Energy and Environmental Policy Research, Institute of Policy Management, Chinese Academy of Sciences, Beijing, China

[b] Department of International Business and Center for Applied Economic Modeling, Chung Yuan Christian University, Taiwan

Abstract: We establish a financial computable general equilibrium model and try to describe the transmit channel of a green credit policy aimed at energy-intensive industries, as well as to quantitatively calculate the systematic effects. In this paper, we apply punitive high-interest rates to the energy-intensive industries as a green credit policy. As well, we assume that the targets are the paper, chemical, cement and iron and steel industries. We first conduct three experiments representing green credit policy scenarios over the short-, medium- and long-term. Second, we simulate a scenario wherein a green security and the green credit policies are both carried out. Finally, we compare the policy effects of the green credit policy to the differentiated electricity price policy or the raising production tax of the energy-intensive industries policy. The result shows that the green credit policy is effective in suppressing the investments of energy-intensive industries, and it is comparatively less effective in the adjustment of the structure of production, especially in the cement and metal smelting industries. The green security policy helps the green

* Corresponding author at: Institute of Policy Management, Chinese Academy of Sciences, 15 Zhongguancunbeiyitiao, 100190 Beijing, China. Tel.: +86-10-59358809. E-mail addresses: yfan@mail.casipm.ac.cn, ying_fan@263.net

credit policy reduce the total financing of the target industries. However, the green credit policy plays the leading role. The policies of differential electricity prices and raising production tax help output structural adjustments but lack harmless investment effects. Although, their negative effects on other industries and the macro economy are much larger than the effects of the green credit policy.

Keywords: Green Credit Policy, Energy-intensive Industries, Financial CGE Model

1 Introduction

Chinese leaders are now incorporating environmental targets in five-year plans and experimenting with market-based mechanisms to supplement their traditional command and control mechanisms for economic transition, energy savings and emissions reductions. In recent years, China has produced a series of green policies, including a green tax, green procurement and green policies that are relevant to the financial sector, namely, green credit, insurance and security policies. Of the last three policies, the green credit policy is the most advanced. In July 2007, the former State Environmental Protection Administration, the monetary authority and the China Banking Regulatory Commission joint issued 'On the implementation of environmental policies and regulations to prevent credit risk'. It stated that the green credit policy was joining the main battlefield in China for economic transition, energy savings and emissions reductions.

The green credit policy applies to commercial banks and other financial institutions that provide loans and cheaper interest rates to environmentally friendly and energy-saving companies. In addition, these institutions apply ease lending and exact punitive (higher) interest rates to those companies or projects associated with highly polluting or energy-intensive industries. The purpose is to guide capital into environmental causes and out of enterprises or infrastructure projects that waste resources and pollute the environment. And the environmental protection authority

is responsible for the data sharing and is expected to provide strong basis of the green credit policy for the banking financial institutions.

In recent years, banks in China have played a key role in conducting the green credit policy, as relevant rules continue to come to the stage. In 2009, Bank of China introduced principles on environment security and saving energy in their lending procedure. Bank of China Inner Mongolia branch actively implemented a national strategy for the development of clean energy. It lent to the wind power industry more than 4.99 billion yuan, issued loan commitments amounting to 9.54 billion yuan and marketed 22 related risky projects. China Construction Bank provided clean energy credit, industrial environmental mitigation loans, agricultural eco industrial loans and other green finance services for customers. By the end of 2009, its green credit balance was 181.097 billion yuan. In January 2009, Industrial Bank (China) founded the first sustainable financial services agency in China. By the end of 2013, policy banks and China Development Bank in Beijing had loan balances in renewable energy and clean energy projects totalling 37.062 billion yuan, or 43.82% of their total loan. They also had their loan balances in energy savings and environmental protection projects equalling 154.228 billion yuan, as well as a 93.408 billion yuan loan for a railway transportation project. It was 32.43% of the total loan and rose 6.7 times.

The relation between saving energy or environmental conservation goals and commercial banks in China is closer than in other countries for a reason. China's capital market and insurance market have not yet fully developed and large

nationalised commercial banks form the main body of the financial sector in China. It might be the key feature of China's commercial bank system, and it is the most prominent difference between China's and the western commercial bank system. Therefore, the development of the concept of sustainable finance in China must include state-owned commercial banks as the main carrier. In this paper, we simulate exacting higher interest rates to energy-intensive industries, and we analyse the effects of the green credit policy on investment reductions, energy savings and emissions mitigation in the target industries.

2 Methods

2.1 Literature

Most scholars believe that the green credit policy has a positive effect on both commercial banks and on energy savings, emissions reductions and economic development. As well, some focus on current challenges, essential development, execution strategies and so on.

Zheng (2008) believed that commercial banks effectively promote environmental protection and sustainable development. Meanwhile, they transfer environmental risks and maintain good business. An (2008) thought that green finance promoted energy conservation, emissions reductions and sustainable development though several channels. They include standardising enterprise management, affecting venture capital flows, promoting technical environmental protection innovation, overcoming market failure effectively, guiding the public

investment behaviour and so on. He (2008) stated that commercial banks allocate funds according to duration, scale of credit funds, interest conditions and risk control. An effective credit audit system is outstanding in terms of risk measurement and pricing. Thus, commercial banks practice conducting green credit policies and guide capital regarding environmentally friendly and energy-saving industries, enterprises and projects through differentiated pricing. Some scholars believed that the green credit policy could also provide huge opportunities for commercial banks (Wei, 2010; Hu, 2011). Many scholars studied the relationship between the green credit policy and environmental risk management and believed that the green credit policy would also be helpful in enhancing the environmental risk management of commercial banks (Wang, 2006; Chang, 2008; Wei, 2010; Hu, 2011). Gao (2009) believed that by promoting the sustainable development of the economy and society, banks can have benefits as well, such as reduced risks, improved brand value, the development of new business, improved social relations, cost savings or increased income. Chang (2008) thought that despite the periodic progress of experimental green credit policies, many problems existed. As well, there is crucial work to be carried out to strengthen the construction of their environmental risk management system.

Among overseas researches, Sahoo et al. (2008) found that since the banking sector is one of the major stakeholders in the industrial sector, it could find itself faced with credit and liability risks. They explored the importance of Green Banking, cited international experiences and highlighted important lessons for sustainable banking and development in India. Aizawa and Yang (2010) believed that the green

credit policy's future success depends on effective environmental data collection and dissemination, technical guidance and the provision of true financial incentives for banks. The continued success of implementation could potentially provide China with the experience and confidence to address new challenges, such as the environmental and social conduct of its enterprises overseas. Zhang et al. (2011) found that the green credit policy is not fully implemented in China. The wide-ranging impact on high-polluting and high energy-consuming industries, vague policy details, unclear implementation standards and the lack of environmental information are the main problems in the implementation of the green credit policy in China. On the other hand, the practice at the local level (Jiangsu Province) is more practical, by integrating the green credit policy with the environmental performance rating system. Biswas (2011) attempted to highlight the major benefits, confronting challenges and strategic aspects of Green Banking, and he presented the status of Indian banks as far as Green Banking adoption is concerned. It was found that there has not been much initiative in this regard by the banks in India, though they play an active role in India's emerging economy. Verma (2012) found that Indian banks are now becoming more conscious of Corporate Social Responsibility, and one of the main CSRs is Green Banking. He concluded that only a few Indian banks have adopted Green Banking and financed some Green Banking-based projects, as there is a negligible awareness of Green Banking among bank staff and customers.

The existing literature analyses the impact of the green credit policy from several different aspects. However, as one of market-based economic means, the

effects of the green credit policy on the economic system, including the direct and indirect effects, are complicated. The effects penetrate all sectors and channels and the transmission path is long and branching. The systematic calculations of the green credit policy are rare in the literature. In this paper, we impose punitive higher interest rates on the energy-intensive industries as a green credit policy. As well, we establish a financial computable general equilibrium (CGE) model of China. We try to describe the transmit path of the green credit policy within the model, as well as quantitatively calculate the systematic effects.

Among the attempts to add the financial sector into CGE models since the 1980s, some focused on currency devaluation and international balance of funds (Easterly, 1990; Rosensweig and Taylor, 1990; Thissen, 2001), some used Financial CGE models to investigate the income distribution effects (Bourguignon, 1989, 1991; Mansury, 2002) or structure adjustment effects (Naastepad, 2002; Khan, 2007) of financial shocks or policies, while some measured the impact of a series of financial liberalization reforms (Lewis, 1992; Yeldan, 1997).

2.2 Transmit channel analysis of the green credit policy

When punitive higher interest rates are imposed, target industries would readjust their financing decisions regarding the ratio between direct financing and indirect financing. Overall, the policy will increase the financing costs of the target industries. Increasing the cost will squeeze profit, thereby reducing the investment demands. Alternatively, the higher costs will also be passed to the downstream

industries and the final demand by raising the prices of products. If the target industries reduce their investments, outputs might decrease because of the decline in the capital input. However, it is also possible for them to maintain a certain output as unchanged if they choose to add other inputs in response to the high demand for products in the market.

The rising prices in the target industries will affect their export competitiveness, thereby putting certain pressures on employment and social stability. When the target industries reduce their investments, other industries increase theirs, altering the investment structure. Therefore, the structure of the investment goods demand is changed as well, and so is the entire commodity market structure. Changes to the commodity structure caused by changes in investments, together with production changes in the target industries, will cause forward and backward linkage effects among all industries in the economy. Furthermore, this makes the policy effect more difficult to predict. Both direct and indirect financing markets fluctuate as financing decisions made by the target industries change, including rises in the security market interest rates and so on. Thus, financing in other sectors is affected. With the changes to the investment and financing behaviours of every economic institute, monetary aggregates and interest rates deviate from the former equilibrium values, which would finally affect the prices of the commodities in the market.

During different periods, the green credit policy has different effects, with factor markets reacting differently. Regarding the labour market, for example, in the short-term, the labour force in all industries is not adjusted, and it still plays a role in

the original department. In the medium-term, labour begins to flow among departments, but wages do not adjust. In the long-term, labour mobility among departments is completed. The impact on employment is completely weakened and it can be regarded as full employment. With the substitutions among capital, labour, energy and other factors in the production process—as factor markets provide different responses with time—more uncertainty appears in the green credit policy effects.

The qualitative analysis methods, or the quantitative analysis using simple calculation in the existing literature, can hardly calculate the impact of its policies completely. The method used in this paper, which is the CGE method, can reflect the interdependence and interaction among multiple departments and multiple markets, as well as uncover more extensive economic ties than the partial equilibrium model. In addition, it estimates the direct and indirect impact of a policy on the overall economic system. Further, this paper adds the financial department to the CGE model, which can describe the interactive effects of various financial markets and real markets. The model will be able to simulate changes in the interest rates, credits and other financial variables to the real economy, and conversely determine investment decisions, product pricings and other real economic behaviours to the financial market. The financial CGE model makes it possible to estimate the overall impact of the green credit policy on the economic system.

2.3 The data and model description

This is a static single-country CGE model with a financial department. The database of the financial CGE model is the Financial SAM (FSAM) with extended financial sectors. Accounts in our FSAM are: 42 production sectors[1], the current accounts of institutions (household, energy enterprise, energy-intensive enterprise, other enterprise, government, ROW), financial accounts of the same institutions, bank systems (commercial bank and central bank) and financial asset accounts (deposit, loan, enterprise bond, government bond, foreign asset, FDI, foreign lending and so on). The benchmark data of the financial CGE model are obtained from a Chinese social accounting matrix from 2007 for the real side and the flow of fund table and balance sheet from 2007 from the Central Bank of China for the financial side, as well as a balance of payment table. The data of the enterprises are calculated from information from the major annual reports of the listed companies.

The schematic FSAM is shown in Table 1. The accounts from 11 to 17 are filled with data split from the 'savings' data in the Chinese SAM of 2007. They represent new debts or new assets of institutions where the consistency between real and financial accounts is maintained. The specification of the real side of the model follows that of the standard CGE model developed by IFPRI in 2002. Readers can refer to Löfgren et al. (2002) for a detailed description of the model specifications. However, our model differs from the standard CGE model in two important aspects. One is in the modeling of energy use. As Figure 1 shows, we consider four kinds of energy (crude oil, petroleum, coal and electricity) as input factors, together with

[1] For display convenience, we demonstrate 15 aggregate industries, which are agriculture, coal, crude oil, paper, petroleum, chemical, cement, metal, construction, traffic, light industries, mining, heavy industries and service.

labour and capital. Thus, we can pinpoint the role of energy in economic activities and take into account the finite substitutions among different kinds of energy, as well as among energy and other input factors. The other is the financial module. We extend the savings-investment closure in the standard CGE models by making use of financial intermediation to achieve the transformation of savings to investments.

Table 1

Figure 1 Structure of the production function of the financial CGE model

Figure 2 demonstrates the financial intermediate channels with dotted lines. The financial decisions of institutions (i.e., household, enterprises, government, ROW) include real investment, financial investment, financing decisions and so on.

2.4 Green credit policy module

Below are the model specifications that are closely related to the operation of the green credit policy.

The investment demand of each industry is decided by the capital cost, the price of the investment goods and the profit rate of the investment. ZD_a represents real investment demand by sector of origin; λ_a is a scale parameter of investment; PINF is the inflation rate; PK_a is the price of the investment goods for industry a; εzd_a is the exponent parameter of the investment demand equation; $QF_{cap,a}$ is the capital input of industry a.

$$ZD_a = \lambda_a \cdot (WF_{cap} \cdot WFDIST_{cap,a} / (1+PINF) \cdot PK_a)^{\varepsilon zd_a} \cdot QF_{cap,a} \quad (1)$$

The profit rate of a commercial bank is constant. $INTRSTD$ represents the interest rate of the deposit; $FSTOCKD_{ins}$ is the financial stock of the deposit for institution ins.; $INTRSTC_{insp}$ is the interest rate of a commercial bank loan for a private institution insp.; $FSTOCKE_{insp}$ is the financial stock of a loan for a private institution insp.

$$\sum (INTRSTD \cdot FSTOCKD_{ins}) * shprofitb = \sum (INTRSTC_{insp} \cdot FSTOCKE_{insp}) \quad (2)$$

Capital gains include interest costs and the profit of capital. YF_{cap} is the capital gains; $WF_{cap} \cdot WFDIST_{cap,a}$ is the profit rate of the capital in industry a; $OMEGA1_{e,a}$ is sector a's share parameter of the real investment for enterprise e.

$$YF_{cap} = \sum (WF_{cap} \cdot WFDIST_{cap,a} \cdot QF_{cap}) + \sum \sum (INTRSTC_e \cdot OMEGA1_{e,a} \cdot FFLOWC_e + INTRSTB_e \cdot OMEGA1_{e,a} \cdot FFLOWB_e) \quad (3)$$

The capital input of each activity includes the initial capital stock and investment. $QF0_{cap,a}$ means the initial capital stock of industry a.

Figure 2 Schematic diagram of the financial CGE model

$$QF_{cap,a} = QF0_{cap,a} + ZD_a \tag{4}$$

The ratio of a commercial bank loan to direct financing depends on the relative interest rate of the loan and security. $FFLOWC_e$ is the financial flow of credit for enterprise e; $FFLOWB_e$ is the financial flow of enterprise security for enterprise e; $g2_e$ is the share of the commercial loan to the total borrowing of enterprise e; $INTRSTA$ is the interest rate of the borrowing for industry a.

$$FFLOWC_e = g2_e \cdot (FFLOWC_e + FFLOWB_e) \tag{5}$$

$$g2_e / (1 - g2_e) = \psi_e \cdot ((1 + INTRSTC_e) / (1 + INTRSTA))^{\varepsilon 2_e} \tag{6}$$

2.5 Features of the financial CGE model

Endogenous price level: standard CGE models need a numeraire to decide other relative prices, usually some weighted price index like labor wage. But it has limitations when explaining macro issues like inflation. This model takes the price of currency as a numeraire, so other prices of commodities or wages can be seen as absolute prices. Thus the price level is endogenous.

Non-neutrality of money: the structure features of the model, such as the fixed labor wage or price control in certain industries, together with the setting that savings and investment are decided by real interest rate, determine the non-neutrality of money in this model. That is, the change of price level would affect real variables (real output of each industry, real import, real export and so on).

Since money is non-neutral, the price level is endogenous, and there are

structure adjustments in real economy and financial economy, it is possible to model the process of interaction and mutual influence of real side and financial side of the economy.

3 Results and Discussion

3.1 Scenario settings

The target industries are the paper, chemical, cement and iron and steel industries.[2]

Table 2 shows us the scenario settings. We first conduct three experiments, representing the green credit policy scenarios over the short-, medium- and long-term. The loan interest rate for energy-intensive industries would be two percentage points higher than that for other industries. According to the presumption that the profit rates of commercial banks are constant, the loan interest rates for other industries would be lower than the initial ones. In the S0a scenario, we conduct a short-term green credit policy experiment. We maintain fixed labour employment in each industry. In the S0b scenario, we conduct a medium-term green credit policy experiment. Compared to the S0a scenario, we allowed labour to flow among the industries, and the average labour wage is exogenous, while unemployment is permitted. In the S0c scenario, we conduct a long-term green credit policy experiment. Compared to the S0a scenario, we also

[2] Energy industries are among the high-emission industries. However, as we calculated from the model, restricting the credit of energy industries has a larger negative effect on other industries, since energy is the basement of our economy. To avoid a major shock to our economy, we should appropriately protect the energy industries. This paper does not involve the energy industries as target sectors.

allowed labour to flow among industries, and the average labour wage is endogenous with full employment.

Table 2

Second, we simulate the S1 scenario, wherein the green security and green credit policies are both carried out. The green security policy refers to the listed companies that must pass the environmental audit by the environmental authority during the listing, financing and refinancing processes. This policy makes it harder for target industries to finance in direct financing markets. Thus, we can see the effects with both policies constraining financing for target industries in both direct and indirect financing markets. We decrease the elasticity of the substitution between loans from commercial banks and security financing. At the same time, we implement a green credit policy as in S0b.

Last, we compare the policy effect of the green credit policy with that of the differentiated electricity price policy and the raising production tax of target industries policy. In the S2a scenario, we levy a production tax in the target industries at one percentage point higher than other industry taxes. According to the zero profit rate assumption of the electricity industry, the electricity prices of other industries decrease slightly. In the S2b scenario, the electricity prices in the target industries are 20% higher than in other industries. According to the tax neutrality principle, the production taxes of other industries decrease slightly.

3.2 Policy effects analysis of green credit in the short-, medium- and long-term

3.2.1 Impacts on financing flows and financing cost of S0 scenarios

Table 3

From Table 3, we can see that, in general, the green credit policy increases the loan interest rates of the target industries and the average finance cost, as a result. Thus, the loans of those industries decrease and security financing increases. However, the total amount of financing decreases. For other industries, the loan interest rates decrease and so does the average finance cost. Thus, the amount of both commercial bank loans and security financing increases.

In the short-term, when the green credit policy is implemented, the loan interest rates of the target industries increase by 1.762%. The security interest rate decreases by 0.313%, while the average finance cost increases by 1.1%. These industries would cut their bank loans by 6.675 billion yuan and increase their security financing by 6.155 billion yuan. Meanwhile the loan interest rate of the other industries decreases by 0.238%, while their average finance cost decreases by 0.182%. The other industries would increase their bank loans by 4.502 billion yuan and cut their security financing by 0.129 billion yuan.

In the medium-term, compared to the short-term, the target industries decrease their financing amounts in the direct and indirect finance markets, respectively. The target industries further reduce their loans from commercial banks by 0.247 billion

yuan, and security financing decreases by 0.088 billion yuan. The security interest rate decreases again by 0.017%, and the average financing cost decreases by 0.008%. The other industries reduce the bank loans compared to S0a scenario by 0.531 billion yuan, and security financing by 0.129 billion yuan. Their average financing cost decreases by 0.001%.

In the long-term, compared to the medium-term, the target industries raise the total financing. Bank loans increase by 0.298 billion yuan and security financing increases by 0.028 billion yuan. The security interest rate increases by 0.019% more than in the medium-term, and the average finance cost increases by 0.003%. And the other industries also raise the total financing. Their bank loans increase by 0.366 billion yuan and security financing further increases by 0.145 billion yuan. Their average finance cost decreases by 0.001%.

Considering the different period, in the medium-term scenario, the target industries have the least amount of total financing and the strongest policy effect. The short-term effect takes second place, and the long-term has the weakest policy effect.

3.2.2 Impacts on production prices of S0 scenarios

Figure 3 Percentage changes of production prices of S0 scenarios

From Figure 3, we find that the paper, chemical, cement and iron and steel industries all experience slight rises in their production prices by less than 0.08% and they pass some of their increased costs to the downstream enterprises and the final demand. Prices do not increase much because some increased finance costs squeeze profit margins, and interest costs account for a small proportion of the total cost.

The finance cost increases and the profit rate shrinks, which will harm the investment activities in relation to the target industries. As Figure 4 shows, the investments of all the target industries decrease by 0.05% to 0.3% in a different period, while those of all other industries have risen. This indicates that the green credit policy can effectively restrain the excessive growth of the investments of the target industries, and it can allocate the saved capital to other industries. In these three scenarios, the depressing effect of the green credit policy towards paper and chemical industry investments is better than that towards the cement and metal smelting industries.

3.2.3 Impacts on investment of S0 scenarios

Figure 4 Percentage change of investment of S0 scenarios

In the short-term, investments were reduced by about 0.2% in the paper and chemical industries, by about 0.073% in the cement industry and by about 0.106% in the metal smelting industry. In the medium-term, compared with the short-term,

their investments are all reduced. This is because when the labour begins to adjust, the process possibly accompanies unemployment. The economy slows down and the investment will be reduced accordingly. In the long-term, except for the paper industry, the decline of the other three target industries' investments is smaller than that in the short-term. As for negative effects, some labour-intensive industries would suffer, such as agriculture, light industries and service.

3.2.4 Impacts on real output of S0 scenarios

From the industry output results in Figure 5, in the medium-term, the green credit policy successfully curbs production in the paper and chemical industries. However, in the long-term, the suppression of the target industries' output is invalid.

In the short-term, the green credit policy curbs the output of the paper and chemical industries more effectively than the cement and metal smelting industries. This is mainly because the commodities in the cement and metal smelting industries are main investment goods. Since the rise in capital cost has little effect on the production prices of the target industries, the prices of investment goods would not decrease much. When the target industries reduce their investments, other industries increase theirs, and the overall economic investment is undiminished. Therefore, demand for cement and metal remains high, which will lead to the maintaining of high outputs in these two industries.

Figure 5 Percentage change of real output of S0 scenarios

In the medium-term, as the labour force flows freely among the various departments, the relative labour wages of the various departments are fixed. Industries will not depress wages to offset the rising costs. The outputs of the target industries will decline compared to the short-term, and agriculture, light industries, the service industry and other labour-intensive industries will be adversely affected.

While the real wages decline from the medium-term to the long-term, the target industries will hire more labour or increase hours of labour to compensate for the capital shortage and to increase output, which will offset the green credit policy effect on the target industries' outputs.

About 90% of the target industries' outputs are used as intermediate inputs, and 10% are used as exports. Whereas, 30% are used as intermediate inputs of the paper, chemical, cement and metal smelting industries themselves, and 40% are used as intermediate inputs of the heavy manufacturing and construction industries, which see exports and investment goods as final demands. As the capital costs have little effect on the price of the product, the target industries may not reduce output because of price promotions. In fact, when other industry investment demands rise slightly, the market demand for investment goods is also guaranteed. High export and investment demands counteract the green credit policy effect.

3.2.5 Impacts on exports of S0 scenarios

Figure 6 Percentage changes of exports of S0 scenarios

As we can see from Figure 6, the paper and chemical industries are more adversely affected than the cement and metal smelting industries. In the short- and medium-term, the exports of paper and chemical reduce, while those of the cement and metal smelting industries are hardly affected. In the long-term, the negative impact on the exports will be greatly eased.

3.2.6 Macro impacts of S0 scenarios

Table 4 shows that, from the perspective of the real GDP, the long-term effect is the most positive. The short-term effect takes second place, and the medium-term effect is third. Among the three scenarios, the largest to smallest drops in the price level are, as follows, long-term, short-term and medium-term.

In the short-term, the price level drops. The gross domestic product (GDP) deflator falls by 0.047%, the consumer price index (CPI) decreases by 0.057%, and the producer price index (PPI) decreases by 0.032%. The nominal GDP falls by 0.035% and the real GDP rises by 0.011%. In the medium-term, the labour flow among departments and unemployment is allowed. Thus, the real GDP decreases by 0.011%. The employment rate drops by 0.034%, and the price level rises slightly more than that in the short-term, yet it is still falling. In the long-term, labour mobility between departments continues, but with full employment. The real GDP rises higher than in the medium-term and the average price level declines further.

Table 4

3.3 Green credit policy and green security policy

3.3.1 Impacts on financing flows and financing cost of the S0b and S1 scenarios

Table 5

The green credit policy restricts the indirect financing of energy-intensive industries. Meanwhile, the green security policy makes it harder for these industries to finance the indirect financing market. We expect that if we implement both policies, it would be easier to achieve our goals of limiting the investments of the target industries, energy savings and emissions reductions. In this model, we assume that the substitution elasticity is reduced between the bank loan and security financing in the S1 scenario with the additional green security policy.

As we can see from Table 5, the target industries reduce their security financing by 27 million yuan in the S1 scenario compared with the S0b scenario. They reduce their bank loan, as well, by 4 million yuan. Overall, the ratio between the indirect and direct financing amounts declines to lower than that in the S0b scenario, wherein only the green credit policy applies. The security interest rate relatively rises by 0.051%, and the average interest rate rises by 0.023% for the target industries and by 0.005% for the other industries. The result indicates that the green security policy

helps the green credit policy to reduce the total financing of the target industries. However, the green credit policy plays the leading role.

3.3.2 Impacts on investment of the S0b and S1 scenarios

Figure 7 Percentage change of investment of the S0b and S1 scenarios

From Figure 7, each industry reduces its investment slightly, and the target industries have tightened their financing channels. For other industries, their increasing average financing costs cause them to reduce their investments.

3.3.3 Impacts on real output of S0b and S1 scenarios

Figure 8 Percentage change of real output of the S0b and S1 scenarios

Figure 8 shows that the when the green security policy is implemented together with the green credit policy, the real outputs in both the target industries and the other industries decrease. This means that the use of the green security policy would have a more negative effect on the economy; in the meantime, it strengthens the policy effect of green credit.

3.4 Green credit policy and other industrial policies

3.4.1 Impacts on production prices of the S0b and S1 scenarios

We can see from Figure 9 that the differential electricity prices policy and the tax policy influence the total demand, mainly through the impact on prices to reduce output. Their impacts on product prices are far greater than the green credit policy's. In the S2a and S2b scenarios, the product prices of the target industries rise by more than 0.5%. In S2a scenario, electricity price in the target industries is 20% higher than that in the other industries. According to the zero profit rate assumption of the electricity industry, the electricity prices of other industries decrease.

Figure 9 Percentage changes in the production prices of the S0b and S2 scenarios

3.4.2 Impacts on investment of S0b and S1 scenarios

We can see from Figure 10 that the green credit policy curbs investments and focuses on target industries more than differential power prices and tax policies do. As well, it also has a less negative effect.

In S2a scenario, differentiated electricity price policy is invalid in supressing investments in the target industries. While in S2b scenario, the production tax policy helps to reduce investments in the target industries. Although, it also reduces investments in the other industries and as a result harm the investment level of the whole society.

Figure 10 Percentage change in investments of the S0b and S2 scenarios

3.4.3 Impacts on real outputs of the S0b and S1 scenarios

From Figure 11, the differential electricity prices policy and the tax policy suppress the target industries' outputs more effectively than the green credit policy. However, their negative effects on other industries are greater. In the S2a and S2b scenarios, the outputs of the four industries fall in the range of 0.25–1%. The outputs of some other industries decrease as well, such as the construction, transportation, heavy manufacturing, service and mining industries in the S2a scenario and the heavy manufacturing and energy industries in the S2b scenario. Meanwhile in the S2a scenario, the consumption of electricity increases, as well as coal and oil. When the other industries have lower electricity price, they would consume more power, and thus more coal is burned. And when the target industries turn to use coal and oil to substitute electricity, they would consume more coal and oil as well.

Figure 11 Percentage change of real outputs of the S0b and S2 scenarios

3.4.4 Macro impacts of S0b and S1 scenarios

Table 6 shows that the decreases in the GDP in the S2a and S2b scenarios are larger than that in the green credit policy simulation. In the S2a scenario, the nominal GDP decreases by 0.01% and the real GDP decreases by 0.201%. In the S2b scenario, the nominal GDP decreases by 0.001% and the real GDP decreases by 0.056%. The employ rate decreases by 0.034% in the S0b scenario, by 0.108% in the

S2a scenario. In the S2b scenario, additional tax revenue has been lump-sum returned to the household. The employment rate increases and so does the household welfare. The green credit policy has a negative impact on the price level, while the differential power prices policy has a positive effect on the price level. In the tax policy simulation in the S2b scenario, the GDP deflator index increased by 0.056%, the PPI increased by 0.116%, but the CPI decreased by 0.044%.

Table 6

4 Conclusions and Policy Implications

The green credit policy can effectively restrain the investment activities of energy-intensive industries during all periods. It can reduce the outputs of the paper and chemical industries in the short- and medium-term, but it lacks the effect on the outputs of the cement and metal smelting industries. As well, in the long-term, the output and investment of the target industry rebounded. The policy has negative effects on the macro economy within an acceptable range.

The green security policy helps the green credit policy reduce the total financing of energy-intensive industries. However, the green credit policy plays the leading role.

The green credit policy is effective in suppressing the investments of the target industries and comparatively less effective on the adjustment of the production structure, especially on the cement and metal smelting industries. Alternative, the

policies of the differential electricity prices and raising production tax can help the output's structural adjustment, but it lacks harmless investment effects. Furthermore, the negative effects on other industries and the macro economy of both policies are much larger than the green credit policy.

While the export- and investment-driven economic growth pattern does not change much, and industrialisation and urbanisation are ongoing in China, these target energy-intensive industries are still going to play an irreplaceable role in the economy. The rigid demand for export and investment activities affects the policy effect. When the green credit policy tries to help readjust the industrial structure to achieve emissions reduction goals, it is subjected to the existing industrial output structure in turn.

If we choose to use the policies of the differential electricity prices and raising production tax to achieve production structure adjustment, it will bring certain costs and risks to the economy. In the current economic environment, we recommend cautious treatment with the production structure adjustment approach and procedure to ensure that economic risks are within a controllable range. Meanwhile, we could adopt the green credit policy to achieve the adjustment of the investment structure to achieve the goals of energy savings, emission reductions and shifting modes of economic development step-by-step.

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Table 1 A Schematic FSAM

		Production		Factors		Current Account of Institutions				Fixed Investment	Inventory	Capital Account of Institutions						Financial Flows	Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Production	1		IMI			HHE		GOE	EXP	FCF	III								Total Demand
	2	DOS																	
Labor	3		LAI																Factor Income
Capital	4		CAI																
Households	5			LI	CI		TR	TR	TR										Income of Institutions
Enterprises	6				CI														
Government	7	TRF	PRT			IT	IT												
Rest of World	8	IMP						TR											
Fixed Investment	9											INV	INV	INV					Investment
Inventory	10									III									
Households	11					SAV												FL	Changes in Liabilities of Institutions
Enterprises	12						SAV											FL	
Government	13							SAV										FL	
Commercial Bank	14								SAV									FL	
Central Bank	15																	FL	
Rest of World	16																	FL	
Financial Flows	17											FA	FA	FA	FA	FA	FA		Financial Flows
Total	18	Total Supply		Factor Income		Expenditure of Institutions				Investment		Changes in Assets of Institutions						Financial Flows	

Notes: The description of the notations in the table is as follows. IMI: intermediate inputs. HHE: household expenditures. GOE: government expenditures. EXP: exports. FCF: fixed capital formulation. III: increase in inventory. LAI: total labor income. CAI: capital income. LI: labor income to institutions. CI: capital income to institutions. TR: Transfer payments. TRF: tariff. PRT: production tax. IT: income tax. Imp: imports. Inv: investment. SAV: savings of institutions. FL: changes in financial liabilities. FA: changes in financial assets.

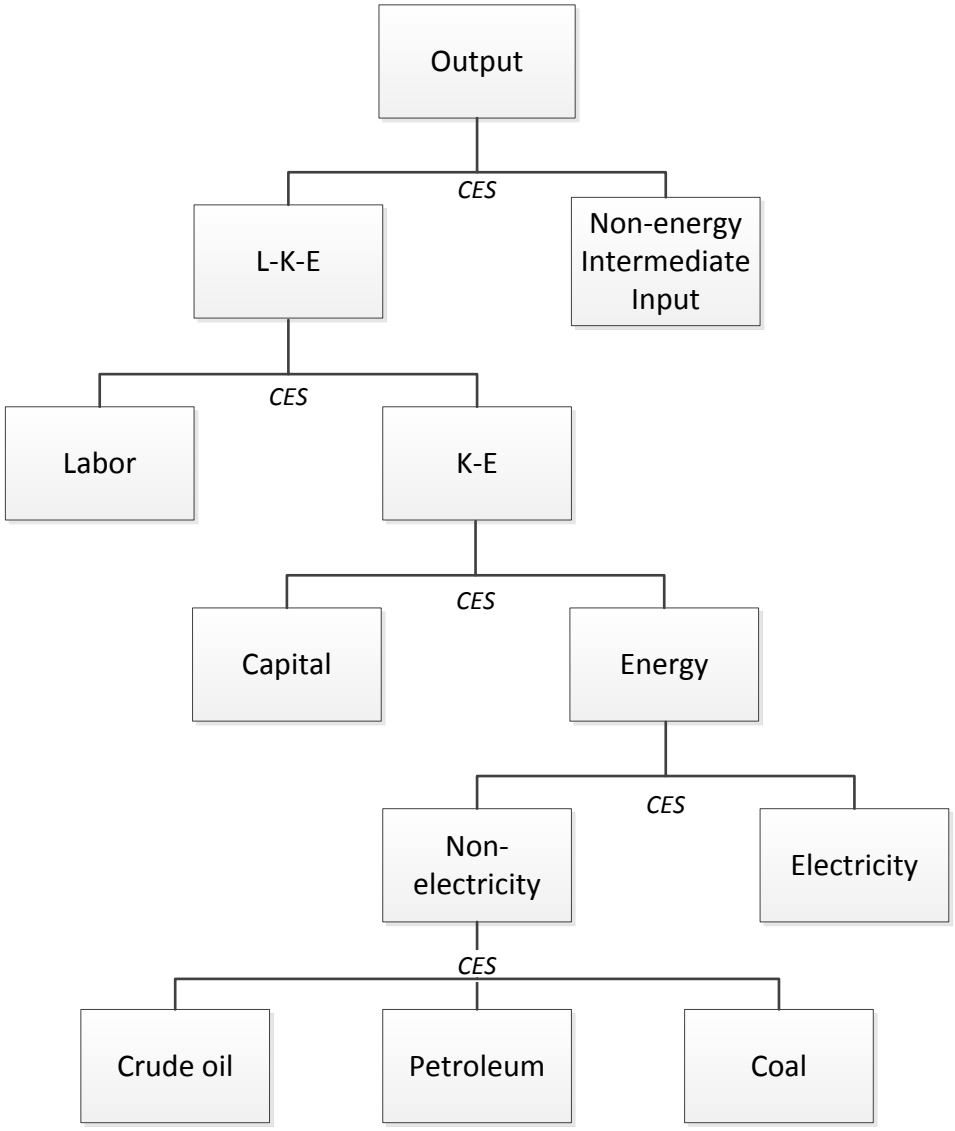

Figure 1 Structure of Production Function of the FCGE Model

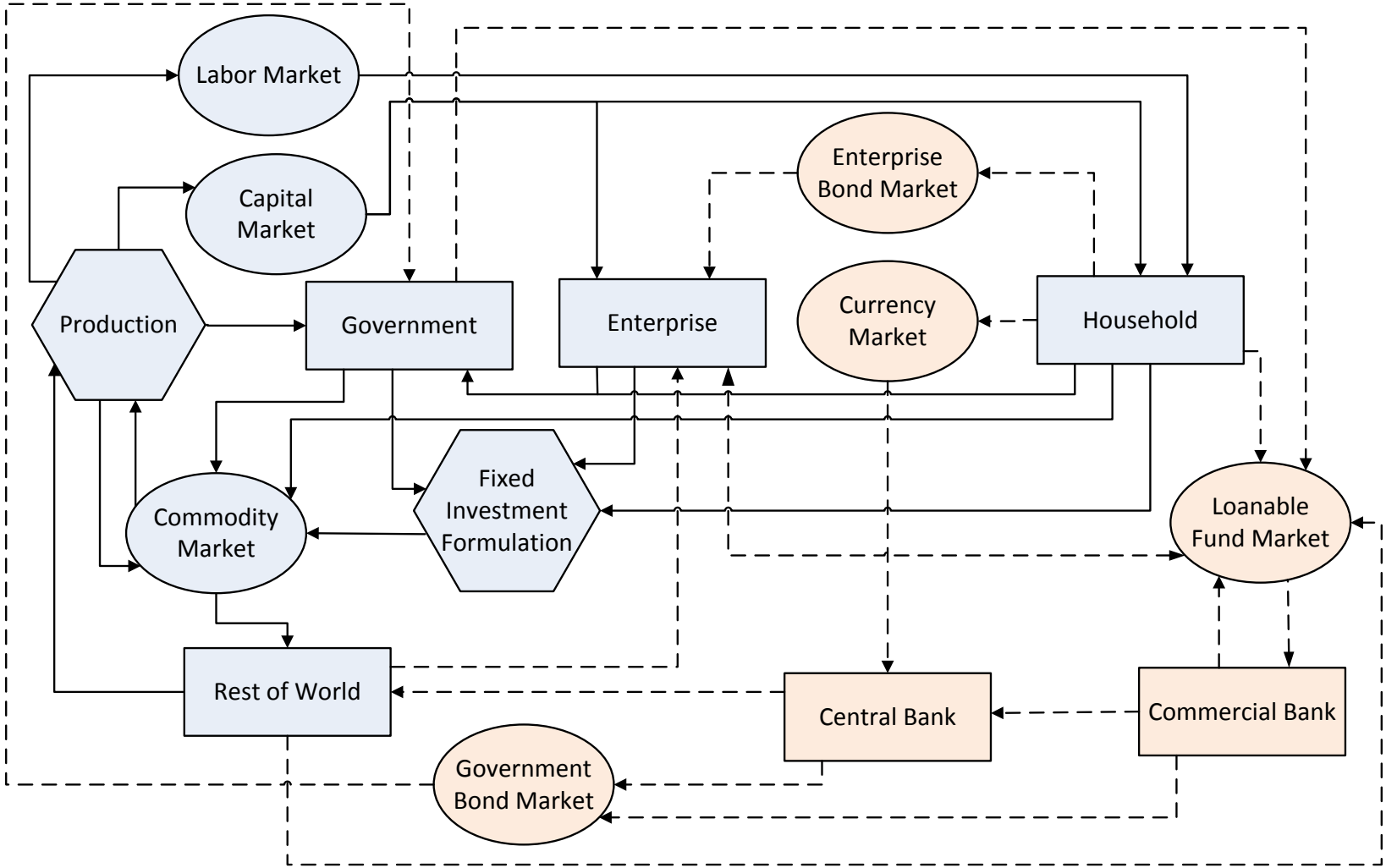

Figure 2 Schematic Diagram of the FCGE Model

Table 2 Scenario Settings

Scenarios	Scenario Explanation	Sub-scenarios	Scenario Explanation
S0	Loan interest rate for energy-intensive industries would be 2 percentage higher	S0a	Short term: labor employment fixed in each industry
		S0b	Medium term: labor flow among industries, average labor wage exogenous, unemployment
		S0c	Long term: labor flow among industries, average labor wage endogenous with full employment.
S1	Green security and green credit policies both carried out.	S1	Green security and green credit policies are both carried out.
S2	Comparison to 2 other policies -- differentiated electricity price policy and production tax policy	S2a	Levy production tax in target industries 1 percentage points higher than in others
		S2b	Electricity price in target industries is 20% higher than that in other industries

Table 3 Changes in Financing Flows and Financing Cost

Unit: Billion Yuan

	Enterprise types	Bank Loan	Security Finance	Loan Interest (%)	Security Interest (%)	Average Interest (%)
S0a	Energy Intensive	-6.675	6.155	1.762	0.313	1.100
S0b	Energy Intensive	-6.922	5.967	1.762	0.296	1.092
S0c	Energy Intensive	-6.624	6.195	1.762	0.315	1.101
S0a	Others	4.502	0.129	-0.238	0.313	-0.182
S0b	Others	3.971	0.078	-0.238	0.296	-0.183
S0c	Others	5.337	0.223	-0.238	0.315	-0.182

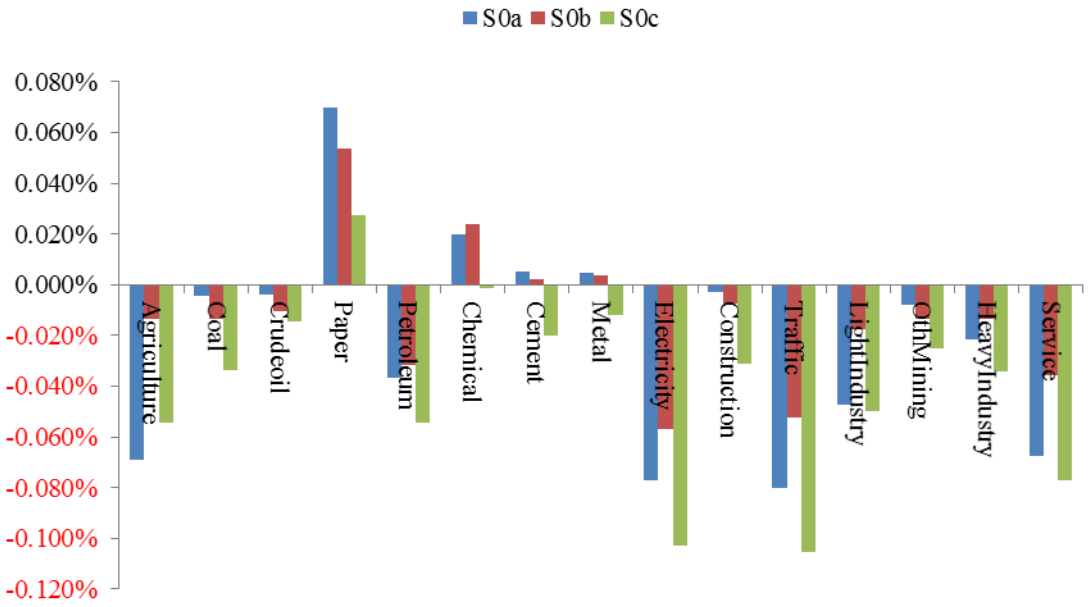

Figure 3 Percentage changes of production prices of S0 scenarios

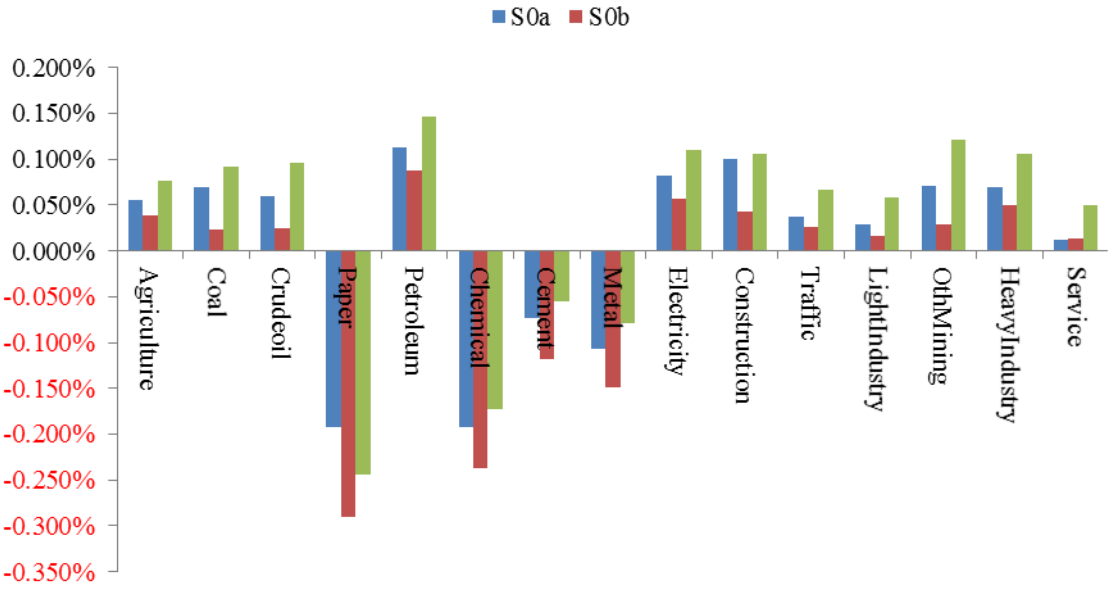

Figure 4 Percentage change of investment of S0 scenarios

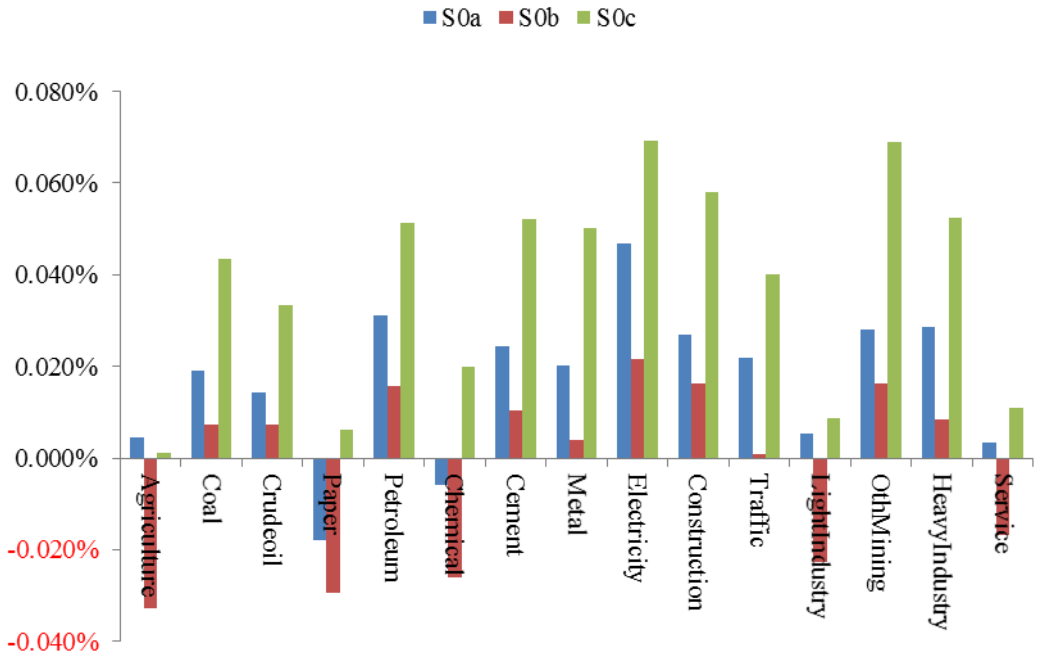

Figure 5 Percentage change of real output of S0 scenarios

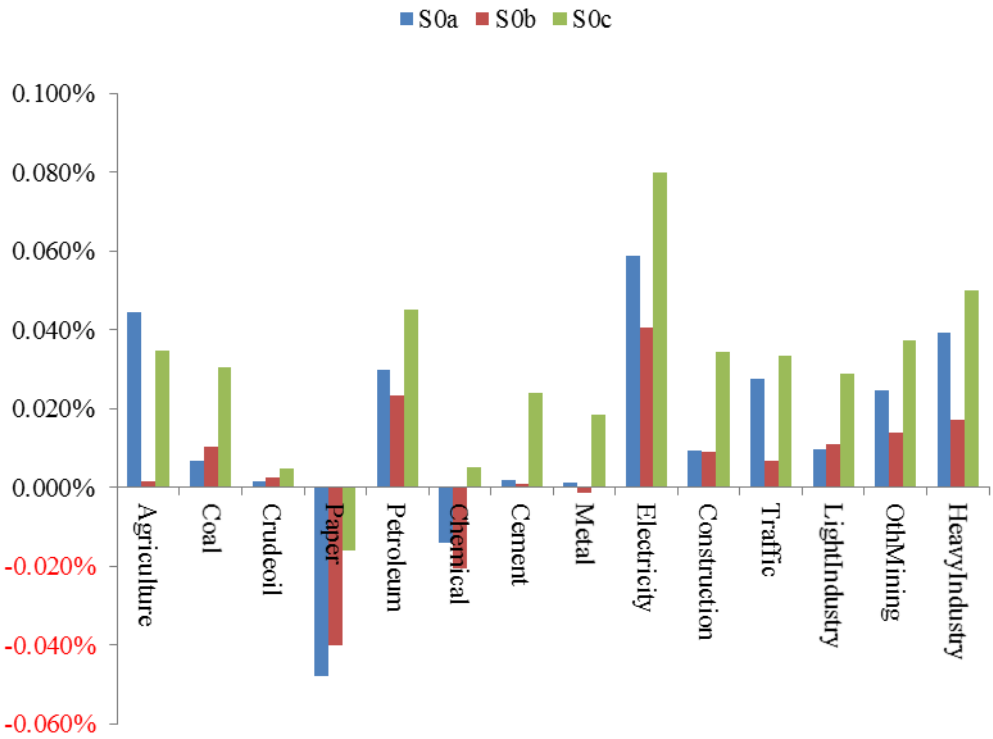

Figure 6 Percentage changes of exports of S0 scenarios

Table 4 Macro Impacts of S0 Scenarios

Unit: %

	S0a	S0b	S0c
Nominal GDP	-0.035%	-0.033%	-0.035%
Real GDP	0.011%	-0.011%	0.027%
GDP Deflator	-0.047%	-0.022%	-0.064%
CPI	-0.057%	-0.027%	-0.064%
PPI	-0.032%	-0.016%	-0.045%
Employment	0.000%	-0.034%	0.000%

Table 5 Changes in Financing Flows and Financing Cost of S0b and S1 scenarios

Unit: Billion Yuan

Scenarios	Enterprise types	Bank Loan	Security Finance	Loan Interest (%)	Security Interest (%)	Average Interest (%)
S0b	Energy Intensive	-6.922	5.967	1.762%	0.296%	1.092%
S1	Energy Intensive	-6.918	5.940	1.762%	0.347%	1.115%
S0b	Others	3.971	0.078	-0.238%	0.296%	-0.183%
S1	Others	3.943	0.049	-0.238%	0.347%	-0.178%

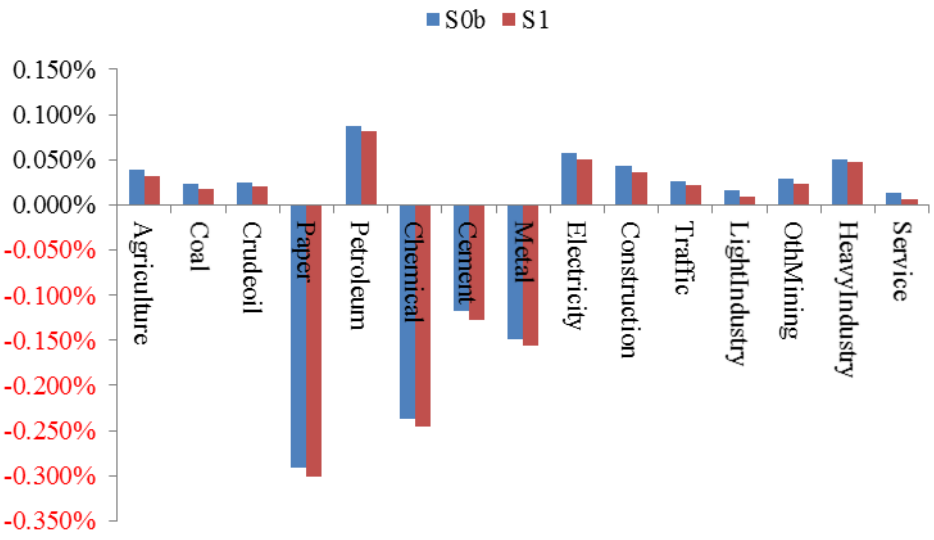

Figure 7 Percentage change of investment of S0b and S1 scenarios

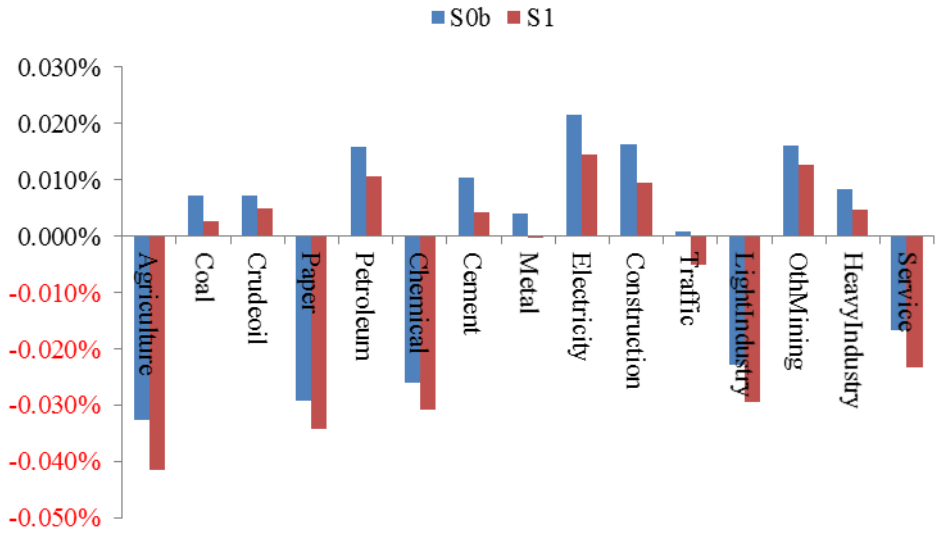

Figure 8 Percentage change of real output of S0b and S1 scenarios

Figure 9 Percentage changes of production prices of S0b and S2 scenarios

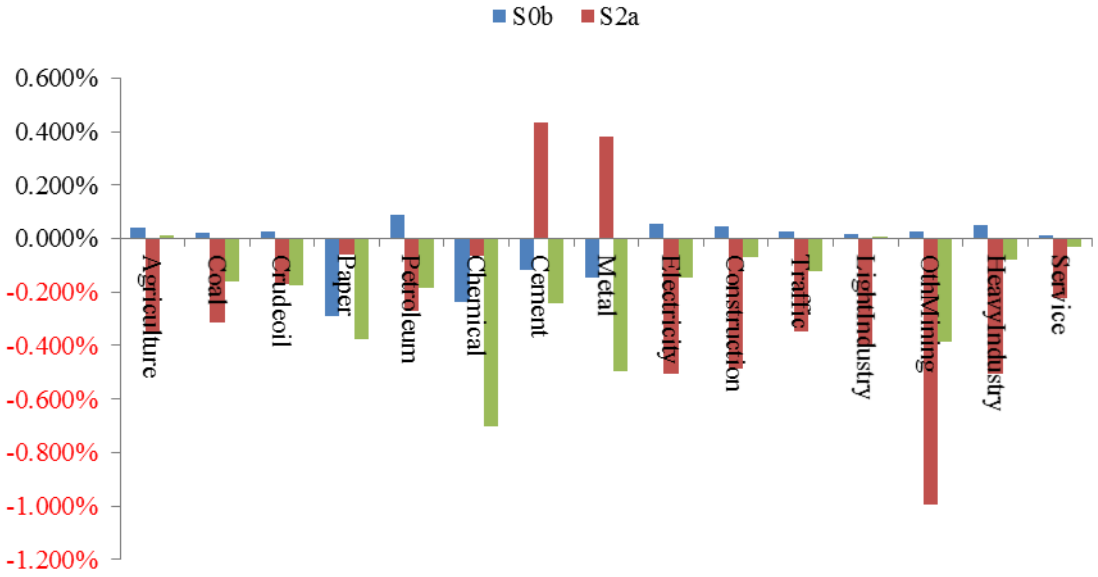

Figure 10 Percentage change of investment of S0b and S2 scenarios

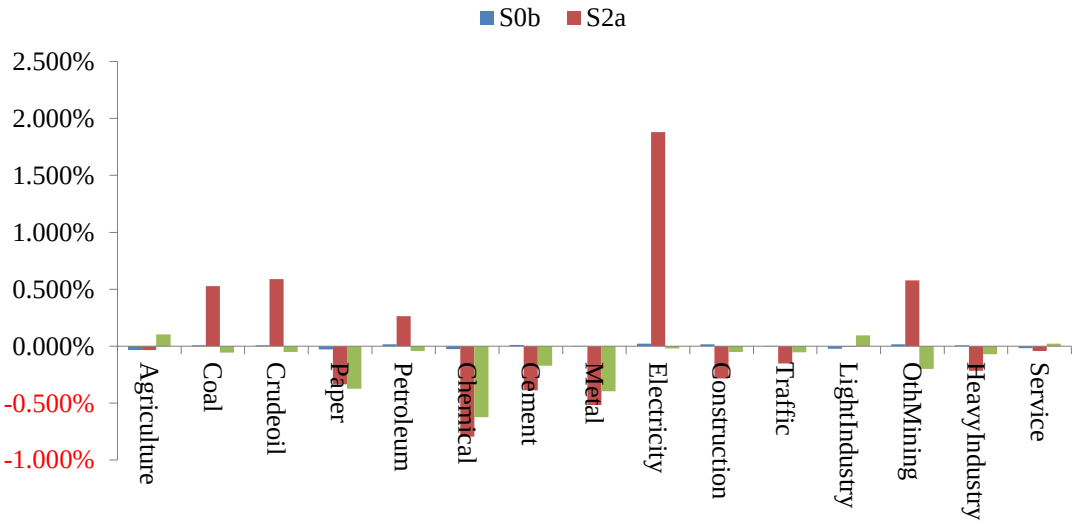

Figure 11 Percentage change of real output of S0b and S2 scenarios

Table 6 Macro Impacts of S0b and S2 scenarios

Unit: %

	S0b	S2a	S2b
Nominal GDP	-0.033	-0.010	-0.001
Real GDP	-0.011	-0.201	-0.056
GDP Deflator	-0.022	0.198	0.056
CPI	-0.027	0.023	-0.044
PPI	-0.016	0.108	0.116
Employment	-0.034	-0.108	0.004