would be 660,000 yuan.

The large gap between these figures stems from two main factors. The first is the difference in GDP per capita between the two cities. At the time of the study, the GDP per capita in Chancheng was 2.6 times of that of Yuantan. The second factor is the difference in the size of the affected populations. The population of Chancheng District, Foshan, was more than 10 times of that of Yuantan Town, Qingyuan. The population density of Chancheng was 6,311 people per km^2 while it was 412 people per km^2 in Yuantan. This means that pollution in Yuantan affects significantly fewer people than in Chancheng.

Shifting Polluting Industry Makes Sense

The results show that keeping all ceramics production capacity in Chancheng District is not a good choice if pollution is to be controlled in the district. The net benefit of not relocating ceramics production capacity (scenario 1) is only 48%-58% of the net benefits of the scenarios in which ceramics production capacity is moved. It was found that Chancheng could not meet national air quality standards if it retained all of its ceramics capacity, even if dust-catching technology was to be adopted by all the ceramic manufacturers in the region.

Out of all four scenarios, the net benefit of scenario 3 was the largest at 1464.51 million yuan. This suggests that the best choice would be to shift all the polluting part of the ceramic production process to Yuantan and to install dust-catching technology in the new plants. However, regardless of the use of dust-catching technology, this scenario would still push Yuantan's air quality beyond the national standard. Only Scenario 4 would ensure that the ambient PM_{10} concentration in both Chancheng and Yuantan would conform to national standards. The net benefit of scenario 4 would be about 84% of that of scenario 3.

Pollution Control Should be Implemented

It is clear that the net benefit of the scenarios in which dust-catching equipment is employed would be larger than those in which it is not used. For example, the net benefit of scenario 3 (which uses the suggested technology) would be larger than that of scenario 2 (which does not use the technology) by 4.35 million yuan. It can therefore be concluded that, whatever decisions are made about industrial relocation, it makes sense for ceramics producers to adopt pollution control technology. Overall, the study finds that the value of the health benefits produced by installing the chosen pollution reduction technology will greatly exceed the cost of putting the technology in place.

In China, the population density of relatively developed areas is commonly greater than that of underdeveloped areas. This study indicates that the relocation of heavily polluting industries to areas with lower population densities can help reduce the overall health impact of the air pollution from those industries, especially if such a move is linked with the introduction of pollution-abatement technology. In the specific case of Foshan and Qingyuan prefectures, it recommends that some ceramics production capacity should be relocated out of Chancheng District to Yuantan and that there should be strict controls on emissions in both locations. This would be the most effective use of environmental capacity and would ensure that the air quality in both locations meets national standards.

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Does Industrial Relocation Work – A Case Study From China

EEPSEA POLICY BRIEF • No. 2010-PB2

In recent years, Chinese policy makers have tried to balance development in different regions of the country by relocating industrial production from prosperous zones to less developed areas. However, this type of industrial relocation is usually accompanied by the transfer of pollution problems. To shed more light on the costs and benefits of this important policy tool, a new EEPSEA study looks at the relocation of ceramics production →

A summary of EEPSEA Research Report No. 2010-RR2: 'Environmental Cost Analysis of the Relocation of Pollution-intensive Industries Case Study: Transfer of Ceramics Industry from Foshan to Qingyuan, Guangdong Province' by Liu Li and Li Bin, College of Environmental Science and Engineering, South China University of Technology, Guangzhou 510006, P. R. China
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“Industrial relocation can... reduce the health impacts of air pollution”

Costs and Benefits of Different Scenarios

Scenario	Costs	Benefits
Scenario 1	Cost of adopting dust-catching technology for the unsettled part of ceramic production capacity in Chancheng	Health benefit of better air quality because of pollution abatement in Chancheng
Scenario 2	Health cost of worse air quality because of additional pollution in Yuantan	Health benefit of better air quality because of pollution abatement in Chancheng
Scenario 3	Health cost of worse air quality because of additional pollution in Yuantan Cost of adopting dust-catching technology for the unsettled part of ceramic production capacity in Yuantan	Health benefit of better air quality because of pollution abatement in Chancheng
Scenario 4	Health cost of worse air quality because of additional pollution in Yuantan Cost of adopting dust-catching technology for the unsettled part of ceramic production capacity in both places	Health benefit of better air quality because of pollution abatement in Chancheng

→ from one region of Guangdong Province to another.

The study is the work of Liu Li's research team from the College of Environmental Science and Engineering at the South China University of Technology, Guangzhou. By analysing a series of different industrial relocation scenarios, the study team finds that the transfer of some ceramics production from populous Foshan to the less densely populated Qingyuan would be an effective way of reducing the overall negative effects of the industry's air pollution. However, the study underlines the importance of using effective pollution-abatement technology and recommends that such technology should be implemented in Foshan and in any new ceramics factories in Qingyuan. It finds that the value of the health benefits produced by installing this technology will greatly exceed the cost of putting the technology in place.

Balancing Growth in Guangdong

Guangdong Province has experienced 30 years of rapid growth. Its Gross Domestic Product (GDP) increased by over 1 trillion yuan between 2005 and 2007. The province is divided into four main areas. Economically, both the East and West of Guangdong and its Mountainous region lag far behind the Pearl River Delta (PRD) area. To bridge this economic development gap, the Guangdong provincial government has made great efforts to encourage industrial relocation between regions.

To assess the effectiveness of this policy, the study looks at two areas in Guangdong: Foshan and Qingyuan prefectures. These are located in the PRD region and the Mountainous region in the north, respectively. Foshan is the more developed of the two study sites. In 2007, the population in Foshan was 5.9 million, and ranked sixth out of the 21 cities in Guangdong, while its GDP was 358.8 billion yuan, ranking third in the province.

The ceramics industry is a mainstay of the local industry in Foshan and generates an industrial output valued at about 40 billion yuan. Most of the ceramics firms in Foshan are located in Nanzhuang Town, Chancheng District. In 2007, the ceramics output from the district included about 490 million m^2 of tiles, 2.2 million pieces of sanitary ceramics and 32.1 million pieces of household porcelain.

The region's ceramic firms cause a significant amount of air pollution, accounting for 50% of the area's total gas emissions and almost 100% of its industrial dust pollution. The ceramics industry is also the second-largest industrial source of sulfur dioxide emissions. Because of this pollution, the Foshan municipal government plans to move some ceramic production out of the prefecture.

In comparison to Foshan, Qingyuan Prefecture is relatively underdeveloped. It has a population of 3.6 million. Its GDP in 2007 was about 59.7 billion yuan, and it ranked thirteenth out of the 21 cities of Guangdong. To improve its economic standing, the municipal government has made great efforts to attract investment into the region. The area already has a developing ceramics industry park in the middle of Yuantan Town in Qingcheng District. However, with the introduction of manufacturing industries into the area, the district's environmental quality is already starting to deteriorate.

The Costs and Benefits of Relocation

Liu Li's study focuses on the health impacts of air particulate pollution from the ceramics manufacturing process. The study assesses the link between particulate air pollution (PM_{10}) and people's health and determines how much an increase in the concentration of air pollution costs people in terms of increased medical bills and lost earnings.

Four potential development scenarios were used to study the costs and benefits of relocating ceramics production from Foshan City to Qingyuan City. The impact of different pollution abatement technologies was also considered. Experts' consultations revealed that the best option would be a combination of a plenum pulse bag filter and an alkaline-solution-spray desulfuration dust-catching system.

In the base scenario, there was no relocation of ceramics production capacity and the suggested dust-catching technology would not be installed for the polluting part of the production process. The first scenario featured no relocation of ceramics production capacity – ie. all ceramics production capacity would be kept in Chancheng while dust-catching technology would be installed for all polluting part of the production process. The other three scenarios involved some relocation of ceramics production capacity. In scenario 2, the polluting part of the production process would be relocated to Yuantan Town but no dust-catching technology would be installed. In scenario 3, the polluting part of the production process would also be relocated but dust-catching technology would be installed in the new plant in Yuantan Town. In scenario 4 all of the polluting part of the production process would be fitted with dust-catching technology, but only some would be shifted to Yuantan. This last scenario would be designed to maintain the PM_{10} concentration in the ambient air in Yuantan to meet the national air quality standard (100μg/m^3).

Assessing the Impact of Air Pollution

Information for the study was drawn from a wide range of sources, for example, data on air quality came from the Pearl River Delta Regional Air Quality Monitoring Network and health data was collected from the Chinese Health Statistical Yearbook, provincial and municipal health departments and local hospitals and clinics. Information on the relationship between people's health and air pollution was drawn from a large number of studies from around China and other countries. A field survey was also conducted to look into the social, economic and health impacts of the relocation of the ceramics industry. The field survey covered 261 households in Qingyuan and 307 households in Foshan.

PM_{10} has a broad range of adverse health effects, predominantly on the respiratory and cardiovascular systems. Health impacts include decreased lung function, respiratory and cardiovascular diseases, increased respiratory morbidity and increased mortality from cardiopulmonary disease. There is little evidence to suggest a threshold of PM_{10} concentration below which it has no adverse health effects. This means that even in a relatively clean area (i.e. where the concentration of PM_{10} is below the national standard) long-term and short-term exposure to PM_{10} will still have adverse effects on human health.

Health and Pollution Linked

The study finds that there is a clear relationship between health and a change in PM_{10} concentration. The health benefit of every 1μg/m^3 decrease of PM_{10} concentration in Chancheng District would be 19.10 million yuan, while the health cost to Yuantan Town for every 1μg/m^3 increase of PM_{10} concentration

Costs and Benefits, Different Scenarios (Million Yuan)

Costs/benefits		Health benefit	Health cost	Tech. cost	Net benefit
Scenario 1	Chancheng	3,353.71	n/a	-15.54	3,338.17
	Yuantan	n/a	n/a	n/a	
Scenario 2	Chancheng	7,182.91	n/a	n/a	6,294.70
	Yuantan	n/a	- 888.21	n/a	
Scenario 3	Chancheng	7,182.91	n/a	n/a	6,488.97
	Yuantan	n/a	- 678.40	-15.54	
Scenario 4	Chancheng	5,957.47	n/a	-8.9	5,493.11
	Yuantan	n/a	- 448.82	-6.64	