# Market demand dynamic induced mechanism in China's steel industry

Wei Sun[a], Kaiqiang Dong[a,*,1], Tianyu Zhao[a,b]

[a] Center for Quantitative Economies of Jilin University, China
[b] Changchun Guanghua School, China

A B S T R A C T

Using the example of iron and steel industry, this paper aims to reveal the market demand effect and the mechanism on investment and capacity allocation. Based on building the theoretical model containing demand dynamic gap with the quarterly data of iron and steel industry since 2004, time-varying parameter model is used to empirically test the asymmetric adjustment mechanism of the productivity allocation under demand inducing and the effect of policies. The results show that obvious asymmetric features in the formulating and withdrawing phases of iron and steel productivity caused by inducing demand dynamics and its asymmetric periodic motion; self-correction mechanism of productivity under the situation of frequent switching between supply and demand is limited. Once the deviation from the equilibrium level of production capacity exceeds its own threshold adjustment mechanism, it is unable to restore equilibrium through market regulation, and leads to the extraordinary "trial and error" cost; further takes the correlation mechanism among industries as the breakthrough point to do more empirical tests of the effects of downstream industry dynamic demand on the steel industry capacity. It also indicates that the development of the real estate industry when Chinese economic environment is good directly introduces the steel industry capacity allocation, Grasping accurately the above rules is the premise of achieving market's decisive role in the resource allocating process while giving full play to government function.

## 1. Problems development

Since the reform and opening-up of China 30 years ago, China's economy not only has realized the continuous expansion of the GDP, but has sustained its high speed growth of 10% per year. In particular, from the WTO accession until the financial crisis, China's economical growth experienced over 11% per year. As a developing country, China provides the premise of the massive infrastructure investment demand in the economical take-off with its rapid accumulation of national wealth. For example, the investment of transportation、warehousing and post industry in 2003 is 567 billion Yuan and the investment is 4289 billion Yuan. Steel is a pillar of china's economic development industries. Its development should satisfy the infrastructure construction on one side, and provide the raw materials to the downstream industries on the other side. In this period, China's steel industry's fixed assets investment had increased by nearly 3 times. The demand-expanding period produces strong induction to the investment while the demand-shrinking time does not help the capacity withdraw find the right routes. The massive investment followed the excess production capacity. In order to prevent the waste of resources from excessive

investment, the government resolutely adopts macro-control policies to curb investment and achieves notable intervention effects on the market. But the subsequent economic situation gives a forceful response to this adjustment which is completely anti-market, showing that there is a collective misjudgment for China's economic development trend prediction by the related government departments at that movement (Chen, 2013). As an economic entity, which realized its economic overall growth within a considerably short time, its market demand and supply dynamic transformation is far beyond the market background in the western mainstream economic theory and its special laws are different from the other economies. The new government suppressed on the market function to make the economical growth sustainable. The paper takes the steel industry as an example to reveal the working mechanism and effect on the investment and capacity allocation of market needs to make the world understand objectively the development features of China's economy on one hand, and provides the references for the new round of regulation and selection in China on the other hand.

The earliest employment of demand and supply to explain investment is in the acceleration principle of neoclassical investment theory.

To overcome the assumption deficiency of quick realization of investment plan in the original acceleration principle, Chenery (1952) and Koyck (1954) introduce the output adjustment coefficient to revise the principle based on their expectation of the former and current output impacting on the current capital stock, making the principle closer to the real economy. Eisner and Strotz (1963) introduce the adjustment costs into the neoclassical investment theory proposed by Jorgenson (1963). With the later promotion by Lucas (1967), Gould (1968), etc., it becomes the principle theory in the research of over-capacity.

Based on economic cycle theory, Fair (1969) puts forward that when the economic operation is undergoing need shrinking, its investment and production capacity do not change simultaneously with need periodically fluctuation. Some researchers argue that the investment originates from the dynamic expectation of economic growth (Kydland and Prescott, 1982; Long and Plosser, 1983; King and Plosser, 1984) . In the abroad research on the industrial investment, Oulton (1981) finds that Tobin's Q has significant impact on factory investment decisions by using the British quarterly data of industry and commerce. Chadh and Sarno (2002) find the uncertainty of price in the short term has greater impact on the investment than the long term counterparts. For the developing country in middle and later stage of industrialization, its market is likely to show wave phenomena of investment (Lin, 2010), resulting in the excess production capacity. From the research results of Chinese scholars (Kong and Gao, 2007; He and Shi, 2012), we find that the market demand has been becoming the main reason affecting Chinese industry investment growth. From the views of Zhou and Fu (2011), Han and Wang (2013), demands had propelling effects on fixed assets investment. But the research based on transition of income distribution by Sun and Su (2013) shows that the sustainable and rapid growth of China's economy drives its 1.3 billion residents' income to change rapidly, resulting in huge consumption potential bursting out within short time and induces a chain of sharp market reaction, like inadequate supply, investment overheating and overcapacity, etc. Although the domestic and abroad research on investment and over-capacity affecting sharp market reaction elementis various, the study of the dynamic adjustment mechanism capacity in the massive emerging economy, which binds the capacity formation and secession in a complete framework based on the features of needs that dynamically induced investment input and dropout from the perspective of market mechanism, under the background of supply and demand switching frequently, has received little attention.

The following will discuss asymmetry dynamic characteristics of capacity adjustment in the process of sustainable and rapid growth of demand by constructing investment and capacity theory framework model, including market dynamic demand gap and characterize asymmetric dynamic features of capacity being adjusted to equilibrium level by the variable capacity error correction model. From all those research results, the paper will make an empirical analysis of the dynamic effect of the main downstream steel industry demand on the investment.

## 2. Construction of theoretical model

The foresightedness of demand-determined investment and the hysteresis of capacity formation make the real economy demand on investment and capacity show the phased asymmetry features, which is characterized as accelerator theory at the demand upstream stage with the investment pouring in. But when the demand slows down, due to the investment inertia and its fixed cost attributes, the investment slips while its capacity keeps the growing trend, resulting in unrelieved overcapacity. Koyck greatly simplifies the model estimation, but lacks some theory foundation thus has been adjusted partly by Nerlove (1958) and by adaptive expectation model of Cagan (1956), which are the rationalized forms of Koyck model (1954). So the paper takes the partly adjusted model of capital stock and adaptive expectation mechanism as the basis and constructs the theory model for the asymmetrical effect of market dynamics gap need on capacity adjust-

ment.

### 2.1. Basic model combining adaptive expectations with stock adjustment mechanism

On normal occasions, the capital stock adjustment is incomplete with the binding of regulations and technologies while the main market roles will adjust their output expectation according to their experience. So when we study the effects of market mechanism needs on capacity adjustment, we should fully take those elements into consideration. In this paper, we construct the basic model combining the output and capacity adjustment. Because the ideal capital stock and the equilibrium output can not be expected, we use partial adjustment mechanism for capital stock and adaptive expectation mechanism for output. Then get the model with both capacity partial adjustment and output adaptive expectations mechanism in it:

$$K_t = \beta_0 \delta \gamma + \beta_1 \delta \gamma Y_t + [(1-\gamma) + (1-\delta)]K_{t-1} - (1-\delta)(1-\gamma)K_{t-2}$$
$$+ [\delta u_t - \delta(1-\gamma)u_{t-1}] \quad (1)$$

where $\delta$ is capacity adjustment coefficient and normally $0 < \delta \leq 1$; $\gamma$ is adjustment coefficient, and normally $0 < \gamma \leq 1$.

Assuming

$\alpha_0 = \beta_0 \delta \gamma$
$\alpha_1 = \beta_1 \delta \gamma$
$\alpha_2 = (1-\gamma) + (1+\delta)$
$\alpha_3 = -(1-\delta) \times (1-\gamma)$
$v_t = \delta u_t - \delta(1-\gamma)u_{t-1}$

Then Eq. (1) can be rewritten as:

$$K_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 K_{t-1} + \alpha_2 K_{t-2} + \nu_t \quad (2)$$

Combine Eq. (2) with $I_t = K_t - K_{t-1}$, the investment Equation is available:

$$I_t = \alpha_1 \Delta Y_t + \alpha_2 I_{t-1} + \alpha_3 I_{t-2} + \zeta_t \quad (3)$$

In which $\zeta_t = v_t - v_{t-1}$, the other parameters are the same as those in productivity equation. So Eq. (3) is the investment theory model combining expected output adaptability with capital stock partial adjustment expectation.

### 2.2. The investment and capacity model with market dynamic demand gap

Although the combined model of adaptive expected output and part of the capital stock adjustment mechanism fully considers the rational manufacturer's revision of the expected out based on past market demand information output and capital stock's slow adjustments by limitations of various factors, there is no clear description about impact by the market dynamic demand conversion on capacity adjustment. With China's ten-year sustained and rapid economic growth, significant changes in residents' income level has caused the non - equilibrium effects of all sorts of durable consumer goods market. This dynamic demand is bound to have a special impact on adjusting production capacity. So in this paper, adaptive expectation mechanism is further emended.

As $Y_t^d - Y_t^s = \lambda Y_{t-1}^*$, then $\lambda Y_{t-1}^*$ represents the market gap, if $\lambda > 0$, it indicates that demand exceeds supply, and there is supply gap; $\lambda < 0$, indicating oversupply, and there is overcapacity. After correction, if there is market supply and demand gap, the manufacturers will adjust their expectations according to market dynamics: if the demand exceeds supply in pre-phase, the vendors will raise the equilibrium output next phase; on the contrary, if there is overcapacity in pre-phase, the manufacturers will adjust downward the equilibrium output next phase, the revised adaptation mechanisms are expected to be

**Situation 1.** $(Y_t^* + \lambda Y_{t-1}^*) - Y_{t-1}^* = \gamma(Y_t - Y_{t-1}^*)$, after revising, it is: