Economic growth and concentrations

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Abstract. Over the past few decades, shift-share (SS) analysis is widely applied to explore the sources of local economic growth; however, it leaves unanswered the inequality question. The purpose of this paper is to exclude these biases caused by inequalities to generate a new identity, which fully shows the concept of externalities and comparative advantage, the nation-industry-region interactions and the structural change of local industry in a timely manner

1. Introduction

Over the past decades, China has been experienced the fastest-growing economy with average annual growth rate of 10% in the world, while China is suffered from the most serious regional inequality of all countries [1, 2, 3, 4]. The conflict between growth and inequality is just a unique China's phenomenon due to the urban-biased policies which pour the huge amounts of social resources into these cities as growth poles that allow China to catch up with the developed economies. Moreover, China's development follows many critical contributions to regional science, for example, growth pole theory and agglomeration economies to propose the concept of regional or industrial clustering as an engine of economic growth and innovation [5, 6]. and these arguments further deteriorate sharply China's inequality problem. In sum, economic polarization in China is actually reflected in imbalance in industrial structure and regional disparities and the inequality question has therefore provoked a great deal of controversy among the authorities, society and researchers in China.

Little attention has been given to a new debate whether inequality question can distort shift-share (SS) analysis, namely, the decomposition of regional economic growth into national, industrial, regional effects externally as well as local specialization effect from comparative advantage. For example, regional or industrial effect of SS analysis is calculated by comparing a region (industry) with its nation based on a classical assumption from regional science that any region or industry is always trivial from macroeconomic angle; that is to say, a region or industry is approximately independent of its nation. However, the fact that regional and industrial inequalities will lead to dominant regions or industries as a critical part of the nation must violate this hypothesis. To make matters worse, when we omit the inequality question to generate three biased external causes, local specialization effect will eventually be incompatible with the law of comparative advantage in need of independencies among different units. Finally, the globalization promotes a higher degree of inequality in order to advance in competitive abilities. It is thus expected that a new decomposition of local growth associated with regional and industrial inequalities is indispensable to SS analysis, especially China.

Even SS analysis is a complicated decomposition approach, the concept of a set is regarded as the best solution: nation can be divided into four separate parts according to industrial and regional classifications and then we can rewrite a new identity with these four areas in order to meet the independent requirements for comparative advantage. At the same time, our new identity possesses

desired properties, including being easy to understand, providing a full description of nation-industry-region interaction and searching a correct turning point of industrial transformation. The remainder of this paper is organized as follows. In Section 2, this new version is created to fully remove the impacts of regional and industrial inequalities; at the same time, we discuss some economic meanings and properties of this newly-revised identity. Finally, some conclusions are given in Section 4.

2.   A new identity

In this section, we will outline all aspects of deriving a new version, especially based on the concept of a set. In addition, the correctness of this new identity will be later proved and analyzed according to the concept of externalities and comparative advantage.

2.1 Traditional decomposition and the inequality problems

SS analysis, using the method followed by [7] in the context of output may be described as follows:

$$\frac{\Delta y_{ij}}{y_{ij}} = \frac{\Delta y}{y} + \left(\frac{\Delta y_j}{y_j} - \frac{\Delta y}{y} \right) + \left(\frac{\Delta y_i}{y_i} - \frac{\Delta y}{y} \right) + \left(\frac{\Delta y_{ij}}{y_{ij}} - \frac{\Delta y_i}{y_i} - \frac{\Delta y_j}{y_j} + \frac{\Delta y}{y} \right), \qquad (1)$$

$$= NE + IM + RE + SE$$

where y_{ij}, y_i, y_j *and* y represent the output level of industry j in region i, the regional output level, the industrial output level and national output with m regions and n industries, respectively. It is clear that (1) is a mathematical identity derived by decomposing the change in industrial output in a region into four portions: NE, IM, RE and SE, which is used to evaluate the growth of local specialization from location quotient (LQ) as the degree of local comparative advantage, which is defined by a ratio of industrial shares in two independent regions as follows:

$$\frac{\Delta LQ_{ij}}{LQ_{ij}} \approx \Delta \ln LQ_{ij} = \Delta \ln \left(\frac{\frac{y_{ij}}{y_i}}{\frac{y_j}{y}} \right) = \frac{\Delta y_{ij}}{y_{ij}} - \frac{\Delta y_i}{y_i} - \frac{\Delta y_j}{y_j} + \frac{\Delta y}{y} = SE, \qquad (2)$$

Although the fact that SS analysis is to decompose the change in local output into national, industrial, regional and localized specialization effects seems very reasonable, many overlapping (non-independent) conditions caused by regional and industrial inequalities may give rise to new problems for these four effects. For example, the national economy is an aggregation of regional or industrial elements in (3). By analogy, industrial and regional output variables can be obtained by aggregating industrial output in all regions in (4) and the sum of regional output in all industries in (5).

$$y = \sum_{i=1}^{m} y_i = \sum_{j=1}^{n} y_j = \sum_{i=1}^{m} \sum_{j=1}^{n} y_{ij} \qquad (3)$$

$$y_j = \sum_{i=1}^{m} y_{ij} \qquad (4)$$

$$y_i = \sum_{j=1}^{n} y_{ij} \qquad (5)$$

Judged from the above equations (3) to (5), comparison between a region or industry and its nation is valid only under the assumption that all inequality possibilities can be ignored based on four

restrictions: $\dfrac{y_{ij}}{y_i} = \dfrac{y_{ij}}{y_j} = \dfrac{y_i}{y} = \dfrac{y_j}{y} \approx 0$. Among these situations, $\dfrac{y_{ij}}{y_i} = \dfrac{y_j}{y} \approx 0$ implies that the shares of industry j in region i and its nation both must be very small; at the same time, regional distributions in this nation and industry j are both much more diversified for $\dfrac{y_i}{y} = \dfrac{y_{ij}}{y_j} \approx 0$. However, these conditions completely conflict with the regional and industrial inequalities, which are caused by industrial and spatial concentrations based on agglomeration economies and growth pole theory as the critical conceptions in the field of regional economics. All of the above makes it clear that omitting the inequality dispute is unsatisfactory for correctly decomposing every source of China's growth.

2.2 The concept of a set

As can be seen from the above, industrial and spatial dimensions each make the inequality issue more complex. The concept of a set is proposed in order to resolve all questions simultaneously. The combination of all types of overlapping opportunities as shown in (3), (4) and (5) can be expressed by using a diagram as shown in figure 1 for the output of nth industry in m[th] region. This provides a convenient way of setting up a truly separated environment to exclude all possible overlapping channels caused by inequalities.

Figure 1. Industries and regions in a nation

There are many important implications in figure 1. First, to obtain the new macroeconomic variable, we must first deduct specific regional and industrial factors with the exception of y_{ij}, namely, the union of two sets (industrial and regional dimensions). In other words, the new national variable ($y' = y - y_j - y_i + y_{ij}$) as the green zone is totally different from original national factor (y) and this variable is defined by the output of other industries in other regions. Secondly, the new industrial (regional) variable, namely, $y'_j = y_j - y_{ij}$ ($y'_i = y_i - y_{ij}$) as the yellow and blue zones, respectively, is a specific industrial (regional) output minus output of industry j in region i. Thus, the new industrial and regional variables correspond to industry j in other regions and other industries in region i, respectively. As far as industry j in region i is concerned, it remains the same as the white zone. Finally, as can be seen in figure 1, it reveals that this new version is especially noteworthy in the case of a dominant region or industry on the grounds that this region or industry caused by regional or industrial inequalities occupies a major area, compared to its nation. It is obvious that original assumption is problematic. In summary, the sum of the four zones is equal to the national economy. This meets the requirement of the separation theorem and we can prove that the four variables must be independent of each other.

2.3 New version and LQ

As soon as the adjusted nation, industry and region, which are added to the local industry, are all determined independently, we can inquire into this new identity through SS analysis as follows:

$$\frac{\Delta y_{ij}}{y_{ij}} = \frac{\Delta y'}{y'} + \left(\frac{\Delta y'_j}{y'_j} - \frac{\Delta y'}{y'}\right) + \left(\frac{\Delta y'_i}{y'_i} - \frac{\Delta y'}{y'}\right) + \left(\frac{\Delta y_{ij}}{y_{ij}} - \frac{\Delta y'_i}{y'_i} - \frac{\Delta y'_j}{y'_j} + \frac{\Delta y'}{y'}\right)$$

$$= RNE + RIM + RRE + RSE \tag{6}$$

For convenience of analysis, our identity in (6) is separated into four new effects: revised national effect (RNE), revised industrial mix (RIM), revised regional effect (RRE) and revised specialized effect (RSE) based on four new variables in Section 3.2. To advance the reliability of new version, it is worthwhile examining the relationship between RSE and the revised LQ (RLQ) more closely. Let us start with the definition of the RLQ in independent case from [8]. as shown in (7).

$$RLQ = \frac{\dfrac{y_{ij}}{y_i - y_{ij}}}{\dfrac{y_j - y_{ij}}{y - y_j - y_i + y_{ij}}} \tag{7}$$

Through some mathematical operations in RSE as in (8), it is obvious that the RSE actually stems from the RLQ. It is better to say that the link between LQ and SE on classic conditions in (1) and (2) just corresponds to the relationship between RLQ and RSE based on the independent positions in (7) and (8). At the same time, from figure 1, it is clear that RLQ is a ratio of industrial shares in two regions, namely, region i and other regions and this is exactly the definition of comparative advantage. According to the above, we come to the conclusion that this revised version can greatly improve the fundamentals of SS analysis in complete agreement with the concept of comparative advantage.

$$RSE = \left(\frac{\Delta y_{ij}}{y_{ij}} - \frac{\Delta y'_i}{y'_i} - \frac{\Delta y'_j}{y'_j} + \frac{\Delta y'}{y'}\right) = \Delta \ln\left(\frac{\dfrac{y_{ij}}{y'_i}}{\dfrac{y'_j}{y'}}\right)$$

$$= \Delta \ln\left(\frac{\dfrac{y_{ij}}{y_i - y_{ij}}}{\dfrac{y_j - y_{ij}}{y - y_j - y_i + y_{ij}}}\right) \approx \frac{\Delta RLQ}{RLQ} \tag{8}$$

3. Economic meanings and policy

3.1 Comparison between old and new identities

It is believed that comparing the new and old identities can provide additional information to evaluate the merits of this new version. The following serves as an example with regional and industrial inequalities: a high-growth economically dominant area with a high-growth industry which plays a critical role in its nation. How can we decompose local-industry growth into four effects? This case will generate four outcomes: RNE<NE, RIM<IM, RRE<RE and a far higher RSE than SE due to the same magnitude of Δy_{ij}. This result tells us that the change in local competitiveness of this industry can be truly reflected in RSE, while an original SE is the wrong index for assessing local competitiveness.

Moreover, since there are other industries in other regions (y'), this industry in other regions (y'_j) and other industries in this region (y'_i) are all external to this industry in this region (y_{ij}), RNE, RIM and RRE can be regarded as three external sources of growth and change in local industrial output. Finally, RSE, representing the degree of industrial specialization by itself in this region based on the law of comparative advantage, is an internal factor. These outcomes are fully consistent with the spirit of SS analysis, where shift and share represent the changes in any economic variable from an internal factor and three external causes, respectively.

3.2 A manifestation of nation-industry-region interactions
The biggest discrepancy between this new version and the classical identity is our emphasis on the closer and clearer interactions between local industry and other external factors. For example, reference area in this new identity is variable by other industries in other regions as a new national element, while there is the same reference area, namely, nation in a traditional model. In a similar way, reference industry and region both are also flexible according to this industry in other regions and other industries in this region as new industrial and regional elements. In other words, this new identity with variable effects is very reasonable for facing different regions and industries. Finally, this new identity can let us see three types of real interactions: first, nation-local industry interaction is reflected in the relationship between local industry and other industries at other regions as RNE. Second, interregional interactions at the same industry are evaluated by RIM. Third, inter-industrial interactions within a region are appreciated by RRE. The above arguments are very reasonable and intuitive on the grounds that for any local industry, all possible external effects of local industry should inherently be different case by case. In sum, these changing effects of RNE, RIM and RRE can delicately delineate the interactive processes between local industry and three external factors.

4. Conclusion
The neglect of industrial and regional inequality questions in traditional regional science is incompatible with a true economic development like China. Moreover, the arguments regarding spatial and industrial concentrations make the ignorance of the inequality questions more and more preposterous. The purpose of this paper is to generate a new identity through the removal of these possible inequalities to reply to these doubts. Fortunately, the concept of a set is used to divide the national economy into four independent parts and it is proved to be very useful in answering this question. More importantly, our new version shows that local growth depends on three types of externalities as well as local comparative advantage and this outcome is totally consistent with economic theory in general. At the same time, it is believed that the regional and industrial inequality questions may apparently result in an under- or overestimation in all effects and it is confirmed by the well-known example of China with seriously regional and industrial inequalities. Finally, the ability to identify structural change can be greatly advanced using our new version and this is critical for setting a new development strategy in today's globalization era.

In sum, we believe that using this new version can improve the evaluation in the sources of growth and change of the regional economy. It is expected that this study can attract a renewal of interest in interdisciplinary MATEC Web of Conferences studies between regional science and other economic fields.

5. References
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