Analysis of Maxproximity and RCA with International Trade Data--Take China as an Example

Mengyu Qiao[1], *Tieju Ma[2]

[1]dept. Management Science and Engineering, East China University of Science and Technology, Shanghai, China

[2]dept. Management Science and Engineering, East China University of Science and Technology, Shanghai, China

[1]qiaomengyu7353@163.com

[2]tjma@ecust.edu.cn

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Abstract. This paper emphasize "maxproximity" to define the maximum proximity between a product with RCA<1 and one with RCA>1, then calculate the relationship between them. We take China as an example to verify the feasibility on maxproximity, simulate the product structure evolution with the rules we summarize, and construct a product space network to demonstrate the process. We draw a conclusion that country specialize the products with high complexity can produce other kinds of goods easily, because the country has the product knowledge more diversified.

1. Introduction

Product diversification has been a recent focus of the trade literature. Economists have revealed the importance of product diversification from multiple angles. For example, diversification is considered a significant policy objective for countries made a specialty of natural resources [1], the concentration of resources in few sectors may be risky in terms of exposure to idiosyncratic shocks which can limit economic growth [2]. Whether a country can upgrade its production and diversify to complicated goods decides its taking off or remaining poor [3]. So the structural transformation plays a very important role in studying economic growth [4,5,6].

It's proved that countries will develop goods nearby the ones they have comparative advantage [7,8].Based on the achievement in the past, this paper emphasizes a concept "maxproximity" accounted for the maximum of the proximity between RCA=<1 product and RCA>1 product, analyzes the relationship between maxproximity and RCA. Then takes China as an example to verify this thought and make a forecast for the future development of products space.

2. Data

This paper use the international trade data are from Huasmman and Hidalgo's study on Economic Complexity (Huasmman and Hidalgo 2013) which is originally from United Nations Commodity Trade Statistics Database. We use the international trade data from 1984 to 2010, classified with the 4-digit level of Standard International Trade Classification.

3. Method

3.1 Proximity

The concept of proximity was put forward by Hidalgo et al. [7], which formalizes the intuitive thought that the ability to produce existing products decides the ability to produce another product. The proximity φ between products i and j is the minimum of the pairwise conditional probabilities of a country exporting a good given that it exports another.

$$\varphi_{i,j} = \min\{P(RCAx_i|RCAx_j), P(RCAx_j|RCAx_j)\} \quad (1)$$

where RCA stands for revealed comparative advantage, which measures whether a country c

exports more of good i, as a share of its total exports, than the "average" country (RCA > 1 not RCA < 1) [7].

$$RCA_{c,i} = \frac{x(c,i)}{\sum_i x(c,i)} \Big/ \frac{\sum_c x(c,i)}{\sum_{c,i} x(c,i)} \quad (2)$$

where products are indexed with i and countries are indexed with c.

3.2 Maxproximity

Hidalgo et al.[7] discovered that countries follow a diffusion process in which comparative advantage move preferentially toward products close to existing goods. So Hidalgo calculated that and found there is a monotonic relationship between the proximity of the nearest developed good (RCA>1) and the probability of transitioning into RCA>1.

In order to further study this problem, we put forward a concept to define the proximity of the nearest developed good, which called "maxproximity". The Maxproximity φ_{max} is the maximum of the proximity between product i and other products which RCA>1.

Then we calculate the relationship between maxproximity and the probability *P* of products transitioning in more detail.

$$P=X_{i,j}/Y_{i,j} \quad (3)$$

Where $X_{i,j}$ stands for the number of products transforming to RCA>1 after 5 years with RCA=i (i<1) and *maxproximity=j* (0=<j<1). And $Y_{i,j}$ stands for the sum of the products with RCA=i and maxproximity=j.

We divide the data from 1985 to 2010 into 5 sets per 5 years. Then we divide the RCA [0, 1) and maxproximity [0, 1) into ten equal parts. Fig.1 shows under different maxproximity, the mean ratio of products with given original RCA transform to RCA>1 of the 5 sets. This ratio can be considered as the probability of a product transform to RCA>1 with a given RCA and maxproximity.

From Fig.1 we can see the higher maxproximity is, the higher probability is, which may indicate it valuable to study transition probability. Bigger maxproximity means a good with RCA<1 is more similar to the goods countries are good at producing now. So the countries can turn to produce it more easily.

4. Computational Experiment

4.1 Global data

In order to certificate the feasibility of the relationship between maxproximity and transition probability, we use the world trade data of 27 years to calculate the moving average of the transforming probability between per 5 years with given original RCA and maxproximity. Specifically, based on 1984's real data, we calculate the maxproximity and current RCA, find the corresponding probability to predict whether every product transforms to RCA>1 for 26 years to 2010. We test it for 10 times and the result is shown in Fig.2. The blue line is actual value and the red ones are simulation results.

From Fig.2 we find that the simulation results are similar and approximate to the reality data.

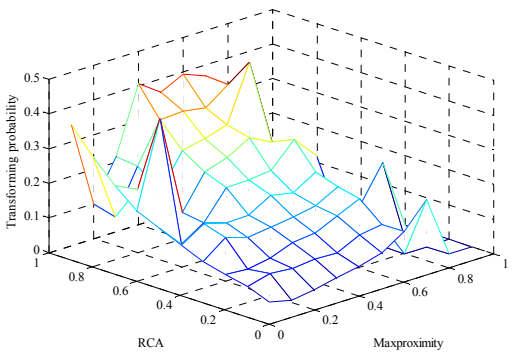

Figure1. The product transforming probability with given RCA and Maxproximity.

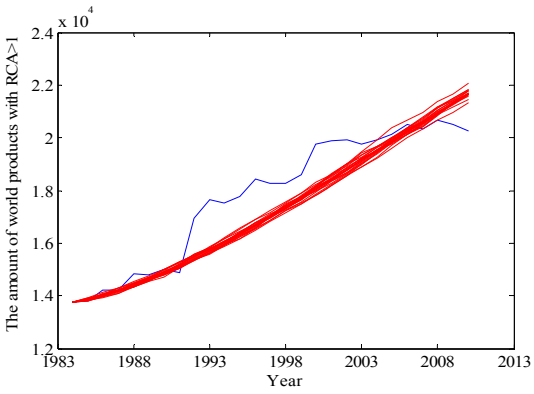

Figure2. The amount of world products with RCA>1 from 1984 to 2010

4.2 China data

In consideration of the above calculation, we use the probability make a prediction of China from 2010 to 2030. Fig.3 is the real products space of China in 2010. The nodes represent different kinds of products and the edges represent the maxproximity between products. When the maxproximity>0.4, we draw an edge. Some isolated nodes are ignored in this figure. From Fig.3 we can find the core is occupied mostly by labor intensive, capital intensive and machinery, which need the factors universal among most goods. So they have higher proximity with others more possibly and locate the core place. The square nodes represent all the products with RCA>1. We can see there are bigger occupancy of RCA>1 products in labor intensive and machinery field. This demonstration is coincident with the conditions in China.

Then we construct the same products spaces of 2020 and 2030 based on the prediction results. They are shown in Fig.4 and Fig.5.

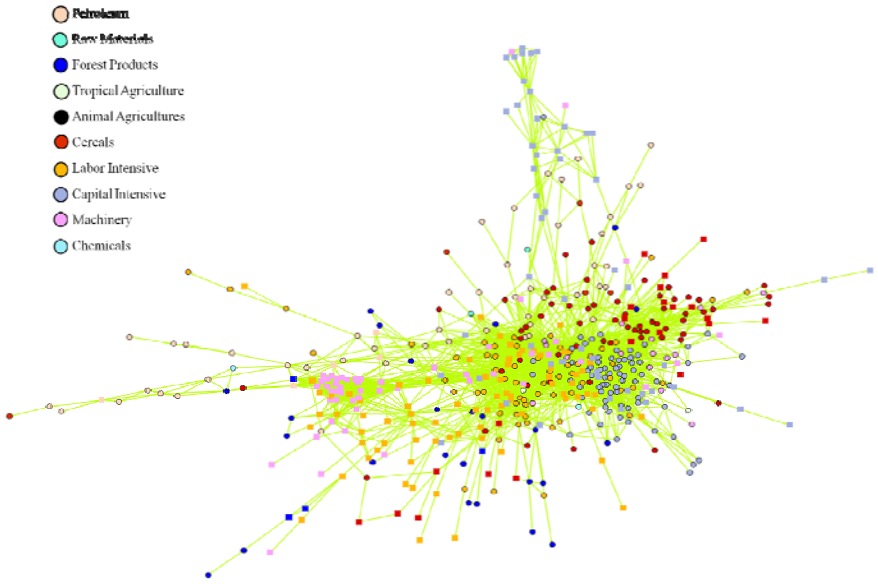

Figure 3. The product space of China in 2010

Figure 4. The product space of China in 2020

Figure 5. The product space of China in 2030

There is not a very significant difference in 2020 but still can find the increase amount of capital intensive products with RCA>1. When in 2030, the change becomes apparent. Firstly, the RCA>1 products occupancy increases sharply. Then cereals have the same variation. Furthermore, there is a decrease in labor intensive goods and machinery.

For the two rising ones, they both have higher maxproximity with others, especially capital intensive products, which had higher maxproximity due to their complex factors. Under the circumstance, they have more and more products with RCA>1 in their own fields. It is a popular appearance for a country, because capital intensive goods can deliver greater benefits and promote production ability.

On the other hand, for the falling ones, China is not that good at producing labor intensive goods in 2030. The goods don't have high maxproximity with others, due to their plain constitution, leads to the lower transforming probability. As for the surprising machinery, it's probably the influence of degeneration probability. Or more chances to transform to RCA>1 are bestowal to capital intensive products.

We select the four of the most significant categories. There are some kinds of nodes not mentioned here, which are relatively isolate and not changing obviously.

5. Conclusion

Through the above research, we may think it meaningful to raise "maxproximity" and study the relationship between maxproximity and the probability of transforming to RCA>1. It is recognized by many economists that a product's development is influenced by the nearby products. This paper also proves this opinion.

We put forward a concept "maxproximity" on the basis of forefathers. Then make use of the real trade data calculate probability of transforming to products with RCA>1. Finally take China for example to simulate the evolution of products space 20 years later. It is found that the capital intensive products and cereals would have a blossom, and the reason is their higher maxproximity, which is corresponding with the opinion we raise previously.

Maxproximity tells us that if a country tends to produce more diversified goods, it should specialize the complex products, which has high proximity with more other goods. Then the ability can transit to other goods easily and efficiently.

To sum up, the maxproximity has value to research. A country can study the relationship between two products to make a forecast for the development of trade, and make appropriate policies to achieve economic aim.

6. Limitation and future research dimensions

This paper calculates the transforming probability according to the real historical data. Although put the curve fitting data (i.e. maxproximity>0.8) which have less chance to use, it leads to less chance

to use parameters. It causes shrink of uncertain of development and simplex consequence. Additional, this paper just provides a prediction of products relied on the relationship of maxproximity and transforming probability. The countries have little chance to make choices. In addition, the classification method we use here only bases on the products' material property, not the complexity. So it's pendent to conclude whether a country is going to produce complex goods.

In later work, we plan to vest products with complexity property. Countries are decision maker to choose the direction products develop. By simulating the different products development rules, we can compare the advantage and disadvantage of kinds of rules, then promote valuable policy suggestions.

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References

[1] Sachs J D, Warner A M. The curse of natural resources[J]. European Economic Review, 2001, 45(6):827–838.

[2] De Ferranti D. From Natural Resources to the Knowledge Economy: Trade and Job Quality[M]// The World Bank, 2002.

[3] McMillan M., & Rodrik, D., Globalization, structural change and productivity growth. NBER Working Paper 17143, National Bureau of Economic Research, 2011

[4] Hausmann R, Hidalgo C A. The Network Structure of Economic Output[J]. Journal of Economic Growth, 2011, 16(4):309-342.

[5] Amiti M, Freund C. The anatomy of China's export growth[J]. Research Working Papers, 2008, pp. 1-29(29).

[6] Broda C M, Weinstein D E. Globalization and the Gains from Variety[J]. Quarterly Journal of Economics, 2004.

[7] Hidalgo C A, Klinger B, Barabási A L, et al. The Product Space Conditions the Development of Nations[J]. Science, 2007, 317(5837):482-.

[8] Rodrik D, Hausmann R, Hwang J. What you export matters[J]. Journal of Economic Growth, 2007, 12(1):1-25.