

Plans of smart growth in Shenmu and Edinburgh

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Abstract: Edinburgh and Shenmu are chosen for plans of smart growth. We make it clear how their plans meet the smart growth principles. Using data in the period of plans (2011~2015), we calculate values of our metrics to simply analyze their success. Furthermore, we use mean value test (t test) to measure the overall performance from 2011 to 2015. In conclusion, Edinburgh's growth plan is more successful while Shenmu still has a long way to go.

Next, we devise a general growth plan for both cities. A specific plan with 7 initiatives is also proposed for each city based on their own features. To forecast the performance of new plans, we choose cities with similar situation, Shenmu and Baotou, Edinburgh and Norway, and analyze their correlation by SPSS. Both Baotou and Norway implemented smart growth plan since 2006, so the smart growth data of Baotou and Norway can be used to forecast the performance of Shenmu and Edinburgh respectively. By comparing TGM under current plan and new plan in 2031, we find both two cities perform better with our new plans.

We use Data Envelopment Analysis Model (DEA) to analyze the efficiency of each initiative and rank them from high to low. Then the same points and differences between two cities are pointed out.

1. Introduction

Smart growth is a way to build cities, towns, and neighborhoods that are economically prosperous, socially equitable, and environmentally sustainable and it has 10 basic principles, such as mix land uses, taking advantage of compact building design, creating walkable neighborhoods and so on. we make a research on the current growth plan in Edinburgh and Shenmu and use our metric to measure it. Next, we design a new plan for Edinburgh and Shenmu and forecast its performance.

2. Terminology and Definitions

Table 1 Terminology and Definitions

Terminology	Meaning
TGM	Total Growth Metric
EGM	Environmental Growth Metric
DGM	Developed Growth Metric
SGM	Social Growth Metric
RC	Resource Consumption
PD	Pollution Discharge
HLE	Human Life Expectancy
EL	Education Level
IL	Income Level
PI	Population Index
CPI	Corruption Perceptions Index
GC	Gini Coefficient

3. Current Growth Plan in Edinburgh

Plan Analysis

Edinburgh is a British city and the capital of Scotland. Edinburgh used to be one of the economic centers of Scotland. The education of Edinburgh is also developed. The Strategic Development Plan for Edinburgh identifies four Strategic Development Areas in Edinburgh providing a focus for new housing development, investment opportunities and job creation in locations with good accessibility to existing or planned public transport services, we list some of the plans [5]:

- The strategy directs new housing to sites which best meet a range of assessment criteria including landscape impact, green belt boundaries, accessibility to public transport and infrastructure capacity.
- The plan must act in the best way to reduce emissions, adapt to climate change and prepare development plans to further sustainable development.
- Help to create strong, sustainable and healthier communities, enabling all residents to enjoy a high quality of life.
- Help ensure that the citizens of Edinburgh can get around easily by sustainable transport modes to access jobs and services

Through the above plans, we can see that Edinburgh's current plans are basically in line with the principles of smart growth. Plans about land-use conform to *mix land uses* and *creating a range of housing opportunities and choices* in smart growth principles. The fourth plan meets the principles--foster distinctive, attractive communities with a strong sense of place and strengthen and direct development towards existing communities. The fifth plan is--create walkable neighborhoods. In a word, the current plan is a good reflection of ten basic principles.

Test with Our Metric

- **Simple Analysis**

To evaluate the influence of growth plan, we should calculate our metrics. In the process of development of a city, plans are constantly changing as well as the development level, so it is meaningless to research plans in long period. Besides, the development plans change every five years in china. Therefore we choose the data from 2011 to 2015 as five samples and calculate EGM, DGM, SGM and TGM for five years. The results are shown in the table below.

Table 2 The metrics of Edinburgh

Year	EGM	DGM	SGM	TGM
2011	0.264	0.863	0.696143221	2.27565
2012	0.259	0.863	0.674349503	2.246963789
2013	0.259	0.875	0.681755975	2.303229644
2014	0.257	0.892	0.693375245	2.406578672
2015	0.253	0.892	0.717083532	2.528215455

In Table 3, we can see that EGM reached 0.253 in 2015, which is lower than average level. It shows a lower level of environmental consumption, meaning a resource-friendly city. DGM is 0.892, which is higher than the baseline of 0.8, indicating an extremely high level of human development. The SGM is 0.717, which is obviously higher than 0.5, indicating that this is a fairly fair society. The final TGM of 2.5282 shows the growth plan is successful.

4. Current Growth Plan in Shenmu

Plan Analysis

Shenmu is located in Shanxi Province, China. The economy of Shenmu is competitive in northwestern China, however, it mainly relies on the coal industry to develop the economy which has a bad influence on the environment. What's more, the climate of Shenmu is characterized by severe heat and cold and frequent disasters which makes the environment even worse. And in social equity,

Shenmu does not well. To solve these problems, the Shenmu government takes a series of measures from 2011 to 2015. We select some of them listed below [6]:

- Attach importance to characteristic agriculture.
- Develop the modern service industry to provide more choices.
- Build an ecological livable city according to the principle of “*four parks, three changes, two lines*”. Four parks refer to build four characteristic parks to improve the living environment of residents. Three changes refer to landscaping, greening and lighting. Two lines aim to develop the traffic.
- Accelerate the construction of key communities. Select communities with bright prospects for key planning and construction and form the main gathering point with beautiful environment and good facilities.

Through the above principles, we can see that the plan meets some of the smart growth principles. For example: the principle of “*four parks, three changes, two lines*” is to preserve open space, farmland, natural beauty and critical environmental areas and to provide a variety of transportation choices. Accelerating the construction of key communities is consistent with strengthening and directing development towards existing communities. But we also find that the plan doesn’t pay attention to mix land uses and compact building design.

Test with Our Metric

- **Simple Analysis**

To see the influence of growth plan, we choose the data from 2011 to 2015 and calculate relevant metric.

Table 4 The metrics of Shenmu

Year	EGM	DGM	SGM	TGM
2011	0.662	0.647	0.377848158	0.369286644
2012	0.654	0.663	0.424911109	0.43075851
2013	0.651	0.695	0.4321172	0.461323278
2014	0.649	0.695	0.430384444	0.46088935
2015	0.649	0.712	0.407862291	0.44745447

In Table 4, we can see that EGM was getting smaller and reached 0.649 in 2015. It shows the environmental conditions are improving. But the EGM is still larger than average level which shows environmental conditions are not optimistic. DGM is 0.712, indicating a high level of human development. The SGM is 0.408, which is obviously lower than 0.5, indicating that Shenmu still a long way to go in social fairness. The final TGM of 0.447 shows the growth plan still needs to be improved.

5. Our Plan for Edinburgh and Shenmu

We develop a growth plan for both cities using smart growth over the next few decades.

1. Pay attention to environmental protection, ensure the proportion of green space, and improve the living environment.
2. Develop industries with low pollution and high returns, such as new service industries.
3. Use renewable energy instead of chemical energy, such as solar energy.
4. Pay attention to people's livelihood, and make great effort to provide medical, education, transportation and other security.
5. Pay attention to adjusting the gap between rich and poor, and guarantee the subsidies to low-income earners.
6. Pay attention to sustainable economic growth, and eliminate backward industries.

6. Conclusion

The rank of Shenmu and Edinburgh is quite different.

In Shenmu, the most potential initiative is adhering to the green development. This is because the environment in Shenmu is damaged in the process of economic development. But in Edinburgh, the initiative on economy works best, since the financial industry is a pillar industry in Edinburgh and account for a large share of Edinburgh's GDP.

In Shenmu, initiative about social fairness is the worst. Shenmu is a resource-based city, a small number of people are rich relied on natural resources, but the majority of ordinary people is still relatively poor because of the low level of economic development. This gap between rich and poor is difficult to change. The worst initiative in Edinburgh is about fossil fuel consumption. Edinburgh is a developed city, with a large car ownership, and urban heating system is perfect, it is difficult to easily reduce fossil fuel consumption.

There are also some same points between Edinburgh and Shenmu. The initiative that develop high-tech industry have achieved some success. Advanced technology can not only create a lot of social wealth, and with the development of technology it will become more and more friendly to the environment, so that the policy for development of high-tech in any city is very effective.

The initiatives of two cities on the creation of a fusion of neighborhood have not achieved any results, Neighborhood integration is not only the design of the building but also need more changes in ideas, which needs slowly cultured, So the effect is not satisfactory after the implementation of the plan.

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