Model for Environmental and Economic Policy

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Content

- Background
- Two Approach of economic policy analysis
- Solution for environmental and economic policy simulation system
- Simulation scenarios of Policy Experiment
- Conclusion

Background

◆Environmental issues have become increasingly prominent, Especially the problem of water pollution In **China**

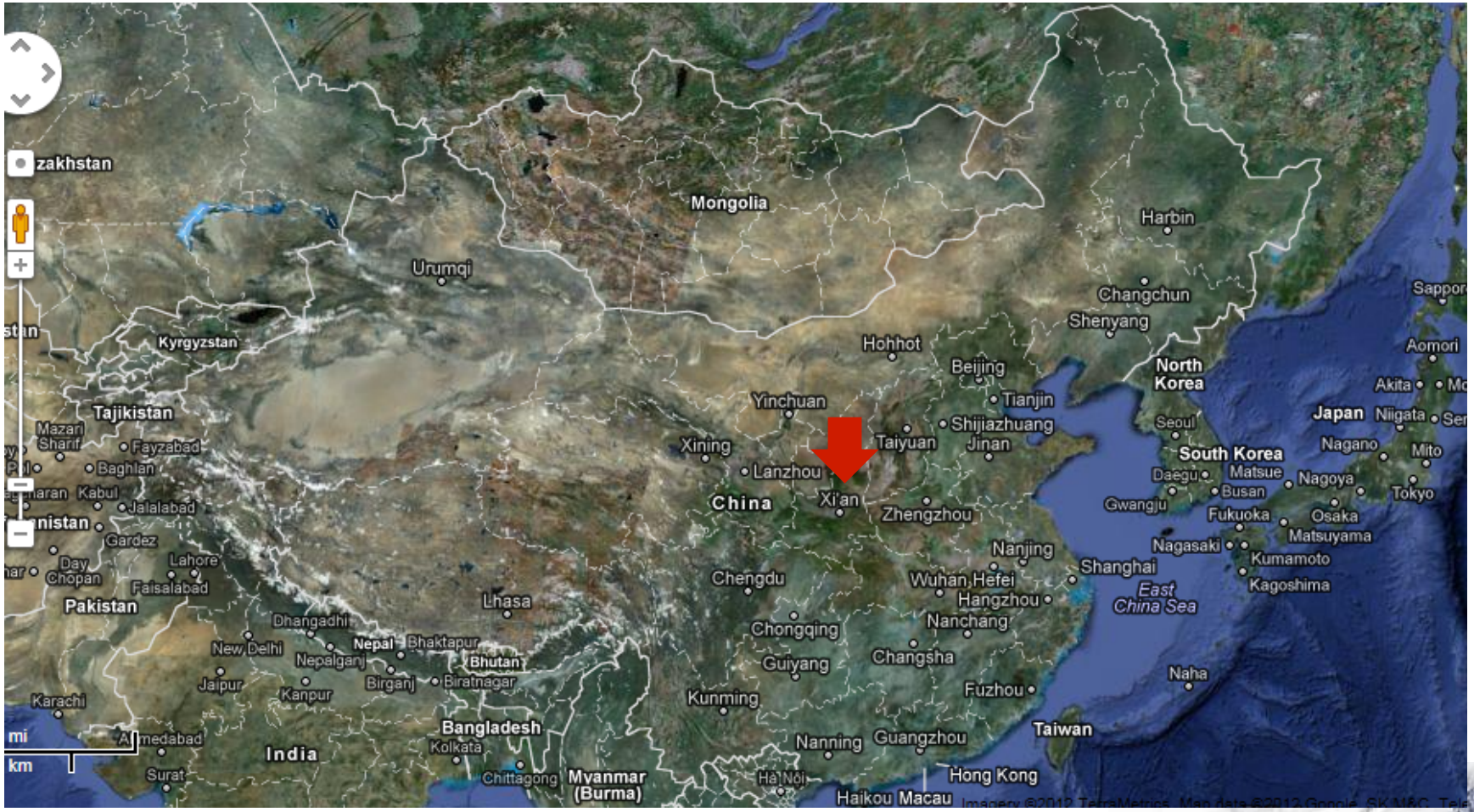
◆Environmental and economic policy use the Price、tax etc. as financial and economic **Means**, adjusting the economic interests of relevant actors, to achieve the protection of environmental and the coordinated development of environment and economy

◆The policy simulation has become an important scientific tool for the formulation of economic policy

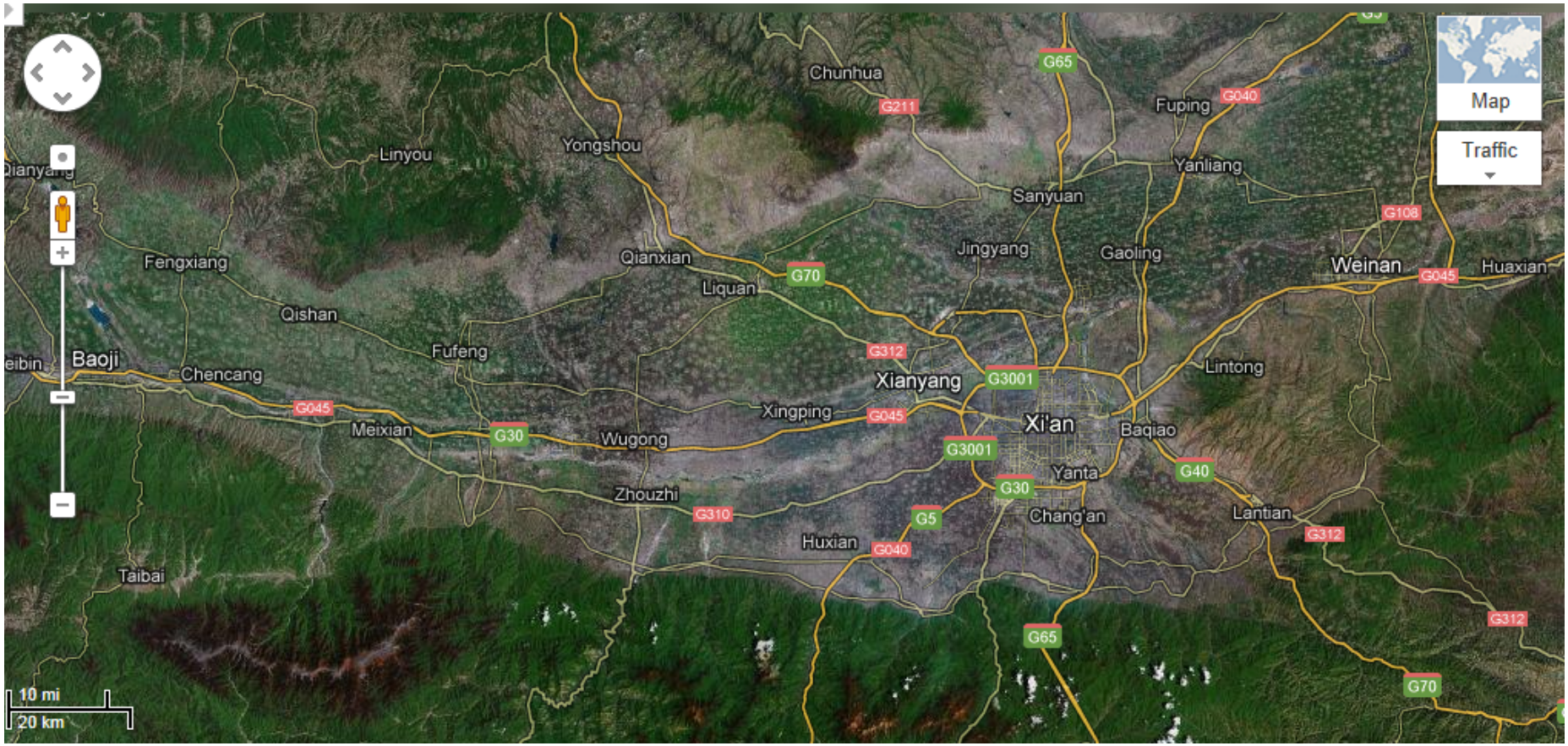
Goal

1. Provide the model , with the Weihe river basin as an example, to explore interactions and the evolution mechanism of the watershed changes in the environment，human economic activity and government policies.
2. Support on Policy Design or Analysis of integrated watershed **management**, for promoting regional social and economic sustainable development

Center of China



WeiHe River basin



Annual Plan

The first year(half year):

1.survey the experiences of evaluating environment-economic policy and agent-based simulation,

2.study the environmental behavior of industrial enterprises,

3.explore the impact of policy on the environment and corporate,

4.carry on agent-based on heterogeneous interaction of environmental policy design simulation research

5.Integrate of decision support systems and adaptive intelligent interface research with GIS

Annual Plan

The second year:

1.Collect watershed data,

2.dentify the impact of major environmental issues and environmental factors of the Weihe River,

3.Summarize the evolution rule of the pollution-intensive industries evolution.

4.Construct agent simulation platform, building agent-based high-performance policy control simulation system

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Computable general equilibrium-CGE

- General equilibrium theory
- Use a set of equations to describe the economic system of supply, demand and market relations, the variable includes the number of goods and production factors、 market prices and factors' incomes. Under the constraint of a series of optimized conditions, Solve these equations, Getting the quantity and price when All markets have reached the balance between supply and demand

Agent-based computational economics -ACE

- Complex adaptive system

- Using agent-based computer simulation to analyze and simulate real economic complex adaptive system, is lots of independent and interaction agent evolution of computing and research methods to the entire economic system

The applications of Agent-based simulation method

- ASPEN
- Simulate the economy, allowing changes in laws, rules and policies, allowing separate analysis or comprehensive analysis of the different sectors in the economy, also accurately simulate the behavior of the economic basic decision sector

The applications of Agent-based simulation method

- EURACE
- Establish a policy analysis economic model, using interact agent of the different roles and the different markets to analyze the role of economic policy in the macro model, and analyze the mutual influence of different types of policy measures

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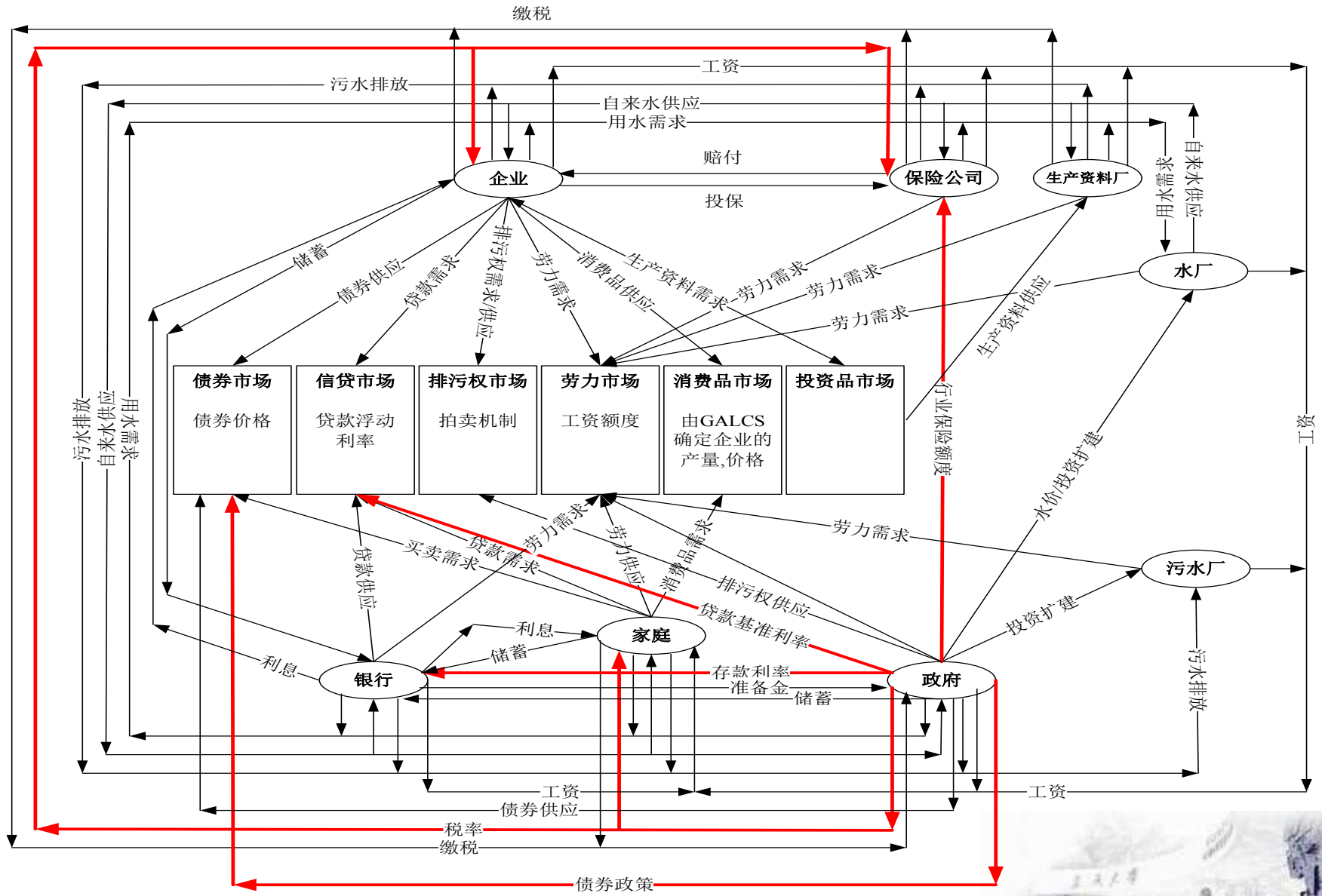
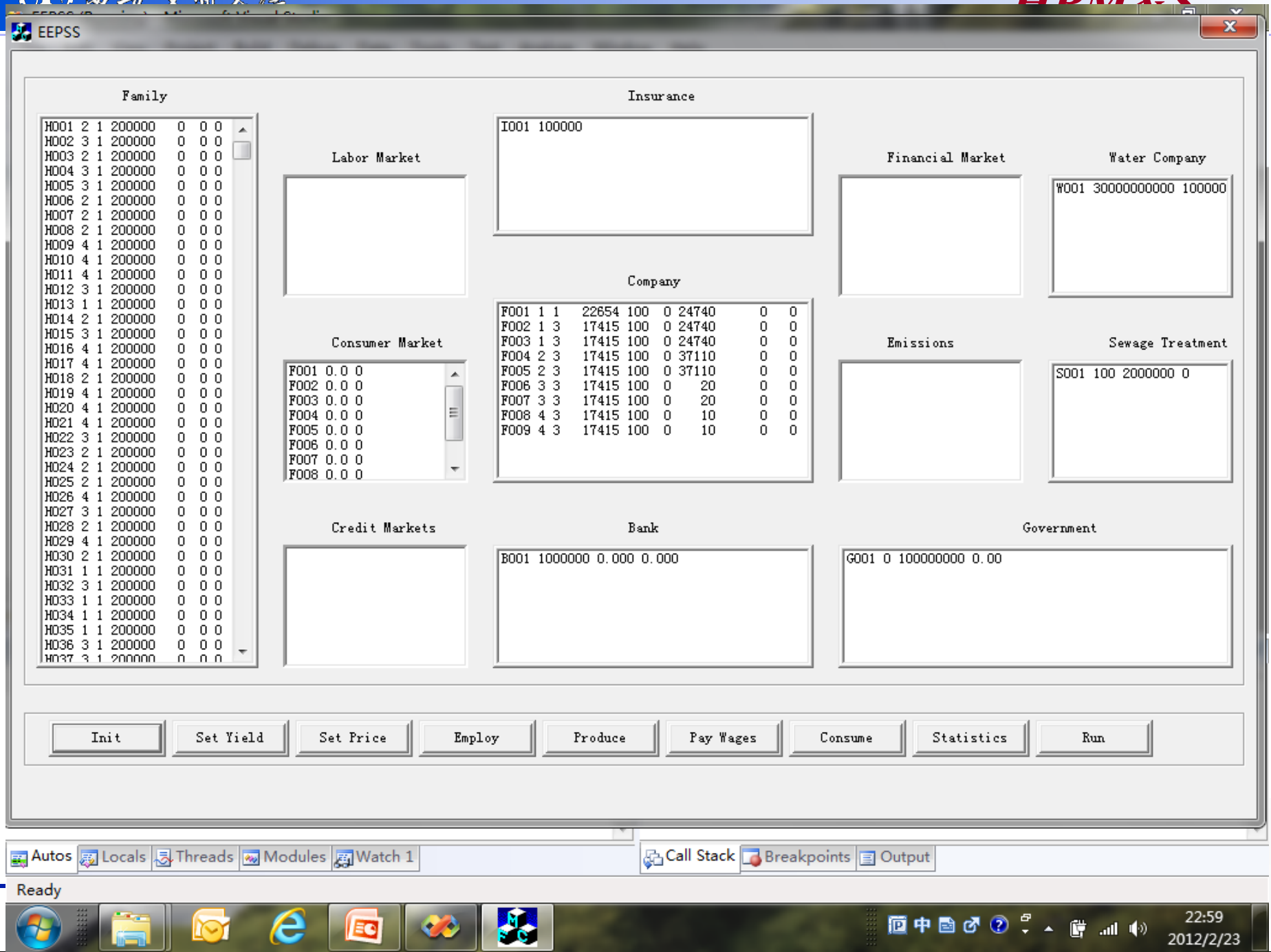
Models and entity

- Agent
  - Households
  - Corporations
  - The government
  - The central bank
  - …
- Market
  - Labor market
  - Goods market
  - Production market
  - Credit market
  - …


缴税
工资
污水排放
自来水供应
用水需求
赔付
投保
企业
保险公司
生产资料厂
水厂
储蓄
债券供应
贷款需求
排污权需求供应
劳力需求
消费品供应
生产资料需求-劳力需求
劳力需求
劳力需求
生产资料供应
债券市场
债券价格
信贷市场
贷款浮动利率
排污权市场
拍卖机制
劳力市场
工资额度
消费品市场
由GALCS确定企业的产量,价格
投资品市场
行业保险额度
水价投资扩建
污水排放
自来水供应
用水需求
劳力需求
劳力供应
消费品需求
劳力需求
贷款供应
买卖需求
贷款需求
排污权供应
贷款基准利率
污水厂
投资扩建
利息
储蓄
家庭
银行
政府
存款利率
准备金
储蓄
污水排放
工资
工资
债券供应
税率
缴税
债券政策


EEPSS
Family
H001 2 1 200000 0 0 0
H002 3 1 200000 0 0 0
H003 2 1 200000 0 0 0
H004 3 1 200000 0 0 0
H005 3 1 200000 0 0 0
H006 2 1 200000 0 0 0
H007 2 1 200000 0 0 0
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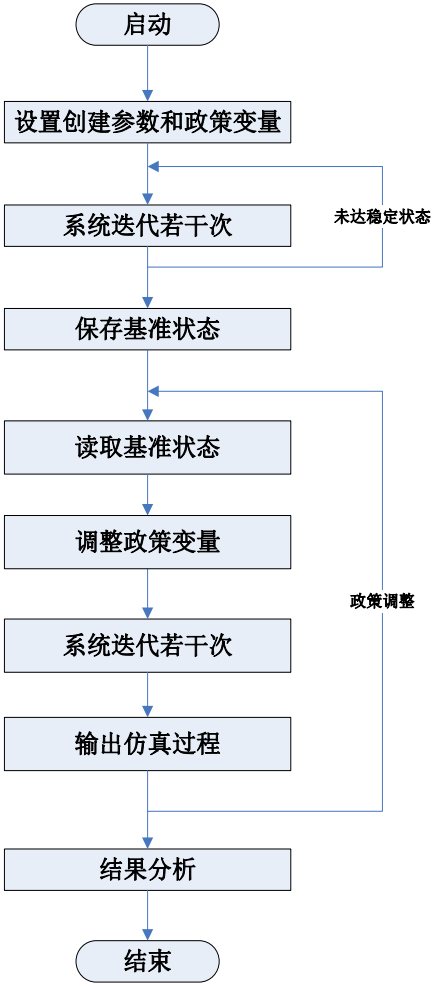
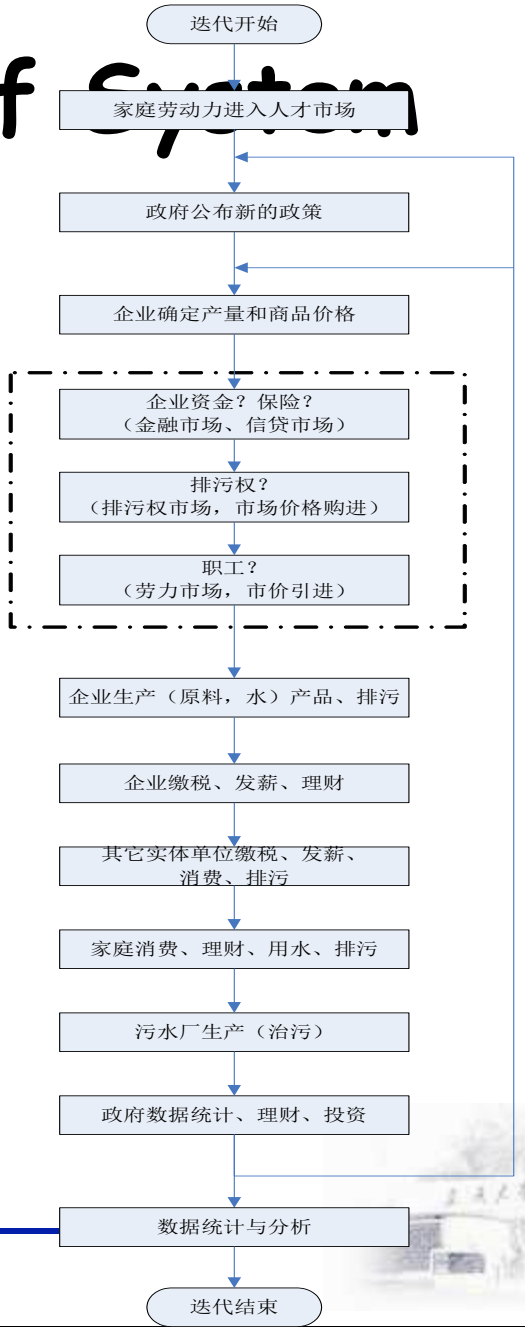
H032 3 1 200000 0 0 0
H033 1 1 200000 0 0 0
H034 1 1 200000 0 0 0
H035 1 1 200000 0 0 0
H036 3 1 200000 0 0 0
Insurance
I001 100000
Labor Market
Financial Market
Water Company
W001 30000000000 100000
Company
F001 1 1 22654 100 0 24740 0 0
F002 1 3 17415 100 0 24740 0 0
F003 1 3 17415 100 0 24740 0 0
F004 2 3 17415 100 0 37110 0 0
F005 2 3 17415 100 0 37110 0 0
F006 3 3 17415 100 0 20 0 0
F007 3 3 17415 100 0 20 0 0
F008 4 3 17415 100 0 10 0 0
F009 4 3 17415 100 0 10 0 0
Consumer Market
F001 0.0 0
F002 0.0 0
F003 0.0 0
F004 0.0 0
F005 0.0 0
F006 0.0 0
F007 0.0 0
F008 0.0 0
Emissions
Sewage Treatment
S001 100 2000000 0
Credit Markets
Bank
B001 1000000 0.000 0.000
Government
G001 0 100000000 0.00
Init
Set Yield
Set Price
Employ
Produce
Pay Wages
Consume
Statistics
Run
Autos
Locals
Threads
Modules
Watch 1
Call Stack
Breakpoints
Output
Ready
22:59
2012/2/23

Simulation Process of System





Events Period

Yearly		Monthly		Every Day
First Day	Promulgation of new policy	First Day		Price determination by firms
	Firms expand their scale			Food demand by families
Some Day		Some Day	Production quantity determination by firms	
			Financial determination by firms	
			Labor demand by firms	
			Production by firms	
Last Day	Statistics released	Last Day	Financial conditions Statistics by firms	

Parameter &Output files

- **Parameter files**
  - Creating Parameters

    Including number of every Agents, simulation period, etc.

  - Initializing Values

    Initializing Values of the state variables of every Agents.

  - Policy control variables

    Policy-relevant variables

- Output files

- Macroeconomic-related data

  Including GDP, total amount of emissions, total household consumption, etc.

- Agents State

  Output the detailed state of Agents, including asset status of the families, financial status of the firms, etc.

Algorithm

The GALCS is used to the production quantity determination by firms in the system.

①Firms develop production plans and determine increase or decrease in production every month.

②According to the following four-dimensional data of firms recently.

(1) Product prices is rising or falling ;

(2) Sales of the product is increasing or decreasing;

(3) Profits is rising or falling ;

(4)Stock is rising or falling.

We can determine the 16 states of a firm. Each state corresponds to a probability vector, including the probability of increase production, to maintain the production and reduce production.

Algorithm

③Based on the change of profit, a firm can determine the correctness of this month decision-making.

If the profit increase, then increase the corresponding probability in the state of the determination and decrease the other probability corresponding to other determinations.

If the profit decrease, then decrease corresponding probability and increase the other probability .

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The price of water

1. Simulate the environmental and economic conditions of Weihe River in the 2009-2014 five-year period according to the water price of Xi'an in 2009;
2. After increase industrial water price to 3.85 and 4.30 yuan per cubic meter, simulate the environmental and economic conditions of Weihe River in the 2009-2014 five-year period.
3. Increase industrial water price year by year according to the program of Xi'an Price Bureau, Simulate the environmental and economic conditions of Weihe River in the 2009-2014 five-year period.

Simulation scenarios program

4. According to the industrial classification and the production process , increase industrial water price of the high-polluting and backward technology firms, as the table shows , simulate the environmental and economic conditions of Weihe River in the 2009-2014 five-year period.

Industry	Technology	Water price
Food	Backward	3. 85
	General	3. 65
	Advanced	3. 45
Nondurable goods	Backward	4. 35
	General	4. 05
	Advanced	3. 85
Durable goods	Backward	4. 45
	General	4. 25
	Advanced	4. 05

Simulation scenarios

5. After the introduction of the behavior of technology improvement, simulate the environmental and economic conditions of Weihe River in the 2009-2014 five-year period.

Industry	Technology level	Needed funds of Technology improvement	Water Consumption Of unit product	Pollution of unit product
Food	Primary	0	0.05	0.2
	Intermediate	100000	0.04	0.1
	Senior	1000000	0.035	0.05
Nondurable goods	Primary	0	0.5	0.4
	Intermediate	200000	0.4	0.3
	Senior	2000000	0.35	0.1
Durable goods	Primary	0	10	0.5
	Intermediate	500000	8	0.4
	Senior	5000000	6	0.3

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- China has **not** establish the mathematical model (or computational model) that used to simulate the mutual interaction of the economic and environment by now.

- Therefore, the introduction of agent-based modeling technology to the field of environmental protection and policy simulation has important theoretical and practical significance.

Any Question

Thank you so much!

My student questions

1.Is households should be divided into the cities and countryside in consideration of the situation in china?

2.How to judge a behavior of one agent is important or not?

3.We determine the price of product by GALCS, at the same time, determine the yield by GALCS too, is it feasible?

4.In the simulation system, the number of agents is determined by what principle?

5.In the development of ASPEN/EURACE model,how to keep each market's design and realization,and in the end how to integrate the markets together,use interface or other means ?

6.How can we run an agent-based simulation system without detailed data?

7.If we want to get some detailed data,for example,we want to get detailed information about factory,how can we do our survey?Can you talk it based on EURACE

8.How to judge whether a price is reasonable or not in the market economy?

9.Which data(results) is the most important (or we most care about)in the simulation?

My questions

- How to hide the technical detail for improving the performance of FLAME
  - Automatic scalability
- How to port the domain model by FLAME to different hardware platform
  - X10

Co-operation?

Simulation scenarios program