1 introduction

China has been experiencing rapid economic growth since it started the industrializing process in 1980s. Simultaneously, its industrial structure has made some adjustment: the share of primary industry declined from more than 30 percent to less than 10 percent, while that of tertiary industry increased by more than 20 percentages. The value added secondary industry has enlarged 117 times within 33 years, despite its share in aggregate GDP remains nearly unchanged. Obviously, the industrial structure in China is featured with high energy-intensive, which causes the energy consumption and CO₂ emission expanded extremely. According to the Energy Information Administration of U.S., China’s energy consumption expanded 6 times during 1980-2012, from 435 Mtoe to 2668 Mtoe; and the CO₂ emissions increased from 1448 MtCO₂ to 8106 MtCO₂.

Comparatively, United States and Japan, the two top developed countries, have a relatively steady industrial structure. They both maintain a small share of primary industry, roughly 1.2 percent, and a large share of tertiary industry, more than 70 percent. Since their secondary industry accounts for much smaller share than China, their industrial structures are less energy intensive than China. Consequently, China has overpass Japan as the second biggest economy in 2010, but its energy intensity is 5 times larger than Japan; in the same year, China’s GDP reached a level one third of the US, but its CO₂ emissions has overpass the US three years ago.

More and more scholars have realized the industrial structure as one of major reasons for the heavy CO₂ emissions in China (Kambara, 1992; Liu et al, 1992; Ang, 1995; Alcantara et al, 2004;
Zhao et al, 2009). As estimated by Yang et al. (2012), the most energy-consuming sectors, e.g. Ferrous and Nonferrous Metals, Oil processing and Coking, Nonmetallic Minerals, and the Chemical industry, contributes only 9.6 percent of economic output, but their CO₂ emissions accounts for 52.4 percent of the total. Thus, China has stressed the importance of adjusting industrial structure to achieve the objective of energy conservation and emission reduction.

On the other hand, China has implemented several economic stimulus policies, for instance, the four trillion investment plan to counter economic crisis in 2008, which is believed to be the cause of excess production capacity and inefficiency. It seems that the Chinese government was inclined to pick up more direct and instant intervention measures, relying more on investment to bring back the economic stagnancy. On the microscopic level, the firms make their decision of investment only when they can sell the product and profit from it. Therefore, it is the consumption that determines the appropriate level of investment and production; and the consuming preference will drive the flow of investment into different sectors and finally affect the output share of each sector, that is, the industrial structure.

Then, how will the industrial structure evolve in China and what is its implication to energy and CO₂ emissions. This paper tries to contribute by building an optimizing model from the perspective of consuming preference pattern. In the simulation, we borrowed the preference pattern of three developed countries with the implied assumption that China will gradually converge to the developed stage, in both household income and consumer’s preference, when it steps into post-industrialized age.

2 Model Description

2.1 General features

We build our model under the Ramsey-Cass-Koopmans framework. Ramsey (1928) gave a concept model to decide an appropriate saving rate, which is further elaborated by Cass (1965) and Koopmans (1965). In their model, the last-for-ever community decides the quantity to consume and invest, in order to maximize their discounted sum-up of utility inter-temporally. However, they assumed an aggregated economy and ignored the difference between different kind of goods and the distributional consideration of labor and capital among sectors. Obviously, this
simplification lacks the ability to reflect the industrial structure and how the economic sectors interact to lead the industrial structure evolving toward the optimal status.

The model in our study, which we called the Multi-sector Inter-temporal Dynamic Optimization (MIDO) model, inherited some virtues of Ramsey-Cass-Koopmans framework that it involves a forward-looking strategy and the customers balance between the current enjoyment from consumption and the delayed bliss increment from investment with complete information. Additionally, we disaggregate the economy into many sectors. Each sector produces distinct goods with specific amount of labor and capital that is provided by the community, as well as intermediate input from other sectors including energy resources. The goods provided by each sector can be consumed directly by the community, invested as capital goods, or reproduced by other sectors as intermediate input. As announced before, the consumption demand and the preference toward each sector will stimulus the firms to produce the according goods and lead the resources, e.g. labor, investment etc. to flow to those sectors. Finally, the industrial structure gets adjusted optimally from the perspective of utility or welfare.

2.2 Model structure

Allowing for the difference of sectors in its importance to the survival and development of the community and its members, the extent to which the community feels, as a whole, satiated from consuming certain quantity of goods varies among sectors and with time. We introduce a concept of great importance in our model, the consuming preference, which reflects the weight of consuming unit goods from certain sector to the utility of community. Here we let $\omega_i$ denote the preference toward sector i. Then the community has an aggregated utility function that is a weighted sum of that from each sector:

$$U(\cdot) = \sum_{i=1}^{n} \omega_i \log C_i$$  \hspace{1cm} (1)

Here we take the conventional log form of consumption as the utility provided by each sector, where $C_i$ denote the community’s consumption to sector i. The social welfare is defined as the discounted utility during the whole planning horizon, which is also the optimizing objective of social planner:
\[
\max W = \sum_{i=0}^{T} U(C_1, \ldots, C_n) \left(1 + \rho\right)^{-t}
\]  \hspace{1cm} (2)

where \(\rho\) is the discount rate of time. On the other hand, in order to satisfy the demand of consumer and make profit from it, each sector competes in absorbing labor and investment to produce sector-specific goods. We suppose a two-tier structure for the production function of each sector. In the top tier, producers take two indispensable input factors – intermediate input and value added to produce goods in each sector. We assume they are not substitutable for each other and hence take the Leontief-type function:

\[
Y_{i,t} = \min \left\{ \frac{M_{1,i,t}}{a_{1,i}}, \ldots, \frac{M_{k,i,t}}{a_{k,i}}, \ldots, \frac{M_{n,i,t}}{a_{n,i}}, \frac{V_{i,t}}{V_i} \right\}, i, k = 1, \ldots, n
\]  \hspace{1cm} (3)

where we denote by \(Y, M\) and \(V\) the total output, intermediate input from other sectors and value added, aka GDP respectively; by \(a\) and \(v\) the direct input coefficient and the share of value added in the total output. The subscript \(i\) and \(k\) both represent the sector index. In the second tier, the value added is produced by physical capital and labor force endowed with the community. The Cobb-Douglas function is applied since these two factors are always assumed to be substitutable with the elasticity of 1, so we have:

\[
V_{i,t} = A_i K_{i,t}^{\alpha_i} L_{i,t}^{1-\alpha_i}, i = 1, \ldots, n
\]  \hspace{1cm} (4)

where \(A\) represents the sector-specific total factor productivity that reflects the technology of production; \(K\) and \(L\) are physical capital and labor force respectively; \(\alpha\) is the output elasticity of capital, and the implied output elasticity of labor is \(1 - \alpha\) due to the presumption of constant returns to scale.

There are three flow direction of produced output of each sector: 1) to be inputted again to other sectors as intermediate material; 2) to be consumed directly that improve the community’s enjoyment and 3) to be invested to the capital stock that increase the capacity of productivity. The latter two are final usage which is obtained by, if we denote it by \(F\):

\[
F_{i,t} = Y_{i,t} - \sum_{k=1}^{n} M_{i,k,t}
\]  \hspace{1cm} (5)

Furthermore, the final goods are divided between consumption and investment, the share of which is sector specific since some sectors mainly produce investment goods and some others
mainly produce consumption goods. Notably, the investment goods provided by each sector are not invested to the same sector completely, so we introduce a variable called savings. Then we have:

\[ S_{i,t} = F_{i,t} - C_{i,t} \] (6)

where \( S \) denote the residue of final goods after consumption of that sector. Imagine there is a virtual account that collects all savings from each sector and then dispatches them to each other. Therefore, the equilibrium condition requires that:

\[ \sum_{i=1}^{n} S_{i,t} = \sum_{i=1}^{n} I_{i,t} \] (7)

where \( I \) represent the investment to each sector. This condition embedded the mechanism that the newly created investment will flow into the sector that induces higher marginal utility. The flow of investment is completely free, and the accumulation process of capital stock is given by:

\[ K_{i,t+1} = (1 - \delta) K_{i,t} + I_{i,t} \] (8)

with \( \delta \) denoting the depreciation of capital stock. Additionally, we assume the economic growth is balanced, which requires the consumption of each sector grows in pace with its final goods growth. This condition will ensure to avoid the economic fluctuation through over-consumption or under-consumption, which also means that:

\[ C_{i} = c_i F_i, \quad \text{since that} \quad \frac{dC_i}{C_i} = \frac{dF_i}{F_i} \] (9)

where \( c \) is a constant value that is specific to each sector, reflecting its property of mainly consumption goods or investment goods.

2.3 Energy sector and CO\(_2\) emission

Energy is also a dispensable factor in production. Instead of bring it explicitly into the production function; we assume that it follows an autonomous energy efficiency improvement (AEEI) rule for the sake of simplicity and tractability. Let \( \tau \) denote the energy intensity of output, we obtained the energy consumption with the product of energy intensity and the according output:
\[ E_i = \sum_i E_{i,t} = \sum_i (Y_{i,t} r_{i,t}) \]  

(10)

where E denote the energy consumption, and the subscripts of i and t represent, as above, the sector index and time. So it is implied that the energy intensity is sector specific and varies with time, which we handle as strategy to catch up with the benchmark level. Commonly, detailed information about energy mix of each sector is required to estimate the CO\(_2\) emissions; while we save the effort to ignore the variation of energy mix in each sector, and give each sector a parameter to reflect the carbon contents that is also sector specific and related to the technology of produce process. This simplification allows us to focus on the effect of industrial structure change on the energy and emissions; while to predict the future trend of them, more complex factors are recommended to be considered. Let \( \kappa \) be the carbon content of unit energy consumption, we have:

\[ Q_t = \sum_j Q_{i,t} = \sum_{i} (E_{i,t} \kappa_{i}) \]  

(11)

where Q refer to the CO\(_2\) emissions.

2.4 Solving method

The model is solved numerically in GAMS/CONOPT for 43 1-year periods, the base year is 2007 and we simulate until 2050. No terminal conditions are imposed; while further studies can impose some constraints about emission reductions. The code is available from the authors upon request.

3 Data and Calibration

3.1 Calibration

This section describes the main features of MIDO model, including the sector division and the key underlying assumptions. Firstly, we have divided the aggregate economy into 14 sub-sectors according to their energy intensive features. The energy intensive sectors involve Coal, Oil Production (OilProd), Gas Production (GasProd), Chemicals (Chemic), Minerals (Mineral), Metals, Transport (Transp) and Electricity (Electric); the less energy intensive sectors are those Agriculture (Agricul), Food & Clothes Manufacturing (FoodClo), Other Light Manufacturing
(LhtMnfc), Other Heavy Manufacturing (HvyMnfc), Construction (Constr), and Other Services (OthServ). These sectors are derived from the aggregation of a more detailed division in Global Trade Analysis Project (GTAP v8) database. The energy intensity of each sector and the industrial structure in 2007 are shown in figure 1.

![Energy intensity of major sectors and the industrial structure in 2007](image)

As soon as we performed the sector aggregation with the tools provided by GTAP, some parameters, e.g. the direct input coefficient and the share of value added can read directly from the newly created Social Account Matrix. To calibrate the output elasticity of capital, we equate the marginal output to the marginal return of capital, and deduce that the output elasticity of capital is equal to the share of capital return in value added. The constant ratio of consumption to final goods is calculated with the relative data in GTAP.

Population is exogenous and follows the high projection of the United Nations; and the potential labor force is also exogenously given by assuming a labor participation rate. We further take into account the labor flow between sectors, the historical trend of which is captured by a transfer matrix assuming it follows the Markov process.

In calculating the energy consumption and CO₂ emissions from economic development, we assumed that the energy intensity converges to the benchmark level of each sector; while the benchmark level is selected as the most efficient one existed in 2007, that is, the smallest EI.
among the three developed countries/regions. The converging rates assure that the EI of each sector catch up their benchmark levels by 2025. And the carbon parameter of each sector is computed by dividing the emissions data by the energy data that are given by GTAP database.

As to the utility weight of each sector in social welfare, that is, the consuming preference pattern, we handle it as the scenarios, which will be illuminated in the scenario setting section. The remaining parameters are calibrated as follows: all sectors share the same capital depreciation rate, which is set to 5.1% as given in GTAP; the discount rate of time is assumed to 0.05. The base year of calibration is 2007.

3.2 Scenario settings

As stressed in the former section, each sector will adjust their behavior according to the consumption demand. Thus, consuming preference patterns have a major influence on the evolution of industrial structure. This study will evaluate this effect by assuming various preference patterns to compare the differences between the according pathways. Before that, we need first to estimate the consuming preference in each scenario.

In the baseline scenario, we assume that the social consuming preference remain unchanged as in 2007. Therefore, in the equilibrium condition where the marginal utility gained from consuming each sector’s goods are all the same, we deduce from eq. (1) that:

$$\frac{\omega_k}{C_i} = ... = \frac{\omega_k}{C_i} = ... = \frac{\omega_k}{C_n}, \text{ since } U_i' = U_k'$$

(12)

when we standardize the preference to make it fulfill the condition of \( \sum \omega_i = 1 \), eq.(12) further indicates that:

$$\omega_i = \frac{C_i}{\sum C_i}$$

(13)

which means that the consumption structure in equilibrium reflects the preference pattern of consumers. This entails us to calculate the preference pattern in the baseline scenario with the consumption data for China in 2007, as well as in the optional scenarios with the according data for the USA, European Union and Japan in 2007 (Table 1). With the comparison, we hope to extract some information on the trend of China’s industrial structure and some policy implication
on which kind of preference pattern is compatible with China’s energy conservation strategy.

Table 1 Consuming preference of each sector for consumers in China, USA, EU and Japan

<table>
<thead>
<tr>
<th></th>
<th>Transp</th>
<th>Electric</th>
<th>Mineral</th>
<th>GasProd</th>
<th>Chemic</th>
<th>Coal</th>
<th>Metals</th>
<th>OilProd</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>0.0387</td>
<td>0.0125</td>
<td>0.0098</td>
<td>0.0006</td>
<td>0.0394</td>
<td>0.0017</td>
<td>0.0355</td>
<td>0.0176</td>
</tr>
<tr>
<td>USA</td>
<td>0.0175</td>
<td>0.0101</td>
<td>0.0017</td>
<td>0.0026</td>
<td>0.0264</td>
<td>0.0003</td>
<td>0.0067</td>
<td>0.0148</td>
</tr>
<tr>
<td>EU</td>
<td>0.0513</td>
<td>0.0096</td>
<td>0.0079</td>
<td>0.0015</td>
<td>0.059</td>
<td>0.0001</td>
<td>0.029</td>
<td>0.015</td>
</tr>
<tr>
<td>Japan</td>
<td>0.0477</td>
<td>0.0112</td>
<td>0.0027</td>
<td>0.0002</td>
<td>0.0308</td>
<td>0</td>
<td>0.0167</td>
<td>0.0132</td>
</tr>
</tbody>
</table>

Table 1 gives the comparison of consumer’s preference pattern between China and three developed countries/regions. As we can see from the table, it is obvious that compared to developed economy, the preference pattern of China gives relatively higher weights on the sectors of mineral, metals, coal, oil production, electricity and other heavy manufacturing, all those are energy intensive. This feature has confirmed China as the manufacturing nation. Notably, the consumption structure reflected here includes both domestic and abroad demand. Additionally, another two sectors also possess higher weights in China, which are the agriculture sector and food & clothes manufacturing sector, demonstrating China has not step out the developing stage for the subsistence consumption still accounted for more than 20 percent of total consumption; while this number for the developed economies is less than 10 percent.

Conversely, China levied much less weight on the other service sector compared with the other three developed economies. Especially, the weight of this sector in China is less than half of that in USA, almost half of that in Japan and still far less than that in EU. Hence, the consumption structure feature of high share of primary and manufacturing goods, low share of service product is compatible with China’s development stage, which results in the energy exhaustive fact during the production process. Moreover, it is predictable that the industrial structure will continue to be so if China failed to turn its preference pattern, which hopefully will change with its income rise.
4 Simulation results

4.1 baseline scenario

In the baseline scenario that China sticks to its consuming preference pattern, the aggregate economy will grow from roughly 4 trillion $ in 2007 to nearly 79 trillion $ in 2050 (figure 2), with an average annual growth rate of 6.85%. However, the growth rate of GDP is decreasing with time due to the declining marginal output of capital and other factors as reduced labor dividend. The result shows that the GDP growth rate will decrease gradually from 10.6% in 2010 to 4.3% in 2050. Each sector, however, demonstrates distinct growth rate with the range lying between 6.16% and 7.59%, owing to the preference pattern that sectors with higher demand weight seize the chance to increase more rapidly. Consequently, the industrial structure gets adjusted accordingly.

Specifically, such sectors as transportation, oil production and other heavy manufacturing present the most rapid growth trend, followed by sectors of chemicals, metals and other light manufacturing. These sectors see their share of output expanding during the planning period. On the contrary, the agriculture, food & clothes manufacturing and construction sectors are shrinking since the growth rates in these sectors are the slowest. Besides, some sectors just experience a little variation in their output share, e.g., the minerals, coal and electricity will shrink slightly and the other service sector will expand only 0.2 percentages.

It is assumed that Chinese firms will narrow the gap of energy intensity within all sectors by learning and assimilating the most efficient technology of energy use. Under the “catch-up by 2025” assumption, the gross energy consumption will keep rising before it reaches the peak by 2033, with the level of 2810 Mtoe; and it further declines to 2408 Mtoe by 2050. Accordingly, the peak of CO₂ emissions appears in 2032, with the level of 2.36 GtC; and the cumulated amount of CO₂ will reach 88.6 GtC (figure 4).

4.2 alternative scenarios

How will the economy of China develop if oriented by the consuming preference pattern of USA, EU and Japan? The simulation indicates that the industrial structure of China will get adjusted more dramatically under the alternative scenario of USA than under that of EU and Japan,
which means the transfer of preference pattern to the one of USA will cause a greater adjustment from the baseline scenario. More specifically, the disparity of growth rate in each sector ranges between [5.02%, 7.83%] for the USA pattern, followed by [5.57%, 7.71%] for the Japan pattern, and by [5.84%, 7.78%] for the EU pattern. The narrower the disparity is, the smoother the industrial structure changes. Furthermore, with the enlargement of the disparity, the aggregated GDP growth rate shows a declining trend, which reflects the fact that the industrial structure change will inevitably cause some economic loss and attenuate the growth momentum. As shown in figure X, the average annual growth rate of GDP will drop from 6.85% in baseline scenario to 6.55% in USA pattern scenario, 6.79% in Japan pattern scenario and 6.82% in EU pattern scenario. By 2050, the aggregate GDP will reach about 65, 72 and 74 billion $ in the USA, Japan and EU pattern scenarios respectively, compared to the 79 billion $ in the baseline scenario (figure 2).

Figure 2 Projection of GDP growth of each sector under four consumption preference scenarios, 2007-2050

As for the industrial structure of China, it shows different directions of adjustment in
different scenarios. Compared figure 3 to figure 1, we can see that some sectors demonstrate consistent variation trend of their shares in all scenarios, e.g., the agriculture and food & clothes manufacturing sectors have their output shares declining, from 6.4% and 9.9% respectively to 3.9–5.3% and 7.1–8.7% by 2050; and the share of agriculture decline most in Japan pattern, and the share of food & clothes manufacturing in the USA pattern. Dramatically, the sector of other service experiences the most significant change in all scenarios. Its share will expend from 19.4% in 2007 to 19.6–33.8% by 2050 with, especially, more than 14 percentage increase in the USA pattern, compared to the baseline scenario where its share increases by only 0.2 percentage.

Moreover, the same trend for some energy intensive sectors also appears in all scenarios. The shares of mineral sector and energy sectors as coal and electricity will decline slightly; and the shares of chemical, oil production and transportation sector will increase, on the other hand. Specifically, for the mineral sector, the percentage decrease varies within 0.3–0.7 with the Japan pattern has the least share; the two energy sector of coal and electricity see their share decreasing by about 0.1 percentage and 0.1–0.3 percentages respectively, with the coal sector taking the least share in the USA and Japan pattern, and the electricity sector taking the least share in the USA pattern. The share of chemical will expand by 0.3–1.8 percentages, and the most significant increase happens in the EU pattern scenario, and the least happens in the USA pattern. The share of oil production will expend by 0.3–0.5 percentage, with the biggest increase appearing in the EU pattern and the least increase in the Japan pattern. Similarly, the transportation sector shows the largest rise of share by 1.7 percentages in the EU and Japan pattern scenario, and the smallest rise by 0.2 percentages in the USA pattern.
Some other sectors, however, show an opposite adjustment trend in these scenarios. For instance, the metal sector will enlarge its share by 0.5 percentage in the baseline scenario, but its share will shrink by 0.8–2.7 percentage in the alternative ones, especially in the USA pattern this sector has the smallest share. While for the light manufacturing sector, its share will increase in all scenarios except in the USA scenario. The other heavy manufacturing sector will see its share expanding in the baseline scenario from 14.0% in 2007 to 16.1% by 2050; while in the other three scenarios, its share will shrink to 7.8–11.8%, with more decrease in the USA pattern and less decrease in the Japan pattern.

Under the same “catch-up” assumption about energy intensity trend, the aggregate energy consumption will decrease significantly owing to the industrial structure adjustment, which implies that the energy conservation strategy can be fulfilled successfully with the help of transfer of consuming preference to that of the developed countries/regions. The simulation shows that it does not change the time when the energy consumption peaks, which is believed to be relevant to
how fast the energy efficiency can be improved. However, the peak value of energy in the alternative scenario will reduce sharply from 2810 Mtoe in the baseline scenario to 2653 Mtoe, 2458 Mtoe and 2166 Mtoe in the EU, Japan and USA pattern scenarios respectively (figure 4). Compared to the baseline scenario, the cumulated energy saved will reach to 6.3 Gtoe, 14 Gtoe and 25.4 Gtoe in the same separate alternative scenarios.

Figure 4 Projection of energy consumption and carbon emission under four consumption preference scenarios, 2007-2050

Besides, the energy also gets “cleaner” due to the industrial structure change in each scenario, because some sectors that require dirty energy in the production process will be substituted by the relatively clean sectors. Notably, we ignore the energy mix evolution here and just reflect the effect of industrial structure change on the carbon content. Consequently, the CO₂ emissions will
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present a similar inverse-U shape trend as the energy consumption does. The peak of CO₂ emission appears in 2032 for all scenarios, with the peak value being 2.22 GtC, 2.06 GtC and 1.82 GtC in the EU, Japan and USA pattern scenarios. Moreover, the cumulated emission will reach 88.6 GtC, 82.2 GtC and 72.6 GtC in these scenarios accordingly. Compared to the baseline scenario, as much as 5.4~21.4 GtC can be saved by transferring the preference pattern to the alternative ones.

4 Conclusions

This study built a Multi-sector Inter-temporal Dynamic Optimization model to reflect the industrial structure feature and its evolution mechanism, based on the Ramsey-Cass-Koopmans framework. Furthermore, the industrial structure optimizing is considered to hinge on how the social consuming preference will become. Thus, we took China’s preference pattern as the baseline scenario, and the preference pattern of USA, EU and Japan as our alternative scenario to simulate how the industrial structure of China will evolve if it steps into the developed stage and picks up different consuming preference pattern.

Under the equilibrium condition, the supply is equal to the demand. Therefore, the production will be stimulated and more resources as investment will flow to the sector that is most demanded by both the final consumer and the other sectors. If the consumer prefers consuming goods from one sector to the other sector or if one sector produces the goods that are most demanded by other sectors as intermediate input, that sector will get booming by attracting more investment, thus the industrial structure will change accordingly.

Through the simulation and comparisons, the primary sectors as agriculture and food & clothes manufacturing will have their output share decreasing, while the other service sector will expand, reflecting the well-known industrial upgrade from primary to tertiary industry. Moreover, the share of mineral, coal and electricity sectors will decline, and on the contrary, the share of chemical, oil production and transportation sectors will rise. Generally, the USA preference pattern makes this trend more obviously, followed by the Japan pattern and the EU pattern; and the baseline scenario has the least adjustment range. Besides, the metal and the other heavy manufacturing sector will get shrink in the alternative scenarios, but still keep rising in the
Our study also proved that the industrial structure change will inevitably cause some economic loss, which manifest as the weak GDP growth. The growth rate of GDP will decline gradually from the baseline scenario to the EU, Japan and USA pattern in the order that the industrial structure adjusts more significantly.

The optimizing of industrial structure has great meaning to the energy conservation and emission reduction strategy. It not only reduces the energy demand through decreasing the share of energy intensive sector, but also changes the energy mix indirectly and makes the energy cleaner. Consequently, the energy and CO₂ emissions demonstrate an inverse-U shape trend and get declined at last in all scenarios. And more reduction can be achieved when the preference pattern of consumer adjust to the developed countries/regions, e.g. the EU, Japan or the USA pattern.

References