We are grateful to the Research Center for Chinese Politics and Business of Indiana University for financial support and to Scott Kennedy, Chunbing Xing, Xiaojun Shi, Risheng Mao and Xiliang Zhao for helpful comments and discussion.

Contributed to the RCCPB’s Initiative on China and Global Governance. 
Abstract

This paper gives a comprehensive analysis of the productivity effects of China received antidumping (AD) measures on Chinese industries from both theoretical and empirical aspects. Theoretical analysis reveals that import country’s AD tax improves export firms’ technological efficiency but hurts scale efficiency. Technological progress and TFP also will be improved in regular conditions. Empirical results show that China’s industrial TFP improved under the pressure of AD from developed countries, increased on average 6.1% after one year; the mechanism is via inspiring both technological efficiency (improved 5.1%) and technological progress (improved 6.4%). Additionally, pure technological efficiency has been significantly improved in AD year but decreased one year later, profit per capital has been hurt in AD measure year but benefited one year later, and total profit has been significantly hurt. Developing countries’ AD measures nearly have no significant productivity effects on Chinese targeted industries, only have some positive effects on technological efficiency and negative impacts on pure technological efficiency. We have included some cases to demonstrate the impact mechanism of the empirical results.

Keywords: Antidumping; Productivity; Data Envelop Analysis; GMM

JEL Classifications: F13; F12; C23

摘要

本文从理论与实证两个方面全面分析了国外涉华反倾销措施对于中国行业生产率的影响。理论分析揭示：进口国的反倾销税会提高出口国企业以及行业的技术效率，但会损害规模效率；技术进步和全要素生产率在通常情况下也会受到正向激励。实证研究的结果发现：发达国家对华反倾销在措施一年后促进行业全要素生产率提高6.1%，影响机制是通过促进技术效率提升5.1%并推动技术进步提高6.4%。同时，纯技术效率在反倾销当年显著提高而措施一年后显著降低，单位资本利润在反倾销当年受到损害但措施一年后效应转为正，总利润受到的冲击是显著为负的。发展中国家对华反倾销措施效应较弱，仅有技术效率得到显著提高而纯技术效率显著下降。另外，我们从实际案例分析了国外涉华反倾销影响中国行业生产率的作用机制并为实证结果提供了一些更多的证据。

关键词：反倾销；生产率；数据包络分析，一般矩估计

JEL 分类号：F13；F12；C23
1. Introduction

China is the world's largest antidumping (AD) recipient country in the last decades as its export volume and trade surplus grew. Thereby how these AD measures affect China’s trade and economy is an important topic for research. This paper aims to comprehensively explore the productivity effects of China received AD investigations and measures to Chinese industries.

AD effects is a familiar trade topic in the literature, they capture the influences of AD from many aspects, include trade (Staiger and Wolack, 1994; Prusa, 2001; Ganguli, 2005; Baylis et al, 2009; Carter and Trant, 2010), price (Prusa, 1994), production (Leidy and Hoekman, 1990), welfare (DeVault, 1996; Gallaway et al, 1999), profit (Konings and Vandenbussche, 2005), foreign direct investment (Belderbos et al, 2004; Girma et al, 2002), market power (Nieberding, 1999) and so on. But just a few of them have paid attention to the productivity effects of AD measures to export countries.

Konings and Vandenbussche (2004) has analyzed the relationship between AD protection and productivity growth with firm level data and found AD protection can induce technological catching-up by domestic firms affected by import protection. Konings and Vandenbussche (2008) found that domestic firms with relatively low initial productivity have productivity gains during protection while firms with high initial productivity experience productivity losses during protection. Chandra and Long (2010) get the results that imposition of AD duty by the US led to as much as 20% decrease in labor productivity of the Chinese firms that are specifically named in the AD duties. Crowley (2006) sets up a theoretical model and shows that a country-specific tariff like an AD duty induces both domestic import-competiting firms and foreign exporting firms to adopt a new technology earlier than they would under free trade.

We can see that the present literature on AD productivity effects are rare and new. But actually productivity side attention is an apparently important field for it is more crucial and permanent for economic growth than some direct fields like export and production. In this paper, we explore the productivity shock of China received AD measures on Chinese industries comprehensively from both theoretical and empirical aspects. The main difference of our research to previous ones is that we will capture not only the effects itself but also the influence channels, in the meanwhile a theoretical analysis will also be given.

Our theoretical analysis reveals that in regular circumstances AD measures can improve export firms’ then industries’ technological efficiency, technological progress and total factor productivity (TFP) but will hurt their scale productivity. We use China’s industrial panel data and GMM estimator to capture China’s received AD influence to the productivity of Chinese targeted industries, data envelop analysis (DEA) method has been used to calculate and decompose TFP, and a series of productivity variables have been used to comprehensively recognize the effects and its influence channels. The empirical results show that China’s industrial TFP improved 6.1% under the pressure of AD from developed countries; the influence mechanism is via inspiring both technological efficiency (improved 5.1%) and technological progress (improved 6.4%). Under developed countries’ AD measures, Chinese industrial pure technological efficiency has been improved in the short term but hurt in the long term, profit per capital has been negatively
impacted in the short term but positively influenced in the long term, total profit has been hurt, the coefficients of scale efficiency are negative but not significant. AD from developing countries just have some significant positive effects on technological efficiency and scale efficiency, and negative influence on pure technological efficiency. Some specific Chinese received AD cases have proved such kind of AD-productivity improvement effects.

Our empirical results seemingly prove that China has benefitted from AD measures from developed countries, so China should welcome this kind of AD measure. We should say that is a misreading of our results. Productivity improvement effect to China is an inspiration effects under export barriers pressure. Actually China’s industrial total profits have been significantly hurt in this process. Therefore AD-productivity improvement benefit is a gain on the sacrifice of huge total profit losses; AD measures will hurt China more than benefit from productivity gain in general.

The empirical data in our research is a 2-digit industry level data, but most of the AD cases are usually related to only a narrow segment of industries (often 4-8 digital HS classification products). So it seems AD effects on 2-digit industries are not very direct in some senses, which may underestimate AD’s influence on the targeted specific products. For example, most of the steel AD cases against Chinese steel companies have focused on either construction steel or some types of cold-rolled steel. Yet our empirical analysis captures its influence to entire metallurgy smelting industry, which may include all kind of steel. Therefore the ideal data for analyzing AD effects is the product level, broader than firm-specific but narrower than 2-digit industry data. Because of data availability we have not used products level data in this paper, but we argue that general industrial level analysis to AD effects is also valuable and makes sense, and additionally may have more policy importance for they reveal that AD measures from developed countries not only have influenced specific product firms but also have impacted general sectors further.

The remainder of the paper is organized as follows: Section two states the situation and data facts of China received AD initiations and measures. Section three is the theoretical analysis of the AD’s productivity effects. Section four introduces the empirical methodology and data. Section five analyzes the empirical results. Section five gives the conclusions and policy implications.

2. Facts of China Received AD Initiations and Measures

China has received 784 AD initiations and 563 AD measures from 1995 to 2010 according to WTO antidumping statistics, accounting for 20.9% of the 3,752 WTO total AD initiations and 23.1% of the 2,433 WTO total AD measures. Especially in recent years from 2008 to 2010, China has received separately 76, 77 and 23 AD initiations and 53, 55 and 25 AD measures, these amounts represent nearly 40% of total world AD initiations and measures. China has become the largest AD recipient country in the world (Figure 1).

In these AD initiations and measures, India, the U.S., the European Union, Argentina, Turkey and Brazil are the main initiative countries targeting China. From 1995 to 2010, India, the US, the European Union and Argentina separately launched 137, 101, 96 and 82 AD initiations and 53, 55 and 25 AD measures, these amounts represent nearly 40% of total world AD initiations and measures. China has become the largest AD recipient country in the world (Figure 1).
of total China received AD initiations and 18.7%, 14.0%, 12.1% and 9.4% of total China received AD measures (Figure 2).

![Graph](image)

**Fig. 1 China Received and the Total World AD Amount (1995/01-2010/06)**

Source: WTO antidumping database (http://www.wto.org/english/tratop_e/adp_e/adp_e.htm).

As for industrial distribution of China received AD, the top four AD initiation and measure recipient industries from 1995 to 2010 are: base metals and articles of base metal (XV); products of the chemical or allied industries (VI); machinery and mechanical appliances (XVI); and textiles and textile articles (XI). These industries received separately 185, 158, 100 and 74 AD initiations and 128, 125, 65 and 56 AD measures in this period (Figure 3).

![Graph](image)

**Fig. 2 China Received AD Amount from Main Complaint Countries (1995/01-2010/06)**

Source: WTO antidumping database.

In main AD initiation and measure recipient countries in the world, China, Korea, US, Taibei Chinese, Japan and Indonesia are listed in top six. They have separately received 784, 268, 210, 201, 157 and 157 AD initiations and 563, 165, 127, 132, 112 and 92 AD measures within 1995-2010 (Figure 4). We can see China lists in the first place.

Although China has received the largest number of AD initiations and measures, his comparative amounts are not more than other main AD recipient countries. We take China, Korea
and US as examples to compare their amount of AD initiations and measures per export value, and find that comparative amounts of AD for US and Korea are both more than China in most years within 1995 to 2010 (Figure 5).

\[ \text{Fig. 3 Industry Distribution of China Received AD (1995/01-2010/06)} \]

Note: Industry XV denotes base metals and articles of base metal; VI denotes Products of the Chemical or Allied Industries; XVI denotes machinery and mechanical appliances, electrical equipment, parts thereof, sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles; XI denotes textiles and textile articles; XX denotes miscellaneous manufactured articles; detailed industries for others please see WTO antidumping database.

Source: WTO antidumping database.

\[ \text{Fig. 4 The Top Six AD Recipient Countries’ AD Amount within 1995/01-2010/06} \]

Source: WTO antidumping database.

Above AD data facts tell us that China is one of the main AD targeted countries in the world especially in the last decade. China’s trade and related industries and firms surely will be influenced by these AD shocks, so it is valuable to explore China’s industrial reactions to these AD measures on the productivity side.
3. Theoretical Analysis of AD’s Productivity Effects

How do AD measures influence export countries’ productivity is an important topic but rare in present theoretical literatures. In this part we set up a simple theoretical structure to explore the mechanism of this effect. In logical sense, import country’s AD may affect the export country’s productivity from these channels: Firstly, AD tax will improve export country’s related goods price and then reduce the outside demand, so production scale may shrink and scale efficiency will decline. Secondly, AD tax will decrease the export country’s industrial and firms’ profit which may hurt related firms’ or industries’ R&D input and then harms productivity. Thirdly, AD tax may form an outside pressure and inspire related firms to improve efficiency and increase input for innovation and so benefit productivity.

AD effects directly influence related firms in targeted products; these firms’ variations together compose the reactions of the whole industry. Therefore industrial productivity effects of AD will be the same as representative firms’ in this industry; our following model will analyze AD’s productivity effects from the firm level for it is more direct.

Our basic model structure bases on Zigic (1998, 2000) which is to analyze intellectual property right protection problem in north-south trade, our research purpose is different so we will extend the analysis in many different ways.

Assuming a two countries economy, separately denote as ex (export country) and im (import country or domestic country). Each country has a representative firm denoted as ex and im separately, these two firms produce the same products and they compete in the import country. We assume that the im firm produces only for the domestic market while the ex firm exports all of its production to the import country. In such assumption we do not need to take account of the market in export country. The two firms ex and im compete in quantities, form a duopoly structure and engage in Cournot-Nash competition.
Then we further assume that country \( im \) initiates an AD measure against the goods from export country and impose an ad valorem AD tax \( t \), and \( 0 \leq t \leq 1 \), this tax will be imposed on import country’s import from the export country. The two firms have unit cost of production:

\[
\begin{align*}
C_{ex} &= \alpha_{ex} - f(r_{ex}, s_{ex}) \\
C_{im} &= \alpha_{im} - f(r_{im}, s_{im})
\end{align*}
\]

(1)

Where \( \alpha_{ex} \) and \( \alpha_{im} \) is parameters that can be thought of as the highest unit costs of firms that can access and stay in the market. \( f(r_{ex}, s_{ex}) \) and \( f(r_{im}, s_{im}) \) can be thought of as the total factor productivity (TFP) of firm \( ex \) and \( im \). Here \( f \leq \alpha \); \( r \) is the R&D, employee training or management innovation investment to improve productivity, can be seen as technological progress of TFP. We also have \( \partial f / \partial r > 0 \). \( s \) is the spirit inspiration variable that forms from outside pressure by AD, it will be influenced by AD tax level \( t \), and has the relation \( \partial s(t) / \partial t > 0 \), which means the higher of AD tax rate the higher of spirit inspiration. Higher spirit inspiration will encourage workers to work harder and more carefully so that improving the firm’s productivity. Such kind of productivity improvement has no actual cost and somewhat like the technology efficiency enhance of TFP. We have the equation \( \partial f / \partial s > 0 \).

Above productivity assumption determines that a firm’s TFP includes technological progress and technological efficiency in our model. For simplifying the analysis, we assume a simple specific TFP function:

\[
\begin{align*}
f(r_{ex}, s_{ex}) &= br_{ex} + cs_{ex}(t) \\
f(r_{im}, s_{im}) &= b^*r_{im} + c^*s_{im}(t)
\end{align*}
\]

(2)

Where \( b(b^*) \) and \( c(c^*) \) are parameters that separately denote the productivity transformation efficiency of R&D investment and spirit inspiration, and they satisfy \( 0 < b, c(b^*, c^*) < 1 \). \( t \) is the AD tax initiated by the import country, it gives pressure to the firm in the export country, so that \( \partial s_{ex}(t) / \partial t > 0 \); but this tax will relax the pressure of the firm in the import country which yields \( \partial s_{im}(t) / \partial t < 0 \).

The inverse demand function for the import country market is assumed to be linear with units chosen such that the slope of the inverse demand function is equal to one. Such that,

\[
P = E - Q \quad (Q = q_{ex} + q_{im})
\]

(3)
Where parameter $E$ captures the size of the market and $E > \alpha_{ex}(\alpha_{im})$, whereas $q_{ex}$ and $q_{im}$ denote the choice variables, that is, the corresponding quantities of the firms $ex$ and $im$. We now start to solve the game, the firms will choose the equilibrium quantities. The firm in import country maximizes

$$\max_{q_{im}} (E - Q)q_{im} - C_{im}q_{im} - r_{im}$$

given $q_{ex}$. Substituting equations (1) and (2) to (4), the first-order condition for a maximum is

$$\frac{\partial \Pi_{im}}{\partial q_{im}} = 0$$

and yields

$$E - 2q_{im} - q_{ex} - C_{im} = 0$$

(5)

The optimization problem for the export country firm is

$$\max_{q_{ex}} (E - Q)q_{ex} - C_{ex}q_{ex} - t q_{ex} - r_{ex}$$

(6)

given $q_{im}$ and $t$. Here we neglect the profit which the export country firm earns on its home market since it is irrelevant to the maximization problem under consideration. The first-order condition for a maximum $\frac{\partial \Pi_{ex}}{\partial q_{ex}} = 0$ yields

$$E - 2q_{ex} - q_{im} - C_{ex} - t = 0$$

(7)

Solving the reaction functions yields the Cournot outputs of firm $ex$ and $im$. We can get

$$\begin{align*}
q_{im} &= (E - 2C_{im} + C_{ex} + t) / 3 \\
q_{ex} &= (E + C_{im} - 2C_{ex} - 2t) / 3
\end{align*}$$

(8)

From the equation (8) we have the result $\frac{\partial q_{ex}}{\partial t} = -2/3 < 0$, that is to say, the export firm’s output will decrease if the import country imposed an AD tax on its imports. Therefore if we take account of the scale productivity effects, AD tax will negatively influence export firms’ scale productivity definitely.

Substituting equation (8) into equation (6) yields the export country’s firm profit function:

$$\Pi_{ex} = \frac{(E + C_{im} - 2C_{ex} - 2t)^2}{9} - r_{ex}$$

(9)

Further substituting equations (1) and (2) into equation (9) and yields
\[ \Pi_{ex} = \left[ E + \alpha_{im} - b^* r_{im} - c^* s_{im}(t) - 2\alpha_{ex} + b r_{ex} + c s_{ex}(t) - 2t \right]^2 - r_{ex} \]  

(10)

On the above equilibrium, firm \( ex \) needs to further determine its R&D, employee training and management innovation investment \( r_{ex} \), profit maximization \( \partial \Pi_{ex} / \partial r_{ex} = 0 \) yields

\[ r_{ex}^* = \frac{9}{2b} - E - \alpha_{im} + b^* r_{im} + c^* s_{im}(t) + 2\alpha_{ex} - c s_{ex}(t) + 2t \]  

(11)

From the above equation, we can see that when the firm \( ex \) from export country has been imposed an AD, the result of its investment in R&D, employee training or management innovation will increase or decrease is not clear. For the equation

\[ \frac{\partial r_{ex}^*}{\partial t} = 2 + c^* \frac{\partial s_{im}(t)}{\partial t} \]  

(12)

if \( \frac{2}{c^*} < \frac{\partial s_{im}(t)}{\partial t} < 0 \) then \( \frac{\partial r_{ex}^*}{\partial t} > 0 \), which means the export firm will invest more on technological progress as the AD tax rate increases. But when \( \frac{\partial s_{im}(t)}{\partial t} < -\frac{2}{c} \) we have

\[ \frac{\partial r_{ex}^*}{\partial t} < 0 \], this means the import country’s AD tax will decrease the export firm’s investment in R&D, employee training and management innovation so technological progress will drop.

According to this logic we think that in most regular cases the AD tax effect of \( \frac{\partial s_{im}(t)}{\partial t} \) is very tiny and we can nearly neglect such influence. If this is so we get \( \frac{\partial r_{ex}^*}{\partial t} > 0 \) and AD tax can increase export firm’s technological progress.

Our basic assumption is that AD tax can inspire employees to work harder and improve technological efficiency, that is \( \frac{\partial s_{ex}(t)}{\partial t} > 0 \). We substitute equation (11) to TFP equation (2) yields

\[ f(r_{ex}, s_{ex}) = \frac{b}{2b} - E - \alpha_{im} + b^* r_{im} + 2\alpha_{ex} + c(1-b)s_{ex}(t) + b c^* s_{im}(t) + 2bt \]  

(13)

In order to explore the AD tax effects to the TFP of export firm, we get

\[ \frac{\partial f(r_{ex}, s_{ex})}{\partial t} = 2b + c(1-b) \frac{\partial s_{ex}(t)}{\partial t} + b c^* \frac{\partial s_{im}(t)}{\partial t} \]  

(14)

Where \( b > 0 \), \( c(1-b) \frac{\partial s_{ex}(t)}{\partial t} > 0 \) and \( b c^* \frac{\partial s_{im}(t)}{\partial t} < 0 \), if we assume that the AD effect of
\( \frac{\partial s_{im}(t)}{\partial t} \) is tiny then \( \frac{\partial f(r_{ex}, s_{ex})}{\partial t} > 0 \), which means that AD tax have positive effects to export firm’s TFP. But when the negative effects of \( \frac{\partial s_{im}(t)}{\partial t} \) is significant enough and satisfies the result

\[
\frac{\partial s_{im}(t)}{\partial t} < -\left(\frac{2}{c} + \frac{c(1-b)}{b\epsilon^*} \frac{\partial s_{ex}(t)}{\partial t}\right)
\]

then the import country’s AD tax will hurt export firm’s TFP. Therefore in conclusion we can say in regular cases the TFP effects of AD to export firms are positive unless some special situations occur.

The above analysis has not taken account of the AD tax’s influence on market structure. Sometimes an import tariff like the AD tax is a device by means of which it can influence the market structure. In a two-firm case as in our model, there are three possible market patterns which could arise in equilibrium: duopoly, constrained monopoly and unconstrained monopoly. If the AD tax from the import country changed the market structure and made the export firm in a more serious position, the export firm’s profit may decrease sharply and have no more money to invest in R&D, employee training or management innovation hence TFP will be injured.

In general, theoretical analysis reveals that the import country’s AD tax will improve export firms’ technological efficiency and hurt their scale efficiency definitely; technological progress and TFP will be inspired in most cases except the market structure had been changed by the AD tax or domestic firms’ technological efficiency had been greatly damaged by the protection.

### 4. Empirical Methodology and Data

We will empirically analyze AD’s productivity effects on Chinese industries in this part. We separate AD from developed countries and developing countries for they may have different effects. We also will use some different productivity variables to reflect productivity level. Dynamic panel data system GMM method has been used for estimations, and Data Envelop Analysis (DEA) method has been used for calculating and decomposing industry productivity.

#### 4.1 Methodology

We use panel data regression to analyze productivity effects of AD on Chinese industries. AD measures may have lag effects. So we have the following regression equation (15).

\[
prod_{i,t} = \alpha + \beta_1 prod_{i,t-1} + \beta_2 AD_{i,t} + \beta_3 AD_{i,t-1} + \beta_4 X_{i,t} + \epsilon_t + \nu_{i,t}
\]

Where \( i \) denotes industry and \( t \) denotes time (year). \( prod_{i,t} \) is the dependent variable, productivity, which specifically includes TFP, technological efficiency, technological progress, pure technological efficiency, scale efficiency, profit per capital (called average profit for short) and total profit so that we can fully capture the productivity effects of AD on Chinese industries and its influence channels. The first five productivity variables mentioned above are typical productivity variables. For the profit per capital and total industry profit, we think that they both
can reflect the industry’s efficiency and productivity from the profit side, so we include them in the dependent variables. \( prod_{t-1} \) denotes one year lag effects of dependent variables for we think previous year’s productivity can influence present productivity level.

\( AD_{i,t} \) denotes antidumping measures, we use one year lag terms \( AD_{i,t-1} \) to capture lag effects. \( X_{i,t} \) in the equation denotes control variables. According to prior literatures (Belderbos, 1997; Blonigen, 2006) experience, common sense and data availability, we choose nine specific variables to control the other factors’ influence on the dependent variable. These variables are: (1) time trend variable to control time growth trend; (2) industry dummy to control industrial fixed effects; (3) industry scale, for large scale industries can gain scale effects and so influence industrial productivity; we choose two variables which are total firm numbers in the industry and total output to control the industry scale influence; (4) industry profitability, for profits can be used to increase R&D input so as to improve productivity. For the profitability variable, when dependent variables are profit per capital (aprof) or total profit (prof), we will omit this control variable in order to avoid multicollinearity problems; (5) total bank capital in the industry, which can control the industry’s scale and financing ability; (6) R&D investment, which will directly influence industries’ productivity; (7) dependence on exports, to control the influence of export per output because export is an important productivity influencing factor; (8) dependence on FDI, used for controlling the FDI influence on productivity; (9) value added tax (VAT) expenditure, for tax is also often seemed as an productivity influencing factor.

Table 1 summarizes these variables. We use logarithmic values for variables of time trend, scale, profitability, bank capital, R&D investment, dependence on export, dependence on FDI and VAT expenditure in the regressions to avoid heteroscedasticity.

<table>
<thead>
<tr>
<th>Variable Type</th>
<th>Variables</th>
<th>Abbreviate</th>
<th>Description</th>
<th>Source of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variables</td>
<td>Total factor productivity</td>
<td>Tfp</td>
<td>One of the efficiency index</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td>Technology efficiency</td>
<td>Effch</td>
<td>One of the efficiency index</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td>Technology progress</td>
<td>Techch</td>
<td>One of the efficiency index</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td>Scale efficiency</td>
<td>Sech</td>
<td>One of the efficiency index</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td>Pure technology efficiency</td>
<td>Pech</td>
<td>One of the efficiency index</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td>Profit per capital</td>
<td>Ln(aprof)</td>
<td>Profit efficiency</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td>Total industry profit</td>
<td>Ln(prof)</td>
<td>Total profit</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td>Independent Variables</td>
<td>Antidumping Measures</td>
<td>AD</td>
<td>AD Measure Dummy</td>
<td>Global AD Database 2010</td>
</tr>
<tr>
<td></td>
<td>Time Trend</td>
<td>Time</td>
<td>Control the time trend</td>
<td>time=ln(Year-1997)</td>
</tr>
<tr>
<td></td>
<td>Industry Dummy</td>
<td>Indu_dum</td>
<td>Control industrial fixed effect</td>
<td>Choose each industry as a dummy variable</td>
</tr>
<tr>
<td></td>
<td>Industry Scale</td>
<td>Ln(output)</td>
<td>Equals total industry output</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ln(firm_num)</td>
<td>Industrial firm numbers</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td>Industry Profitability</td>
<td>Ln(aprofit)</td>
<td>aprofit=(profit/capital)</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td>Bank capital</td>
<td>Ln(capital)</td>
<td>Total bank capital</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td>R&amp;D investment</td>
<td>Ln(r&amp;d)</td>
<td>Research and development investment</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td>Dependence on export</td>
<td>Ln(exp)</td>
<td>Exp=export/output</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td>Dependence on FDI</td>
<td>Ln(fdi)</td>
<td>Fdi=FDI/output</td>
<td>CSY(1998-2010)</td>
</tr>
<tr>
<td></td>
<td>Value added Tax</td>
<td>Ln(VAT)</td>
<td>Total value added tax charge</td>
<td>CSY(1998-2010)</td>
</tr>
</tbody>
</table>
We use a general-to-specific method to determine the lag length numbers for dependent and independent variables (Hendry and Clements, 2004). Our data embodies autocorrelation with one lag and so we include one lag in the right-hand side of our empirical specification. Because of lags in the dependent variable, we use dynamic panel methodology to estimate equations. We deploy the Arellano-Bond instrumental variable procedure (Arellano and Bover, 1995; Blundell and Bond, 1998) and which proposes a GMM estimator which accounts for within-panel autocorrelation and heteroskedasticity and estimates a dynamic panel specification.

The dynamic panel estimator first put forward by Arellano and Bond (1991) as a first order difference GMM produces estimates after taking first order differences in order to eliminate individual effects. Such methods however can induce sample partial bias (Blundell and Bond, 1998). Blundell and Bond (1998) propose a GMM-system estimator which not only first order differences but also uses lagged difference variables as instrumental variables to construct level equations. This GMM estimator can be divided into one step and two step forms; the two step GMM method can give more robust results (Arellano and Bond, 1991; Windmeijer, 2005). Regressions in our paper are all two step system GMM results of this form.

For the endogeneity problem, it is an important issue in AD empirical analysis, for one of the main features of AD is that it is not random and depends on both domestic and foreign industrial behavior. In our regression, we use two-step systematic generalized method of moments (GMM), such dynamic panel data method take both level function and difference function to do estimation. Its advantage is using lag items of dependent and difference variables as instrumental variables to construct level function, such a lot of instrumental variables can solve endogenous problems in the estimation.

### 4.2 Calculation of Productivity

The Calculation of productivity is important for empirical analysis. In our empirical model, we include TFP, technological efficiency, technological progress, scale efficiency, pure technological efficiency, average profit per capital, and total profit to denote industrial productivity. The first five productivity variables are calculated from TFP and its decomposition results with Malmquist exponent method of data envelop analysis (DEA). They are all typical productivity variables. The last two variables are easier to calculate from direct data.

Theoretically we can use either the parametric method or non-parametric method to calculate industrial TFP. Parametric methods calculate productivity by assuming specific production function to estimate productivity; their advantage is their ability to recognize the influence of random factors, while the disadvantages are requiring large amounts of sample observations and model assumption that may not be accurate and so induce deviation in estimation. Non-parametric methods do not need to assume the production function; their advantages include having no sample observations amount demand and can avoid the model assumption deviations, and main disadvantage is they cannot recognize the random factor influences. DEA is one of primary

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1 For dynamic time series data, we can use an AIC and BIC rule to determine lag numbers. But there are no such rules for panel data. Here in the general-to-specific method developed by Hendry and Clements, the specific rule is first select a large lag order in the regression, if the coefficient is significant keep it, if not drop.
non-parameter methods.

We use DEA method to compute Chinese industrial productivity in this paper. This method uses mathematical optimization to calculate the production technology frontier and evaluate producers’ technological efficiency. DEA is a mathematical programming approach to provide a relative efficiency assessment (called DEA efficient) for a group of decision making units (DMU) with multiple numbers of inputs and outputs. In addition, the input and output vectors of the DMUs expand the production possibility set. Determining whether a DMU is efficient from the observed data is equivalent to testing whether the DMU is on the "frontier" of the production possibility set. The concept of the production frontier is extended from the production function to the case of multiple outputs. The methods and models of DEA can be used to comprehensively describe the structure of the production frontier (Wei, 2001).

Specifically we use Malmquist exponent method of DEA to calculate productivity, this method is bring out by Sweden economist Malquist in 1953 (Farrell, 1957). In 1989, Fare, Grosskopf and Ross used this method to productivity analysis for the first time (Fare, Grosskopf and Ross, 1989). And in 1994, some scholars set up the Malmquist exponent to compute total factor productivity (TFP) change (Fare et al, 1994; Fare et al, 1997).

The Malmquist exponent method can directly calculate TFP change (tfpch), and can decompose TFP to technological progress (techch) and technological efficiency (effch). Technology efficiency can further decompose to pure technological efficiency (pech) and scale efficiency (sech). According to these relations, we have the following equations:

\[
\begin{align*}
\text{tfpch} &= \text{effch} \times \text{techch} \\
\text{effch} &= \text{pech} \times \text{sech}
\end{align*}
\]  

(16)

In order to specifically calculate industrial productivity, we need industries’ input and output data. Our sample includes China’s 37 main manufacturing industries\(^2\) data from 1998 to 2009. These industries are two-digit industry classified by Chinese “National Economy Industry Classification (NEIC)” method. This industry statistics collects all state-owned firms and non-state owned firms with main operation income more than 5 million RMB, it is a firm summed industrial data collected by Chinese National Bureau of Statistics (NBS). All of these industrial data are getting from Chinese Statistics Yearbook (CSY). We use annual average surplus amount of fixed net assets to denotes capital input, use annual average employee number to denotes labor input, and use annual industrial added value to denotes total production value. But in some years’ data, there are no industrial added value variables, then we use total output to denote total production value; annual average surplus amount of fixed net assets in some years are lacking either, then we use total fixed assets value to denote capital amount. Additionally we use industrial products price index to deflate annual industrial added value, and use fixed assets investment price index to deflate capital. We denote these industries with codes 1-37 for convenience.

Figure 6 describes the industrial division average TFP and its decomposition results. It is clear that China’s industrial TFP growth mainly gained from technological progress growth. As to

\(^2\) Most years’ data have 39 industries in Chinese Statistic Yearbook (CSY), but some of years only have 37 industries, in order to get a balanced data set, we drop the two different industries and just choose 37 industries in our panel data.
the decomposition of technological efficiency growth, scale efficiency growth contributes more than pure technological efficiency. In the specific industries, productivity of electric power and thermodynamic energy production and supply industry (37), the agriculture non-staple foodstuff adds industry (7), petroleum and coke add industry (19) and tobacco production industry (10) are comparatively higher than other industries.

Figure 7 is the yearly division average TFP and its decomposition results. We can see that China’s productivity grew comparatively quicker in the years of 2003, 2005 and 2008. For the growth of TFP by yearly level, technological progress contributes more; and for the growth of technological efficiency, pure technological efficiency contributes more.

Fig. 6 Industry Division Average TFP and Its Decomposition 1998-2009
Source: Calculated by the authors.

Fig.7 Year Division Average TFP and Its Decomposition 1998-2009
Source: Calculated by the authors.

4.3 Data

Our data consist of 37 Chinese industries from 1998 to 2009, which is a typical balanced
panel sample (37 by 12). All of these industries data are collected from the Chinese Statistical Yearbook (CSY). Dependent variables of productivity come from the calculations above. The AD data come from a World Bank global AD database (Bown, 2010).

Control variables are all from the CSY and we use producer price indices as deflators. For the variables of dependence on export and dependence on FDI, we did not get industry division annual export and FDI values, so we just used yearly whole industry dependence on export and FDI data to substitute each industries’ value, then this kinds of variable data just captures time level difference in export and FDI but do not include industry level difference. For the R&D investment data, it is available only after the year of 2003; they have different industry division data before 2003, we merge them one by one and we give data to some a little default industries according to R&D growth rate in order to avoid observation reduction in the regression.

The global AD database (Bown, 2010) provides detailed AD case information by country. We can easily get AD investigation and measure information from these cases statistics. We have not included AD tax variables in the regression to simplify data compilation and make AD investigation and measure in a balance position simultaneously. Therefore the AD variables in our analysis are all dummies.

Here, data from CSY are all classified by Chinese NEIC; but data from global AD database are classified by the Harmonized System Codes Commodity Classification (HS). They cannot be directly merged together by industry. We take the NEIC as our benchmark; and allocate all of the AD cases into NEIC industries according to the detailed AD products as named one by one$^3$.

We will divide China received AD measures into AD from developed countries and AD from developing countries to capture and compare their different effects, so we must collect this data separately. We denote AD measures from developed countries as AD, and measures from developing countries as LAD.

![Fig. 8 China’s export Value and Share to Main Developed and Developing Countries](image)

$^3$ There are no good methods for merging these two kinds of industry division according to present literature and our wisdom, what we do here is the most original way, that is according to the product name and industry name to classify them together.
The global AD database (Bown, 2010) collects AD information by country. We take the US and the EU to jointly denote developed countries (these two countries account for more than 25% of China’s total received AD initiations and measures (WTO, 2010), and China’s exports to these two countries share nearly 50% of total Chinese exports and 90% of exports to developed countries (Figure 8)); and Argentina, India, Brazil, and Turkey as developing countries (these four countries account for about 40% of China’s total received AD initiations and measures (WTO, 2010), and China’s exports to these three countries share about 4.5% of Chinese total exports and more than 90% of exports to developing countries in recent years (Figure 8)).

Table 2 gives the overall summary statistics of the dependent, independent and main control variables in the empirical analysis. Comparing AD from developed countries with AD from developing countries, we find that the former ones are more than latter ones in amount. It proves that developing countries have become more important AD launching countries to China.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>tfp</td>
<td>444</td>
<td>1.319</td>
<td>0.832</td>
<td>0.197</td>
<td>5.840</td>
</tr>
<tr>
<td>effch</td>
<td>444</td>
<td>1.126</td>
<td>0.422</td>
<td>0.239</td>
<td>4.120</td>
</tr>
<tr>
<td>techch</td>
<td>444</td>
<td>1.122</td>
<td>0.325</td>
<td>0.460</td>
<td>2.487</td>
</tr>
<tr>
<td>pech</td>
<td>444</td>
<td>1.197</td>
<td>0.803</td>
<td>0.187</td>
<td>11.946</td>
</tr>
<tr>
<td>sech</td>
<td>444</td>
<td>1.087</td>
<td>0.600</td>
<td>0.094</td>
<td>6.843</td>
</tr>
<tr>
<td>profit</td>
<td>444</td>
<td>368.651</td>
<td>584.428</td>
<td>-1003.140</td>
<td>4601.230</td>
</tr>
<tr>
<td>aprofit</td>
<td>444</td>
<td>0.056</td>
<td>0.056</td>
<td>-0.086</td>
<td>0.448</td>
</tr>
<tr>
<td>ad</td>
<td>444</td>
<td>0.196</td>
<td>0.397</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>lad</td>
<td>444</td>
<td>0.232</td>
<td>0.423</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>output</td>
<td>444</td>
<td>6220.773</td>
<td>8287.224</td>
<td>1.960</td>
<td>44727.960</td>
</tr>
<tr>
<td>firm_num</td>
<td>444</td>
<td>6674.158</td>
<td>6758.757</td>
<td>13.000</td>
<td>37374.000</td>
</tr>
<tr>
<td>capital</td>
<td>444</td>
<td>6693.485</td>
<td>8669.768</td>
<td>1.950</td>
<td>69086.990</td>
</tr>
<tr>
<td>Vat</td>
<td>444</td>
<td>219.173</td>
<td>283.375</td>
<td>0.110</td>
<td>1704.090</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>444</td>
<td>33.460</td>
<td>70.643</td>
<td>0.021</td>
<td>549.606</td>
</tr>
<tr>
<td>exp</td>
<td>444</td>
<td>0.265</td>
<td>0.065</td>
<td>0.180</td>
<td>0.359</td>
</tr>
<tr>
<td>fdi</td>
<td>444</td>
<td>0.026</td>
<td>0.006</td>
<td>0.018</td>
<td>0.037</td>
</tr>
</tbody>
</table>

5. Empirical Results

We present and analyze estimation results in this part. Two methods have been used to test the validity of the parameter estimates. The first is the Sargan over-identification test to assess the validity of instrumental variables. If this cannot reject the null hypothesis, it suggests that the instrumental variable is appropriate. The second is using an AR(2) test to check for residual non-autocorrelation, that is testing the existence of second-order residual autocorrelation. In the empirical results presented in Tables 3-5, all of the P values for the AR(2) test are bigger than 0.15, so there would seem to be no residual autocorrelation problem for the estimation. All of the P values for the Sargan over identification test reveal that instrumental variable selections are appropriate.
5.1 Panel Data Estimation Results

Table 3 is the estimation results. We can see that AD measures from developed countries have significant effects on Chinese industrial productivity, in detail they positively affect Chinese industrial TFP, technological efficiency and technological progress, but negatively affect Chinese industries’ total profits (which fell 4.8% one year after AD measures). Specifically, one year after AD measures, Chinese industrial TFP increased 6.1%, technological efficiency improved 5.1% and technological progress was enhanced 6.4%. Scale efficiency’s coefficients are negative but not significant. Pure technological efficiency improved 9.1% in the short run (AD measure year) but decreased 6.0% in the long run (one year after AD measure). Profit per capital suffered (decreased 11.1%) in the short term (AD measure year) and gained (increase 17.0%) in the long term (one year after AD measures). Most of these influences are lag effects, proved that AD measures need years later to take effect.

AD from developing countries does not have significant influences to Chinese industrial productivity. The reason may be because developing countries are not China’s main export partners and their AD measures have no severe impact on China’s exports, so industrial productivity does not vary significantly. Carefully analyzing these results, we find that only technological efficiency and scale efficiency were positively influenced but pure technological efficiency has been negatively impacted. They show that faced with AD measures from developing countries, Chinese related industries may try to improve their management and technological efficiency to avoid export suffering and this behavior may improve industrial scale and increase efficiency, but pure technological efficiency has been hurt all the same.

Comparing estimation results of TFP and its decomposition variables, we find that the positive TFP effects of developed countries’ AD to Chinese industries are mainly gaining from the channel of improving both industrial technological efficiency and technological progress; comparatively technological progress’ effects are somewhat larger than technological efficiency. These results prove that AD from developed countries has promoted related industries to adopt new technologies and improve their organization and management efficiency in order to resist outside competitiveness and demand reduction.

Table 3: Productivity Effects of China Received AD Measures

<table>
<thead>
<tr>
<th>Variables</th>
<th>tfp</th>
<th>effch</th>
<th>techch</th>
<th>sech</th>
<th>pech</th>
<th>aprof</th>
<th>prof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y(-1)</td>
<td>-0.551***</td>
<td>-0.167***</td>
<td>-0.602***</td>
<td>-0.214***</td>
<td>-0.141***</td>
<td>0.234***</td>
<td>0.183***</td>
</tr>
<tr>
<td>AD</td>
<td>0.225</td>
<td>0.051*</td>
<td>0.049</td>
<td>-0.039</td>
<td>0.091***</td>
<td>-0.111**</td>
<td>-0.049***</td>
</tr>
<tr>
<td>AD(-1)</td>
<td>0.061***</td>
<td>-0.027</td>
<td>0.064*</td>
<td>-0.056</td>
<td>-0.060*</td>
<td>0.170***</td>
<td>-0.048***</td>
</tr>
<tr>
<td>LAD</td>
<td>-0.045</td>
<td>-0.002</td>
<td>0.008</td>
<td>0.093*</td>
<td>-0.113***</td>
<td>-0.04</td>
<td>-0.014</td>
</tr>
<tr>
<td>LAD(-1)</td>
<td>0.112</td>
<td>0.119***</td>
<td>-0.011</td>
<td>0.044</td>
<td>0.089</td>
<td>-0.04</td>
<td>0.006</td>
</tr>
<tr>
<td>Ln(firm_num)</td>
<td>1.267***</td>
<td>0.528***</td>
<td>0.549***</td>
<td>-0.622***</td>
<td>0.987***</td>
<td>-1.702***</td>
<td>-0.703***</td>
</tr>
<tr>
<td>Ln(output)</td>
<td>-1.308***</td>
<td>-0.426***</td>
<td>-0.857***</td>
<td>1.790***</td>
<td>-1.272***</td>
<td>2.687***</td>
<td>0.788***</td>
</tr>
<tr>
<td>Ln(aprofit)</td>
<td>-0.306***</td>
<td>-0.250***</td>
<td>0.051***</td>
<td>-0.069***</td>
<td>-0.204***</td>
<td>-0.011</td>
<td>0.044</td>
</tr>
<tr>
<td>Ln(capital)</td>
<td>-2.183***</td>
<td>-1.668***</td>
<td>-0.007</td>
<td>-1.054***</td>
<td>-1.210***</td>
<td>-3.223***</td>
<td>-0.116***</td>
</tr>
<tr>
<td>Ln(VAT)</td>
<td>2.416***</td>
<td>1.145***</td>
<td>0.937***</td>
<td>-0.882***</td>
<td>1.593***</td>
<td>-1.904***</td>
<td>0.897***</td>
</tr>
<tr>
<td>Ln(R&amp;D)</td>
<td>-0.722***</td>
<td>-0.260***</td>
<td>-0.265***</td>
<td>-0.098*</td>
<td>0.044</td>
<td>-0.136</td>
<td>-0.029</td>
</tr>
<tr>
<td>Ln(exp)</td>
<td>0.430***</td>
<td>1.186***</td>
<td>-0.500***</td>
<td>0.252***</td>
<td>1.008***</td>
<td>0.929***</td>
<td>0.078</td>
</tr>
<tr>
<td>Ln(fdi)</td>
<td>1.931***</td>
<td>1.210***</td>
<td>0.362***</td>
<td>1.056***</td>
<td>1.012***</td>
<td>-0.292</td>
<td>0.317***</td>
</tr>
<tr>
<td>Time</td>
<td>0.220***</td>
<td>0.013</td>
<td>0.132***</td>
<td>0.035*</td>
<td>-0.052</td>
<td>-0.121*</td>
<td>0.0001</td>
</tr>
</tbody>
</table>
Industrial technological efficiency improved in the AD measures (from developed countries) year, but actually may be hurt one year after AD from developed countries, just this injury is not significant. This may be because faced with AD measures, firms in the related industry try to improve technological efficiency in the first year, but when export and profit injuries take effects one year after the AD measure, technological efficiency will be hurt either.

Chinese industrial total profit has been definitely hurt by AD from developed countries, which mean that Chinese industries have suffered from AD measures. But such kind of suffering may had formed a burden to inspire firms in related industry to improve their productivity so that industrial productivity has been improved under the threat of AD. Profit per capital is more related to efficiency, so it has been negatively influenced in the short term but improved in the long term.

If we compared the effects of AD measures with other variables like VAT tax inspiration, dependence on export and dependence on FDI, the results show that AD productivity improvement effects is only 1/7 of export effects, 1/30 of FDI effects and 1/40 of tax inspiration effects. This proves that AD effects to productivity is actually so small, but on the other hand, AD variables in our regression are dummies but other variables are level value so they may not have enough comparability.

For the control variables, most of them have showed significant results. Total output, bank capital, R&D, profit per capital all showed negative relations with productivity, this may show that large scale industries and firms may have lower TFP and small firms or industries may be more efficient in TFP. R&D has showed negative result which may prove that Chinese industrial research and development investment are somewhat inefficient, also may because total R&D has not taken account of industrial scale and so per output R&D may positively influence productivity. Firm number, export, FDI and time trend are all positively related with TFP. The positive effects of firm numbers may because it increased competition within the industry. Positive effects of export, FDI and time trend are fit for common logic. The results of these control variables are not our focus in this paper, so actually we do not need to pay much attention to them.

5.2 Robustness Check for the Regression

We check the robustness of the above estimation results in this part. Two check methods have been used, the first is deleting main control variables (industrial dummies) to compare the results, dropping to control individual fixed effects is an often used method for robustness check as it is some like change the regression methods from fixed effects model to random effects model; the second is dividing AD from developed countries with AD from developing countries to separately estimate their coefficients and compare the results with the combined regression results, if there are no significant differences then the results are consistent and robust.
Tables 4-5 list these results, compared them with regression results in Table 3, we find that productivity effects of AD from both developed countries and developing countries are nearly the same. Estimation coefficients all have the same influence direction, just some variables’ significance levels have changed a little. These feasibility checks can prove that the estimates presented above are robust.

Table 4: Robustness Check Results I

<table>
<thead>
<tr>
<th>Variable</th>
<th>tfp</th>
<th>effch</th>
<th>techch</th>
<th>sech</th>
<th>pech</th>
<th>aprof</th>
<th>prof</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y(-1)</td>
<td>-0.461***</td>
<td>-0.179***</td>
<td>-0.582***</td>
<td>-0.174***</td>
<td>-0.163***</td>
<td>0.191***</td>
<td>0.198***</td>
</tr>
<tr>
<td>AD</td>
<td>0.283</td>
<td>0.029</td>
<td>0.076***</td>
<td>-0.077***</td>
<td>0.093***</td>
<td>-0.171***</td>
<td>-0.077***</td>
</tr>
<tr>
<td>AD(-1)</td>
<td>0.052***</td>
<td>-0.050**</td>
<td>0.128***</td>
<td>-0.081**</td>
<td>-0.076***</td>
<td>0.342***</td>
<td>-0.035***</td>
</tr>
<tr>
<td>LAD</td>
<td>-0.163***</td>
<td>-0.029</td>
<td>-0.027</td>
<td>0.056</td>
<td>-0.112***</td>
<td>-0.021</td>
<td>-0.008</td>
</tr>
<tr>
<td>LAD(-1)</td>
<td>0.078</td>
<td>0.117***</td>
<td>-0.009</td>
<td>-0.008</td>
<td>0.091**</td>
<td>-0.034</td>
<td>-0.006</td>
</tr>
<tr>
<td>Time</td>
<td>-0.017</td>
<td>-0.045***</td>
<td>0.128***</td>
<td>0.064***</td>
<td>-0.077***</td>
<td>-0.473***</td>
<td>0.010***</td>
</tr>
<tr>
<td>Ln(firm_num)</td>
<td>0.941***</td>
<td>0.350***</td>
<td>0.389***</td>
<td>-0.280***</td>
<td>0.385***</td>
<td>-1.979***</td>
<td>-0.056</td>
</tr>
<tr>
<td>Ln(output)</td>
<td>-0.219</td>
<td>-0.258***</td>
<td>-0.984***</td>
<td>0.729***</td>
<td>-0.456***</td>
<td>3.496***</td>
<td>0.521***</td>
</tr>
<tr>
<td>Ln(aprofit)</td>
<td>-0.311***</td>
<td>-0.241***</td>
<td>0.105***</td>
<td>-0.061***</td>
<td>-0.240***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln(capital)</td>
<td>-2.682***</td>
<td>-1.707***</td>
<td>0.128*</td>
<td>-0.494***</td>
<td>-1.116***</td>
<td>-2.113***</td>
<td>-0.341***</td>
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<tr>
<td>Ln(VAT)</td>
<td>1.789***</td>
<td>1.144***</td>
<td>1.504***</td>
<td>-0.515***</td>
<td>0.920***</td>
<td>-2.426***</td>
<td>0.787***</td>
</tr>
<tr>
<td>Ln(R&amp;D)</td>
<td>0.294**</td>
<td>-0.025</td>
<td>-0.410***</td>
<td>-0.128***</td>
<td>0.022</td>
<td>0.440***</td>
<td>0.064***</td>
</tr>
<tr>
<td>Ln(exp)</td>
<td>0.539***</td>
<td>1.092***</td>
<td>-0.710***</td>
<td>0.537***</td>
<td>0.962***</td>
<td>1.501***</td>
<td>0.136***</td>
</tr>
<tr>
<td>Ln(fdi)</td>
<td>2.589***</td>
<td>1.235***</td>
<td>0.374***</td>
<td>1.063***</td>
<td>0.730***</td>
<td>0.241</td>
<td>0.294***</td>
</tr>
<tr>
<td>Cons</td>
<td>11.197***</td>
<td>9.132***</td>
<td>0.145</td>
<td>8.187***</td>
<td>4.555***</td>
<td>6.537***</td>
<td>1.246***</td>
</tr>
</tbody>
</table>

| Obs.           | 397 | 397 | 397 | 397 | 397 | 387 | 387 |
| AR(2)-P value  | 0.2036 | 0.1927 | 0.3083 | 0.2716 | 0.2129 | 0.1872 | 0.2022 |
| Sargan test-P  | 0.2781 | 0.1736 | 0.2426 | 0.6325 | 0.5019 | 0.1815 | 0.3217 |

Notes: (1) *, **, *** denote significantly different from zero at 15%, 10% and 5% confidence level. (2) Sargan test-P v. denotes P value of sargan test result.
## Table 5: Robustness Check Results II

<table>
<thead>
<tr>
<th>Variable</th>
<th>tfp</th>
<th>effch</th>
<th>techch</th>
<th>sech</th>
<th>pech</th>
<th>aprof</th>
<th>prof</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(1)</td>
<td>(2)</td>
<td>(1)</td>
<td>(2)</td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Y(-1)</td>
<td>-0.56***</td>
<td>-0.55***</td>
<td>-0.17***</td>
<td>-0.60***</td>
<td>-0.21***</td>
<td>-0.15***</td>
<td>-0.14***</td>
</tr>
<tr>
<td>AD</td>
<td>0.182</td>
<td>0.04</td>
<td>0.052</td>
<td>-0.038</td>
<td>0.072***</td>
<td>-0.101*</td>
<td>-0.05***</td>
</tr>
<tr>
<td>AD(-1)</td>
<td>0.040***</td>
<td>-0.028</td>
<td>0.063*</td>
<td>-0.056</td>
<td>-0.09***</td>
<td>0.178***</td>
<td>-0.04***</td>
</tr>
<tr>
<td>LAD</td>
<td>-0.056</td>
<td>-0.023</td>
<td>-0.001</td>
<td>0.090*</td>
<td>-0.12***</td>
<td>-0.044</td>
<td>-0.005</td>
</tr>
<tr>
<td>LAD(-1)</td>
<td>0.100</td>
<td>0.092***</td>
<td>-0.015</td>
<td>0.068</td>
<td>0.073</td>
<td>-0.032</td>
<td>0.015</td>
</tr>
<tr>
<td>Ln(firm_num)</td>
<td>0.217***</td>
<td>0.236***</td>
<td>0.005</td>
<td>-0.003</td>
<td>0.134***</td>
<td>0.138***</td>
<td>0.040***</td>
</tr>
<tr>
<td>Ln(output)</td>
<td>1.350***</td>
<td>1.286***</td>
<td>0.553***</td>
<td>0.509***</td>
<td>0.542***</td>
<td>0.552***</td>
<td>-0.61***</td>
</tr>
<tr>
<td>Ln(aprofit)</td>
<td>-1.36***</td>
<td>-1.28***</td>
<td>-0.45***</td>
<td>-0.38***</td>
<td>-0.85***</td>
<td>-0.85***</td>
<td>1.822***</td>
</tr>
<tr>
<td>Ln(capital)</td>
<td>-0.30***</td>
<td>-0.31***</td>
<td>-0.25***</td>
<td>-0.25***</td>
<td>0.049***</td>
<td>0.051***</td>
<td>-0.07***</td>
</tr>
<tr>
<td>Ln(VAT)</td>
<td>-2.23***</td>
<td>-2.23***</td>
<td>-1.69***</td>
<td>-1.69***</td>
<td>-0.017</td>
<td>0.001</td>
<td>-1.11***</td>
</tr>
<tr>
<td>Ln(R&amp;D)</td>
<td>2.451***</td>
<td>2.417***</td>
<td>1.160***</td>
<td>1.138***</td>
<td>0.929***</td>
<td>0.918***</td>
<td>-0.86***</td>
</tr>
<tr>
<td>Ln(exp)</td>
<td>-0.67***</td>
<td>-0.75***</td>
<td>-0.19***</td>
<td>-0.19***</td>
<td>-0.27***</td>
<td>-0.26***</td>
<td>-0.096*</td>
</tr>
<tr>
<td>Ln(fdi)</td>
<td>0.422***</td>
<td>0.445***</td>
<td>1.198***</td>
<td>1.152***</td>
<td>-0.51***</td>
<td>-0.52***</td>
<td>0.245***</td>
</tr>
<tr>
<td>Time</td>
<td>1.978***</td>
<td>2.088***</td>
<td>1.273***</td>
<td>1.180***</td>
<td>0.360***</td>
<td>0.398***</td>
<td>1.243***</td>
</tr>
<tr>
<td>Indu_dum</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Obs</td>
<td>397</td>
<td>397</td>
<td>397</td>
<td>397</td>
<td>397</td>
<td>397</td>
<td>397</td>
</tr>
<tr>
<td>AR(2)-P value</td>
<td>0.2718</td>
<td>0.2981</td>
<td>0.2034</td>
<td>0.2219</td>
<td>0.3319</td>
<td>0.3026</td>
<td>0.2819</td>
</tr>
<tr>
<td>Sargan test-P</td>
<td>0.2899</td>
<td>0.1927</td>
<td>0.1916</td>
<td>0.2037</td>
<td>0.2527</td>
<td>0.2766</td>
<td>0.6024</td>
</tr>
</tbody>
</table>

Notes: (1) *, **, *** denote significantly different from zero at 15%, 10% and 5% confidence level. (2) YES means we have controlled the industrial fixed effects. (3) Sargan test-P v. denotes P value of sargan test result.
6. Some Case Evidences

In order to further explain our empirical results, we will give some proof cases to further analyze AD effects to Chinese industries in this part. The main important finding for our previous analysis is that AD measures from developed countries have inspired Chinese industries to improve productivity. This effect is produced by pressures of more severe export market and more competition. We give two China received AD cases to demonstrate this productivity improvement mechanism.

The first case gets from the magazine “Global Aquaculture Advocate”, named “Unintended Effects: Antidumping Tariffs Could Increase China’s Competitiveness” by Andrew J. Kaelin and Cecilia Ciepiela in 2004. This paper talked about China-US shrimp antidumping case. On July 6, 2004, the US Department of Commerce (DOC) announced preliminary import tariff determinations for China with margins ranging 0-112.81%. This wide range in tariffs is the first indication that something may be amiss with the analytical model used to determine “damage”. Processors sourcing from the same production area have received widely varying tariffs, despite facing the same costs for raw material.

The shrimp market situation in China in 2003 is that China produced an estimated 370,000 mt of shrimp, with approximately 66% of the total consumed in the domestic market and the remaining 33% exported from China. A volume of 80,909 mt was exported to the US in 2003. The primary source of exported, farm-raised white shrimp in China is small producers who generally have less than 5 ha in cultivation in the Guangdong, Hainan, and Guangxi provinces of China. These farmers generally sell through the regional wholesale market located in Zhangjiang, Guangdong. Prices rise and fall according to supply and demand for head-on shrimp.

In 2004, the US announced that Chinese shrimp products have dumping behavior in the US market, which hurt its domestic production and employment. So they initiated AD measures to Chinese shrimp products by levying antidumping tax.

How will the Chinese adjust to this new challenge? As Isaac Newton famously said, “To every action there exists an equal and opposite reaction.” Likely responses include the following: (1) Low-tariff processors will continue to ship shrimp to the US. (2) New packers will petition as respondents and attempt to secure low tariffs. (3) Chinese businessmen, who operate throughout Southeast Asia, will invest in new production areas in nontariff Asian countries. Indonesia is already expanding its production and processing base with investment from China. (4) High-tariff packers in China will diversify their product mix to other seafood or fisheries products, while investing in value-added products that do not fall within the scope of the antidumping suit. In the meanwhile they try their best to improve productivity and reduce costs to keep their production and export.

In other words, the antidumping tariffs will cause the Chinese to become more competitive. No other country has a HACCP- and E.U.-certified shrimp industry that is better positioned to

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produce prepared meals and other value-added products. With higher shrimp prices in the U.S. and lower supplies as a result of the antidumping tariffs, US value added producers will find it harder to compete with new Chinese competition that previously did not exist in their markets. For example, products that are currently processed on automated lines in the U.S. using imported raw, shell-on, or peeled shrimp will now be produced in China.

So, while US shrimpers use their limited resources to hire lawyers to win protection, the Chinese are using their resources to actively increase productivity, expand value added capabilities, and improve competitiveness. This case show that AD measures actually can inspire related firms to improve productivity and competitiveness, then the whole industry’s productivity has been improved also.

The other case comes from China Daily news about the EU’s AD measures on Chinese bicycle exports titled “China urges EU to drop anti-dumping duties on bicycle”. The news said that the EU imposed anti-dumping duties on imports of bicycles originating in China after 1993 following the allegation of the European Bicycle Manufacturers Association (EMBA) that Chinese bicycle producers were dumping in the EU and squeezing them out of the market.

The duties were rolled over twice in 2000 and 2005 following confirmative findings of the commission through investigations, standing as one of the longest EU anti-dumping measures against Chinese products. EU anti-dumping measures are usually imposed for five years. They expire automatically, unless a review is initiated and determines that if they were to expire, dumping and injury would probably continue or recur. During the past 17 years, various initiatives were also taken by EMBA to extend the scope of measures to cover also bicycle parts and to increase the duty level. The duty rate was initially set at 36 percent and raised to 48.5 percent in 2005, effectively reducing imports of Chinese bicycles from over three million annually in early 1990s to around 700,000 now.

But these AD measures and protection have not promoted the development of the EU’s bicycle industry, they just got a temporary protection effects. China’s exports of bicycle products to the EU kept growing in this period. We can deduce that China’s bicycle industry has successfully reduced costs, improved productivity and adopted some innovations to increase its competitiveness.

Under such circumstances, in view of the expiration of the AD measures in 2010, the EU refused to enforce another AD measures. This gives another proof that AD measures really have productivity inspiration effects to targeted firms and industries.

7. Conclusions and Policy Implications

We use both theoretical and empirical analysis to explore productivity effects of AD from developed and developing countries to China in this paper. We employ some differently measured variables to denote productivity to carefully evaluate the effects and its influence channels. Some conclusions and policy implications emerge from the results.

Firstly, China has been the largest AD recipient country in the world in recent decades according to the data. Therefore it is necessary for China to adjust economic structure, strengthen
trade negotiation and find measures to reduce AD injuries and try to remove AD trade barriers.

Secondly, theoretical analysis reveals that the import country’s AD tax will improve export firms’ technological efficiency and hurt its scale efficiency definitely. Technological progress and TFP will be improved in regular cases but may change in some unusual situations.

Thirdly, industrial TFP calculation and decomposition results show that China’s TFP growth is mainly gained from technological progress growth, technological efficiency growth is comparatively lower. This means China should pay more attention to the technological efficiency and invest more on organizing and management efficiency improvement.

Fourthly, China’s industrial TFP has been improved (increased 6.1% one year after AD measure) under the pressure of AD from developed countries, the influence mechanism is via inspiring both technological efficiency (improved 5.1% in the AD measure year) and technological progress (improved 6.4% one year after AD measure), the total profit has been hurt (decreased 4.8% one year after measures) by developed countries’ AD measures. Additionally, Chinese industrial pure technological efficiency has been hurt in the AD year and improved one year after AD measures; profit per capital has been negatively influenced in the AD measure year and positively promoted one year after measures. AD effects from developed countries to scale efficiency are negative but not significant. Therefore we can say that although Chinese industries’ profit has been severely hurt by developed countries’ AD measures, but they have gained positive productivity inspiration effects on the other hand. Related firms and government should pay more attention to technology innovation and try to improve industrial productivity and promote industrial upgrading.

At last, AD from developing countries shares more than half of China received AD measures in amount, but just has small effects to Chinese industries’ productivity and efficiency. The reason may because they are not China’s main export markets. This tells us that AD from different countries has different influences, so different countermeasures should be adopted and taken by the governments and related firms.
References


