Iranian automotive industry and global economy: Future study based on game theory

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Abstract
Being one of the main drives of Iranian industrial development, automotive industry has been received government extensive attention in order to become competitive. There are many backward and forward linkages between automotive industry and other industries because of technical and structural properties of that. Thus development of Iranian economy is closely related to the competitive advantage of Iranian automotive industry. This paper tried to develop a primary forecast of industry future equilibrium and trends under the condition of non-government protection based on chaotic learning in game strategies. Forecasting possible equilibrium lead us to improve strategic behavior and establishing the win-win situation.

Despite the adoption of some network strategies in Iranian automotive industry, there is still a single nature and because of activity in low – risk with middle income, this industry does not have the ability to compete in highly competitive markets. More investment on the national car with quite unique coordinates and quality and prepare the low risk financial resources are the needs of the industry in the global economy.

Introduction
It is essential to do futurology studies in order to evade passivity and choosing appropriate strategies for having the proper position. Iran's automotive industry is one of the countries industrial development strategic choices. Hence an analysis of automotive industry and its presence in the world economy was offered from the viewpoint of play theory. It is supposed that changing methods of production and stockpiling as chaotic transition were accepted and each vector has its own strategies. Domestic automotive industries in order to gain the merits of competition in world economy should change from semi-ford structure and internalize innovation; besides, it is essential to approach reliable methods for securing wealth and capital. In first part, there is a description about play theory; the second part is devoted to theoretical analysis of competition in world economic process which leads to the conclusion.

Manufacturing method change in auto industry
The oil shock in 1970,s concluded in renewal of automotive industry structures. Ford manufacturing method, which was organized in the form of mass and focused manufacturing, was replaced by Japanese Toyota method. Before 1970s American auto manufacturer had entered the majority of auto markets. The Americans' learning process did not coordinate with changes and fluctuations. Japanese manufacturers by focusing on petrol consumption and managerial methods for lowering the risk of price fluctuations notably entered the markets held by the Americans.

Consumerism positive feedback loop in the American society together with the negative feedback loop of the need to develop the market share for preventing the decline of interest's rate, caused the learning process of American auto manufacturers in choosing manufacturing structures does not spin on the axis of productivity and management change. from the intricacy viewpoint the grid manufacturing system in automotive industry, namely focused manufacturing within the three last decades, has created a very different situation from individual factory balances and manufacturing lines. In fact the distance

between the two close points in 1970,s which one belongs to ford stockpiling and the other to Toyota, has increased superficially. Toyota manufacturing method expands manufacturing process in regions with cheaper institutions. The current transition toward world digital economy doesn't show any significant distance but gradually it will go up apparent development properties moves away from Toyota manufacturing method. In fact by chaotic transition to new manufacturing methods the characteristics of position vector and the interaction type will change. In ford's era the strategies were sheer confrontation and the battle of a few certain trade marks in Toyota method, new ways of granting license on the condition of closed borders and sufficing to low income markets will be more efficient. In globalizes digital economy the severity of competition and the fragility of relying on old methods will increase. The dynamics of new structures will be analyzed later. In case of globalizes economy, our country's automotive industry will enter a serious competition even in domestic markets. Simulating the competition process in the world market of server competition will help us identify the possible vulnerable points of domestic automotive industry.

Within the framework of the falcon and dove classic model, in order to model free competition for entering markets and finding a stable position, two kinds of auto manufacturers can be specified the doves which follow non-aggressive strategies, namely the institutions which seek low risk markets with average productivity and the prices which are quite low. Such investment, which is usually made in less developed markets, will end in an average value for the institution but there is no negative long term effect on market's total risk. On the other hand the falcons follow aggressive strategies. Institutions working in severely competitive markets with higher risks are of this type. When selling products, falcons move aggressively and the investment caused by their activities has the confusion potential in the market's stability. Both institutions fight for attracting the regional customers with average salaries. If both fight for a single market there is the possibility for both to be falcons, doves or a falcon and a dove.

If a falcon and a dove fight for a market, the falcon will win because it offers quality various products which cost more. If two doves confront each other the market will be shared equally because it is supposed that both have the same offering for sale. If two falcons fight because of their similar characteristic the market will be shared equally, but the productivity of all the players in all three cases is rather different and has two parts.

The first part of the analysis is devoted to added value. The added value depends on the expected productivity of the amount of need for the institution product. In first case the dove didn't have a sale and gained nothing while the added value over p_h is earned by the falcons. In second case the total demand is shared between the two doves and they gain the average added value of P_m. in third case again the demand is shared and both falcons gain half of the added value.

The second part includes the cost of the competition between the two players on a single investor. This parameter is very important due to world economic situation. In first case an aggressive auto manufacturer encounters non-aggressive ones. So there is no fight because the non- aggressive auto manufacturer is has committed himself to his conditions and expected productivity is preferred. Aggressive auto manufacturer has no reason to start fight and can sell the product. In second case there is no fight again because the market is shared between the two auto manufacturers. As a result there is no cost for first and second case. It two aggressive auto manufacturer struggle for more market share they would start fighting. On one hand the prices may come down as a result; on the other hand products with more expected productivity and higher covert risk will emerge. Parameter d shows all these effects. Likewise both aggressive auto manufacturers gain half of the subtraction of the value and costs. The factor cost introduces the degree of falcon's aggression and it is also the risk of the falcon's fight which will lead to the fragility cased by the covert risk. In table 1 productivity matrix is offered briefly.

A / B	**Falcon**	**Dove**
Falcon	$\left(\frac{P_h - d}{2}, \frac{P_h - d}{2}\right)$	(P_h, O)

Dove	(O, P_h)	$\left(\frac{P_m}{2}, \frac{P_m}{2}\right)$

Table 1: the productivity matrix of the auto manufacturers A and B within the framework of falcon and dove play. The definition of the parameters comes as follows p_h: added value over sales d: dissatisfaction caused by the confrontation and P_m: average added value of sales.

In order to ensure the above table coordinates the falcon and dove play structure parameters in table one should apply to this non- equation $P_h > P_m > 0 > \frac{P_h - d}{2}$. It means that dissatisfaction d is less than the added value over sales

Theory of falcon and dove development play

The two players' symmetrical play with n strategies Γ is as follows:

Two players' play: $\Gamma := \left(\{A, B\}, S \times S, \hat{\$}\right)$

Combined strategy: $S = (S_1, S_2, ..., S_n) \in S$

Productivity matrix (1): $\hat{\$} = \begin{pmatrix} \$_{11} & \$_{12} & \$_{1n} \\ \$_{21} & \$_{22} & \$_{2n} \\ \cdots & \cdots & \cdots \\ \$_{n1} & \$_{n2} & \$_{nn} \end{pmatrix}$

To describe chronological development of the play's frequent version Γ, reproduction dynamics will be offered. Reproduction dynamics which are in the form of differential equations, define the population evolution method within time $\vec{x} := (x_1, x_2, ..., x_n)$ each element $x_i = x_i(t), (i = 1,2,....,n)$is specified to describe time evolution of the fractions of different types of players i in whole population and the player with type i is a player who follows s_i strategy. Population vector $\vec{x}$ should secure the condition for normalizing the single vector:

$$x_i(t) \geq 0, \forall i = 1,2,...,n, t \in \ \& \ \sum_{i=1}^{n} x_i(t) = 1 \qquad (2)$$

The following equation systems from population vector $\vec{x}(t) = (x_1(t), x_2(t), ..., x_n(t))$ are known as reproduction dynamics. (Web, 2009).

$$\frac{dx_i(t)}{dt} = x_i(t)\left[\underbrace{\sum_{l=1}^{n} \$_{il}\, x_l(t)}_{:= f_i(t)} - \underbrace{\sum_{l=1}^{n}\sum_{k=1}^{n} \$_{kl}\, x_k(t) x_l(t)}_{:= \bar{f}(t)}\right] \qquad (3)$$

In the above formula $f_i(t)$ shows type i estimate and $\bar{f}(t)=\sum_{i=1}^{n} f_i(t)$ shows the estimate of the total population the formal description is limited to two strategies $(i=1,2=H,D)$ because of definition z population vector $\vec{x}(t)=(x_1(t)x_2(t))$ can be delivered to a single element $(\ x(t)=(x_1(t)x_2(t)=1-x(t))$ and equation 3 is simplified as follows:

$$\frac{dx}{dt}=x\left[(\$_{11}-\$_{21})(x-x^2)+(\$_{22}-\$_{12})(1-2x+x^2)\right]$$

By putting the parameters of productivity matrix of falcon and dove we reach to the following differential equation:

$$\frac{dx}{dt}=\frac{1}{2}(p_h-p_m+d)x^3+\left(p_m-\frac{3}{2}p_h-\frac{1}{2}d\right)x^2+\left(p_h-\frac{1}{2}p_m\right)x \qquad (4)$$

In order to show the consequences of equation 4 and to interpret and describe the fundamental characteristics the falcon and dove play productivity parameters in table 1 have been put in 3 different parametrical set.

Collection parameters	**Risk of unstable**	**d**	P_h	P_m
P_1	Low	10	a	b
P_2	Average	50	a	b
P_3	High	100	a	b

Table 2: hypothetical parameters of three different sets from fundamental productivity matrix used in modeling investment market of falcon and dove play.

In parametrical sets high and low added value of sales is constant $(P_h=a,P_m=b)$ but the cause of instability is variable d. in parametrical set P_1 the instability risk is a little more than high added value $(d=10)$ in parametrical set P_2 the average vale of instability cased by the fight is the average (d=50) and in parametrical set P_3 is quite high (d=100).

Population fraction development x (t) of falcons in falcons and doves population is most important in analyzing future trends of the market. x (t) as a function of time is shown for parametrical set P_i in which by using different fractions of falcons in zero time $\left(x(0)=\frac{1}{20},\frac{2}{20},...,\frac{19}{20}\right)$ have been calculated as algorithm. All population curves converge toward the limit $x_L:=x(t\to\infty)$.

After a time period the fraction of falcons for the parametrical set P_1 will end in $x_L > 0/50$ namely the population of falcons and doves will be stable as long as more than 50% are falcons and fewer are doves. Although the difference between P_h, P_m is beneficial for the second the ratio of falcons will be greater and the competition will be more sever. Within such situation the play theory prognostigate that the number of risky auto manufacturers (falcon strategy) quite high (more than 50 percent) as a result the fraction of auto manufacturers with average productivity and low risk is less than 50%. To understand the simulated results, the concept of strategy with development stability is introduced briefly as follows:

A) (s^*, s^*) is the Nash equilibrium of the play

B) $\$(s,s) \le \$(s^*, s), \forall s \in r(s^*), s \ne s^*$

The function $r(s^*)$ is the best reaction to strategy s^* and \$ (s, s) describes generalized combined strategic productivity function. So it is essential that stable development strategy s^* becomes a symmetrical Nash equilibrium of the play while the non-equation B should be secured for each strategy belonged to the best reaction set s^* namely $s \in r(s^*)$. To explain this definition we limit the number of mere strategies to n=2 and use productivity matrix in table 1. $x := s_1^A$ Shows the possibility of adopting aggressive strategy B falcons by player A and $y := s_1^B$ shows the possibility of following the falcon strategy by player B. thus the combined strategy productivity function will have the following structure:

$$\begin{aligned}&\$(x,y) = \$_{11}xy + \$_{12}x(1-y) + \$_{21}(1-x)y + \$_{22}(1-x)(1-y)\\&= \frac{P_h - d}{2}xy + P_h x(1-y) + \frac{P_m}{2}(1-x)(1-y)\end{aligned} \qquad (5)$$

Because of changing the form of variables $(x \to y, y \to x)$ player A's productivity namely $\$^A(x,y) = \$(x,y)$ and player B as a result of the symmetry become equal.

$$\$^A(x,y) = \$(x,y),\ \$^B(x,y) = \$(x,y)$$

So the two necessary conditions to prove a Nash equilibrium (x^*, y^*) in two players play with two strategies will reduce to one condition (21):

$$\begin{aligned}&\$^A(x^*, y^*) \ge \$^A(x, y^*) \qquad \forall x \in [0,1]\\&\$^B(x^*, y^*) \ge \$^B(x^*, y) \qquad \forall y \in [0,1]\\&\Rightarrow \$(x^*, y^*) \ge \$(x, y^*) \qquad \forall x \in [0,1]\end{aligned} \qquad (6)$$

This play has three Nash equilibrium. Two balances of $((x=1, y=0) \hat{=} (H, D))$ and $((x=0, y=1) \hat{=} (D, H))$ are asymmetrical and one of them namely combined strategy Nash equilibrium

$\left(x = \frac{P_m - 2P_h}{P_m - P_h - d}, y = \frac{P_m - 2P_h}{P_m - P_h - D} \right)$ is symmetrical. Definition 6 necessitates that in each balance the function $\psi := \$(x^*, y^*) - \$(x, y^*)$ should be positive for all $x \in [0,1]$.

With non- technological language economy globalization which will lead to more competition between each field of activities is the bases of formation of fight between doves and falcons. Even if dove auto manufactures do not have the tendency to enter the falcon's market the movement by falcon's capital and the desire for entering more markets, will lead to more confrontation between two types of institutions in automotive industry. In such a case all the auto manufacturing institutions which are dependent on government support will be made to fight the falcons in form 3 of doves. In order to survive institutions supported by government (doves) should incline toward markets which have less operation risk namely they are less competitive. But markets with such characteristics in auto manufacturing industry belong to countries which have high potential risk and in long term period they have serious political fluctuations, thus they are not a good long term choice unless the doves incline toward complete flexibility in manufacturing and lowering the cost of dependence on supplement chain until the fluctuations covered.

On the other hand chaotic transition from Toyota manufacturing method to knowledge – based digital manufacturing method has caused some internal paradoxes in stockpiling method. The amount of dissatisfaction and heterogeneity in comparison with ford and early days of Toyota (competition was merely based on prices and outward characteristics) has increased significantly. As Tapscott (1995) indicates presumption in digital economy, entering customers in designing and manufacturing and making investments are among the factors for the distinction which have made the competition more difficult. Expanding exchanges to virtual space and the high rate of moving financial sources in virtual space to compete with actual capital of manufacturing sector will be followed by sever decline of the potentials to secure financial sources of projects and high cost of the fight: Hence Iranian auto manufacturers , beside their efforts to internalize innovation in their products like international auto manufactures, have to think of reliable financial security namely rely on low risk capital sources Iran's automotive industry structure, in content, has the ford focused structure, auto manufacturing institution should go toward distributing their supplying chain regions having cheaper deposits and make their efforts to internalize transferring knowledge.

Conclusion

Future of economy will be severely competitive and its characteristics is notably different from Ford and Toyota manufacturing method the form of the competition and adapting play strategies will also change for each method sheer competition between grade marks in Ford manufacturing method will be replaced by economy in which the players strategy is a combination of competition and coordination. Grid economy is on the verge of transition toward world economy which is competitive and digital. In this type of economy virtual capital is competing with actual capital and such an opposition will end in fragility of manufacturing structure. As a result the most important aspects of strategy in new markets especially in automotive industry will switch to efforts for internalizing innovation and devising methods to evade financial breaking down. Despite adopting some grade strategies, Iran's automotive industry still has a Ford identity. Because of activities in low risk regions with average salary. It doesn't have the ability to compete in competitive markets. More investment on national automobiles with unique quality and characteristics and low risk financial facilities are among the necessities of the industry in world economy.

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