RESEARCH AND DEMONSTRATION OF AGRICULTURAL POLICY SIMULATION BASED ON CGE MODEL

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Abstract: In the event that lacks of faced to policy simulation platform, we presented a simulation platform which makes use of computer technique in this paper. On this platform, we integrated CGE model, DSS, data warehouse, data convert and other components together, established a prototype of policy simulation platform system, and simulated the agriculture subsidizes policy through the scene analysis method. The analytic results demonstrated the feasibility and functionality of the simulation platform prototype system.

1 INTRODUCTION

Policy simulation is a virtual policy test aimed at policy problems based on mathematical modeling, computer simulation and computer technology. Facing with various social and economic problems, it is necessary to test them on virtual economic system, which means to analyze its impact through the simulation of economic policy on many aspects of society, assess the effects of policies and improve the science of policy establishment (Xueming Liu, 2004). The development of policy simulation is helpful to progress policies of economic, trade, energy and environment, determines the state of the economy and so on. Particularly, it is very realistic to improve governmental decision-making in the conditions of policy development through simulation competition in the market of developed countries after China joined WTO.

In the research field of policy simulation, developed countries has developed a number of policy simulation systems by computer technology and widely used computer optimization. U.S. economic model ASPEN (Basu, 1998) is a new economic simulation platform, whose prototypal version was used for the analysis of business cycle phenomena and extended version was used to analyze the effects of monetary policy. T.Iba (Iba, 2000) et al developed crates economic model which provided a model of open development environment. Zhang Shiwei et al (Shiwei Zhang, 2004) developed a macroeconomic model platform called ASMEC-I, which used to analyze the effects of various agricultural products, consumption, prices, markets and trade in China under policies and external shocks. Jikun Huang et al (Jikun Huang, 2003) established the Chinese Agricultural Policy Analysis and Prediction Model (CAPSiM for short), which used to analyze of policies and external shocks on the production of various agricultural products in China, consumption, prices, markets and trade. The current version is programmed by Visual C #. It has friendly user interface and is easy to operate.

Computable General Equilibrium (CGE for short) model (Yuxin Zheng, 1999; Yong Zhao, 2008) treated the economic system as a whole analytic object, analyzed specific changes in economic policy by simulation of the whole economic system, and investigated the supply and demand relationship between various commodities and factors of production with a comprehensive view. CGE model divided macro-economic system into a large number of computable parts, calculated by computer simulation rather than analytical analysis to study the general equilibrium price changes within the framework of the impact of the economic system. Based on CGE technology, developed countries established a number of macroeconomic modeling

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and analysis systems (Powell, 1995), such as Fair-model system in United States, the Murphy Model systems in Australia, the MSG2 multi-country model from the United States, Japan, Germany, Australia and other countries. In this field, China's previous experience mainly relied on statistical analysis, which is a wide gap. In recent years, there have been some developments in models, but not enough. Policy simulation system has broad prospects for development, so this type of research and development of new simulation platform has great theoretical and practical significance.

With the widely use of CGE model in policy simulation fields, the studies on integration of policy simulation, CGE model and DSS decision-making system is still rare yet. This study aimed to construct a CGE model based on policy simulation platform called PSPBCGE (Policy Simulation Platform Based on CGE), applied advanced computer technology into the economic system modeling and policy simulation, effectively analyzed the policy simulation centered the CGE model as the core driver for the simulation platform, provided an effective system tools for the establishment and maintenance of CGE models by using the advantages of DSS and give full play to the efficacy of mathematical economic models.

2 COMPUTABLE GENERAL EQUILIBRIUM MODEL

The basic idea of CGE model is: based on the principle of profit maximization and under the conditions of resource constraints, producers determined the optimal supply of various commodities and needs of production factors; rested on the principle of utility maximization and in the budget constraint conditions, consumers determined the demand for various commodities. When the optimal supply is equal to the optimal, economic system achieved to the most stable equilibrium and a set of equilibrium price of a commodity could be calculated by the balance of supply and demand.

From the point of modeling view, CGE model is a set of equations for the balance between supply and demand economic systems, generally includes three equations of supply, demand and equilibrium. Its general structure can be shown in Table 1 below:

3 CONSTRUCTION OF POLICY SIMULATION PLATFORM

Policy simulation is the development of science policy in the computer age, therefore the extension of the policy simulation in technology respect is decision support system. From a purely technical point of view, policy research is also a process of information requiring, processing transmission and analysis, which is an intelligential technology comprehensively utilized of information technology and human brain functions. This allows us to take full advantage of modern computer technology to build data collection, processing and delivery system, establish comprehensive and effective database and carry out policy simulation analysis.

Table 1: Basic structure of CGE models.

	Supply	Demand	Supply-demand relationship
Main body	Producer= National production sector	Consumer= Residents + Business + Government	Market
Behavior	Producers maximize profits	Consumers maximization utility	Seek the market equilibrium price
Equations	Production equations Constraint equations Optimization condition equations Demand equation of production factors	Consumer utility equations Constraint equations Optimization condition equation Demand equation Supply equation of production factors	Product market equilibrium equation Factor market equilibrium equations Residents of the Balance Equation Government budget balance equation International market equilibrium equation
Variables	Commodity price and quantity, price and quantity of production factors, institutional variables, the variables that technological progress, the macro variables		

3.1 Basic Functions and Features of Simulation Platform

(1) Data acquisition, import, processing functions. System has the function of importing data from an external database, establishing realistic standards for data structure in order to conveniently access to user data system and updating data warehouse at any time. Data query can be process at any time by user needs, and data can be stored and converted so that each module can facilitate the data.
The system can response users request at any time of data query, data storage and data conversion, so that the data can be conveniently invoked by all functional modules.
(2) Functions of policy simulation, calculation and analysis. The system can satisfy the calculation needs of the CGE model, policy-oriented integrate the CGE model, DSS decision-making methods and tools and data warehouse, and maximally provide an efficient, comprehensive and visualized policy simulation platform to users.
System can provide users to maximize an efficient, comprehensive, policy simulation visualization platform.
(3) System running process is a process of interaction with policy makers, provides visual and vivid support to help users understanding the structure of CGE models, social accounting matrix and policy simulation theory. Furthermore, this process can clarify decision-making problems and form policy simulation scenario by gradually interactive process, obtains policy simulation results after running the system and finally get policy recommendations.

3.2 Simulation Platform based on the Overall Data Warehouse Structure

Prototype system consists of six modules: knowledge base management system (KBMS), database management systems (DBMS), question generation system (QGS), CGE model generation system (CGEGS), CGE model solving system (CGESS), input and output and analysis system (IOAS). Figure 1 shows the overall structure.

3.3 Programming Language

There are three parts: Human Machine Interface and decision-making processing system based on Microsoft Visual C++.Net (Hongshen Gao, 2009), CGE model generation and solving system based on GAMS software (http://www.gams.com, 2009) which is a calculation module simulation platform, and database system based on Microsoft SQL sever 2000 (William, 2007). The hierarchy of the simulation platform is shown in Figure 2.

3.4 Implementation Process of Policy Simulation

Users can use the CGE model to simulate policy changes on economic systems to meet the needs of government policy makers. Establish the base year equilibrium data namely social accounting matrix, design specific policy variables according with specific policy issues and department assembly, simulate, calculate and analyze in the last. The implementation process shows in Figure 3.

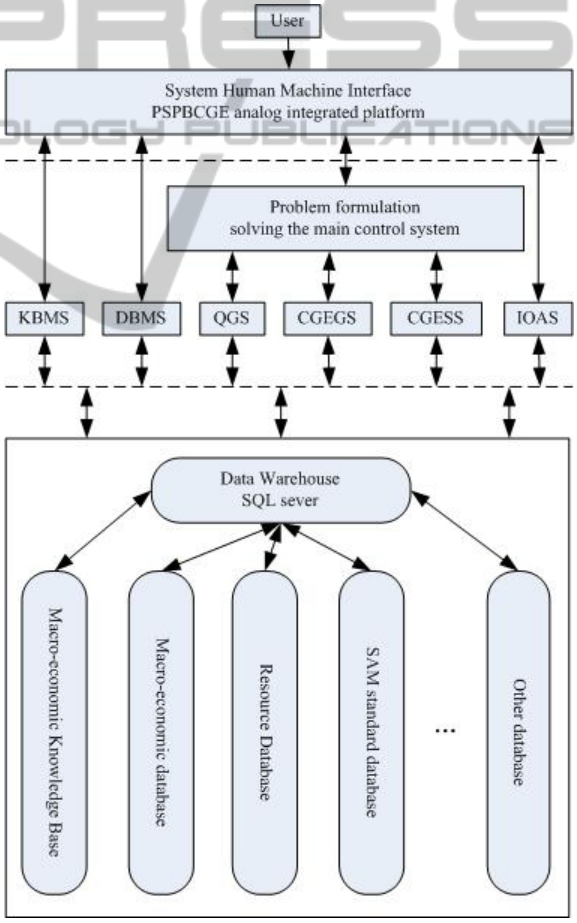

Figure 1: PSPBCGE overall structure simulation platform.

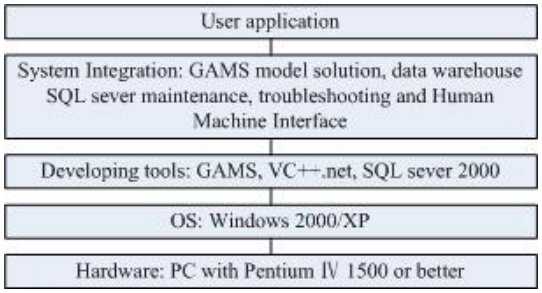

Figure 2: The Hierarchy Structure of PSPBCGE.

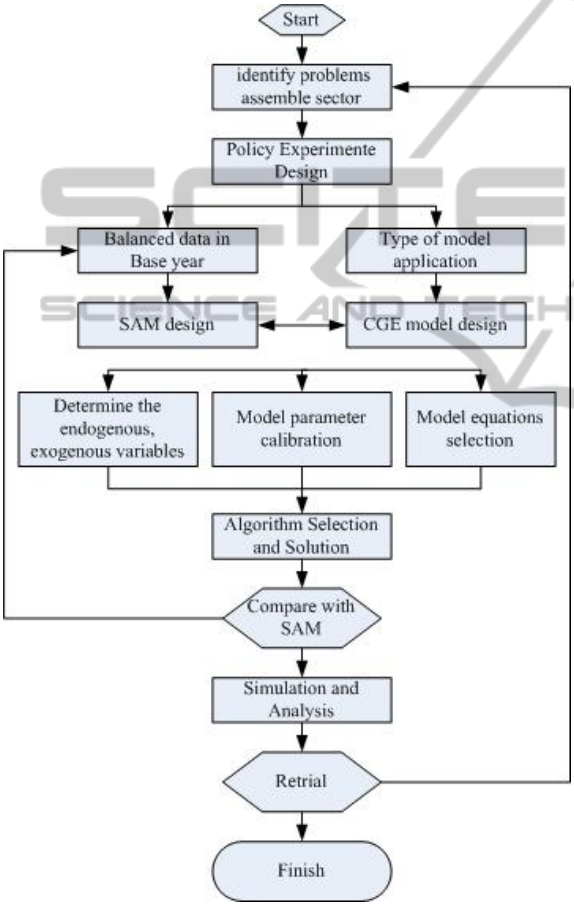

Figure 3: Chart flow of simulation platform.

4 EMPIRICAL SIMULATIONS OF AGRICULTURAL SUBSIDIES

Using simulation platform prototype, given China's agricultural subsidy policy as policy variables, Empirical simulations of agricultural subsidies can analyze the scenario simulation how the change of policy variables impact national economy and test the construct validity of the policy simulation platform.

Scenario assumptions: on the premise of other variables remained constant, change one variable and calculate the changed value of other variables, and achieve the impact results from policy variables to other variables.

Simulation process: According to specific policy issues assemble sectors, design specific policy variables, select variable base value, set the simulation scenario, simulate calculation and analysis, and give recommendations in policy analysis.

4.1 Simulation Program Design

Departmental assembly: 1. Agriculture; 2. Industry; 3. Construction industry; 4. Post and telecommunication; 5. Commercial food service; 6. Non-material production sectors.

Evaluating indicator: 1. Classification wages (wage), divided into urban income and rural income; 2. Consumer price index (CPI); 3. Actual government savings (RSg); 4. Government subsidies (TSubs); 5. Exports (PS).

Variable base value: yellow box agricultural subsidies in 1997 were 50.092 billion (Yuan Xiwen Cheng, 2005).

Scenarios are: Scenario 1: 20% increase of agricultural subsidies based on 1997 base value; Scenario 2: 30% increase of agricultural subsidies based on 1997 base value; Scenario 3: 40% increase of agricultural subsidies based on 1997 base value.

4.2 Simulation Results and Analysis

The results are shown in Figure 4, where: horizontal ordinate shows income of urban residents income, rural people's income, consumer price index, real government savings, government subsidies and export value index; vertical ordinate shows the impact from raise of agricultural production subsidies indexes to evaluating indicator under 3 scenarios, namely the percentage relative to the base period. The result shows that increase of agricultural sector production subsidies significantly impacted the income of rural residents but little effect to wages of non-agricultural sector. Simultaneously, consumption has increased, so rural workers were beneficiaries. Increased agricultural production subsidies declined government's saving, but not great. Escalation of production subsidies expanded governmental public spending. Moreover, as the international competitiveness of agricultural products increased the increase in agricultural subsidies to stimulate exports to some extent.

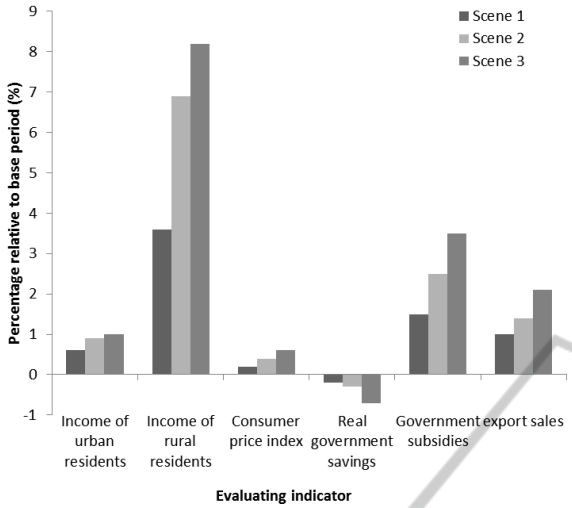

Figure 4: The impact of economic indicators.

5 CONCLUSIONS

From the respect of policy simulation, this paper proposed and built a simulation platform for policy decision-making prototypes. The construction of simulation platform included modeling, model computer expression, establishment of data warehouse, data exchange and format conversion, CGE computing environment and effective integration of DSS and so on. Using this integrated simulation platform, an empirical simulation for policy issues of agricultural subsidies was tested.

The results showed that the simulation platform achieved the intended purpose and could solve practical problems. We hope this paper can play a role in attracting valuable opinions and promote the application of policy simulation platform.

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