Differences of Technology Absorptive Capacity: Evidence from China's Automotive Industry

Donghui Meng, Xianjun Li, Ke Xu
Department of Automotive Engineering, State Key Laboratory of Automotive Safety and Energy,
Tsinghua University, Beijing, P. R. China

***Abstract*--Technology absorptive capacity (TAC) is critical for innovation and competitiveness of enterprises in latecomer countries. The current literature lacks deep study on the differences of corporate TAC. Taking automotive industry as an example, this study selected 13 self-brand passenger car manufacturers in China and researched on the existence and dimensions of differences in corporate TAC through principal component analysis, complemented with analysis of major reasons causing the differences. The results proved to be significant, with emerging enterprises' TAC generally stronger than traditional ones. Specifically, emerging enterprises have much stronger realized technology absorptive capacity (RTAC), while traditional enterprises are slightly advantageous in potential technology absorptive capacity (PTAC). The fundamental reason of traditional automobile companies' weakness in TAC, in spite of their abundant prior knowledge, is low intensity of effort and lack of input in assimilation and transformation, which is a validation of Kim's absorptive capacity model.**

I. INTRODUCTION

Cohen and Levinthal [4] introduce the term absorptive capacity, since then it has become one of the most important construct in innovation research in recent decades. Numerous theoretical work have been done involving absorptive capacity's influencing factors [25], process dimensions [3, 23, 29], antecedents [10, 13], its effect on innovation performance and integrative studies [18, 26, 29], etc. In a considerable number of empirical studies, scholars have developed plenty of qualitative and quantitive measures of absorptive capacity [9, 22]. Nevertheless, the current literature lacks deep study on the differences of absorptive capacities between enterprises. Past theoretical and empirical work on absorptive capacity are mostly based on entrepreneurial or industrial experiences in western developed countries. Furthermore, the present absorptive capacity research generally take information [4] or knowledge [18] as the absorbate, while no literature have clearly defined technology absorptive capacity. In comparison with information and knowledge, technology has dissimilar content and narrower extension.

As for China, despite the fact that absorption being the weakest point in realizing the transition of technology acquisition to innovation, most domestic research on absorptive capacity in China merely focus on macro other than firm level. In particular, even fewer studies have investigated the differences of Chinese automotive companies' technology innovation in the perspective of absorptive capacity. Automotive industry is the biggest in technology acquisition yet the most unsatisfactory one in assimilation and absorption. China, Japan and Korea have all been following the same developmental path in automotive industry, which is acquisition, assimilation, absorption and innovation. China began importing automotive technology from Soviet Union in mid 1950s, since then it had carried out large scale and comprehensive technology acquisition for 60 years, however had not changed its weakness in technological capability and competitiveness. In contrast, Japanese and Korean automotive industry had established strong independent development ability and international competitive advantage after less than 30 years' technology introduction. One of the key reasons is Chinese local auto manufacturers' low investment to absorption compared with Japanese and Korean competitors. In the last decade, as with rapid growth of Geely, Chery and BYD, self-brand auto firms have made impressive progress in innovation and competitiveness. A new setup of automotive industry in China has formed, with emerging companies co-developing with traditional auto makers represented by FAW, Dong Feng and SAIC.

Based on the context above, this study chooses the absorptive capacity of Chinese automotive enterprises as the research object and investigates the differences of corporate technology absorptive capacity. We try to find out to what extent and on which dimensions do Chinese auto firms differ from each other in technology absorptive capacity and analyze the main reason causing such differences. This research has remarkable significance in the exploration of absorptive capacity and technology catching up of enterprises in late comer countries and meanwhile provides valuable suggestions for the improvement of corporate technology absorptive capacity in China.

II. LITERATURE REVIEW

In their seminal work, Cohen and Levinthal define absorptive capacity (henceforth, "AC") as the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends [4]. Afterwards the AC theory have received increasingly greater attention in the fields of organization learning, innovation and strategic management. This process view of AC definition established by Cohen and Levinthal has remarkable influence on the subsequent AC research paradigm. The following researchers [3, 4, 18, 23, 25, 26, 29] support the necessity of explicitly separating the multiple sub-dimensions or phases of AC because each of them requires different processes within the organization [18] and is differentially influenced by exogenous and endogenous forces [29]. Zahra and George make the most important contribution to this perspective, who reconceptulize AC as a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability [29]. Many studies make further theoretical and empirical investigation based upon their findings [3, 23]. The fundament of this study is also the four-dimension view of AC proposed by Zahra and George.

The four sub-dimensions of AC are, respectively, (1) acquisition, a firm's capability to locate, identify, value and acquire externally generated knowledge that is critical to its operations; (2) assimilation, a firm's routines and processes that allow it to analyze, process, interpret , understand, internalize and classify the information obtained from external sources; (3) transformation, a firm's capability to develop and refine the internal routines that facilitate the transference and combination of previous knowledge and the newly acquired and assimilated knowledge. Transformation may be achieved by adding or eliminating knowledge, or by interpreting and combining existing knowledge in a different, innovative way; (4) exploitation, organizational capacity based on routines that enable firms to incorporate acquired, assimilated and transformed knowledge into their operations and routines to refine, perfect, expand and leverage existing routines, processes, competences and knowledge as well as to create new operations, competences, routines, goods and organizational forms [3,29]. The acquisition and assimilation capabilities together constitute potential absorptive capacity (henceforth, "PAC"), while the transformation and exploitation capabilities together constitute realized absorptive capacity (henceforth, "RAC") [29].

PAC and RAC have separate but complementary roles. Both subsets fulfill a necessary but insufficient condition to improve corporate performance and competitive advantage [29]. Without the ability to acquire external knowledge, i.e. PAC, firms cannot possibly exploit it. Similarly, firms can acquire and assimilate knowledge but might not have the capability to transform and exploit the knowledge for profit generation. RAC improves firm's performance directly by incorporating newly acquired and assimilated knowledge into its operations, whereas a high PAC alone does not guarantee higher performance. Firms with well-developed PAC are likely to be more adept at continually revamping their knowledge stock by spotting trends in their external environment and internalizing this knowledge [29]. Yet if they cannot gain profit through RAC, these firms may suffer from the cost of acquisition and assimilation. On the other hand, a higher RAC would imply better short-term profitability. But meanwhile they must attach equal importance to PAC as it would keep the firms sensitive and flexible in face of market or technological change [29], otherwise they may fall into competence trap caused by overemphasis on refining of exsisting operations [1]. Moreover, as noted above, a variety of external and internal factors can influence PAC and RAC in different ways, suggesting that firms should take different managerial measures to enhance these two components. In recent studies, researchers have validated that firms can improve PAC through R&D cooperation, experience with knowledge search [10], organizational mechanisms associated with coordination capabilities such as cross-functional interfaces, participation in decision making and job rotation [13]. Socialization related organizational mechanisms including connectedness and socialization tactics is positively related to a firm's RAC [13]. A clear distinction between PAC and RAC can help explain why some firms are more effective in using AC [29] to improve performance and why some former industrial leaders fail during environmental change or technological shift while the past late comers harvest prosperity in the same condition.

The existing research usually take knowledge as the general object of AC. In this study we propose a more concrete concept of technology absorptive capacity (henceforth, "TAC") by narrowing the absorbate to a more limited scope of technology based on the classic definition of AC noted above. This emphasis of limitation on technology is due to the abstractness of "knowledge" and difficulty in incorporating it into a quantitive measure. TAC has the same basic connotation and sub process dimensions as AC and similar influencing forces, therefore we further put forward potential technology absorptive capacity (henceforth, "PTAC) and realized technology absorptive capacity (henceforth, "RTAC").

Researchers mostly apply quantitive indicators as measurement of AC, such as intensity of R&D expenses [2, 4, 24], R&D expenses [8, 17], number of patent [15, 20], number of R&D employees [11, 17]. Some scholars have developed qualitative measurement for empirical research in recent years. For instance, in several studies [10, 21] the respondents from sample firms are asked to rate the use and importance of different external knowledge sources on a four-point scale and these results are applied as indicator of the sample firms' AC level. Other scholars such as Jansen et al. [13], Flatten et al. [9] and Jiménez-Barrionuevo et al. [14] create measurement scale based on the routines, mechanisms and activities underneath different AC sub dimensions.

Few domestic studies in China have made an intensive discussion on firm level AC differences. Several empirical analysis [19, 28] are based upon only one or two quantitive indicators and thus are insufficient to reveal and illustrate the theoretical meaning of AC. Others [7, 27] applied the AC measurement scales introduced above in their studies of Chinese enterprises yet it is very difficult to compare the conclusions of each other due to universally limited amount of samples and significant variance of measurement and results.

III. METHODOLOGY

A. Evaluation Model

According to the models proposed by Cohen and

Levinthal [4], Zahra and George [29], Fosfuri and Tribó [10], the functional mechanism of AC is a process of turning externally acquired knowledge into innovation or firm performance which essentially is also an input – output procedure. Therefore, this study view the formation of firm TAC as an input – output system. See Fig. 1. In Zahra and George's four stage AC model, input and output of TAC is respectively in correspondence with acquisition and exploitation. Process mainly refers to assimilation and transformation. Thus the input, process and output of technology absorption jointly determine a firm's TAC. However, this paper only include input and output aspects in the evaluation model of corporate TAC resulting from three reasons. Firstly, the process is difficult to quantify. Secondly, the input factors are decisive on the process quality in a certain respects, such as R&D expenditure and number of employees. Thirdly, output factors, containing the major information of process, is a reflection of it.

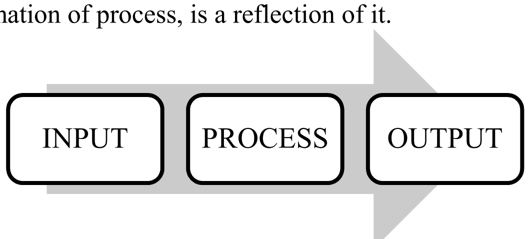

Figure 1 Firm TAC System Model

Therefore we establish the firm TAC evaluation model as follows:

$$V_{AC} = f(I, O) = \sum I_i \times W_i \tag{1}$$

Where V_{AC} represents sample firms' TAC; I and O are input and output factors of TAC, respectively; I_i is the evaluating indicator and W_i is its corresponding weight. For the overall evaluation, a higher W_i means I_i has a more significant impact on input and output of TAC.

B. Evaluating Indicators

With reference to measurement in prior AC empirical works, this study selected 8 input and output indicators based on comparability and feasibility.

(1) Input indicators: number of technology cooperative partners, R&D expenditure, R&D expenditure intensity (R&D expenditure divided by sales), number of R&D personnel, R&D personnel intensity (number of R&D personnel divided by total personnel quantity). Specifically, technology cooperative partners include assembly and auto part companies, universities and research institutions who have launched or are launching technological cooperation with the sample firm through founding joint venture, technology introduction, joint R&D establishing strategic cooperative partner relationship, etc. Data of R&D expenditure and personnel are average of year 2010 to 2012.

(2) Output indicators: patent quantity, new self-brand product publish quantity and sales of self-brand product. Specifically, patent data is the average of 2010 to 2012, product data is the average of 2010 to 2011.

C. Data and Sample

This study selected 13 Chinese self-brand passenger car companies in the sample. See Tab.1. Traditional firms are those founded before 1995, including FAW Car, TJ FAW, Haima, Dongfeng, SAIC, Changan, BAIC, GAC. Emerging firms are established after 1995, including Chery, Geely, BYD, Great Wall and Huachen.

TABLE 1. DATA OF 13 SAMPLE FIRMS

Name	No. of technology cooperative partners	R&D expenditure (Unit: 100 million RMB)	R&D expenditure intensity	No. of R&D personnel	R&D personnel intensity	No. of patents	No. of new self-brand product	Sales of self-brand product	Founding year	Category
FAW CAR	37	5.61	1.92%	3015	3.87%	1254	3	12.26	1958	Traditional firms
TJ FAW	7	1.59	1.86%	403	4.38%	46	2	25.17	1984	
HAIMA	7	2.52	3.85%	620	7.50%	120	10	15.57	1988	
DONGFENG	28	31.58	2.50%	1333	4.79%	2479	9.5	2.69	1969	
SAIC	45	51.52	1.25%	2000	11.23%	1678	12	16.13	1958	
CHANGAN	34	14.05	4.85%	5852	9.01%	2142	10.5	19.95	1984	
BAIC	36	18.92	2.08%	920	3.87%	3217	2.5	1.20	1958	
GAC	13	16.56	1.91%	967	3.02%	401	2	7.40	1985	
CHERY	23	14.91	4.68%	7383	31.20%	3319	22	65.45	1997	Emerging firms
GEELY	36	36.63	5.13%	2191	12.75%	5510	12	42.45	1996	
BYD	10	14.51	5.10%	5000	9.41%	2677	14	48.41	1995	
GREAT WALL	35	6.80	2.09%	6500	12.14%	1562	14	32.96	2001	
HUACHEN	21	6.92	1.58%	1233	4.75%	177	6	14.70	2002	

Source: China Automotive Industry Yearbook (2009-2013), annual reports of listed companies, official websites of sample companies, State Intellectual Property Office.

D. Principal Component Analysis

The evaluation system contains multiple indicators. Thus it is necessary to determine the weight of each indicator, eliminate the redundant information and simplify analysis. Principal component analysis (PCA) can highlight the major problems by recombining the original variables into fewer new and linearly independent composite indexes [5, 12]. The new set of index is able to keep the majority of information in original indicators. SPSS 21.0 is used to apply PCA.

Applicability test results are shown in Tab.2, where KMO measure is above 0.6 and Bartlett's test of sphericity significance is lower than 0.1%, implying notable correlation within variables and the applicability of PCA method.

Two principal components are identified, i.e. f_1 and f_2. Their weight are calculated according to the proportion of the variance of each principal component. See Tab.3.

Therefore we get the mathematical evaluation model of firm TAC as follows:

$$V_{AC} = 0.6861 f_1 + 0.3139 f_2 \qquad (2)$$

Where V_{AC} is the evaluation of TAC of sample firm. The analysis of factor loading reports the correlation between principal conponents and indicators, suggesting that f_1 is primarily related to self-brand new product number and product sales, R&D personnel quantity and intensity, R&D expenditure intensity and patent number, while f_2 mainly related to number of technology cooperative partners and R&D expenditure. See Tab.4.

We relate the underlying indicators of f_1 and f_2 to TAC sub dimensions, see Tab.5. Among the indicators most related with f_1, R&D expenditure intensity, number of R&D personnel, R&D personnel intensity are primarily concerned with "assimilation" and "transformation", number of patents are concerned with "transformation" and "exploitation", number of new self-brand product and sales of self-brand product are concerned with "exploitation". As for f_2, number of technology cooperative partners is directly related to "acquisition", R&D expenditure primarily concerns "assimilation" and "transformation". This matching process reveals that f_1 and f_2 respectively constitute indicators approximately covering the 2^{nd} and 1^{st} half of TAC, thus we use f_1 as measure of RTAC and f_2 as measure of PTAC.

TABLE 2 KMO MEASURE AND BARTLETT TEST FOR SPHERICITY

Tests		Value
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.619
Bartlett's Test of Sphericity	Approx. Chi-Square	65.591
	df	28
	Sig.	0.000

TABLE 3 WEIGHT OF EACH PRINCIPAL COMPONENT

Principal Component	f_1	f_2
Weight	0.6861	0.3139

TABLE 4 FACTOR LOADING MATRIX

	Principal Component	
	1	2
No. of technology cooperative partners	0.191	0.850
R&D expenditure	0.225	0.855
R&D expenditure intensity	0.746	-0.227
No. of R&D personnel	0.809	-0.165
R&D personnel intensity	0.901	-0.087
No. of patents	0.681	0.518
No. of new self-brand product	0.923	-0.040
Sales of self-brand product	0.877	-0.330

TABLE 5 PRINCIPAL COMONENTS AND RELARED TAC SUB DIMENSIONS

Principal Component	Most Related Indicators	Related TAC Sub Dimensions
f_2	No. of technology cooperative partners	Acquisition
	R&D expenditure	Assimilation & Transformation
f_1	R&D expenditure intensity	Assimilation & Transformation
	No. of R&D personnel	Assimilation & Transformation
	R&D personnel intensity	Assimilation & Transformation
	No. of patents	Transformation & Exploiation
	No. of new self-brand product	Exploiation
	Sales of self-brand product	Exploiation

IV. FINDINGS AND ANALYSIS

According to the calculation in last section, we get the results of TAC evaluation of sample firms. See Tab.6.

The calculation results suggest that the sample firms significantly differ from each other in TAC level. Chinese automotive enterprises' TAC are in unbalanced development, which can be further illustrated in three aspects.

(1) Emerging firms have stronger overall TAC than traditional firms.

Traditional automotive producers' average synthesized score (after standardization) is 0.331, whereas the emerging's average is 0.644. See Fig.2. Therefore generally speaking, emerging auto companies have stronger TAC than traditional ones at a notable extent. For example, the top two firms with highest TAC are Chery and Geely, scoring 1.000 and 0.927 respectively, both of which are emerging companies. Two traditional firms, SAIC and Changan are in the third and fourth place, yet their score (0.694 and 0.600, respectively) are much lower than the top 2. The other two biggest traditional auto makers in China, Dongfeng and FAW Car only get 0.460 and 0.278, implying much lower TAC level. See Tab.4. This gap evinces traditional automotive firms' lack of input and low effort intensity in absorption after technology introduction. It is also validated by the market performance of their products.

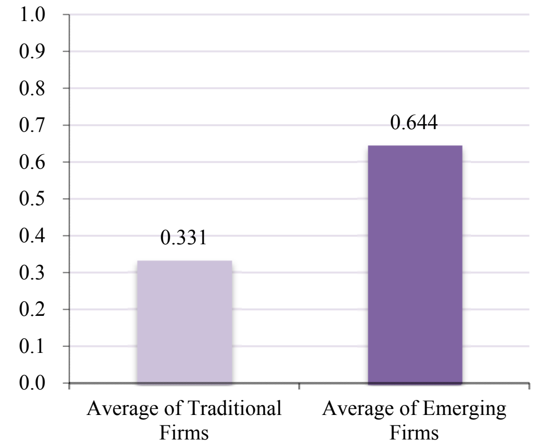

Figure 2. Comparison of TAC between Traditional and Emerging Automotive Enterprises

(2) There is notable differences among the samples' RTAC, with emerging firms being much stronger than the traditional.

Score and rank of sample firms' RTAC is summarized in Tab.7.

TABLE 6. SYNTHESIZED SCORE AND RANK OF SAMPLE FIRMS' TAC

Name	Synthesized Score	Standardization Synthesized Score	Rank
CHERY	1.310	1.000	1
GEELY	1.136	0.927	2
SAIC	0.579	0.694	3
CHANGAN	0.355	0.600	4
BYD	0.314	0.583	5
GREAT WALL	0.281	0.569	6
DONGFENG	0.019	0.460	7
BAIC	-0.172	0.380	8
FAW CAR	-0.416	0.278	9
HAIMA	-0.731	0.146	10
HUACHEN	-0.740	0.142	11
GAC	-0.857	0.093	12
TJ FAW	-1.079	0.000	13

TABLE 7. SCORE AND RANK OF SAMPLE FIRMS' RTAC

	Original Score	Standardization Score	Rank
CHERY	2.258	1.000	1
GEELY	1.099	0.654	2
BYD	0.898	0.594	3
GREAT WALL	0.512	0.479	4
CHANGAN	0.511	0.479	5
SAIC	-0.018	0.321	6
DONGFENG	-0.397	0.208	7
HAIMA	-0.476	0.184	8
FAW CAR	-0.684	0.122	9
BAIC	-0.725	0.110	10
HUACHEN	-0.864	0.068	11
TJ FAW	-1.022	0.021	12
GAC	-1.093	0.000	13

The top 4 enterprises with strongest RTAC are all emerging. Traditional firms' average score is 0.181, emerging firms' is 0.559. See Fig.3.

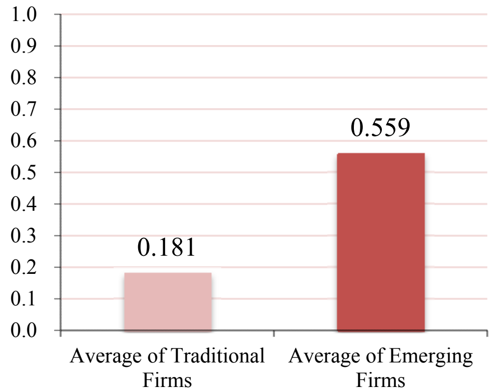

Figure 2. Comparison of RTAC between Traditional and Emerging Automotive Enterprises

Although emerging companies have shorter history and weaker knowledge stock, they out perform traditional firms as a result of higher value on R&D activities. Average R&D expenditure intensity of emerging firms is 3.72%, among which Chery, Geely and BYD's R&D investment all exceeded 5% of total sales during 2010 to 2012. Yet traditional firms averagely had 2.53% R&D intensity. On the R&D personnel aspect, emerging firms have 4461 employees doing R&D related work on average, which is 2.36 times that of traditional companies (1889). In emerging firms, R&D personnel averagely take 14.05% of total staff, while this number in traditional firms is only 5.96%. In addition, emerging firms' product and technology output performance are all conspicuously higher: 2649 patents are licensed to emerging firms during 2010 to 2012 on average, while the traditional only have 1417; emerging companies averagely sell 408 thousand units products each year, much higher than traditional firms' 125 thousand units.

(3) There is indistinctive differences among the samples' PTAC, with traditional firms slightly better than emerging firms.

Score and rank of sample firms' PTAC is summarized in Tab.8.

TABLE 8. SCORE AND RANK OF SAMPLE FIRMS' PTAC

	Original Score	Standardization Score	Rank
SAIC	1.885	1.000	1
GEELY	1.216	0.789	2
BAIC	1.036	0.733	3
DONGFENG	0.928	0.699	4
FAW CAR	0.170	0.460	5
CHANGAN	0.014	0.411	6
GREAT WALL	-0.222	0.336	7
GAC	-0.340	0.299	8
HUACHEN	-0.470	0.258	9
CHERY	-0.761	0.166	10
BYD	-0.963	0.103	11
TJ FAW	-1.204	0.027	12
HAIMA	-1.289	0.000	13

Average scores of traditional and emerging automotive companies' PTAC are 0.453 and 0.331, respectively, suggesting that traditional firms have better PTAC yet the gap is not as notable as RTAC. See Fig.3.

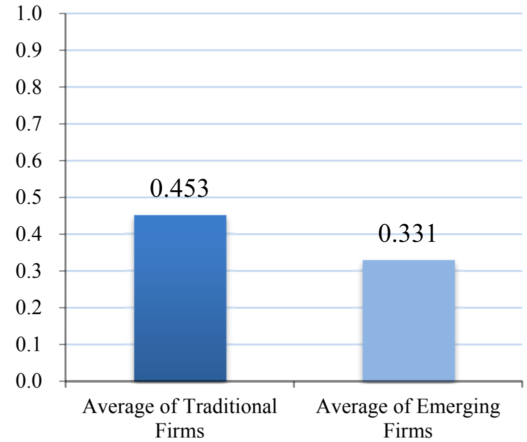

Figure 3.. Comparison of PTAC between Traditional and Emerging Automotive Enterprises

The second principal component primarily contain two indicators, R&D expenditure and number of technology cooperative partners. On both aspects, traditional firms have small advantage. They invest 1.7 billion RMB to R&D, slightly larger than emerging firms' 1.6 billion. Traditional auto producers have 25.9 technological cooperative partners on the average, while the emerging have 25.0 on average.

Though having approximately equal number of average technological partners, traditional and emerging firms significantly differ with each other in terms of partner feature and cooperation form. Establishing joint ventures with foreigh multinational corporations or technology introduction from them are the most common strategies among traditional companies. Founded much later, emerging firms do not enjoy sufficient funding or policy support from the government which are both necessary for large scale external technological cooperation. Reverse engineering based on mature product models and absorption of technological spillovers from competitors are the two fundamental technology sources at their early developmental stages. Thereby the self-dependent emerging automotive enterprises have less chances of external technological cooperation. However, recent years have witnessed substantial change in market environment as well as Chinese auto firms themselves. Chinese automotive maket have been continuously developing at a high pace since financial crisis in 2008, in sharp contrary to severe recession of foreign major auto markets. Under this condition the international vehicle and accessory companies are compelled to open more technological cooperation in advanced auto technology fields, which gives Chinese auto firms much more than ever technology absorption opportunities. For instance, Geely acquired Manganese Bronze Holdings (U.K.) and Volvo Car Corporation (Sweden) in 2006 and 2010 respectively. It have

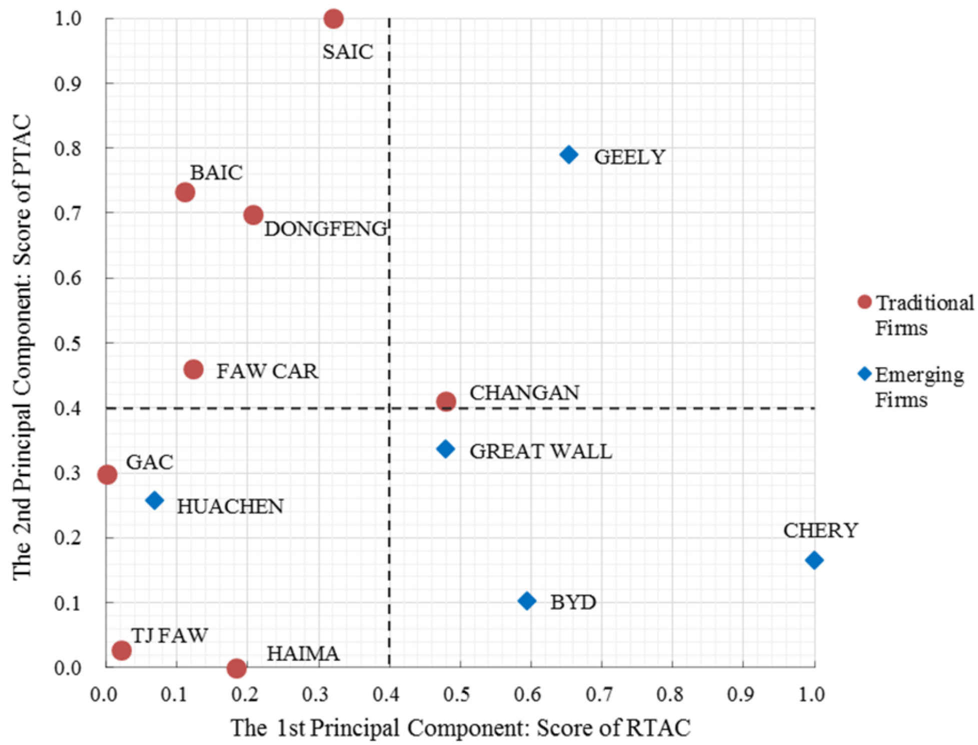

Figure 4. Difference Distribution of Sample Firms' TAC

established over 20 auto part joint ventures until end of 2011 with Johnson Controls (U.S.), Halla Climate Control (Korea), Taichi-S (Japan), BrogWarner (U.S.), etc. Great Wall has signed strategic agreements for technological cooperation and established R&D alliance with over 20 world leading auto component suppliers.

The distribution of sample firms' TAC differencs, under categories of RTAC and PTAC, is summarized in Fig.4.

V. CONCLUSIONS AND DISCUSSIONS

Based on prior research on absorptive capacity theroy, this study established a measurement system with multiple indicators under input and output dimensions, and empirically investigated the differences of technology absorptive capacity (TAC) among sample firms. The results proved significant variance in TAC levels, specificly in two subsets of potential technology absorptive capacity (PTAC) and realized technology absorptive capacity (RTAC). The traditional firms generally have much lower average TAC than emerging companies, mainly because of inferior performance in RTAC. What is the reason causing this remarkable gap? According to resource based view of competitive advantage, traditional firms should have advantage over emerging competitors for they have notably stronger prior knowledge. Yet why late comers with weaker knowledge base out perform traditional companies in RTAC?

RTAC is a firm's ability of transformation of newly acquired and assimilated technology and of exploitation for commercial ends [29]. Kim maintain that AC has two important elements, prior knowledge base and intensity of effort [16]. Traditional firms have been founded for a relatively longer period of time and thus have abundant prior knowledge base, richer experience and more talented personnel. Nevertheless they have fallen behind the emerging firms in intensity of valuation and effort in technology innovation (R&D expenditure and personnel input). This is the fundamental reason of the formers' weakness in TAC and especially RTAC.

PTAC refers to a firm's ability to acquire and assimilate new technology [29]. Traditional firms have stronger PTAC at a trivial degree. Cohen and Levinthal denote that AC is the byproduct of corporation's R&D activities [4]. The external new knowledge and technology cannot be automatically obtained, and firms must invest adequate R&D resources into relative areas for effective absorption. Traditional firms have been incumbent for longer time and have more resources to gain new technologies (e.g. joint ventures and technology introduction), all of which help forming their advantage. But the traditional have attached less attention to R&D activities. Emerging companies have caught up in terms of the absolute amount of R&D expenditure and meanwhile taking effort to diversify their technology sources through technological acquisition and joint R&D. Compared with emerging firms, the traditional still possess slightly higher PTAC.

We further put forward the following three policy suggestions in accordance with the conclusions above.

Firstly, traditional firms should attach more importance to input of absorption after technology introduction. Chinese automotive enterprises' lack of investment in technology absorption is an important reason for the gap of technological capacity compared with Japanese and Korean auto makers. The same reason leads to higher RTAC and better market performance of emerging companies over the traditional. Traditional firms should truly and really regard self-brand product development as their supreme responsibility, make effective use of their experience and talent advantage, increase R&D investment and personnel and turn these resource advantages into innovation output.

Secondly, both traditional and emerging companies should enhance external technological cooperation in multiple forms. The current prosperity within Chinese auto market and recession outside provide all Chinese automotive enterprises with more than ever opportunities to launch comprehensive and in depth cooperation in advanced auto technologies. They should take advantage of integrated innovation to improve product developing speed and capability. Geely acquired Volvo cars, DSI and other advanced auto companies. Great Wall carried out cooperation with top auto accessory manufacturers such as Bosch and BrogWarner to tackle core technology problems one by one. The two companies' successful experience is worth of learning.

Thirdly, the government should launch technology absorption policies. The Chinese government have made numerous industrial policies to promote establishing joint ventures or technology introduction. In recent years there are gradually more policies aimed at supporting independent innovation of automotive enterprises, especially in the area of new energy automotive. However, the government has always neglected sufficient policy support and guidance of the technology absorption phase after introduction. Therefore in addition to technology introduction encouraging policies, the government should further lead automotive corporations to enhance investment in technology absorption and try to turn the externally introduced new technology into their own product as soon as possible.

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