INTERACTIONS OF INDUSTRIAL WATER WITHDRAWAL AND ENERGY CONSUMPTION: A MULTI-SECTORAL DECOMPOSITION ANALYSIS IN CHINA

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Overview

The continuous changes of freshwater withdrawal and energy consumption are relevant to each other since they are sensitive to common or related driving factors, such as production structural adjustment, economic and population growth, and resource intensity. However, to our knowledge, few studies have reviewed and explained the changes of water withdrawal and energy consumption simultaneously to identify the correlations between these two indicators. To fill this gap, this study has a simultaneous look at the driving factors behind the changes of Chinese industrial water withdrawal and energy consumption. The timeframe for the analysis is 2002-2012 and it is divided to two periods, 2002-2007 and 2007-2012, to distinguish the influence before and behind the economic crisis in 2008. Then the contributions of individual industrial sectors to these factors were quantitatively evaluated. Beyond the decomposition analysis, the relevance between water withdrawal and energy consumption were identified and illustrated hints for the integrated planning in the future.

Methods

The decomposition analysis in this study adopted Log Mean Divisia Index method (LMDI)[1-2], a frequently used IDA method. This study focuses on 36 secondary industrial sectors in China, covering energy production and supply, manufacture. The value added data of each sector in 2002 and 2007 come from the Annual China Industry Economy Statistical Yearbook . The value added data of each sector in 2012 come from China's Input-output table 2012 . The current industrial value added was deflated into 2002 constant price. The energy consumption data were cited from the Chinese Energy Statistic Yearbook 2014 . For freshwater withdrawal of industrial sectors, the data were from the Annual Statistical Report of China Environment .

Results

The decomposition results of both industrial freshwater withdrawal changes and industrial energy consumption changes are shown in Fig. 1.

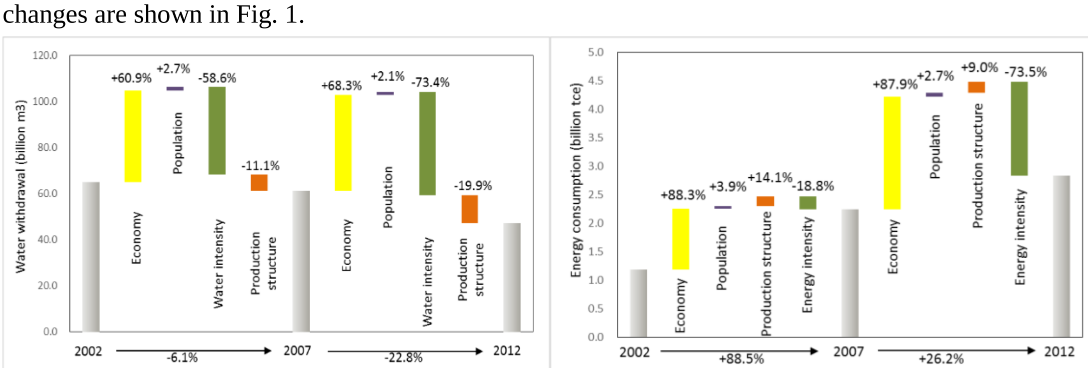
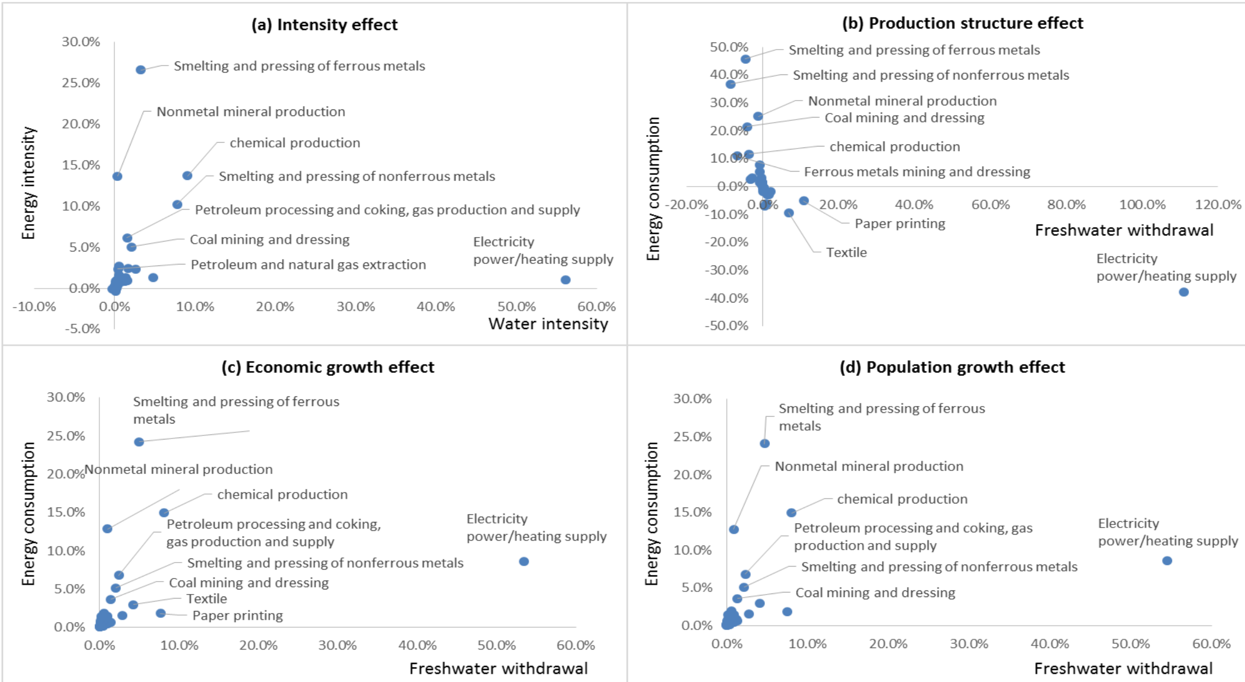


Figure 1. Contributions of different factors to the changes in industrial freshwater withdrawal and energy consumption 2002-2007 and 2007-2012.

We further performed multi-sectoral decomposition analysis on the industrial freshwater withdrawal and energy consumption to investigate the contributions of individual industrial sectors to each factor. The results are present in Fig. 2.



Figs. 2. The contributions of individual industrial sectors to each factor.

Conclusions

Economic growth act as the main positive factor which drove the increase of industrial freshwater withdrawal and energy consumption. And the intensity decrease is the primary driver which curb the industrial freshwater withdrawal and energy consumption. Moreover, a divergence between the driving effects of production structure on freshwater withdrawal and energy consumption was observed between 2002-2007 and 2007-2012. The increases of industrial freshwater withdrawal was inhibited by production structure adjustment while industrial energy consumption was increased.

Over the entire period, the increase of energy consumption caused by economic growth mainly happened in Smelting and pressing of ferrous metals sector, Nonmetal mineral production sector, chemical production sector and Smelting and pressing of nonferrous metals sector. These sectors also contribute significantly to the decrease in energy intensity (26.6%, 13.7%, 13.7%, and 10.2% respectively). Similarly, the increase of freshwater withdrawal caused by economic growth mainly happened in electricity power/heating supply sector, which is also the main contributor to the decrease in water intensity (56.1%).

References

[1] Ang, B. W.; Zhang, F. Q., A survey of index decomposition analysis in energy and environmental studies. Energy 2000, 25, (12), 1149-1176.

[2] Ang, B. W., LMDI decomposition approach: A guide for implementation. Energy Policy 2015, 86, 233-238.