# The exporters behaviors : Evidence from the automobiles industry in China

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January 31, 2010

**Abstract**

In this paper, I present some evidence about the Chinese exporters in the automobile industry. In particular, I find that productivity is linked positively with exports, although this relationship is not significant in some sectors, as well as when we control for the state and foreign capital. More siginificant is the relationship between export and market share which is positive in all of the specifications. Younger firms export more, while firms with more foreign capital export less. Finally there is no evidence that exporters are capital intensive.

## 1 Introduction

Automobile is one of the economic pillars in the Chinese economy. The government gives a lot of support to the manufacturers, especially in the form of export subsidies. Domestic demand has been growing continously and substantially in the past decade[1]. However the behaviors of firms within the industry are not well understood. There is belief that China, especially in automobile industry, may hold different characteristics from other countries. For instance the recent proposal from Geely, a low-end manufacturer from

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[1]Vehicles sales grow from 2 million units in 2000 to more than 13 million units in 2009, making China the number one market in the world (Wall Street Journal Jan 12th 2010)

China, to buy Volvo, a well-known brand from Ford, raises the eyebrows of many auto specialists, "the US$2 billion acquisition defies business logic by any standard"[2].

Even less well known is the behavior of exporters. Studies on those entities are limited due to the lack of data. Most of them focus on the question whether exporters are more productive, i.e. more efficient, than non-exporters (Bernard and Jensen 1995, Tybout and Westbrook 1995). Some papers show evidence that exporters are bigger in size and capital intensive (Bernard, Jensen and Schott 2005). However none of the studies look at the case of China. China is a special case because of it growing importance, as well as its unique role as a big, developing country. Chinese firms, in particular exporters, might have strategic behaviors in concordance with the size of the economy.

The goal of this paper is to provide some evidence of export characteristics in China. In particular, I will test whether the efficiency and size dominance as well as the capital intensity of exporters still hold in China. In the next section, I will describe the data, outline my empirical strategy and provide the empirical results. The last section concludes.

# 2 Empirics

## 2.1 Data description

The data we use here is an industrial statistics database, provided by HuaMei Commercial Information Consulting Corporation. Collected by the Chinese National Bureau of Statistics, this database covers every firm whose sales are more than 5 millions yuan (RMB) per year, from 1998 to 2007. Those firms are state-owned enterprises, collective enterprises, joint-stock cooperative enterprises, joint ventures, limited liability companies, private and domestic-funded enterprises, firms invested from HongKong, Macao and Taiwan as well as foreign invested firms. They account for more than 90% of the total value output.

This dataset contains the usual financial variables such as taxes, value of assets, depreciation expenses, cost of sales, etc. Moreover, it can provide details such as the quantity of output (together with its nominal value), the

[2]Shanghai Daily Jan 13th 2010

source of capital (whether it comes from investors or shareholders, or from the mainland or oversea),... Besides the financial data, we can also observe how much firms export. As we expect, trade is very concentrated. Among 2387 observations, only 606 observations have non zero export values.

Table 1: Summary statistics

| | **No of observations** | **log of Productivity** | | **Production** |
|---|---|---|---|---|
| | | (1) | (2) | |
| | | Olley-Pakes | OLS | |
| Car producers | 760 | 0.106 | .271 | 161067 |
| | | (1.570) | (1.485) | ( 433238) |
| Bus producers | 387 | 3.958 | .257 | 30163 |
| | | (1.287) | (1.169) | (93239) |
| Truck producers | 315 | -.544 | .931 | 78354 |
| | | (.963) | (.956) | (202811) |
| Others producers | 315 | 1.694 | -1.02 | 68974 |
| | | (1.278) | (1.178) | (192200) |
| Autoparts producers | 272 | -.931 | -.062 | 46001 |
| | | (1.354) | (1.308) | (121752) |

Note: Standard errors are reported in parentheses.

## 2.2 Empirical strategy

The most common measure of industrial performance is total factor productivity (TFP), which is defined as the Solow residual after we account for the contribution of inputs such as labor, capital and materials in the production function. The easiest way to measure TFP is to use the OLS methodology to estimate a production function. However, such a methodology fails to address several biases. Two of them are the selection bias (we do not observe firms that do not survive in the data set) and the simultaneity bias (firms that observe a high productivity, which is not observed by the econometrician, will employ more inputs, in particular capital). Olley and Pakes (1996) recognize those biases and propose a methodology based on the investment decision of the firms. It consists of three steps. In the first step, output is regressed on labor, materials and a polynomial of investment and capital :

$$y_{jt} = \alpha_0 + \alpha_l l_{jt} + \alpha_m m_{jt} + \phi(i_{jt}, k_{jt}) + u_{jt}$$

$y_{jt}$ - the quantity of products firm $j$ produces at time $t$ [3]

$l_{jt}$ - the number of employees

$m_{jt}$ - the spending on intermediate inputs

$i_{jt}$ - longterm investment

$k_{jt}$ - total capital, which is the sum of the capital from shareholders and investors

$\phi(.)$ - a polynomial of order 3.

All variables are taken in log term. This first step gives us consistent estimates of $\alpha_l$ and $\alpha_m$, as well as an estimation of $\phi$. In the second step, I estimate the survival probability of a firm as a polynomial of investment and capital. using probit estimation. The estimated survival probability $\widehat{P}$, together with $\widehat{\alpha}_l$,$\widehat{\alpha}_m$ and $\widehat{\phi}$ given in the first step are used in the final step estimation:

$$y_{jt+1} - \widehat{\alpha}_l l_{jt+1} = \alpha_0 + \alpha_k k_{jt+1} + \varphi(\widehat{P}_j, \widehat{\phi} - \alpha_k k_{jt}) + \eta_{jt}$$

As $\alpha_k$ appears with $k_{jt+1}$ and $k_{jt}$, I need to use the non linear least square methodology to estimate. This final step provides an estimate of $\alpha_k$, therefore TFP is calculated as follows:

$$tfp_{jt} = y_{jt} - \widehat{\alpha}_l l_{jt} - \widehat{\alpha}_k k_{jt} - \widehat{\alpha}_m m_{jt}$$

However it is well known that the automobile industry is not perfect competition (Bresnahan 1987, Goldberg 1995). Moreover, one firm may produce many products, which means that we can not use one industry price index to deflate the value of output. Recently De Loecker (2009) proposes a method to deal with the oligopolistic competition. The process can be divided in 2 stages. In stage 1 we regress the production of each firm on the number of employees, the spending on intermediate inputs, a polynomial of capital and investment (here we use a polynomial of degree 3), the total demand in the sector that the firm belongs to [4] and the input dummies as well as the sector dummies (we divide the industry into 5 sectors: car, bus, truck, auto parts, others). In other words, the regression in the first stage is the following:

[3] In their paper, they use the value of output deflated by the industry price index. However, since I can observe the quantity of products a firm produces, I can use directly the real output. That allows us to avoid the multi products bias as I discuss later.

[4] Since we observe the quantity of production for each firm, the total demand is the sum of production of all the firms in the corresponding sector

$$r_{jt} = \beta_0 + \beta_l l_{jt} + \beta_m m_{jt} + \beta_\phi \phi(i_{jt}, k_{jt}) + \beta_q q_{s_j t} + \sum \delta_s D_s + \sum \delta_p D_p + u_{jt}$$

where $r_{jt}$ - firm's quantity of production
$l_{jt}$ - number of employees
$m_{jt}$- spending on intermediate inputs
$i_{jt}$ - long term investment
$k_{jt}$- total capital from investors and shareholders
$q_{s_j t}$-total demand in the sector
$D_s$- sector dummies
$D_p$- product dummies

All variables are taken in log term. This stage provides the consistent estimators of $\beta_l$ and $\beta_m$. Also the markup are given by the estimator of $\beta_q$. In the second stage, we estimate the coefficient for capital, using the non linear least square technique:

$$r_{jt+1} = c + \beta_k k_{jt+1} + g(\widehat{\phi}_t - \beta_k k_{jt}) + e_{jt+1}$$

Productivity will be calculated as follows:

$$\omega_{jt} = \left(r_{jt} - \widehat{\beta}_l l_{jt} - \widehat{\beta}_k k_{jt} - \widehat{\beta}_m m_{jt} - \widehat{\beta}_q q_{st}\right)\left(\frac{\eta_s}{\eta_s + 1}\right)$$

After estimating productivity, I can use it in my main regression :

$$x_{jt} = \alpha_0 + \alpha_1 y_{jt} + \alpha_2 tfp_{jt} + \alpha_3 l_{jt} + \alpha_4 age_{jt} + \alpha_5 cap\_int_{jt} + u_{jt}$$

$x_{jt}$ - export value
$y_{jt}$ - output value (in real term)
$tfp_{jt}$ - productivity
$l_{jt}$ - number of employees
$age_{jt}$ - firm's age
$cap\_int_{jt}$ - capital intensity. It is calculated as the ratio of total capital against output value (in nominal term).

## 2.3 Results

### 2.3.1 The production function

The coefficients of inputs are reported in table 2. All of them are significant. I also report the coefficients given by OLS and Olley-Pakes methodologies in table 3. They will be used for robustness check.

Table 2: Estimated production function

| | |
|---|---|
| Labor | .43*** |
| | (.065) |
| Material | .26*** |
| | (.040) |
| Capital | .26*** |
| | (.021) |

Note: Standard errors are reported in parentheses. All coefficients are significant at 1%. The methodology used is De Loecker's.

Table 3: Estimated production function

| | OLS | | | Olley-Pakes | | |
|---|---|---|---|---|---|---|
| | Labor | Capital | Material | Labor | Capital | Material |
| Car | .512*** | .088* | .360*** | .450*** | .075*** | .204*** |
| | (.070) | (.047) | (.042) | (.097) | (.018) | (.058) |
| Bus | .223*** | .204*** | .378*** | .158 | .201*** | .289*** |
| | (.074) | (.048) | (.050) | (.125) | (.005) | (.076) |
| Truck | .353*** | .234*** | .346*** | .035 | .368*** | .401*** |
| | (.066) | (.050) | (.047) | (.100) | (.024) | (.064) |
| Others | .394*** | .253*** | .435*** | .550*** | .134*** | .215 |
| | (.104) | (.066) | (.077) | (.169) | (.012) | (.163) |
| Autoparts | .458*** | .151** | .412*** | .664** | .110** | .352** |
| | (.100) | (.066) | (.071) | (.230) | (.037) | (.165) |

Note: Standard errors are reported in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

### 2.3.2 Markups

We can receive the consistent estimators for the coefficients of labor and material. Besides, as a by product, we can also get the markup which is the inverse of the coefficient of total demand. What we find is that the markups

are estimated to be from 4% to 60%. In particular, the markup for car is about 30%, which is similar to what Goldberg (1995), Berry, Levinsohn and Pakes (1995) find in the U.S. car industry. The lowest markup is in autoparts (4%). Our conjecture is that since the manufacturers in China might have to import the autoparts, the most part of markup might stay with the original foreign producers.

Table 4: Estimated markups

| | W/ product dummies | W/o product dummies |
|---|---|---|
| Car | 34% | 32% |
| Bus | 46% | 58% |
| Truck | 4% | 10% |
| Autoparts | 4% | 3% |
| Others | 22% | 21% |

### 2.3.3 Evidence

**There is evidence that higher productivity leads to higher export, although not strong.** The most common finding is that there is a positive relationship between export status and industrial performance (Tybout and Westbrook 1995, Bernard and Jensen 1995 among others). From table 5, I find a similar thing: the correlation between export value and productivity is positive. This result is robust with the way we measure productivity [5]. However, when we look at figure 1, the relationship does not seem strong. Indeed, when I include a polynomial of productivity with an order higher than 1, all the coefficients of productivity become insignificant. Also as reported in table 6, while the correlations are significantly positive in the car sector, they are not significant, even negative in the bus sector. And finally, when I control for the investment of the government and foreign investors, again the effect of productivity becomes insignificant (table 7).

**Bigger size implies more export.** The new trade theory predicts that exporters sell more than other firms due to their superior efficiency, which allows them to sell their products at cheaper prices. In the case of Chinese

[5] Results are shown in table 5. I do not report here the result from Olley-Pakes methodology since this methodology also deals with the survival probability which might be different across sectors.

automobile manufacturers, I find that this prediction holds true in all of the specifications.

**Younger firms export more.** The negative coefficients of age in table 5 show that young firms in China export more than old firms. This might be surprising at first since the former lack the resource and experience needed to penetrate foreign markets. However in China, firms do not have to rely on their own to export. There are intermediate companies whose role is to help manufacturers sell goods in foreign markets. Moreover, most old firms have rigid organizational structure. Therefore it might be harder for those firms to adapt to the requirements of foreign buyers.

**No evidence that exporters are capital intensive.** There is no evidence that exporters are capital intensive. The coefficients of capital intensity are positive in some specifications and negative in others. None of them are statistically significant.

**Firms with more foreign capital export less.** Different from other studies, I find evidence that firms with foreign capital will export less. This is because the goal of foreign companies when cooperating with Chinese counterparts is to enter the domestic market.

Table 5:

| Dependent variable: log of export | | |
|---|---|---|
| | (1) | (2) |
| Constant | 2.58*** | 1.55** |
| | (.804) | (.723) |
| Output | .561*** | .581*** |
| | (.088) | (.086) |
| Productivity | .107* | .315*** |
| | (.055) | (.073) |
| Number of employees | .007 | .020 |
| | (.118) | (.117) |
| Age | -.015*** | -.015*** |
| | (.005) | (.005) |
| Capital intensity | -.003 | -.006 |
| | (.034) | (.033) |
| Number of observations | 577 | 577 |
| $R^2$ | .25 | .27 |

Note: Standard errors are reported in parentheses.* significant at 10%; ** significant at 5% *** significant at 1%.
(1): We apply De Loecker methodology
(2): We apply OLS methodology

Table 6:

| Dependent variable: log of export | | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Constant | 4.503*** | 2.67** | 2.96** | .934 | 1.27 | .510 |
| | (1.19) | (1.19) | (1.15) | (2.88) | (2.69) | (3.50) |
| Output | .340*** | .317*** | .328** | 1.76*** | 1.75*** | 1.76*** |
| | (.130) | (.129) | (.128) | (.352) | (.351) | (.351) |
| Productivity | .520*** | .382*** | .363*** | -.0567 | -.036 | .099 |
| | (.142) | (.096) | ( .100) | (.232) | (.346) | (.321) |
| Number of employees | .307* | .339* | .302* | -2.18** | -2.15*** | -2.14*** |
| | (.175) | (.174) | (.176) | (.578) | (.567) | (.559) |
| Age | -.021** | -.020* | -.021* | .035 | .035 | .037 |
| | (.010) | (.010) | (.010) | (.023) | (.023) | (.024) |
| Capital intensity | -.036 | -.050 | -.053 | .159 | .171 | .203 |
| | (.055) | (.055) | (.055) | (.201) | (.196) | (.202) |
| N of observations | 286 | 286 | 288 | 55 | 55 | 55 |
| $R^2$ | .23 | .23 | .24 | .37 | .36 | .37 |

Note: Standard errors are reported in parentheses.* significant at 10%; ** significant at 5% *** significant at 1%.
(1): We apply De Loecker methodology in the car sector
(2): We apply OLS methodology in the car sector
(3): We apply Olley-Pakes methodology in the car sector
(4): We apply De Loecker methodology in the bus sector
(5): We apply OLS methodology in the bus sector
(6): We apply Olley-Pakes methodology in the bus sector

Table 7:

| Dependent variable: log of export | | |
|---|---|---|
| | (1) | (2) |
| Constant | 2.546*** | 3.861* |
| | (.724) | (2.16) |
| Productivity | .175 | .343 |
| | (.135) | (.247) |
| Output | .898*** | .928*** |
| | ( .265) | (.258) |
| Size | -.398 | -.359 |
| | (.289) | (.294) |
| Age | .021 | .022 |
| | (.014) | .014 |
| Capital intensity | -.107 | -.086 |
| | (.118) | (.117) |
| State capital | .074 | .077 |
| | (.210) | (.209) |
| Foreign capital | -.463*** | -.441*** |
| | (.159) | (.163) |
| Number of observation | 95 | 95 |
| $R^2$ | .39 | .39 |

Note: Standard errors are reported in parentheses.* significant at 10%; ** significant at 5% *** significant at 1%.

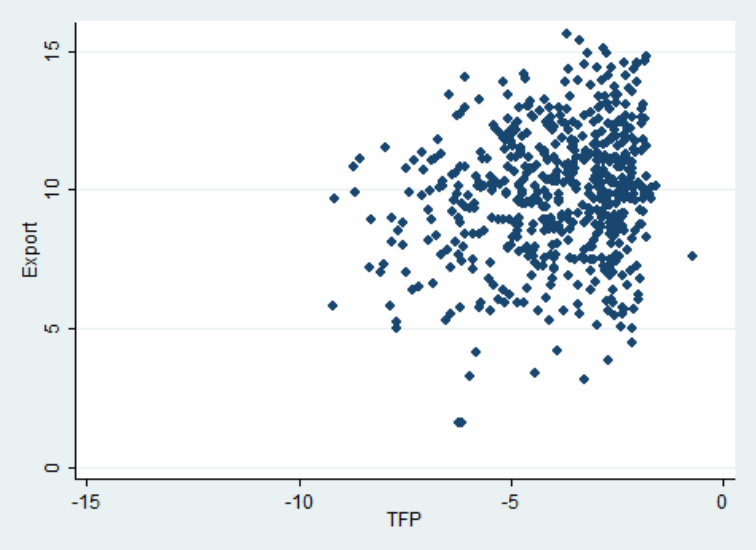
Table 8:

| Dependent variable: log of export | | |
|---|---|---|
| Constant | 2.58*** | 7.716*** |
| | (.805) | (1.785) |
| output | .561*** | .487** |
| | (.088) | (.218) |
| capital intensity | -.0029 | .0096 |
| | (.033) | (.115) |
| Number of employees | .0075 | .041 |
| | (.118) | (.234) |
| Age | -.015*** | .017 |
| | (.005) | (.015) |
| Productivity | .107* | .322*** |
| | (.055) | (.102) |
| Foreign capital | | -.323** |
| | | (.144) |
| Number of observations | 577 | 198 |
| $R^2$ | .25 | .18 |

Note: Standard errors are reported in parentheses.* significant at 10%; ** significant at 5% *** significant at 1%.

Table 9:

| Dependent variable: National capital | |
|---|---|
| Foreign capital | .501*** |
| | (.023) |
| constant | 78884*** |
| | (12222) |
| Number of observations | 2387 |
| $R^2$ | .16 |




# 3 Conclusion

Automobile is a growing, important industry in China, yet it is believed that things might work differently from what one expects. This paper presents some evidence about Chinese exporters characteristics in this industry. In particular, I find that exporters are more productive, although the evidence might be not strong. Also they are bigger, younger, and have less foreign capital. There is no evidence that they are capital intensive. I hope that this can help policy makers have a clear picture and shape their policy. Future works will be finding the micro foundations to rationalize those findings.

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