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Export fluctuation and overcapacity in China's manufacturing industry—the inspection of the causes of excess capacity from the perspective of external demand

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Abstract

Background: Intuitively speaking, there is an inverse proportional relationship between exports and overcapacity, which means in export's busy season, enterprises would expand output and improve capacity utilization rate but control yields to avoid dull sale in slack season, causing exacerbated excess capacity. However, this is just the reflections of "sales effect" on overcapacity by export fluctuation. For some enterprises, there is indeed "competition effect" which may alleviate overcapacity because enterprises face even more fierce domestic competition for the sake of weak exports and may increase the utilization load of existing capacity in order to cut costs.

Methods: A test is conducted in this paper to verify the relationship between export fluctuation and excess capacity based on data of China's manufacturing industry from 2001 to 2013.

Results: The overall results indicate that export fluctuation is not the significant cause for excess capacity. In the small- and medium-sized enterprises or in industries with higher proportion of non-state capital, the negative relationship between exports and excess capacity is more obvious, with sales effect taking a dominant position. On the other hand, under the influence of competition effect, the relationship between the two may be positive.

Conclusions: Thus, external demand shocks exert different influence on the alleviation of excess capacity of different industries, and extensively driven exports may not have anticipated effect on the dissolution of the excess capacity. To regulate overcapacity with the aid of external market, a fair and orderly competition environment should be provided to the export subjects of different size and ownerships.

Keywords: Export fluctuation, Capacity utilization, Excess capacity, Manufacturing, External demand shock

Background

Since the 1990s, China's manufacturing industry has experienced several rounds of overcapacity which have involved heavy chemical industries including metal smelting, mineral products, machinery, and equipment. In recent years, newly emerging industries such as wind power and optoelectronic device also cannot be spared. Excess production capacity means that the production capacity formed in advance exceeds the

needs of equilibrium quantity, and then leads to the situation in which there is idle surplus of production factors, which is originally a common phenomenon under specific economic operation conditions (Dixon and Rimmer 2011; Chaturvedi and Martínez-de-Albéniz 2009). If the enterprise can neither foresee falling demand caused by financial shocks and structural adjustment nor collect sunk fixed investment, excess capacity will hardly be avoided. Such overcapacity can normally be resolved by market pullback automatically. However, in the past 20 years, there have been many times of large-area overcapacity which lasts for a long time in some industries and is not identical with macrocycle. Such formation system is indeed worth discussion. Many studies attribute overcapacity to special transitional system and government-enterprise relationship. It has been pointed out by the *research group on China's economic growth and macro stability* (2010) that surpassing strategy and government controls cause the stock of resources to be capitalized quickly, which causes innovation deficiency of the real economy and excess capacity. Han et al. (2011) argue that the improper intervention on microcosmic body by government caused investment distortion and excess capacity. Jiang et al. (2012) find that the fiscal system and promotion system prompt the local government to attract investment at a lower price regardless of the risk of excess production capacity, and local discretion and ambiguous property rights of public resources provide condition. Liu and Sun (2014) find that the local governments, in order to cope with the employment pressure caused by urbanization, increase support on enterprises' finance and land, eventually exacerbating overcapacity. The above studies analyze the causes of excess capacity from supply side. In theory, excess capacity may come from both excessive growth capacity in supply and may be from constraints of market demand (Squires et al. 2010; Somayeh et al. 2012). Then what influence do factors from demand side exert on current overcapacity?

Most studies regard demands as a variable self-evident in influencing overcapacity, and they tacitly approve that there is an inversely proportional relationship between the prospect of sale and overcapacity. This may conform to logic, as the low demand in both domestic and foreign market has no doubt play a helpful role in spreading of excess capacity in China's manufacturing sector. However, the existing literature lack the analysis of causes on demand side for excess capacity, which is particularly reflected in empirical studies where demand is merely treated as a control variable in seeking the cause for excess capacity. The conclusions drawn from such studies may seem to be simple, for the mechanism of action on overcapacity by demand fluctuations cannot be revealed. From the perspective of domestic demands, capital deepening restricts the increase of real labor reward, together with the situation in which the burden of pension and housing have posed heavy burdens for residents, so consumption stagnation will necessarily cause the decrease of investment efficiency. In the future, it is one of the approaches to dissolve overcapacity from channels like reforming income distribution system and adding the supply of public goods to expand internal demand. However, from the perspective of external demands, the influence of export fluctuation seems to be much more complex. Before 2007, China's cargo exports had experienced years of speedy growth. At that time period, the domestic overcapacity was not significantly released. Ever since 2008, under the impact of financial crisis, domestic overcapacity became increasingly prominent, but the decrease of China's utilization rate of production capacity is obviously lower than the decrease of the export growth. According to related

estimates, in recent years, overcapacity mainly occurs in heavy chemical industry and some newly emerging manufacturing industry (Han et al. 2011; Dong et al. 2015) both of which are not the industries that have undergone the most serious exports downturn. The phenomenon that exports' growth and capacity utilization rate more inversely has been observed by several researches such as the one done by Qi et al. (2014) which discovers the supply and the demand are relatively balanced and the capacity utilization level is relatively high accordingly. After 2001, the internal and external demand expands positively, cultivating the entrepreneurial innovative sluggishness and causing phrasal overcapacity.

Some views state that in current stage, the decreasing export growth should be stopped so that the overcapacity can be solved with the help of the external marketization, but this statement has not pointed out the concrete approaches for the problem's solution. The reason lies in the fact that existing researches have not revealed the "black box" for the enterprises' decisions concerning capacity thus regard the influence of exports on overcapacity with a rather simple perspective. The authors believe that when responding to the export fluctuation, the decision of entrepreneurial capacity should not only be based on the feedback information from their own sales but also consider the relationship between the room for industrial growth and competitors. The external demand, in addition to influencing the sales of entrepreneurial products directly, will also affect the industry structure and competitive relationship among enterprises; the latter of which is an important factor in influencing enterprises' capacity utilization level (Svensson and Wijnbergen 1990; Mathis and Koscianski 1997; Crotty 2002; Besanko et al. 2010; Nikiforos 2013; Han 2013). Apart from the mechanism that demands retrenchment and the difficulty of expanding output caused by decline in exports, we have to accept the mechanism of lower capacity utilization(Wan et al. 2009) . Even if the external environment of export sales becomes deteriorated, the enterprises will not have to reduce capacity utilization rate if the competition condition is not available. The influence of export fluctuations on the sales of the products from domestic enterprises and competitive relationship happens at the same time and exerts influence on capacity utilization rate from two respective channels.

A deep analysis into the two effects as well as their function mechanism and scope of external demand fluctuation on enterprises' products' sales and competition relationship will be helpful to reveal the causes for overcapacity. This paper attempts to classify the two effects of export fluctuations into "sales effect" and "competition effect." Furthermore, basing on the data of each branch industry of China's manufacturing industry from 2001 to 2013, empirical studies analyze whether overcapacity will be deteriorated or alleviated as exports fluctuate with certain scale of capacity investment, explore the heterogeneity of external demands' fluctuations on overcapacity, and determine the category of industries where the sales effect and the competition effect of export fluctuation on excess capacity are more prominent.

Function mechanism and hypothesis

The influence of export fluctuations on the enterprise's desired output

Export fluctuations imply that there are changes in the demand of external market and thus the desired supply of domestic enterprises will also be adjusted accordingly. Based on intuition when exports go down, the overall external demand of the whole industry

becomes insufficient. So if enterprises still keep original amount of output, some products will not be sold and the ratio between production and sales will drop accordingly, causing heavier burden for inventory investment. In order to prevent the loss of profit, actual output must be reduced. As Fig. 1a demonstrates, domestic manufacturing industry is supposed to be a monopolistic competition market. The imaginary demand curve of a single enterprise is d_0, while the actual market share demand curve is D_0 whose original equilibrium stays at E_0. When imports undergo negative fluctuations, the external demand reduces and curve d_0 will be translated to d_1, while actual market share demand curve will be translated from D_0 to D_1 and the new equilibrium will also be translated to E_1 whose equilibrium production q_1 is lower than the original equilibrium output q_0. This means that with the impact of decline in exports, the products' equilibrium price decreases and the desired output of enterprises will be reduced accordingly. Figure 1a depicts the situation in which exports witness negative fluctuations. Similarly, when exports grow rapidly, with the stimulus of upward price, enterprises will be more willing to add supply and to curb output for de-stocking, thus the new equilibrium will correspond to a higher desired output.

The above is the mechanism inferred only from classic theories and can be concluded as sales effect, but there exists competition effect in reality. The desired output of some enterprises may be affected by this and make corresponding opposite adjustment. The new equilibrium E_1 depicted in Fig. 1a is not a long-term one, while the original equilibrium E_0 represents long-term equilibrium, for the average cost curve must be tangential to the point of the imaginary demand curve of the enterprises. The negative impact of exports cause the market equilibrium to stay at E_1 whose price and output are both lower, meaning that there will be a large number of enterprises undergoing losses and there may be competition for the survival of the fittest in the industry. As Fig. 1b shows, as some competitors are knocked out, the remaining incumbent enterprises will gain more market shares, so the demand curve they imagine and the demand curve of actual market share will turn in an anticlockwise direction, both of which can be marked as d_0 and D_2. As a result, the short-term equilibrium of single enterprises turns into E_2. It can be seen that when exports fluctuate negatively, the decrease of the desired output of a single enterprise would not be so serious if the

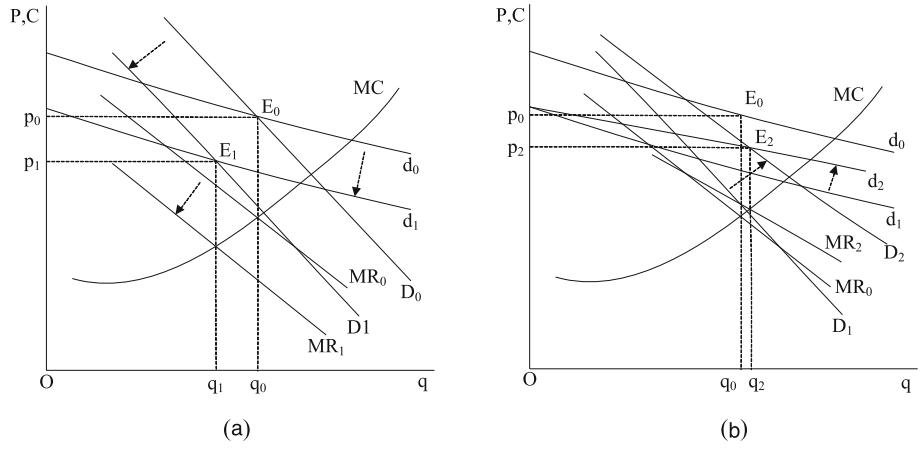

Fig. 1 Sales (**a**) and competition (**b**) effects of negative export fluctuation on desired output

competition effect functions. The desired output of a single enterprise may even be higher than original equilibrium output. Figure 1b depicts the function process of competition effects on desired output when exports fluctuate negatively. Similarly, if the exports fluctuate positively, strengthening demand will cause a large number of competitors to flock in and the market share of a single enterprise decrease accordingly, which will further cause the desired output increase caused by sales effect to be hedged by competitive effect.

The influence of changing enterprises' desired output on industrial capacity utilization rate

It can be seen from the above analysis that under sales effect, the relationship between export fluctuations and desired output is positive, but under competition effect, the effect of export on the desired output of enterprises may be opposite. Considering the actual situation of China's export and the relationship among industries, the authors have deduced the ways that export fluctuations affect enterprises' capacity utilization rate through desired output.

The positive transmission of export fluctuations on capacity utilization: taking sales effect as a channel

Firstly, judging from the perspective of sales effect of export fluctuations, the desired output of enterprises decreases when exports go downward. Enterprises at this moment can curb output from two channels: the first is to curtail the capacity scale, and the second is to keep capacity steady and reduce capacity utilization rate. If enterprises choose the first approach, they can "live through the winter" with a "small and efficient" model enabled by capacity reduction. However, this does not conform to local government's political target. Facing multiple pressures such as "sustaining growth" and "promoting employment," governments have enough discretionary power and controllable resources to shift the pressure. For a long time, local government provides all kinds of privilege for enterprises to stimulate investment and set up exit barriers in all kinds of forms in order to keep at least the scale of investment unchanged. Thus, once enterprises have to reduce output under the influence of sales effect, they tend to choose to lower capacity utilization rate and keep a certain amount of idle capacity in the hope of avoiding the losses of overstock caused by using capacity with high load and furthermore make the overcapacity exacerbated.

Conversely, when the export situation is optimistic, enterprises' desired output increases under the influence of sales effect and will use invested production factors with high loads in order to keep a relatively high capacity rate instead of wasting paid sunk cost. Otherwise, market would be abandoned voluntarily, unless the price elasticity of demand for exports is extremely low. Of course, enterprises can seize market opportunities by investing new capacity when exports go upward. But the cycle of building manufacturing capacity is quite long, which is even prominent with the entry and exit barriers under the fiscal intervention. (Zhang and Dong 2014). Therefore, under the premise that capacity is established, if enterprises desire to increase output, they should improve the established capacity utilization rate. In a word, if the sales effect of exports takes the dominant position, the relationship between the degree of overcapacity of the whole industry and the exports situation will be negative.

The negative transmission of export fluctuation on the capacity utilization: taking competition effect as the channel

Under competition effect, the downward export will cause industries to select the superior and eliminate the inferior. During such a process, enterprises as winners will get higher equilibrium output and their losses of profit will also be reduced to the minimum. However, it is not easy to extrude other manufacturers in an unfavorable situation for exports, for single enterprises should first have enough confidence on their own capability, take measures such as expanding their output and going against market to lower average costs, and threaten competitors for higher market shares and even desired output. Under the current system mechanism, the domestic enterprises' expanding output and going against market mainly comes from government support. For example, after the international financial crisis in 2008, governments at all levels quickly issued supporting policies for export enterprises that include policy tools such as export credit insurance and tax reimbursement as well as fiscal subsidies, supportive loans, and construction land support to assist enterprises to share export costs. Government intervention not only prevents enterprises from contracting capacity timely according to the changes in market demand but also provides motivation and conditions for individual incumbents that incur violation costs like law of return and capacity utilization rate increased by going against market. Thus, in the situation of decline in exports, enterprises are influenced by competition effect, which means that under the given scales of production capacity, they usually cope with competition by raising the capacity utilization rate.

When some industries are undergoing peak season of exports, the equilibrium output of all manufactures will expand correspondingly if there is no competition effect. This will initiate competitors to flock in, causing the market share and desired output of single enterprises to decrease. Incumbent firms, in order to expand market share, are likely to go against market and lower capacity utilization with higher average cost. With such "self-destructive" behavior, a threatening promise is put forward to competitors. As Mathis and Koscianski (1997) put, keeping a spare capacity is equivalent to raising the barriers to entry. Incumbent firms can inhibit investment enthusiasm of potential competitors through this way. In addition, the conditions of market demand are relatively superior, making the competition among enterprises regard production efficiency less (Qi et al. 2014). The competition means like "hoarding" capacity in production is less likely to be punished by market mechanism. To sum up, if competition effect of export fluctuation functions, negative export fluctuations will partly offset the excess production capacity increase of sales effect; when exports fluctuate positively, competition effects will make the mitigation role of sales effect on overcapacity less obvious or even exacerbate overcapacity.

Theoretical hypothesis

Export fluctuations will exacerbate or mitigate the domestic overcapacity through both sales effect and competition effect. Both effects function at the same time with opposite directions and can only determine the direction of industrial capacity utilization rate by the balance between growth and decline.

H1: There are two opposite function mechanisms for export fluctuations to exert on overcapacity; thus, weak exports may not result in exacerbated overcapacity, and the fast export growth may not be helpful to assist to alleviate the overcapacity of all industries either.

Which effect is taking a dominant position has an important bearing on the industrial structure and the competition situation it determines. For large enterprises and state-owned enterprises, those having used competition effect to gain market share and monopoly advantages are more motivated and have more chances. This is due to the fact that state-owned enterprises and large enterprises are usually easier to get support from government, so they can use production network and investment as well as financing system to spread risk when employing self-mutilation strategy. With higher expectations on the returns for the strategy of going against market, they tend to give less consideration to signals like export prices. Therefore, when exports are weak, state-owned enterprises and large enterprises tend to improve capacity utilization rate by going against market and "hoard" capacity while going against market in the peak season of exports.

Conversely, those small and medium enterprises or private enterprises with weak market power and obvious risk aversion usually lack the capability to use the strategy of going against market, and they tend to follow the changing signals on price caused by export fluctuation. With certain capacity, such enterprises usually lower capacity utilization rate to adapt to decline in exports and increase capacity utilization rate to adapt to export growth, making the relationship between overcapacity and export fluctuations more likely to be negative. Judging from this, the competition effect caused by export fluctuations on overcapacity mainly occurs in large enterprises and industries with a high proportion of state-owned capital, while the sales effect plays a major part in small and medium enterprises and industries with higher proportion of non-state-owned capital. Hypothesis 2 is thus proposed.

H2: The higher the proportion of small and medium enterprises or non-state-owned capital is in the industry, the more likely for the relationship between export fluctuations and excess capacity to be negative; the higher the proportion of large enterprises or state-owned capital is in the industry, the less obvious the relationship between export fluctuation and excess capacity is and it may even be positive.

Methods

Econometric model

According to theoretical analysis, export shocks may function as exacerbation or alleviation on overcapacity, which becomes stronger or weaker as the proportion of small and medium enterprises (or the proportion of non-state capital) changes. Next, with the data from the China's manufacturing sector, taking industrial excess capacity index as explained variables and the contrary indicator of industrial export growth as the core of explanatory variables, we test the above hypothesis through an empirical test.

$$EC_{it} = \lambda_0 + \lambda_1 Exd_{it} + \lambda_2 Scal_{it} + \lambda_3 (Exd_{it} \times Scal_{it}) + \xi X + u_i + b_t + \varepsilon_{it} \quad (1)$$

$$EC_{it} = \lambda_0 + \lambda_1 Exd_{it} + \lambda_2 Stat_{it} + \lambda_3 (Exd_{it} \times Stat_{it}) + \xi X + u_i + b_t + \varepsilon_{it} \quad (2)$$

Of the two equations, EC_{it} is an explained variable, signifying the excess capacity index of i industry at the year of t; Exd_{it} as the core explanatory variable signifies the opposite number of the export growth of i industry at the year of t; $Scal_{it}$ and $Stat_{it}$ are regulated variables, with the former signifying the proportion of small and medium enterprises in industry i at the year of t and the latter symbolizing the proportion of non-state-owned capital of industry i at the year of t; $Exd_{it} \times Scal_{it}$ and $Exd_{it} \times Stat_{it}$ are the interaction items for core explanatory variables and regulated variables; while X is control variable, u_i is industry factor, b_t is time factor, and ε_{it} is residual error.

In order to test whether the scale of all industries and the ownership characteristics influence the overcapacity caused by export fluctuation, this paper will mainly observe the regulated variables of $Scal_{it}$ and $Stat_{it}$ and the coefficient signs as well as the significance of the interaction item of core explanatory variables. According to Jaccard and Turrisi (2003), with interaction item added, if equations' goodness- of-fit is higher than the figure before the addition and the coefficient of interaction item is significantly positive, then regulated variables will make slope of explained variables against the regression of core explanatory variables higher, which means the higher the value of regulated variables are (higher proportion of small and medium enterprises or the proportion of non-state capital), the more obvious the influence of core explanatory variables on explained variables is.

What should not be neglected is while explained variables Exd_{it} may affect excess capacity EC_{it}, there may be endogenity caused by reverse causality. If weakened external demand leads to excess capacity, and the possibility that excess capacity of the last term has become pressure on manufacturing technology innovation cannot be ruled out, which may promote or hinder current export growth increase, the results of least squares regression may be overvalued or undervalued. This paper plans to first get the least-squares regression results and then adopts SYS-GMM to conduct robustness test and observe whether the estimated result of weakened endogenous problem is consistent with the original results.

Treatment of variables

Core explanatory variables

This paper uses the opposite number of goods exports (in Yuan) of various industries against the previous year's growth that is core explanatory variable Exd_{it} to measure the changes of the external demand of the industry. This method has been applied in a rather similar way (Li and Liu 2009). Among these applications, value of exports deflates on the basis of producers' production price index (take the figure of 2000 as base period). The exports' value can be gained by totaling the money of related exports. The corresponding relationship between HS code used in Custom's statistics and the two-bit code of manufacturing industry can be referred to Sheng (2002). As a cycle of several months are needed to transmit the feedback of the changes in export market to domestic manufacturing industry for enterprises' decision, Exd_{it} is thus treated by the author in a later time period with the data of t-1 representing the observation value in period of t. In addition, this variable should adopt standardized value in order to ensure the possibility of multiplying the regulated variables.

Regulated variables

The first regulated variable $Scal_{it}$ refers to the proportion of small- and medium-sized enterprises in industry i, which is measured by the proportion of total output value, a figure gained by ratio of the total industrial output of the small and medium enterprises to that of small, medium, and large enterprises. The second regulated variable $Stat_{it}$ is the proportion of non-state capital in the industry, measured by using the proportion of non-state capital of industrial enterprises above a designated size in the whole paid-in capital. *Scal* and *Stat* should all adopt standardized values.[1]

Control variables

This paper tries to prove the external demands' influence on capacity utilization rate under a certain capacity scale; thus, the interference of factor input on the above regression relationship needs to be controlled. In addition, even if the external demand and factor input of some industry have not changed, the capacity utilization rate will also be affected by the conduction of other industries through the upstream and downstream relevance and should be controlled in the econometric model. This paper selects the following control variables: (1) $InpK_{it}$, changes in capital inputs. The variable uses the growth rate of the capital expenditure of industrial enterprises above designated size (that is the net value of fixed assets) against the last year's figure to measure and the price index of investment in fixed assets to deflate (taking 2000 as the base period). (2) $InpL_{it}$, changes on labor inputs. The index uses the growth rate of the labor expenditure of industrial enterprises above designated size against the figure of the last year (taking 2000 as base period) to measure. In this process, the labor spending can be calculated by the multiplication of the number of employees in this industry with the average wage at urban units, and the average wage is deflated by the consumer price index over the years.[1] (3) *Up*, the changes in the scale of production in upstream industry. The variable can be measured by the growth rate of the sum of weighted average of the industrial value from upstream industry. (4) $Down_{it}$, the changes in the scale of production in downstream industry. This variable is measured by the growth rate of the sum of weighted average of the industrial output from upstream industry among all industries and the growth rate against the last year's figure.[2] (5) *Year*, dummy variables of the year. In order to control the impact of this financial crisis on the relationship between exports and excess capacity, we set samples before 2008 as 0 and those after 2008 as 1.[3]

The data source

The main data source is the export value of export products corresponding to all industries is derived from "Statistics Yearbook of China Trade over the years"; the gross Industrial value of enterprises above designated sizes, the net value of fixed assets, the paid- in capital and its structure, the number of practitioners, and the gross value of industrial output of small, medium and large businesses come from Statistical Yearbook of China's Industrial Economy (data of and after 2012 is included in the Statistics Yearbook of China's Industry); The data of the average wage of employees at urban units of all industries come from "Statistical Yearbook of China's Labor"; Relevant price indexes are derived from China Statistical Yearbook. The observation time of samples is 2001–2013.

Calculation of excess industrial capacity index

Cost function method is the mainstream way to measure the excess capacity. For example, Han (2011) uses standardized variable cost function to calculate the industry capacity output with minimized costs and the ratio of actual capacity utilization rate, that is the ratio between actual output and output capacity. Shen et al. (2012) utilize the marginal production function to calculate theoretical production to eliminate the difference on industry characteristics. In addition, there is profit function method (Kim 1999) and DEA method (Dupont et al. 2002). This paper first borrows Han et al. (2011), calculates the potential output for all industries according to variable cost function, and then get the ratio of potential output to actual output as the excess capacity index. Variable cost can be defined as the sum of labor, energy, and raw materials. After a standardized treatment on variable cost V, energy price pE, price of raw materials pM (divided by labor price, equal to variables added wavy lines), variable cost function can be written as follows:

$$\begin{aligned}\tilde{V} = Y \times [&\alpha_0 + \alpha_{0t} \times t + \alpha_E \times \tilde{p}_E + \alpha_M \times \tilde{p}_M + 0.5 \times \left(\gamma_{EE} \times \tilde{p}_E^2 + \gamma_{MM} \times \tilde{p}_M^2\right) \\ &+\gamma_{EM} \times \tilde{p}_E \times \tilde{p}_M + \alpha_{Et} \times \tilde{p}_E \times t + \alpha_{Mt} \times \tilde{p}_M \times t] + \alpha_K \times K + 0.5 \times \left(\gamma_{KK} \times \left(K^2/Y\right)\right. \\ &\left.+\beta_{KK} \times \left(\Delta K^2/Y\right)\right) + \gamma_{EK} \times \tilde{p}_E \times K + \gamma_{MK} \times \tilde{p}_M \times K + \alpha_{Kt} \times K \times t\end{aligned} \tag{3}$$

Using regional panel data of 20 manufacturing industries, variable cost functions are estimated. After gaining corresponding parameters, potential output $Y^*_{i,k,t}$ is calculated when the cost of all industries at all regions is minimal. Adding each one of them can get the potential output of all industries Y^*_{it}, which when divided by actual output Y_{it} can produce overcapacity index EC_{it}. The method to calculate $Y^*_{i,k,t}$ can refer to Han et al. (2011). When estimating the variable cost function of all industries, we adopt the data at provincial level of corresponding industries. Samples include those of 20 manufacturing industries and 30 provinces, not including Tibetan Autonomous Region, Hong Kong, Macao, and Taiwan due to the lack of data. The concrete disposal of data of all provinces at various industries is (1) capital stock $K_{i,k,t}$ and capital price $p_{K,i,k,t}$. The capital stock of industry i in region k can be demonstrated by the net value of fixed assets of enterprises above designated size and be deflated by the price index of fixed assets investment at all regions of the same year. Capital price, the total opportunity cost of capital, can be demonstrated by the ratio between interest expense of enterprises above designated size and the total liability. (2) Labor input $L_{i,k,t}$ and the labor price $p_{L,i,k,t}$. Labor input of industry i in the area of k can be represented by the number of employees in enterprises above designated size. Labor price is represented by the average wage of employees and deflated by consumer price index among regions. (3) Energy prices $p_{E,i,k,t}$ and raw material prices $p_{M,i,k,t}$. The energy price in area k in industry i can be indicated by the fuel with fixed base, price index of purchased motivational items (year 2000 = 1). Raw materials' prices can be indicated by price index of purchased materials of seven categories with fixed base, and the corresponding relationship between industries and the type of raw materials can be referred to Han et al. (2011). (4) Actual output $Y_{i,k,t}$, variable costs $V_{i,k,t}$, and the technical progress $t_{i,k,t}$. The handling method can refer to Han et al. (2011). The actual output is deflated by the regional producer price index, and the intermediate input is deflated by price index of

purchased raw materials. The above price indexes used for data's deflation all use year 2000 as base period.

After gaining all the data by above methods, we have formed the 20 sets regional panel data and make estimate according to (3). In estimates, we use SYS-GMM to avoid endogeneity problem. The results show that when the group Sargan test and Arellano-Bond AR (2) have passed, most parameters were significantly different from-zero. Then, $Y^*_{i,k,t}$ is calculated for all industries across all regions and their adding together produce Y^*_{it}. $\left(Y^*_{it}/Y_{it}\right)$ is then used as basis to produce EC_{it}, excess capacity index of all industries from 2001 to 2013.[4]

Results and discussion

Preliminary estimates

Table 1 shows the regression results of panel data signifying the relationship between export changes and overcapacity. In estimation process, control variable is gradually added without regulated variables and interaction items being included. Through Hausman test result, it can be concluded that random effect model should be adopted by each column. From column (1) it can be known that Exd_{it} as the only explanatory variable plays an obvious positive role in overcapacity index before adding control variables. The estimated value of coefficient of 0.31 means each decrease of one unit of the export growth (after being standardized) in one industry will reduce the ratio of the potential output of the industry to the actual output by 0.3. After the variables like the investment of industries' own factors and the scale of downstream as well upstream industry are gradually controlled, goodness-of-fit of the estimating equation and integral significance have been significantly improved. Meanwhile, the effect of Exd_{it} on overcapacity has been weakened, which can be witnessed by apparently reduced estimated coefficient and the lack of significance. This illustrates that with certain capacity scale the exports' negative changes cannot reflect the obvious promotional role it plays

Table 1 Preliminary estimated results of export fluctuations' effect on excess capacity

	Index of industrial overcapacity *EC*					
	(1)	(2)	(3)	(4)	(5)	(6)
Exd	0.3100** (2.19)	0.1431** (2.08)	0.1323 (1.68)	0.1001 (1.43)	0.1225 (1.49)	0.1009 (1.11)
lnpK		0.3919*** (7.09)	0.3711*** (7.04)	0.2020*** (5.73)	0.2778*** (5.49)	0.2705*** (4.73)
lnpL			0.1604*** (4.07)	0.1413** (2.20)	0.1614*** (2.55)	0.1279** (2.10)
Up				−0.9554 (−1.26)	−1.0520 (−0.99)	−0.9664 (−0.74)
Down					−0.3131* (−1.90)	−0.1820* (−1.76)
Year						0.0920** (2.13)
Hausman test	1.3700	1.5200	1.1300	2.6600	2.2400	2.5900
Adj-R^2	0.7822	0.8034	0.8112	0.8624	0.8863	0.8901
Wald test	17.4500	19.2600	17.6700	20.0800	24.3900	25.6600

Note: The figures inside brackets are statistical magnitude; *, **, and *** represent the significance above 0.1, 0.05, and 0.01. There are constant terms in estimates, but their results are not listed. This is same with Tables 2 and 4

on excess capacity and positive fluctuations can neither embody its obvious neutralizing role. At least, this logic is not tenable among all samples.

In addition, the estimated results of control variables such as *InpKit*, *InpLit*, and $Down_{it}$ are basically consistent with expectations, which means that the expanding of industrial factors can aggravate overcapacity and expanding downstream industries will alleviate overcapacity. More elaboration will not be given here. However, Up_{it}, the figure signifying the expanding of upstream industries, does not exert any significant negative effect on overcapacity. According to the general understanding, some industry is easily to receive passively pressure on capacity transferred from upstream. While the results in Table 1 indicate that in reality, some downstream enterprises are capable of avoiding being trapped in disadvantageous situations. The reason is the concentration ratio of downstream industries is usually lower than that of the upstream ones and their investment decisions are relatively rational, which means they will not blindly expand capacity for increasing supply of intermediate goods or decreasing prices. Such is also one of the reasons that overcapacity of China usually occurs in the upstream of heavy industry.

Estimated results of adding regulated variables

In order to observe the influence of enterprise scale and ownership characteristics on the relationship between export fluctuation and excess capacity, $Scal_{it}$ and $Stat_{it}$ are included into estimation equations as regulated variables. The results can be seen in Table 2. The left side is situation in which $Scal_{it}$ is considered as regulated variable,

Table 2 Estimated results on the regulated effect of scale and ownership variables on the relationship between exports and excess capacity

	Scal as regulated variables				*Stat* as regulated variables			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exd	0.2021*** (2.94)	0.1423 (1.60)	0.1622 (0.87)	0.0981 (0.80)	0.1957* (1.96)	0.1016 (1.35)	0.0957 (0.90)	0.0796 (1.02)
Scal	0.1929** (2.08)	0.1480* (2.00)	0.1211* (1.78)	0.1095 (1.01)				
Stat					0.2498*** (2.65)	0.2100** (2.03)	0.2434*** (2.49)	0.1763* (1.78)
Exd × *Scal*		0.1421*** (3.15)		0.1211** (2.17)				
Exd × *Stat*						0.2055*** (3.11)		0.1623*** (3.03)
InpK			0.3456*** (3.08)	0.2951*** (3.01)			0.2879*** (4.00)	0.3002*** (3.13)
InpL			0.1925** (2.07)	0.1897* (1.82)			0.1761* (1.85)	0.1682* (1.83)
Up			−0.9304* (−1.81)	−0.9224 (−1.52)			0.0408 (0.65)	−1.1250 (−1.63)
Down			−0.1290* (−1.96)	−0.1402* (−1.77)			−0.1317* (−1.80)	−0.2020** (−2.08)
Year			0.0807* (1.83)	0.0911* (1.72)			0.0904* (1.93)	0.0825* (1.77)
Hausman test	1.9600	1.9700	0.9800	1.4200	2.0900	1.6600	2.6600	1.7900
Adj-R^2	0.8007	0.8369	0.9015	0.9128	0.8201	0.8455	0.8970	0.9089
Wald test	15.5400	13.5200	19.6500	19.9700	9.4900	11.6800	20.1400	21.5500

while the right side is one taking $Stat_{it}$ as regulated variable. There are no interaction items in regulated variables in columns (1), (3), (5), and (7), and interaction items of regulated variables are added into columns (2), (4), (6), and (8). From the left side, it can be known that the coefficient of $Exd_{it} \times Scal_{it}$ is obviously positive at levels of at least 0.05, the overall goodness of fit in column (2) is higher than column (1) by about 0.04 and the overall goodness of fit in column (4) is higher than column (3) by about 0.01. This suggests that the interactional influence has about 4% of the explanatory power on variable variance to be explained before adding control variables, but only 1% of the explanatory power when control variables are added. Thus, it can be concluded that the higher the proportion of the output of small and medium enterprises takes in total industrial value, the more likely the slope of overcapacity index against the regression of Exd_{it} is lowered, making the aggravation role of export fluctuations on overcapacity increasingly obvious with the proportion of small and medium enterprises increasing. It can be judged from the above that the negative influence of export fluctuations on capacity utilization rate through sales effect is more prominent among small and medium enterprises and decline in exports are easier to lead capacity utilization rate to decrease. Similarly, the measure to eliminate excess capacity with the help of external market is more effective for small and medium enterprises and relatively ineffective for large enterprises.

From the right part of Table 2, it can be seen that the coefficients $Exd_{it} \times Stat_{it}$ of columns (6) and (8) are all above the level of 0.01 and are significantly positive. Moreover, the overall goodness of fit of column (6) is higher than that of column (5) by about 0.03, while overall goodness of fit of column (8) is higher than that of column (7) by about 0.01. This shows that interactional influence has about 3% of the positively explanatory power on the variance of explained variable and only 1% of positively explanatory power after adding control variables. This means that the higher the proportion of non-state capital in one industry is, the more obvious the aggravation role of negative export fluctuations will be; otherwise, the aggravation role on excess capacity will be weakened. Similarly, in order to eliminate excess capacity, the measures to promote exports are more effective for non-state enterprises than state-owned enterprises. From this, it can be concluded that the second theoretical hypothesis proves right, that is, expected regulated effect have been produced in small and medium enterprises and the proportion of the non-state capital. However, as stated earlier, endogenous problems are likely to exist in explained variables, and the results of the random effects model may be biased; thus, there is a need to be further inspect by the SYS-GMM method.

Estimation results of SYS-GMM

Through preliminary test results, it can be concluded that hypothesis 1 and hypothesis 2 prove to be right. As a result of decline in exports may not aggravate excess capacity and the proportion of small- and medium-sized enterprises and the proportion of state-owned capital have all shown the expected effect. Next, SYS-GMM method is used for estimating to ensure the robustness. Table 3 reports the estimation results by SYS-GMM with regulated effect of industry characteristics. Under the SYS-GMM method, interaction item of export variable and its regulated variable is set as

Table 3 Estimated results of regulated effects based on SYS-GMM

	Scal as regulated variable				*Stat* as regulated variable			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Exd	0.3536*** (2.51)	0.1788 (1.61)	0.1133 (0.99)	0.0655 (0.86)	0.2694*** (2.85)	−0.0433 (−0.86)	0.1336 (1.25)	0.0832 (0.68)
Scal	0.1625*** (2.72)	0.1553** (2.19)	0.1281* (1.99)	0.1659 (1.56)				
Stat					0.3727*** (2.95)	0.1863** (2.03)	0.2120* (1.81)	0.1768 (1.21)
Exd × *Scal*		0.2869*** (5.10)		0.2009** (2.15)				
Exd × *Stat*						0.4619*** (3.37)		0.3997*** (2.62)
lnpK			0.3435*** (3.66)	0.3060*** (3.13)			0.3245*** (3.09)	0.3007*** (2.75)
lnpL			0.2031*** (2.56)	0.1989** (2.12)			0.1998*** (2.39)	0.1990** (2.28)
Up			−0.3120 (−1.23)	−0.1063 (−1.44)			0.2869 (1.27)	−0.1423 (−1.62)
Down			−0.1066*** (−3.44)	−0.1386** (−2.16)			−0.1697** (−2.16)	−0.1066** (−2.26)
AR(1)	0.0070	0.0210	0.0080	0.0110	0.0300	0.0320	0.0390	0.0120
AR(2)	0.1240	0.1080	0.1260	0.1290	0.3330	0.2930	0.1860	0.2610
Sargan test	0.4500	0.3750	0.4720	0.3990	0.1620	0.2770	0.4310	0.3670
Hansen test	1.0000	1.0000	0.9880	1.0000	1.0000	1.0000	1.0000	1.0000

Note: Figures in brackets are *z* statistics; *, **, and *** represent the significance above 0.1, 0.05, and 0.01; estimates are made by using two-step estimation, and factors like industry and year are controlled; constant terms and the lagged variables of explained variables are included in estimates but their results have not been listed; all four test values are all the value of *p*

endogenous explanatory variable. The first-order difference of the lagged variable is set as instrumental variable. Four control variables are defined as strictly exogenous variables. The *p* value tested by AR (2) of Arellano-Bond illustrates that set specification model is effective enough to avoid residual autocorrelation. The results of Hansen test and Sargan test show that there is no excessive recognition of instrumental variables. The situation on the left side is to regard $Scal_{it}$ as regulated variables, and the estimated coefficient of interaction item $Exd_{it} \times Scal_{it}$ in columns (2) and (4) are significantly positive at the level of at least 0.05, 0.29 when no other control variables are included and 0.2 after adding other control variables. It can be seen that after weakening endogeneity, regulated variables $Scal_{it}$ can still demonstrate obvious strengthening role on overcapacity effect caused by negative exports' impact. After controlling other variables, interaction of estimated coefficients at least significant at the 0.05 level is positive, in does not contain other control variables is about 0.29, about 0.2 after joining other control variables. Visible, weaken the endogeneity problem, after can still show a negative impact on exports of excess capacity effect has obvious reinforcement. After controlling other variables, each 10% increase of the proportion of small and medium enterprises (after being standardized) in a certain industry can increase 2% of positive contribution rate of negative export fluctuations on excess capacity. On the contrary, the positive contribution is down by 2%.

The right side of Table 3 describes the situation where $Stat_{it}$ is regulated variable. $Exd_{it} \times Stat_{it}$, the estimated coefficient of SYS-GMM in columns of (6) and (8) is

significantly positive at the level of 0.01, namely 0.46 and 0.4 respectively. This means that after weakening endogeneity problem, the proportion of non-state capital $Stat_{it}$ as regulated variable can exert obvious strengthening effect on the excess capacity by export fluctuations. After controlling other variables, each 10% increase of non-state capital of some industry (after being standardized) will improve 4% of decline in exports' stimulating influence on overcapacity. On the contrary, the stimulus is down by 4%.

By contrast, it can be found that the coefficient absolute value of the core explanatory variable Exd_{it} and significance in Table 3 are higher than those of the corresponding columns in Table 2. Then, it can be judged that due to the lack of random effect model's control on endogenous problem, the including effect of decline in exports in Tables 1 and 2 on excess capacity is relatively undervalued. If interference of endogenous problems is weakened, the including effect of decline in exports on excess capacity should be obviously enhanced despite it is not significant at the 0.1 level when there is no control variable included. This is because once the excess capacity has happened in the previous period, it is difficult for enterprise to collect cost timely, so the improvement of production efficiency is restricted, causing inhibiting effect on export advantage. It was because of the influence of export on the excess capacity that some errors appeared with traditional estimation method, and estimation results under SYS-GMM are more reliable. The symbol for control variable coefficient in Table 3 is basically same; thus, we will not elaborate any more here.

Estimated results from groups

First of all, samples in all 19 industries are sorted according to the level of $Scal_{it}$. The top 10 are classified into industries with high proportion of small- and medium-sized enterprises listed in column (1), while the latter 9 are industries with high proportion of large enterprises listed in column (2). Although such disposal has reduced sample size, derating some effective information, it is still enough to reflect the different influences of export in industries of various scale characteristics on overcapacity. From the left side of Table 4, it can be shown that the estimated coefficient of Exd_{it} in column (2) is significantly negative at the level of 0.1, much lower than the coefficient of Exd_{it} in column (1). This can be interpreted: if there is excess capacity in industries with higher proportion of small- and medium-sized enterprises, there will be higher contribution from external demand, the positive relationship between capacity utilization rate and exports is stronger, needing external market's expanding to eliminate excess capacity; the situation in industries with higher proportion of large enterprises is just the opposite. They have neither such obvious positive flexibility as the former capacity utilization rate exerting on export growth, nor alleviated overcapacity with export decline, so expanding exports will exacerbate overcapacity instead. This is basically the same with the judgment of the previous text on regulated effect. The difference lies in that the significantly positive relationship between exports and overcapacity apparently presented among industries with high proportion of large enterprises has been further discovered. In addition, Up_{it} in control variables performs quite differently between the two groups of samples. Industries with higher proportion of small- and medium-sized enterprises are more easily to suffer overcapacity due to upstream scale expansion, and large companies are more likely to resist the pressure on capacity from upstream, which is consistent with reality.

Table 4 Estimated results from groups

	Grouped by *Scal*		Grouped by *Stat*	
	(1)	(2)	(3)	(4)
Exd	0.1898* (1.90)	−0.0862* (−1.81)	0.1535*** (2.37)	−0.0029* (−1.86)
lnpK	0.2007** (2.86)	0.4031*** (3.82)	0.4162*** (3.29)	0.1767*** (2.93)
lnpL	0.1420** (2.06)	0.1339*** (2.67)	0.1658* (1.98)	0.1561** (2.30)
Up	0.1990** (2.30)	−0.4050* (−1.82)	0.1432 (1.34)	−0.3545 (−1.59)
Down	−0.2634* (−1.88)	−0.3012** (−2.15)	−0.1441** (−2.09)	−0.3667*** (−3.44)
Year	0.1364*** (3.12)	0.0461*** (2.54)	0.2117** (2.56)	0.0101*** (2.99)
Hausman test	1.3300	4.4200	2.8700	4.7700
Adj-R^2	0.8762	0.8836	0.8665	0.8794
Wald test	13.3600	15.5100	11.4400	20.0800

Then, all industries are sorted according to $Stat_{it}$ with top 10 classified as industries with lower proportion of state-owned industry and the latter 9 as industries with high proportion of state-owned capital. We then observe the influence of export fluctuation on overcapacity, and the results are listed in the right part of Table 4. Column (3) shows the first 10 industries, while column (4) lists the rest 9 industries. It can be found that the estimated coefficient of the column (4) Exd_{it} is significantly negative at the level of 0.1, much lower than the coefficient of column (3) Exd_{it}. This suggests that the excess capacity index of industries with lower proportion of state-owned capital has negative flexibility on exports; thus, exports expansion is favorable to alleviate overcapacity. Apart from the regulated effect of $Stat_{it}$, a variable mentioned above, on the relationship between export decline and overcapacity, it can also be sure that the relationship between exports and excess capacity in industries with higher proportion of state-owned capital is obviously positive.

To sum up, excess capacity of small- and medium-sized enterprises or industries with higher proportion of non-state capital is likely to happen during the export downturn. While in large enterprises and state-owned enterprises, capacity utilization rate may be lowered for the purpose of competition at the time when external demand is strong. Thus, it can be testified from hypothesis 2 that the sales effect of export fluctuation mainly exists in the small- and medium-sized enterprises or industries with higher proportion of non-state capital. In large enterprises and industries where the proportion of state-owned capital is higher, competition effect is dominant.

Conclusions

Usually, it is believed that there is a connection between versatile external market and domestic capacity utilization rate. Weakened external demand and impeded export will cause domestic excess capacity to exacerbate. However, this logic does not have any inevitability among all industries. Some large companies may make decisions contrary to the sales effect of export fluctuations for the purpose of competition. Whether the excess capacity occurs depends on the ebb and flow between sales effect and competition

effect. This paper uses the panel data of China's manufacturing industry from 2001 to 2013 to conduct empirical study for analysis and discovers the following: (1) Judging from the overall estimated results, export growth's slowdown cannot lead to exacerbated excess capacity of domestic manufacturing industry. Although the estimated coefficient is positive, the degree of significance is not enough; (2) With the increase in the proportion of small- and medium-sized enterprises or the proportion of non-state capital increase, the transmission effect of negative export fluctuation on excess production capacity will be strengthened; (3) In industries with higher proportion of large enterprises or state capital, the competition effect is more likely to play a leading role, which means the excess capacity of similar industries is more likely to happen during the period of rapid export growth.

According to the above conclusions, volatility from the external market does not exert as much impact on domestic excess capacity as imagined. At least, the flexibility of capacity utilization rate of all industries to export fluctuation is all positive. When exports are in decline, the enterprises owning market power may expand capacity by going against market in order to increase market share to win domestic market; and when export is in fast growth, this type of enterprises may curb capacity utilization rate, improve average cost to raise industry threshold, and then enable competition effect to offset sales effect, which will finally lead to an absence of significant relationship between excess capacity of manufacturing industry and exports. Export is originally a reflection of advantage for production efficiency of domestic enterprises, but the rapid quantitative export expansion over a long time period is not a natural extension of the competition on efficiency among domestic enterprises, but may exacerbate excess capacity in some industries instead. Under the current situation of recession in external market, continuing to improve export growth through extensive approach will lose more than gain. If enterprises of different size and ownerships cannot realize fair and orderly competition on export, it is still difficult to address excess capacity contradictions fundamentally even if exports recovered faster growth as large enterprises may "hoard" production factors.

Currently, there are many views opposing eliminating domestic excess capacity by excessively stimulating external demand. For example, Chen (2013) believes it is not feasible to alleviate the domestic overcapacity by stimulating foreign consumption demand and increasing external demand. This is because such deeds will raise the international price of bulk imports products like energy and worsen China's trade conditions. The innovation of this paper is to have broken the analysis framework for China's export to influence international market, emphasizing the exports' influence on overcapacity by affecting supply and explaining the overcapacity fluctuations rule by linking demand with supply. Extensive export has provided room of survival for domestic low production capacity and ineffective supply, dragged domestic structural adjustment and industrial upgrading down. Such export growth will exacerbate overcapacity risks. For a long time, industries with traditional advantage and large state-owned enterprises depend on advantages of scale to gain export growth. Currently, relatively stagnant external demand has provided a transitional adjustment period, traditional advantageous industry and large scale advantage, the current external demand in which if export growth is improved extensively regardless of this rule or public resources are mobilized to continue its advantage in exports, overcapacity will be more serious under the double effect of weakening scale effect and worsening trade conditions.

As economic new normal comes, export growth of China's manufactured products is slowing down, causing previous foreign trade development mode of low-level expansion unsustainable. At present, the adjustment direction and focus of foreign trade and industry policy should be placed on providing fair and orderly market environment for enterprises of different sizes and ownerships. Only by speeding up domestic industrial structural adjustment, deepening reform of the factor market, striving to perfect the unified domestic market, and breaking the regional segmentation and industry monopolies (Liu and Yang 2013) are we able to turn this round of adjustment evolution in external demand to be a favorable opportunity for China's manufacturing industry to close down outdated production facilities and resolve excess capacity contradictions. Each region should adjust measures to local conditions, refine and perfect industry directory and guidelines to encourage the development of small and micro enterprises, mainly support promising small- and medium-sized private enterprises to get an advantage in export competition and develop rapidly with the help of external market, and realize synergetic upgrading of both industry efficiency and exports quality in structural optimization of exports institutions. Meanwhile, we should constantly promote innovation-driven development, realize the transmission and upgrading from "made in China" to "innovated by China," promote the newly emerging industries without advantages on exports as new export growth source, and lead and cultivate new domestic supply through new export advantage.

Endnotes

[1]As "2013 Statistics Yearbook of China's Industrial Economy" has not published the number of employees of industrial enterprises above designated size for the year 2012. This thesis plans to, on the basis of the average growth rate of the previous 3 years to calculate the number of employees of industrial enterprises above designated size for 2012 by using the statistics of 2011.

[2]Of the third and fourth variable, the definition of the upstream and downstream industries and the determination of weight value is based on the input-output table of China in 2007, in which gross industrial output value is deflated by the producer price index over the years.

[3]Estimates by SYS-GMM have controlled the factors like region and years; thus; this dummy variable does not need to be added under SYS-GMM.

[4]Because the potential output of oil processing, coking, and nuclear fuel processing industry in some areas is negative, this industry is thus temporarily not considered. The rest 19 industries can be samples.

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Competing interests
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References

Besanko D, Doraszelski U, Lu LX, Satterthwaite M (2010) On the role of demand and strategic uncertainty in capacity investment and disinvestment dynamics. International Journal of Industrial Organization 28(4):383–389
Chaturvedi A, Martínez-de-Albéniz V (2009) Safety stock or excess capacity: trade-offs under supply risk, IESE Business School Working Paper
Chen JQ (2013) Revaluation and strategic choice of China's overcapacity problem with an open perspective, International Trade., 4
Crotty JR (2002) Why there is chronic excess capacity. Challenge 45(6):21–44
Dixon PB, Rimmer MT (2011) You can't have a CGE recession without excess capacity. Economic Modelling 28(1–2): 602–613
Dong MJ, Liang YM, Zhang QZ (2015) China's industrial capacity utilization: comparison among industries, regional disparities and influencing factors. Economic Research (1): 84-98
Dupont DP, Grafton RQ, Kirkley J, Squires D (2002) Capacity utilization measures and excess capacity in multi-product privatized fisheries. Resource and Energy Economics 24:193–210
Han GG (2013) Distorted motivation of urbanization and overcapacity of manufacturing industry—analysis on the basis of provincial panel data from 2001 to 2012. Journal of Northeast University of Finance and Economics (4): 17-24
Han GG, Gao TM, Wang LG, Qi YF, Wang XZ (2011) Measurement, fluctuations and reasons for overcapacity of Chinese manufacturing industry. Economic Research (12): 18-31
Jaccard J, Turrisi R (2003) Interaction effects in multiple regression (2nd edition). Thousands Oaks: SAGE Publications Inc
Jiang FT, Geng Q, Lv DG, Li XP (2012) The formation mechanism of regional competition, mechanism distortion and excess capacity. Chinese Journal of Industrial Economy (6): 44-56
Kim HY (1999) Economic capacity utilization and its determinants: theory and evidence. Review of Industrial Organization 15(4):321–339
Li YD, Liu XH (2009) Shock from external demand and China's investment fluctuation—empirical study basing on the relationship between shock and conduction. Study of Finance and Trade (4): 85-90
Liu H, Sun Z (2014) Distorted motivation of urbanization and overcapacity of manufacturing industry—analysis on the basis of provincial panel data from 2001 to 2012. China Industrial Economy (11): 5-17
Liu H, Yang DH (2013) Market factors, organizational factors, and advantages of exports in China's manufacturing industry—empirical analysis basing on the cross data of industries and regions. Journal of Finance and Economy (6): 75-84
Mathis S, Koscianski J (1997) Excess capacity as a barrier to entry in the US titanium industry. International Journal of Industrial Organization 15(2):263–281
Nikiforos M (2013) The (normal) rate of capacity utilization at the firm level. Metroeconomica 64(3):513–538
Qi HQ, Huang BM, Li W (2014) Changes of elemental production rate and China's overcapacity under the shock of supply and demand. Social Sciences in Nanjing (8): 16-23
Research Group on China's Economic Growth and Macro Stability (2010) Capitalised expansion and technical progress of catching-up economy. Economic Research (5): 4-20
Shen KR, Qin XS, Sun CH (2012) Causes and measurement of China's excess capacity. Review of Industrial Economics (4): 1-26
Sheng B (2002) Political and economic analysis of China's foreign trade policy. Shanghai: Shanghai people's publishing house
Somayeh MC, Ghasem T, Shaghayegh L, Sanaz MC (2012) Capacity utilization of buyer–supplier relationships. Indian Journal of Science and Technology 5(9):3345–3348
Squires D, Jeon Y, Grafton RQ, Kirkley J (2010) Controlling excess capacity in common-pool resource industries: the transition from input to output controls. Australian Journal of Agricultural and Resource Economics 54(3):361–377
Svensson LEO, Wijnbergen SV (1990) Excess capacity, monopolistic competition, and international transmission of monetary disturbances, NBER working paper, 2262
Wan GC, Chen Z, Liu L (2009) Structural imbalances, wave phenomenon and reversion between inflation and deflation. The Journal of Quantitative & Technical Economics (12): 3-18
Zhang QX, Dong YF (2014) Gradual technological innovation, construction cycle of productivity and excess capacity—a mock analysis basing on "neo-sebumpetertan" evolution model. Economist (8): 33-42