Research on Innovation Model of Auto Industry in China

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Abstract: To strengthen China's automobile industry technological innovation, enhance the capability of technological innovation and find a technological innovation mode being suitable for the development stage of China's automobile industry are essential to accelerating the development of our national economy. In this paper, we find some determinative factors that affect innovation model adoption in auto industry. Conducting an empirical study of these factors, we assume chins should adhere to imitation innovation and collaborative innovation model. Strengthening technical absorption and application capacity, we can gradually move onto independent innovation model.

Keywords: innovation model, independent innovation, collaborate innovation

I. Introduction

With complicated techniques, mass customization and high quality, auto industry is the only one industry in the world that produces thousands of cars and ten thousands of car parts. How auto industry develops reflects the comprehensive national strength and technological development of one country. Meanwhile, auto is the most important factor which influences the whole country and it also promotes development of other related industries. According to statistics, auto industry brings economic benefit to its related industries by 2.5 times. Specifically, Auto industry exerted huge effects in three aspects. Firstly, it drivess the development of raw material, electronics, manufacture, management technology and so on. Secondly, it propels the service industry (such as road construction，transportation，tourism，finance and insurance). Thirdly, it promotes the industry system, agriculture and national defense construction.

Auto industry which is the focus of the global carmakers has become to take shape in more than half century. As the pillar industry, auto industry accounts for a considerable proportion of the national economy and plays important role in a country. Statistics show that Chinese auto industry has the annual capacity of 2 million in 2002, 7 million in 2006, and 9.34 million in 2008. When it comes to 2009, the yearly production goes to 13.791 million, the largest amount in the world.

Meanwhile, Ford, Chrysler, etc. have been hit by a severe financial crisis, which left us a great opportunity to become a center of auto manufacturers. This conclusion is based on the following reasons. First, innovation resources such as technology, personnel and favorable polices are increasing as the rapid development of China's automobile industry. Second, Chinese government give priority to foster automotive technology innovation. For example, China's "Eleventh Five-Year Plan" clearly states that "auto industry is aimed at enhancing innovative capacity to absorb core technology and building sound law environment of independent intellectual property rights. In addition to that, we also strive to build our brands and encourage key technology such as energy-saving, environmental protection and new fuel."

However, comparing with counter parts abroad, china's auto industry lacks key technology due to many factors: e.g. production scale, R & D level and innovation capability. Although China expands its international market since being a member of WTO, technical barriers associated with trade protection still stand in our way. Thus, finding a suitable model of innovation is crucial to auto industry.

II. Theoretical Framework, model and results

Recalling the previous theoretical analysis model of technological innovation, technological innovation model can be found from four aspects: the size of a market, and second, development level, the third is the development factor, four are open to the outside. Because this analysis is to specify technical innovation of our automobile industry the choice of model, therefore, this article analyzes four factors into a single framework, construct a model empirical conditions of China's technology innovation, technological innovation in order to judge the appropriate mode.

Variables and data

This section describes the construction of variables, data sources and econometric techniques employed in the analysis. Where Y refers to auto innovation, which is proxied by total factor productivity of automobile industry. Xc refers to R & D intensity, proxied by the ratio of engineering and technical employees in whole industry; Xp represents auto industrial scale, proxied by auto industry output. Xo is referred to as institutes, proxyed by the share of the total NON-SOES proxied s industrial output. Xi and Xe are variables measuring the openness on behalf of auto industry, proxied by import and export volume.

Total factor productivity is computed as $Y_t/(K_t{*}L_t)$. We use auto industry gross domestic product at constant price as the measure of real output (Y). Real capital stock (K_t) is computed using the perpetual inventory method (i.e., $K_t=I_t+(1-\delta) K_t-1$). In line with Coe and Helpman 1995), a depreciation rate (δ) of 5% and the growth rate of gross capital formation (g) at constant prices during the sample period,1991–2008, are used to obtain the initial stock (K_0) for the year 1991,that$K_0=I_0/(g+\delta)$,where I_0 is real gross capital formation in 1991. Following the established practice in the literature, capital's share of income (π) is set at 0.3. Data for Y_t, K_t and L_t for China covering the period 1953–1999 are obtained from Wang and Yao (2003). We extend the data using more recent data points available from the China Statistical Yearbook.

Table I..Variables in Use

year	Y	Xc	Xp	Xo	Xi	Xe
1990	1.6849	8.8	231.3	17.80%	12.0293	2.4
1991	1.7119	8.2	333.9	21.30%	16.5992	2.7
1992	1.7683	8.3	555.2	21.30%	35.3523	3.5
1993	1.7310	8.4	733.4	25.20%	53.5143	4.2422
1994	1.8043	8.5	875	27.30%	47.1482	5.152
1995	1.8449	8.5	1023.5	29.80%	25.7549	7.2138
1996	1.9040	8.6	1178.4	32.90%	25.0018	8.165
1997	1.9784	8.6	1393.3	36.80%	20.7821	9.8784
1998	2.0776	8.6	1510.2	57.00%	20.5789	8.8343
1999	2.4893	9.4	1714.8	60.90%	25.8018	11.8727
2000	2.7628	9.2	2128	66.90%	40.475	24.7854
2001	3.6067	10.4	2687.5	67.40%	47.0326	27.1227
2002	4.7299	10.7	3892.6	68.90%	65.9985	33.589
2003	5.1363	10.8	5753.9	69.60%	148.3964	80.2642
2004	6.1125	11.8	5762.7	71.00%	168.6001	124.1912
2005	5.5049	11.6	5640.4	73.40%	154.3392	167.7028
2006	6.7846	11.9	7429.8	75.20%	212.741	289.0961
2007	6.6539	12	17242	76.02%	267.6775	412.6332
2008	6.7726	12.1	18780.5	76.30%	322.2993	476.2503

Unit root test variables

Using ADF test, we find all variables are I(1), this allow legitimate use of the cointegration test.

In order to obtain the long term relationship between these variables, we conduct cointegration test. Johansen cointegration test is based on the VAR (vector auto regression model) testing method, The choice of this lag length appears to be consistent with the optimal lag suggested by standard information criteria such as AIC,SC and LR. The table shows the results obtained cointegration test.

Results from Table 4-4 indicate that the six variables exists a cointegration relationship. Auto industry R & D intensity, property rights, openness and Auto Industry The technical level are found to be of long term consistency.

As cointegration test results allow legitimate use of Granger causality test, the results are reported in Table 4-5. in this way, we can find the causal relationship between automotive industry technical progress, R & D intensity, property rights, industrial scale and degree of openness.

Granger causality analysis shows: there is a one-way causality between R & D intensity, openness, technological level of the automotive industry the scale of the industry, institutions and the technical level of the automotive industry. Industrial scale, institutions are found to be causes of technology advance at 10% level of significance. R&D intensity and openness are fond to be a cause of technology advance at 5% level of significance. Technological progress is also found to be the cause of R & D intensity and the degree of openness in auto industry at the same level of significance.

Estimation results:

The estimation results are reported as following:

$$Y=10.2537 + 7.\ 25748Xc + 3.1658Xp +1.6708Xo + 0.0037Xi + 0.0048Xe$$

(2.3765) (3.8645) (1.9956) (0.6631) （0.0018）（0.0017）

(4.3142) (1.8778) (1.5863) (2.5196) （2.0556）（2.8235）

R=0.7843 $\overline{R^2}$ =0.7648

As can be seen from the above, it is evident that the regression specification fit remarkably well indicated by R = 0.7843, adjusted R = 0.7648. Scale of the industry R & D intensity, property rights, openness and the automotive industry technical levels have positive relationship. R & D intensity, market size, non-state economic activity, the degree of openness enter the equation significantly at 5% level with the expected signs.

However, R & D intensity and automotive market size are found to have no significant impact on technology advance of auto industry at 5% significance level, suggesting current market size and R & D intensity are well behind the optimal level, thus can hardly be devices in promoting technology advance. While turning to the measures of property rights system and the opening degree, the results strongly suggest NON-SOES firms and a large openness are effective mechanisms for technology progress in auto industry at 5% significance level.

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Ⅲ. Conclusion

Based on the above empirical results, we can see a relatively high degree of China's openness. In line with above theoretical analysis of technological innovation model, a high degree trade openness of auto industry implies a diversity of technology model will co-exist. That is to say, independent innovation combined with imitation innovation and collaborative innovation model will coexist. empirical results also find that the present R & D intensity of China's automobile industry and industrial scale have no impact on technology advance, thus proving that there is a big gap between China's independent innovation capacity and industry scale compared to abroad, we still have to adhere to imitation innovation and collaborative innovation. Strengthening technical absorption and application capacity, we can gradually move onto independent innovation model. In short, our country's automobile industry pattern of technological innovation should be a variety of innovative models, not simply rely on a solo model.

References

[1] Hu et al. (2001). Hu, X.J., Zhang, X.L., He, J.K., 2001. A Review of the Auto Industry in China, Qsinghua University, Beijing.
[2] IIEC (1996). IIEC., 1996. A Brave New World for the Green Transport Technology and Services Industry, Introducing Opportunities for Industry and Options for Policymakers in Developing Countries. IIEC, Washington, DC.
[3] International Energy Agency, 1994 (1994). International Energy Agency (IEA). 1994. World Energy Outlook. OECD, Paris.
[4] James and Polenske (1998). X. James and K.R. Polenske , Energy use and air-pollution impacts of China's transportation growth. In: M.B. Mcelroy, C. Nielsen and P. lydon, Editors, Energizing China: Reconciling Environmental Protection and Economic Growth, Harvard University Press, Cambridge (1998).
[5] Litman (2001). Litman, T., 2001. Transportation Cost Analysis for Sustainability. Victoria Transport Policy Institute.
[6] Logan and Chandler (1998). Logan, J., Chandler, W., 1998. Natural gas gains momentum. China Business Review.
[7] Mccormick (1999). Mccormick, J., 1999. GM Committed to China market. Automotive Industries.
[8] Menz (2002). Menz, F.C., 2002. Mobile source pollution control in the United States and China. Working Paper 2002-01, Center for International Climate and Environmental Research-Oslo, Oslo.
[9] Mohr (2001). Mohr, R.D., 2001. Environmental Performance Standards and the Adoption of Technology, Report. Department of Economics, University of Texas at Austin, USA.
[10] Morrison (2000). Morrison, W.M., 2000. China's Economic Conditions, Congressional Research Service Report, IB98014, September 21. National Council of Science and Environment Washington, DC.
[11] National Statistics Bureau (1996). National Statistics Bureau, 1996.A Statistical Survey of China 1996. China Statistics Press, Beijing.
[12] National Statistics Bureau (2000). National Statistics Bureau, 2000. China Statistics Yearbook (1999). China Statistics Press, Beijing.
[13] OECD, (2000). OECD, 2000. Environmentally Sustainable Transport: Futures, Strategies and Best Practices, Austrian Federal Ministry for Agriculture, Forestry, Environment and Water Management. OECD, Paris.
[14] Phipott (1995). Phipott, J. (Ed.), 1995. Transport Growth in Bangkok: Energy, Environment, and Traffic Congestion, Proceedings from November 1994 Workshop. IIEC, Washington, DC.
[15] Shenzhen Statistics Bureau (2000). Shenzhen Statistics Bureau, 2000. Shenzhen Statistic Yearbook. Shenzhen Statistics Bureau, Shenzhen.
[16] SSTC, 1992 (1992). SSTC (State Science and Technology Commissions), 1992. China Science and Technology Policy Guidebook, S & T White Paper, No.5. Science and Technology Document Press, Beijing.

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