water

MDPI

*Article*

# The Impact of Water Resources Tax Policy on Water Saving Behavior

**Lei Wang [1], Muniba [2,*], Zoltán Lakner [3,4] and József Popp [5,6]**

[1] YueTai Medical Treatment (Shandong) Limited Company, Taian 253000, China
[2] School of Insurance and Economics, University of International Business and Economics, Beijing 100029, China
[3] Department of Agricultural Business and Economics, Institute of Agricultural and Food Economics, Hungarian University of Agriculture and Life Sciences, 2100 Budapest, Hungary
[4] Faculty of Agriculture, University of Science and Technology, Aliero 863102, Nigeria
[5] Hungarian National Bank–Research Center, John von Neumann University, 6000 Kecskemét, Hungary
[6] College of Business and Economics, University of Johannesburg, Johannesburg 2006, South Africa
* Correspondence: munibauibe@hotmail.com

**Abstract:** The Chinese water administration department has continuously explored and formulated regulatory and market-oriented water control policies to alleviate the contradiction between water shortage and economic and social development and promote the new idea of 'water-saving first' water control. Among them, implementing a water resources tax policy as a price means has achieved initial success. The water-saving effect of water resources tax collection is one of the important bases for determining whether the tax reform will be promoted nationwide in the next stage. Based on this, taking Hubei Province, the first tax reform pilot in China, as an example, water resource elements are integrated into the economic system and a dynamic stochastic general equilibrium model (DSGE) is constructed, embedded in water resources tax to simulate the persistent impact of such a tax on water saving objectives. The research shows that: (1) A water resources tax can effectively achieve the goal of water-saving and improve the utilization efficiency of water resources. (2) Levying a water resources tax helps to improve the water-saving awareness of enterprises and residents and promotes enterprises to optimize their production structure. (3) Rational and efficient use of special water resources protection funds is the basis for ensuring the effective implementation of a water resources tax. It can also improve the recycling capacity of water resources. This means that the government should speed up the exploration of the relationship between supply and demand for comprehensive water resources, to establish a reasonable range of water resources tax rates to guarantee people's livelihoods, and to accelerate the construction of water resources tax guarantee measures, in order to achieve a relatively steady-state of water resources utilization and protection, realizing the dual goal of sustainable economic development and sustainable use of water resources.

**Keywords:** water resources tax; water saving behavior; DSGE model; policy effect; Hubei province

check for updates

**Citation:** Wang, L.; Muniba; Lakner, Z.; Popp, J. The Impact of Water Resources Tax Policy on Water Saving Behavior. *Water* **2023**, *15*, 916. https://doi.org/10.3390/w15050916

Academic Editor: Anas Ghadouani

Received: 10 January 2023
Revised: 20 February 2023
Accepted: 22 February 2023
Published: 28 February 2023



## 1. Introduction

The uneven spatial and temporal distribution of water resources, frequent water drought disasters, human activities interfering with the water cycle, and low water use efficiency are gradually becoming major factors hindering China's green and sustainable development [1]. To solve this problem, the government is exploring the development of new water resources management policy initiatives, attempting to shift from levying water resources fees to water resources taxes and establishing a water resources protection tax system in the country [2]. Based on the coexistence of water scarcity and sustainable development requirements in China, water administration departments and scholars generally believe that the current design of water resources tax should not consider only its fiscal revenue but should focus more on its important significance in resource conservation, ecological protection, and green development in the field of water resources [3,4]. On the one hand, the water resources tax is an effective compensation for the use of natural resources, which concentrates on the labor value, service value, and ecological value of water resources [5]; on the other hand, a water resources tax effectively curbs the unreasonable demand for water in the region [6], and tax collection and management is more reasonable and transparent [7]. It improves the efficiency of water use and reduces the exploitation of groundwater, which plays a role in the protection of water resources [8–10], thus promoting environmental protection to a certain extent. In addition, from the various practices of water resources tax in foreign countries, the water-saving effect is also significant [11,12], but it also has a severe negative impact on agricultural production [13]. Therefore, the water-saving effect must be combined with the country's actual situation. If there is a lack of experience and inefficient water resources management, the policy effect of a water resources tax may be unsatisfactory [14].

Since China is in the critical period of transforming from a water resources fee to a water resources tax, Chinese scholars have researched the applicability and consensuality of the water resources tax system. Ref. [15] proposed that the water resources tax be administered to match the country's water conditions and geography. A water resources tax administration model with Chinese characteristics should be established. As the water resources tax pilot work found, the water resources tax burden standard should be adjusted simultaneously with change in the local economic level. The improvement of the ecological environment [16] and the earmarking of tax revenue should also be clarified to emphasize enhancement of the regulating function of the water resources tax [17]. However, implementing a water resources tax policy in the short term also harms socio-economic development. Ref. [18] point out that the water resources tax has increased the tax burden of urban water supply enterprises. Ref. [19] argued that the current water resources tax levy approach had not been applied to agricultural water use and the efficiency of agricultural water use is still low, and proposed an agricultural water resources tax levy and management model that is tailored to local conditions and is simple, rather than difficult. Ref. [20] found that although the introduction of a water resources tax has raised the awareness of water conservation, reduced the water demand of enterprises, and improved the efficiency of water use in various sectors, it has not played a significant role in reducing the total amount of water used in multiple sectors. There are still specific problems in tax collection and administration.

As a new tax system, the impact of the water resources tax on residents' life, enterprise production, and social development still need to be studied in depth. Regarding its characteristics, the water resources tax is a fiscal policy tool. Its regulating effect is not only for current economic benefit and water-saving effects but also should be based on protecting water resources. The DSGE model can meet the current demand for a more comprehensive study of the water resources tax. Since [21] first used the DSGE model to study the time-series characteristics of the U.S. macro economy, the effects of energy price shocks [22], the impact of stochastic technology shocks [23], and coal and carbon resources [24] have been continuously introduced to optimize this. Subsequently, [25] used a DSGE model to simulate the dynamic responses of total output and environmental quality before and after the carbon tax, comparing and analyzing the effects of imposing a carbon tax, and increasing the carbon tax rate under different carbon emission intensities. Ref. [26] used a DSGE model to find that increasing the tax rate could reduce carbon emissions in the power sector. Still, at the same time, the price of electricity would also increase, making carbon emissions reductions and economic growth difficult to achieve simultaneously. Ref. [27] introduced the effects of environmental technologies and energy prices in DSGE to simulate the response changes of the ecological–economic system. Ref. [28] used a DSGE model to conclude that financing constraints can amplify the impact of fuel tax shocks, and the stronger the constraints, the more pronounced the stimulating effect on the economy.

Reviewing the existing literature, there is a lack of research on the overall and lasting effects of water resources tax policies, and most of the research analyses are short-term or static, such as using the CGE model to study the optimal tax rate for water resources [29], which has not yet formed an internal logical structure for the impact of water resources tax policies on economic growth. It is difficult to analyze further the transmission path of a water resources tax on economic impact. On the other hand, although the theoretical basis of the DSGE model can solve the above problems, there is a lack of a DSGE model for extended water resources, and the available references come from the research results on the DSGE model on carbon taxation. Based on this, this paper constructs a DSGE model incorporating water resources based on the characteristics and economic value of water resources and takes the first pilot tax reform in Hubei Province as an example to simulate the long-term dynamic response mechanism of the water resources tax in order to explore how the behavior of micro-entities influences decisions and to evaluate the effect of water resources tax on social water conservation and water resources protection from the perspective of long-term development. The DSGE model was used to simulate the long-term dynamic response mechanism of water taxation in Hubei Province, the first pilot project.

## 2. Theoretical Background

As a kind of resource tax, the analysis of the water resources tax policy effect is in line with the paradigm of fiscal policy analysis [30]. In this paper, the policy effect of the water resources tax refers to its economic impact and the combined effect of water users' change in water consumption behavior. Therefore, the analysis of the behavior of micro-actors directly affected by the implementation of the water resources tax policy can help to understand its transmission mechanism and help to understand why each actor chooses to conserve water resources and reduce unreasonable water demand through such a tax; moreover, it can help to reflect the way to achieve the structural change in water consumption and the restructuring of water abstraction by the differential tax rate. The analysis of the effect of the water resources tax policy can explain how the water resources tax can alleviate the contradiction between the supply and demand of water resources, change the water supply structure and promote industrial upgrading, as well as to infer and argue for its impact on economic development.

### *2.1. Mechanisms of the Impact of Water Resources Tax on People's Lives*

As per the current policy document of the pilot tax reform, the water resources tax follows the principle of 'Tax and fee for translation'. Therefore, the reform measures implemented in the current tax reform pilot will have almost no direct impact on residents. However, in the long term, the existing taxation principle makes it difficult to adjust the price of water in a short time. Still, the price of water is bound to increase in the future because the water resource fee that residents should bear is temporarily transferred to the urban public water supply sector. In addition, with the improvement of the water resource tax system and the promotion of tax reform, residents will gradually realize the importance and urgency of water conservation and water resource protection, thus reducing the unreasonable demand for water and achieving the goal of protecting water resources.

As the water resources tax reform is at its early stage, each pilot area's overall tax rate is still low. Still, the demand for water resources in social development and the scarcity of water resources increase the value of water resources. Therefore, it is reasonable to consider the increase in the water resources tax rate in this paper, and this will eventually reach a reasonable range that integrates the supply and demand of water resources and the protection of people's livelihood.

### *2.2. The Mechanism of the Impact of Water Resources Tax on Enterprise Production*

The reverse regulation of a water resources tax reduces the production scale of high water-consuming enterprises, promotes the introduction of water-saving technology, and optimizes the industrial structure. As current high water-consuming enterprises generally do not use water resources efficiently, the levy of a water resources tax will significantly impact high water-consuming enterprises. From the perspective of the production chain, as the production cost of high water-consuming enterprises increases, to keep their profits unharmed they transfer the tax burden to downstream enterprises or consumers by raising the price of their products in the short term [31], and the resulting impact can be divided into the following two cases.

Case 1: The high water-consuming enterprises produce products that are inelastic in demand, and the transfer of the tax burden ensures that their interests are not damaged because the products made are in immediate demand, and consumers who buy such products bear the pressure of the tax burden, which reduces the consumption level of consumers and damages their interests.

Case 2: The high water-consuming firm produces an elastic product, and the price increase makes consumers choose substitutable products—the higher costs caused by the tax need to be borne by themselves.

Since the current water resources tax is based on the principle of 'Tax and fee for translation' and is an in-price tax, Case 1 is not in line with the actual situation, while the comprehensive result of Case 2 is that a high water-consuming enterprise will reduce the scale of production, improve the efficiency of water use, and promote the optimization and upgrading of its industrial structure. The positive regulation of a water resources tax enables enterprises to innovate water conservation techniques and guides them to switch from wasteful to economic production and use of water. Since the water resources tax is a general, special tax, the tax revenue is used for the construction of water conservation facilities and for the incentive of water conservation effectiveness. On the other hand, in a fully competitive market, innovative water-saving enterprises are rewarded for their low production costs and water-saving production, which increases the market competitiveness of their products and motivates their competitors to transform to water-saving production, further spreading the impact to the whole production chain. The effect will be transmitted to the entire production chain, leading to the optimization and upgrading of industrial structure and improving the efficiency of water use.

### *2.3. Comprehensive Impact Mechanism of Water Resources Tax on Social Development*

The water resources tax levy will have a negative impact on economic development in the short term. At the same time, the economy tends to stabilize in the long term, the efficiency of water use increases, and the value of water use increases. By the national income accounting expenditure method, the main driving factors of a country's economy include consumption, investment, and government spending, if only closed economic conditions are considered. In the short term, the reduction in consumption occurs instantaneously. It is directly reflected in economic indicators, while the promotion effect of investment on the economy takes a longer time to respond. With the gradual emergence of investment effects, the widespread popularity of water-saving technologies, the improvement of water resources utilization efficiency, and the decline of production water costs, the level of wages and benefits and consumption levels will return to a steady state. At that time, the supply of water resources meets the demand for water resources. The water ecological environment, the natural cycle of water, and the ecological functions of water bodies are protected. Therefore, although the water resources tax reform needs to pay the price of damaged economic development in the short term, from the perspective of long-term sustainable development the water resources tax is the most effective means to solve the contradiction between the current water shortage and the growing water demand in China.

## 3. Material and Methods

### *3.1. Data*

The water resources data used in this study are from the Hubei Water Resources Bulletin from 2001 to 2020. The data on social and economic indicators such as capital volume and GDP are from the China Statistical Yearbook from 1990 to 2020. Data that cannot be obtained directly from statistical data are estimated according to previous research methods.

### 3.2. Assumptions

Dynamic stochastic general equilibrium is a kind of equilibrium state that various economic entities achieve in pursuing their respective goals according to their behavior rules and habits. Therefore, to simplify the complex reality, the DSGE model constructed in this paper is a closed model, including households, firms, and government. The operation of the whole economic system is simulated by constructing the behavior equation of each micro subject. To establish the model equation, it is necessary to put forward corresponding assumptions from the four aspects of production, consumption, factor capital, and government departments before constructing the model. The following four model assumptions are proposed regarding the previous research experience [32] and combined with the research needs of the water resources tax issue.

Assumption 1: On the production side, the market structure is assumed to be a perfectly competitive market in which manufacturers follow the principles of cost minimization and profit maximization when producing, and the production function has the characteristic of constant returns to scale. Assumption 2: On the consumption side, residents consume various goods according to the principle of utility maximization, and their utility is modeled using the constant relative risk aversion (CRRA) function. Assumption 3: Capital, labor, and water resources are freely mobilizable, while wages conform to the supply and demand theorem and can change instantaneously. Assumption 4: Only the government department levies the water resources tax, and it is used only for water resources protection management and infrastructure construction expenditure.

### 3.3. Hypothesis

To simplify the complex reality, the DSGE model with embedded water resources tax is a closed model that includes three sectors, households, firms, and government, and simulates the operation of the whole economic system by constructing the behavior equations of each micro-actor. To make the model equations hold, the corresponding assumptions are made before constructing the model. Regarding the previous research experience [33–35] and combined with the research needs of the water resources tax issue, the following four model assumptions are proposed.

(1) **Hypothesis 1**: On the production side, the market structure is assumed to be a perfectly competitive market in which manufacturers follow the principles of cost minimization and profit maximization when producing, and the production function has the characteristic of constant returns to scale.
(2) **Hypothesis 2**: On the consumption side, residents consume various goods according to the principle of utility maximization, and their utility is modeled using the constant relative risk aversion (CRRA) function.
(3) **Hypothesis 3**: Capital, labor, and water resources are freely mobilizable, while wages conform to the supply and demand theorem and are free to change instantaneously.
(4) **Hypothesis 4**: only the government department levies the water resources tax, and it is used only for water resources protection management and infrastructure construction expenditure.

### 3.4. Model

The basic framework of this paper is as an extension of the research results of [36]. Since there is no research on applying the DSGE model to the analysis of the implementation effect of water resources tax reform policy, this paper draws on the research method of [25] on carbon tax. It incorporates water resources as a critical element into the model. Based on the research of [33,34] a water resources embedded DSGE model including households, firms and the government is constructed.

### 3.4.1. Households

Based on the principle of tax equalization in the water resources "fee-to-tax" reform, theoretically, the water resources tax will not directly impact the households sector, so the construction of the households sector follows the classical RBC construction. Assuming that there is an infinite representative household, the utility of consumption and labor is in the form of CES, and the utility of money balance is in the form of a logarithm to simplify the model. Thus the utility function of the representative household is:

$$\max_{C_t, N_t, B_{t+1}, M_t, K_{t+1}} E_0 \sum_{t=0}^{\infty} \beta^t \left( \frac{{C_t}^{1-\sigma}}{1-\sigma} - \frac{{N_t}^{1+\eta}}{1+\eta} + \ln \frac{M_t}{P_t} \right) \tag{1}$$

where $C$ denotes consumption, $N$ denotes labor, $B$ denotes bond holdings, $I$ denotes investment, $M$ denotes the quantity of money, $P$ denotes the price level, $M/P$ denotes real money holdings, $\beta$ denotes the discount factor, $\delta$ denotes the inverse of the intertemporal elasticity of substitution of consumption, and $\eta$ denotes the inverse of the Frisch elasticity of labor supply.

The utility maximization of the residential sector is subject to the constraint that the income in each period is higher than or equal to the expenditure

$$C_t + (K_{t+1} - (1-\delta)K_t) + \frac{B_{t+1}}{P_t} + \frac{M_t - M_{t-1}}{P_t} \leq w_t N_t + R_t K_t + (1 + i_{t-1}) \frac{B_t}{P_t} \tag{2}$$

where $w_t = \frac{W_t}{P_t}$, $R^K$ denotes the return on capital per period and $i$ denotes the bond rate. In $I_t = K_{t+1} - (1-\delta)K_t$, the investment $I$ that the households sector can decide in the utility function can also be replaced by the capital $K$.

The Lagrange equation can be constructed from the utility function and constraints

$$L = E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \frac{{C_t}^{1-\sigma}}{1-\sigma} - \frac{{N_t}^{1+\eta}}{1+\eta} + \ln \frac{M_t}{P_t} + \lambda_t (w_t N_t + R_t K_t + (1+i_{t-1}) \frac{B_t}{P_t} - C_t - (K_{t+1} - (1-\delta)K_t) - \frac{B_{t+1}}{P_t} - \frac{M_t - M_{t-1}}{P_t}) \right\} \tag{3}$$

Derivatives for $C_t$, $N_t$, $K_t$, $B_t$ and $M_t$, respectively, give the following first-order conditions

$$\lambda_t = C_t^{-\sigma} \tag{4}$$

$$N_t^{\eta} = C_t^{-\sigma} w_t \tag{5}$$

$$\lambda_t = \beta E_t (\lambda_{t+1} (R_{t+1} + 1 - \delta)) \tag{6}$$

$$\lambda_t = \beta E_t (\lambda_{t+1} (1 + r_t)) \tag{7}$$

$$\frac{M_t}{P_t} = C_t^{\sigma} \left( \frac{i_t}{1+i_t} \right)^{-1} \# \tag{8}$$

Since money is introduced in the utility function, this paper assumes that the money supply is a non-stationary time series and therefore considers the (logarithmic) growth rate of the money supply $M_t$ as a policy instrument with the following money growth rate equation

$$g_t^m = (1 - \rho_m) \log \pi - \log \pi_t + \rho_m g_{t-1}^m + \rho_m \log \pi_{t-1} + \varepsilon_t^m \tag{9}$$

where $\pi$ denotes the steady-state nominal money supply growth rate. If we use the real money balance $m_t$ CPI inflation rate is $\pi_t$, i.e., $m_t = \frac{M_t}{P_t}$, $\pi_t = \frac{P_t}{P_{t-1}}$.

### 3.4.2. Firms

(1) Introducing the water resources factor into the production function.

Since the levy of a water resources tax will directly affect the production of enterprises, it is necessary to include water resources as a production factor in the production function. In this paper, with reference to the research results of [37,38], the extended form of the CD function is used to introduce water resources into the production function at the same level of production factors as capital and labor supply. The equation of the production function is as follows

$$Y_t = A_t K_t^{\alpha} N_t^{\lambda} Z_t^{1-\alpha-\lambda} \tag{10}$$

where $Y_t$ denotes $t$ period output, $\alpha$ is the output elasticity of capital, and $\lambda$ is the output elasticity of labor; $K_t$ denotes capital input in $t$ period; $N_t$ denotes labor supply in period $t$; $Z_t$ denotes water use in $t$ period; and $A_t$ denotes the technology level in $t$ period, assuming that technological progress obeys the AR (1) process, yielding

$$\log A_t = \rho_A \log A_{t-1} + \varepsilon_t^A, \varepsilon_t^A \sim N(0, \sigma_A^2) \tag{11}$$

where $\rho_A$ denotes the duration parameter of the technology shock, $\varepsilon_t^A$ denotes the random error under the technology shock, and $\sigma_A$ denotes the standard deviation.

(2) Introduction of water resources tax into the production cost of enterprises.

In levying the water resource tax, the taxation department levies according to the number of water resources used, so the amount of water resource tax payable by the enterprise in the period $t$ is $T_t Z_t$, where $T_t$ denotes the water resource tax rate in the period $t$. To simulate the dynamic effect of the water resource tax, it is assumed to obey the AR (1) process

$$T_t = \rho_T T_{t-1} + \varepsilon_t^T, \varepsilon_t^T \sim \left(0, \sigma_T^2\right) \tag{12}$$

where $\rho_T$ denotes the persistence parameter of the water tax shock, $\varepsilon_t^T$ denotes the random error of the water tax shock, and $\sigma_T$ denotes the standard deviation.

The maximization of corporate profits can be expressed as

$$\max \Pi_t = A_t K_t^{\alpha} N_t^{\lambda} Z_t^{1-\alpha-\lambda} - (R_t^K K_t + W_t N_t + T_t Z_t). \tag{13}$$

Because the firm seeks to maximize profit, the optimal first-order condition can be obtained by taking derivatives of $K_t$ $N_t$ and $Z_t$, respectively.

$$R_t = \alpha A_t K_t^{\alpha-1} N_t^{\lambda} Z_t^{1-\alpha-\lambda} = \alpha \frac{A_t K_t^{\alpha} N_t^{\lambda} Z_t^{1-\alpha-\lambda}}{K_t} = \alpha \frac{Y_t}{K_t} \tag{14}$$

$$W_t = \lambda A_t K_t^{\alpha} N_t^{\lambda-1} Z_t^{1-\alpha-\lambda} = \lambda \frac{A_t K_t^{\alpha} N_t^{\lambda} Z_t^{1-\alpha-\lambda}}{N_t} = \lambda \frac{Y_t}{N_t} \tag{15}$$

$$T_t = (1-\alpha-\lambda) A_t K_t^{\alpha} N_t^{\lambda} Z_t^{-\alpha-\lambda} = \alpha \frac{A_t K_t^{\alpha} N_t^{\lambda} Z_t^{1-\alpha-\lambda}}{Z_t} = (1-\alpha-\lambda) \frac{Y_t}{Z_t} \tag{16}$$

### 3.4.3. Government

In addition to the effectiveness of water savings, the water resources tax policy effect should also focus on what impact its collection may have on socio-economic development. The water resources tax policy effect is the combined effect on economic development and the water-saving effect of water-saving behavior after optimal choices by a series of actors guided by the government's water-saving objectives. To simplify the model, it is assumed that the source of government tax revenue is the water resources tax. The income tax revenue is set up as a special fund for water resources protection, entirely for water resources protection. The government revenue equation is as follows

$$G_t = T_t Z_t \tag{17}$$

where $G_t$ denotes the $t$ period of government expenditure.

Since water resources are incorporated into the economic system cycle as a factor of production, according to the general equilibrium model idea, water resources need to be resource-constrained to converge to the steady state; based on this, this paper assumes the water cycle equation

$$Z_t = (1-\psi)Z_{t-1} + G_t \cdot Z_t/Y_t \tag{18}$$

where $\psi$ denotes the rate of water depletion per period and $Z_t/Y_t$ represents the amount of water used per unit of output. In the steady state, this equation indicates that the value transfer function of the water resources tax in the next period will compensate for the converted value of water resources depletion in the current period.

#### 3.4.4. Market Equilibrium

When the market reaches clearing equilibrium, the resource constraint is

$$Y_t = C_t + I_t + G_t \tag{19}$$

## 4. Results

### *4.1. Parameter Estimation*

#### 4.1.1. Calibration of Structural Parameters

The calibration of capital elasticity parameter $\alpha$ and labor elasticity $\lambda$ can be used to replace capital income indicator by total capital formation, and labor compensation by labor income indicator, and the long-term average value of $\alpha$ can be calculated as 0.49 and $\lambda$ as 0.5; the subjective discount parameter $\beta$ can be calculated as 0.976 based on the average value of the historical one-year national bond yield of 2.6% of Ying for Finance; the capital depreciation parameter $\beta$ is calculated as 0.976 based on the 1990–2020 China Statistical Yearbook; the ratio of long-term average value of depreciation of fixed assets to long-term average value of capital stock in Hubei Province is calibrated to obtain $\delta$ as 0.08; the parameter $\psi$ of water resources depletion rate is obtained as a proxy variable based on the water consumption rate of water resources in the Hubei Province Water Resources Bulletin from 2001–2020 as $\psi$ = 0.27; parameter $\sigma$ is set to 1 by referring to the study of [38]; parameter $\eta$ is set by referring to [39], calibrated $\eta$ to 3.

#### 4.1.2. Dynamic Parameter Estimation

In this paper, H.P. filtering is used to obtain the fluctuation components of the observed data. Then the regression is performed by least-squares according to the first-order autoregressive assumption of the shock, the coefficient of the first-order lag term can be used as the persistence parameter, and the standard deviation of the regression can be used as the estimate of the standard deviation of the exogenous shock, taking the natural logarithm of both sides of the output function and making the first-order difference, obtained as follows

$$\log A_{t+1} - \log A_t = \log Y_{t+1} - \log Y_t - \alpha(\log K_{t+1} - \log K_t) - \lambda(\log N_{t+1} - \log N_t) - (1-\alpha-\lambda)(\log Y_{t+1} - \log Y_t) \tag{20}$$

The time series data of GDP $Y$, capital $K$, and labor $N$ are substituted into the above equation, and the volatility components are obtained through H.P. filtering. The AR (1) of the tax rate variable $T$ is used as the regression equation to obtain the persistence parameter of the water tax rate.

The regression equation for the monetary variable $M$ with AR (1) of first-order difference is

$$\log M_t - \log M_{t-1} = (1-\rho_m)\log \pi + \rho_m(\log M_{t-1} - \log M_{t-2}) + \varepsilon_t^m \tag{21}$$

The persistence parameter of the monetary shock is obtained by the same method.

The results were obtained as follows.

As shown in Table 1, the regression results of dynamic parameters are all significant and plausible. All parameters are shown in Table 2.

**Table 1.** Regression results.

| Variable | First-Order Lag Coefficient | Standard Error of the Coefficient | $t$-Test | $p$ v. | Regression Standard Deviation |
|---|---|---|---|---|---|
| Tax rate $T$ | 0.518 | 0.162 | 3.196 | 0.004 | 0.095 |
| Currency $M$ | 0.546 | 0.135 | 4.045 | 0.000 | 0.043 |

**Table 2.** Summary of parameter setting values.

| Parameter | Representative Meaning | Calibration Value |
|---|---|---|
| $\beta$ | Subjective discount factor | 0.976 |
| $\sigma$ | Reciprocal of the intertemporal elasticity of substitution of consumption | 1 |
| $\eta$ | Inverted Frisch elasticity of labor supply | 3 |
| $\delta$ | Capital depreciation rate | 0.08 |
| $\alpha$ | The elasticity of capital output | 0.49 |
| $\lambda$ | The elasticity of labor output | 0.51 |
| $\psi$ | The loss rate of water resources | 0.27 |
| $\rho_m$ | Persistent parameters of monetary policy shocks | 0.56 |
| $\rho_T$ | Persistent parameters of water resources tax shocks | 0.53 |

### *4.2. Calculation of Steady-State Values*

The steady-state value is generally calculated by setting $A$ to 1 and then manually solving some of the steady-state values based on this. In addition, the steady-state value can be set first for some variables, such as labor; assuming a person works 8 h a day, the steady-state of $n$ can be set first to $1/3$. The long-term per capita water use in Hubei province is 275 $m^3/\text{person}$, and the logarithmic value of 2.44 can be used as the steady-state value of water use $z$. After setting the steady-state value, Dynare is used to calculate the steady-state value of the whole system.

### *4.3. Impulse Response Analysis of Water Resources Tax Shocks*

#### 4.3.1. Responses of Enterprises to Water Resources Tax Shocks

Compared with the imposition of water resources fees, the overall price of water in Hubei Province increases after the imposition of a water resources tax. In this context, the scenario of a 1% increase in the water resources tax rate is simulated. As seen in Figure S1, the water resources tax shock causes a short-term decline in water consumption and a gradual return to a steady state in the long term. In periods 1–7, the water resources tax rate gradually returns to a steady state, while the effect of water use suppression gradually diminishes. In periods 8–20, the water resources tax rate is steady, while water use is still suppressed; this suggests that the water resources tax has effectively reduced water use and suppressed water demand for a longer time. In periods 1–7, both the effect of raising water prices and reducing water use is gradually diminishing, with the change in water prices being greater than the change in water use and an increase in tax revenues, all of which are used to invest in water conservation and other areas, enhancing the recycling capacity of water resources. In periods 8–20, water price has returned to a stable state, while water consumption is still in gradual recovery. Compared with the initial state, tax revenue also shrink, but at the same time the enhanced recycling capacity of water resources is restored, and the required input also shrinks. Tax revenue is in a relatively stable state. In contrast, water consumption gradually returns to a steady state; compared with the initial state, water use does not shrink, but the water ecosystem's continued restoration of water ecosystems can meet the increasing water demand. In the long run, the increased recycling capacity of water resources meets the growing water demand and ensures sustainable economic and social development.

The impact of the water resources tax reduces labor and lowers the wage level. On the one hand, due to the effects of the water resources tax, the industrial structure is optimized and adjusted, resulting in structural unemployment and reduction of labor quantity; on the other hand, production enterprises, facing the increase in tax rate, will take measures such as introducing water-saving equipment, upgrading water-saving technology, improving the production process, etc., which brings about the improvement of efficiency making labor time decrease. In periods 1–5, there is a vertical recovery of labor, some unemployed people find jobs again, and labor time gradually recovers. After period 6, the recovery of labor slows, and some unemployed people need longer to search for matching positions, while the labor time of employed workers recovers. With the gradual employment of the unemployed, labor returns to a steady state by period 45. A decline in wage levels accompanies a decrease in labor. On the one hand, the impact of the water resources tax makes it more expensive for firms to produce water, with lower output obtained per unit of labor and lower welfare pay; on the other hand, the reduction in the amount of labor also reduces the wages required to be paid. In periods 1–5, there is a vertical decline in wages. Still, due to the gradual recovery of labor time and the increase in the value of unit labor, the wage level gradually increases after period 6. It returns to a steady state in period 65.

The impact of the water resources tax reduces both capital and capital gains. With higher costs, lower output value, and lower profits, the return per unit of capital also decreases, and the nature of capital for profit reduces capital investment. However, with the general implementation of the water resources tax policy, the demand for water-saving technology and water-saving equipment has increased, and the prospect of research and development in water-saving technology and manufacturing of water-saving equipment is promising. The investment in such development will gradually increase. In addition, the government supports enterprises to change their production methods and improve their water-saving capacity, encouraging them to purchase water-saving equipment and develop water-saving technology. They will also invest a lot of capital in water-saving. Although the water resources tax affects the capital investment in the short term, in the long time, due to government support and enterprise demand, the capital factor investment will return to a steady state. In periods 1–3, capital and capital gains continue to decrease simultaneously. In periods 4–65, capital gains gradually recover due to the positive market outlook for water-saving technologies and equipment, and capital investment also recovers, returning to steady-state levels in period 65.

#### 4.3.2. Resident Response to the Water Resources Tax Shock

The shock of water resources tax leads to a decrease in wage levels, a reduction of disposable income of residents, and, consequently, a decrease in consumption. Higher production costs, lower profits, and lower-wage levels for businesses are caused by a higher water resources tax. There is a decline in short-term income of residents as workers directly reduce the level of consumption in the short term, and consumption decreases. From Figure S2, in the period of 1–5, the wage level continues to decline; industrial restructuring, continuous decline in short-term profits, reduction in capital investment, and increase in the unemployed population all aggravate the decline in wage level; in contrast, the decrease in consumption level is alleviated; as the constraint of residents' consumption is tightened, enterprises have to recover funds in time by lowering product prices, the price level can fall, the residents' real money balance rises, and the real purchasing power is elevated, which promotes the recovery of consumption. In periods 6–60, the reduction in unemployed workers, the improvement of the labor efficiency of employed workers, the popularization and application of water-saving technologies, the reduction of water costs, and the recovery of corporate profits promoted the gradual return of the wage level to the steady state. With the recovery of wages, disposable income increased, and the consumption level was further restored, returning to a steady state in 60.

The impact of the water resources tax makes residents save more and promotes the increase of long-term investment. Under the influence of the water resources tax, the decline in corporate profits leads to the reduction of residents' wages, the income of residents in the current period decreases, the opportunity cost of consumption increases, and the propensity of residents to save increases. Under the lower-income level, people tend to worry about future life security, curtail unnecessary current consumption and save to ensure that basic consumption in the future is satisfied. In periods 1–7, the increase in savings gradually slows down. On the one hand, the continuous decline in wage level makes the funds available for saving also gradually shrink; on the other hand, the gradual recovery of consumption makes more funds available for consumption, which weakens the incentive to save. In the 8th period, savings return to a steady state. With the recovery of wages, the increase in income and consumption reaches a relative balance, and the share of savings remains unchanged. Since saving funds equals investable social funds, saving is the supply of funds, and investment is the demand for funds. Both are two sides of the same coin, so the dynamics of long-term investment should be the same as saving.

The impact of the water resources tax has reduced the real money balance held by residents. On the one hand, the decline in wages reduces residents' disposable income; on the other hand, with the continued impact of the water resources tax, there is a strong demand for water-saving equipment and technologies, which gives companies related to the development of water-saving technologies an incentive to obtain R&D financing by rising bond rates. The increase in bond returns makes the opportunity cost of holding money higher for residents, who will allocate more of their wealth to bond investments. The water resources tax only raises the inflation rate in period 1. In contrast, from period 2 until the steady-state, the implementation of the water resources tax, in turn, lowers the inflation rate, raises real purchasing power, and promotes residents to hold money, but even though the purchasing power of money increases, in the face of future consumption concerns and reduced income, residential consumers still allocate more wealth to savings and bonds with higher short-term investment returns. From Figure S2, the impact of savings is short-lived, just as in periods 1–8, so the most important reason for residents to reduce their money holdings is the higher opportunity cost of holding money due to lower incomes. In periods 1–60, the real money balance remains steady as the bond rate gradually decreases. In the long run, residents' wealth distribution is still determined by their expected profits.

#### 4.3.3. Comprehensive Impact of Water Resources Tax on the Economy and Society

In general, the level of aggregate output measures the overall state of economic development. From Figure S3, the shock of the water resources tax causes the economy's total output to fall in the short run and return to a steady state in the long run. In the case of a closed economy, total output is composed of consumption, investment, and government spending. Total output briefly rises in period 1 due to the increase in tax expenditures and investment outweighing the decrease in consumption. Still, from period 2 onward, total output enters a phase of sustained decline. Combining the changes in total output fluctuations in the previous periods, it can be assumed that total output has a downward trend in the short run. In periods 2–5, total output continues to decline, the pulling effect of tax expenditures and investment on the economy weakens, and the impact of reduced consumption on total output increases. In periods 6–60, tax expenditures and investments are steady. Changes in total output are mainly influenced by changes in consumption, with both total output and consumption showing an upward trend. As water-saving technologies become widespread, corporate profits return to normal, and wage levels recover, consumption levels rise and total output gradually recovers. In the 60th period, total output and consumption return to a steady state.

Overall, under the impact of a water resources tax, water consumption drops significantly in the short term. Still, the increase in water consumption cost makes enterprises' profits drop, resulting in lower wage and benefit levels and less labor quantity and time. At the same time, enterprises introduce water-saving technologies and equipment to improve water use efficiency and reduce production costs to ensure long-term growth and respond to the government's water resources tax policy. In contrast, as workers, residents see their savings and money holdings fall, their bond investments rise as they receive less income, and their consumption shrinks. The increase in residents' savings and the rise in bond investment boosts business investment, accelerating the development of water-saving technologies and the diffusion of water-saving equipment. In the long run, due to the enhanced water conservation technology, the cost of water use decreases, enterprises regain average profits, wages return to normal levels, residents' consumption capacity continues to recover, and socio-economic development returns to a steady state.

## 5. Discussion

(1) The collection of a water resource tax can effectively achieve the water-saving goal, and help promote water-saving production in enterprises, change the industrial water consumption structure, and improve the utilization efficiency of water resources.

The implementation of the water resource tax reduces the proportion of industrial and agricultural water use. It increases the proportion of ecological and domestic water use while the overall water use remains relatively stable. Since the water resource tax adopts differential tax rates based on the method used and the amount of water drawn by enterprises, the implementation of the water resource tax firstly affects the production of enterprises and increases the overall production cost of enterprises, while the cost of the living water of residents is not directly affected for the time being, but indirectly affected by changes in income level and commodity consumption. The increase in water cost reduces the amount of water resources used by enterprises. Meanwhile, it reduces enterprises' current output and unit labor value, thus reducing the wage level. The decline of residents' income as laborers in the current period directly affects their willingness to distribute wealth: they reduce consumption, hold money, and increase savings to guarantee future consumption demand. The decrease in current consumption and abandonment of high-water consumption products further promote enterprises to introduce water-saving technologies and equipment to reduce the cost of water use. The increase in current investment and the decrease in income are the transition problems enterprises face. The rise in savings provides a stable supply of funds to ensure that enterprises can pass through the difficult period of transition in the short term through financing. At the same time, tax funds used for water resources protection, on the one hand, can increase the capacity of sustainable water supply.

On the other hand, enterprises should be encouraged to develop water-saving technologies, adopt water-saving equipment for production, improve production processes, and promote the upgrading of industrial structures. Through the investment of special tax funds, the production cost of enterprises decreases, profit returns to the average level, the wage level gradually recovers, consumption activities increase, and economic development returns to stability. Overall, the water resources tax reduces industrial water demand and improves water efficiency. Although it harms economic growth in the short term, the economy returns to stability after long-term recovery. The sustainable supply capacity of water resources is improved to achieve the dual goals of economic development and water environment protection.

(2) The collection of the water resources tax is conducive to improving the water-saving consciousness of enterprises and residents, and the price mechanism adjustment helps encourage enterprises to change the water intake mode and optimize the production structure.

The mandatory water resources tax effectively promotes the necessity of water-saving production in enterprises; especially, if high water consumption enterprises do not improve the awareness of water-saving, change the method of water intake and introduce water-saving technology, the increase of production costs will lead to the decrease of enterprise profits, the decline of market competitiveness and the reduction of production scale. From the view of long-term development, the transformation and upgrading of enterprise production is the inevitable trend. When the price of water is at a certain level, the cost of water should be paid more attention to. For example, the water price of the Beijing special industry is 160 yuan/$m^3$. The high cost of water inhibits the extensive water use behavior of special industry enterprises, the awareness of water-saving is enhanced, and each water account is actuarially calculated. The implementation and publicity for the water resources tax policy have also improved residents' awareness of water-saving and enhanced the awareness of water scarcity and the urgency of water resources protection. At the same time, the income of enterprises affects the income level of residents, resulting in reduced consumption, especially of high water consumption products. For example, due to the increase in car washing costs, the extent of car washing is reduced. The choice of consumers forces enterprises to introduce water-saving technology and equipment for water-saving production and improve the production process to promote industrial structure towards an intensive production transformation. With the improvement of water-saving awareness of residents and enterprises, water consumption gradually decreases, the utilization efficiency of water resources steadily increases, and the carrying capacity of the water environment consolidates and strengthens. Water resources' supply and demand capacity reach equilibrium, promoting the economy's sustainable development and that of the water resources environment.

(3) The collection of the water resources tax effectively protects the water ecological environment and improves the recycling capacity of water resources and the water supply capacity in meeting water demand.

The water resources tax restrains the desire of enterprises to develop and utilize water resources endlessly, ensures the intergenerational equity of water resources utilization, and provides the necessary means for water resources protection and sustainable utilization. Although the impact of the water resources tax will have a negative effect on the economy in the short term, the promotion of the water resources tax is still worthy and must be implemented. Tax funds provide a financial guarantee for local governments to control environmental water pollution, restore water ecological functions, and use the funds obtained from production enterprises to repair the environmental damage caused by them, which also reflects the effect of fiscal and tax policies to achieve social wealth redistribution and social equity. Therefore, the rational and efficient use of water resources tax funds is an important guarantee for an effective water resources tax policy. Currently, the expenditure items of special funds for water resources tax need to be further improved, the implementation of funds needs to be additionally supervised, and the corresponding water-saving incentive measures need to be further supplemented. Water resources tax policy requires a perfect means of rigid and more comprehensive incentive coverage. The correct guidance and water-saving incentives from the government enhances the confidence of enterprises in water-saving priority and innovative development, accelerates the process of enterprises in completing the introduction of water-saving technology facilities, promotes the optimization and upgrading of industrial structure, and improves the utilization efficiency and use-value of water resources. The water resources tax absorbs the profits of enterprises and supplements the ecological environment, which ensures the recovery of water resources' recycling capacity and the improvement of water supply capacity under the condition of increasing water demand and realizes the dual goals of sustainable economic development and sustainable use of water resources [40].

## 6. Conclusions

This paper analyzes the theoretical mechanism of the water resources tax, establishes a DSGE model with embedded water resources tax, and simulates the comprehensive effect of the water resources tax on water conservation and social development in Hubei Province through impulse response analysis. It was found that, on the one hand, the water resource tax can effectively achieve the goal of water conservation and help promote water-saving production, change the industrial water use structure, and improve water use efficiency; on the other hand, the water resource tax can help raise the awareness of water conservation among enterprises and residents, and help prompt enterprises to change their water extraction methods and optimize their production structure through price mechanism adjustment. In addition, the effective implementation of a water resources tax is guaranteed by the reasonable and efficient use of special water resources protection funds to effectively protect the water ecological environment and improve the recycling capacity of water resources, and the ability to supply water to meet water demand.

Therefore, the government should speed up the exploration of a reasonable range of water resources tax rates that integrates water resources supply and demand and protects people's livelihood so that the water resources tax levied within this tax range can meet the social demand for water and protect people's livelihood at the same time, and achieve a relatively steady state of water resources utilization and protection. The water resources tax should be earmarked for specific purposes, and should be used for water resources protection reasonably and efficiently, which can increase the sustainable supply capacity of water resources on the one hand and motivate enterprises to develop water-saving technologies, improve production processes and promote industrial structure upgrading on the other. At the same time, correct guidance from the government to enterprises can enhance their confidence in prioritizing water conservation and innovative development, accelerate the process of completing the introduction of water conservation technology facilities, and achieve the dual goals of sustainable economic growth and sustainable use of water resources.

**Supplementary Materials:** The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/w15050916/s1, Figure S1: Responses of enterprises to water resources tax shocks; Figure S2: Resident response to the water resources tax shock; Figure S3: Overall impact of water resources tax on economy and society.

**Author Contributions:** Writing—review & editing, Validation, Supervision, Funding acquisition, L.W.; Writing—original draft, Conceptualization, Data curation, Software, M.; Writing—original draft, Formal analysis, Investigation, Visualization, Z.L.; Writing—original draft, Project administration, Resources, J.P. All authors have read and agreed to the published version of the manuscript.

**Funding:** Project no. 132805 has been implemented with the support provided from the National Research, Development and Innovation Fund of Hungary, financed under the K_19 funding scheme.

**Data Availability Statement:** The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

**Conflicts of Interest:** The authors declare that they have no competing interest.

## References

1. Wang, Y.; Yang, J.; Chang, J. Development of a coupled quantity-quality-environment water allocation model applying the optimization-simulation method. *J. Clean. Prod.* **2019**, *213*, 944–955. [CrossRef]
2. Zhai, J.L.; Feng, R.G.; Xia, J. Constraining factors to sustainable utilization of water resources and their countermeasures in China. *Chinese Geogr. Sci.* **2003**, *13*, 310–316. [CrossRef]
3. Majeed, A.; Wang, Y.; Muniba; Islam, M.A. The Impact of Social Preferences on Supply Chain Performance: An Application of the Game Theory Model. *Complexity* **2023**, *2023*, 1–12. [CrossRef]
4. Thomas, A.; Zaporozhets, V. Bargaining Over Environmental Budgets: A Political Economy Model with Application to French Water Policy. *Environ. Resour. Econ.* **2017**, *68*, 227–248. [CrossRef]
5. Lago, M.; Mysiak, J.; Gómez, C.M.; Delacámara, G.; Maziotis, A. Defining and assessing economic policy instruments for sustainable water management. In *Global Issues in Water Policy*; Springer: Berlin/Heidelberg, Germany, 2015; Volume 14, pp. 1–13. ISBN 9783319182872.
6. Xu, Q. Water Resource Tax Reform to Build Resource-saving Society. *J. Coast. Res.* **2020**, *115*, 506–509. [CrossRef]
7. Ma, Z.; Zhao, J.; Ni, J. Green tax legislation for sustainable development in china. *Singapore Econ. Rev.* **2018**, *63*, 1059–1083. [CrossRef]
8. Sabohi, M.; Soltani, G.R.; Zibaie, M. Evaluation of the strategies for groundwater resources management: A case study in Narimani plain, Khorasan Province. *J. Sci. Technol. Agric. Nat. Resour.* **2007**, *11*, 475–484.
9. Llop, M.; Ponce-Alifonso, X. Identifying the role of final consumption in structural path analysis: An application to water uses. *Ecol. Econ.* **2015**, *109*, 203–210. [CrossRef]
10. Berrittella, M.; Rehdanz, K.; Roson, R.; Tol, R.S.J. The economic impact of water taxes: A computable general equilibrium analysis with an international data set. *Water Policy* **2008**, *10*, 259–271. [CrossRef]

11. Berck, P.; Moe-Lange, J.; Stevens, A.; Villas-Boas, S. Measuring Consumer Responses to a Bottled Water Tax Policy. *Am. J. Agric. Econ.* **2016**, *98*, 981–996. [CrossRef]
12. Qin, C.; Jia, Y.; Su, Z.; Bressers, H.T.A.; Wang, H. The economic impact of water tax charges in China: A static computable general equilibrium analysis. *Water Int.* **2012**, *37*, 279–292. [CrossRef]
13. Mushtaq, S.; Khan, S.; Dawe, D.; Hanjra, M.A.; Hafeez, M.; Asghar, M.N. Evaluating the impact of Tax-for-Fee reform (Fei Gai Shui) on water resources and agriculture production in the Zhanghe Irrigation System, China. *Food Policy* **2008**, *33*, 576–586. [CrossRef]
14. Kilimani, N.; van Heerden, J.; Bohlmann, H. Water taxation and the double dividend hypothesis. *Water Resour. Econ.* **2015**, *10*, 68–91. [CrossRef]
15. Shen, J.; Luo, C. Overall review of renewable energy subsidy policies in China - Contradictions of intentions and effects. *Renew. Sustain. Energy Rev.* **2015**, *41*, 1478–1488. [CrossRef]
16. Xin, C.; Guo, F.; Wang, A. Exploring the impacts of China's water resource tax policies: A trade-off between economic development and ecological protection. *Front. Environ. Sci.* **2022**, *10*, 2163. [CrossRef]
17. Ouyang, R.; Mu, E.; Yu, Y.; Chen, Y.; Hu, J.; Tong, H.; Cheng, Z. Assessing the effectiveness and function of the water resources tax policy pilot in China. *Environ. Dev. Sustain.* **2022**, 1–17. [CrossRef]
18. Mu, L.; Zhang, X.; Cheng, S.; Song, P. The effectiveness of a water resource tax policy in improving water-use efficiency: A quasi-natural experiment-based approach. *Water Policy* **2022**, *24*, 899–922. [CrossRef]
19. Mu, L.; Mou, M.; Tang, H. Does the water resource 'fee to tax' policy alleviate water poverty? Evidence from a quasi-natural experiment. *Water Supply* **2022**, *22*, 8465–8482. [CrossRef]
20. Liu, Y.; Zhang, Z.; Zhang, F. Challenges for water security and sustainable socio-economic development: A case study of industrial, domestic water use and pollution management in Shandong, China. *Water* **2019**, *11*, 1630. [CrossRef]
21. Kydland, F.E.; Prescott, E.C. Time to Build and Aggregate Fluctuations. *Econometrica* **1982**, *50*, 1345. [CrossRef]
22. Dhawan, R.; Jeske, K.; Silos, P. Productivity, energy prices and the great moderation: A new link. *Rev. Econ. Dyn.* **2010**, *13*, 715–724. [CrossRef]
23. Angelopoulos, K.; Economides, G.; Philippopoulos, A. First-and second-best allocations under economic and environmental uncertainty. *Int. Tax Public Financ.* **2013**, *20*, 360–380. [CrossRef]
24. Filardo, A.J. Monetary Policy and Asset Price Bubbles: Calibrating the Monetary Policy Trade-Offs. *SSRN Electron. J.* **2011**. [CrossRef]
25. Sun, C.; Xu, Z.; Zheng, H. Green transformation of the building industry and the government policy effects: Policy simulation based on the DSGE model. *Energy* **2023**, *268*, 126721. [CrossRef]
26. Benavides, C.; Gonzales, L.; Diaz, M.; Fuentes, R.; García, G.; Palma-Behnke, R.; Ravizza, C. The impact of a carbon tax on the chilean electricity generation sector. *Energies* **2015**, *8*, 2674–2700. [CrossRef]
27. Majeed, A.; Ye, C.; Chenyun, Y.; Wei, X. Muniba Roles of natural resources, globalization, and technological innovations in mitigation of environmental degradation in BRI economies. *PLoS ONE* **2022**, *17*, e0265755. [CrossRef]
28. Argentiero, A.; Bollino, C.A.; Micheli, S.; Zopounidis, C. Renewable energy sources policies in a Bayesian DSGE model. *Renew. Energy* **2018**, *120*, 60–68. [CrossRef]
29. Llop, M.; Ponce-Alifonso, X. A never-ending debate: Demand versus supply water policies. A CGE analysis for Catalonia. *Water Policy* **2012**, *14*, 694–708. [CrossRef]
30. Xiong, Z.; Li, H. Ecological deficit tax: A tax design and simulation of compensation for ecosystem service value based on ecological footprint in China. *J. Clean. Prod.* **2019**, *230*, 1128–1137. [CrossRef]
31. Chen, Z.R.; Yuan, Y.; Xiao, X. Analysis of the Fee-to-Tax Reform on Water Resources in China. *Front. Energy Res.* **2021**, *9*, 641. [CrossRef]
32. Pan, D. The Economic and Environmental Effects of Green Financial Policy in China: A DSGE Approach. *SSRN Electron. J.* **2019**. [CrossRef]
33. Li, H.; Peng, W. Carbon Tax, Subsidy, and Emission Reduction: Analysis Based on DSGE Model. *Complexity* **2020**, *2020*. [CrossRef]
34. Sun, D.; Wang, F.; Chen, N.; Chen, J. The impacts of technology shocks on sustainable development from the perspective of energy structure—a dsge model approach. *Sustainability* **2021**, *13*, 8665. [CrossRef]
35. Zhang, J.; Zhang, Y. Examining the economic and environmental effects of emissions policies in China: A Bayesian DSGE model. *J. Clean. Prod.* **2020**, *266*, 122026. [CrossRef]
36. Acemoglu, D.; Aghion, P.; Bursztyn, L.; Hemous, D. The environment and directed technical change. *Am. Econ. Rev.* **2012**, *102*, 131–166. [CrossRef] [PubMed]
37. Shao, S.; Yang, L.; Huang, T. Theoretical Model and Experience from China of Energy Rebound Effect. *Econ. Res. J.* **2013**, *48*, 96–109.
38. Niu, T.; Yao, X.; Shao, S.; Li, D.; Wang, W. Environmental tax shocks and carbon emissions: An estimated DSGE model. *Struct. Chang. Econ. Dyn.* **2018**, *47*, 9–17. [CrossRef]

39. Yang, B.; Chen, X. Improvement on the congested government productive spending in stochastic endogenous growth model. In Proceedings of the 2012 International Conference on Modelling, Identification and Control, ICMIC 2012, Wuhan, China, 24–26 June 2012; pp. 426–428.
40. Majeed, A.; Wang, L.; Zhang, X.; Muniba; Kirikkaleli, D. Modeling the dynamic links among natural resources, economic globalization, disaggregated energy consumption, and environmental quality: Fresh evidence from GCC economies. *Resour. Policy* **2021**, *73*, 102204. [CrossRef]