RESEARCH ARTICLE

A Game Theoretic Model of Iranian Labor Market

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ABSTRACT

In this paper, we analyze the interactions among workers, employers, and the government in the Iranian labor market using game theory. For this purpose, different games among the factors affecting the labor market are analyzed in both static and dynamic situations. In each case, intervention and non-intervention of the government are also examined. Thus, four different types of games are studied, including a static game between worker and employer, without government intervention; a static game among workers, employers, and the government; a dynamic game between worker and employer, without government intervention; and a dynamic game among workers, employers, and the government. In the first three games, Nash equilibrium implies low productivity of worker, low employer's profits, and high unemployment rate in which players want to maintain the status quo. However, in the dynamic game among workers, employers, and the government, the sub-game perfect equilibrium of the game can provide some conditions in which the labor market gets away from the low productivity situation

Keywords: Iranian labor market, Labor productivity, Game theory, Government intervention

1. INTRODUCTION

The labor market is one of the most important markets to be considered while studying economics. Labor force plays a significant role in the production process because its weaknesses and strengths have a great impact on the quality and quantity of products. Indeed, the performance of the labor market has a significant effect on the performance of the product market. Therefore, the study of the labor market is very important.

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Labor market, like any other market, has both supply and demand sides. The supply side of the labor market is the labor force. The labor force plays an important role in production and, given its role in production, expects to receive a share corresponding to its role. The demand side of the labor market is the firm (or the employer). A firm seeks to maximize its profits, and therefore expects the workforce to work hard to maximize its production and profit margins.

One of the most important achievements of having an active labor force is the high profit level for the firm and also macro-economic growth and development. Creating motivation and welcoming individual creativity can help the labor force to be active. However, the labor force has expectations from the employer in order to work actively.

Certainly, having purchasing power, job security, and promotion of organizational status are among the most important factors that are at the top of the labor force's expectations. Failure to adhere to the hierarchy and issues such as the lack of in-organization decentralization are cases that kill the motive of the labor force. It should be noted that active labor will only arise if both sides of the labor market (i.e., the worker and the employer) interact in an accommodating manner. In addition, the lack of appropriate social coverage, including social security, is one of the main concerns of the labor force. However, these elements are considered as basic labor rights and there is no justification for the firm's failure to provide them.

In the labor market, interaction between worker and employer has been a major problem for a long time. The current labor market in most societies is the result of centuries of conflict and controversy between labor market factors. The main reason for this conflict is the distribution of profits between the employer and the worker. In fact, profits gained from selling of goods and services by a firm should be distributed among the factors of production. On the one hand, the employer, as the owner of the firm or pursuing the interests of the owner of the company, seeks to obtain the maximum share of the profits. On the other hand, the worker seeks to make his share of the profits to an acceptable level, and because the profit is a fixed amount, increasing one's share will reduce another, which means there is a conflict between the interests of the worker and the employer. The question is, how do the worker and the employer determine their share of profits? The best approach for solving such issues is game theory. Game theory is based on a kind of mental argument derived from the combination of mathematics and logic. This theory monitors rational behavior in controversial situations in which participants engage in conflict. Game theory usually addresses the issues in which there are conflicting interests among participants.

In addition to the worker and the employer, a third factor can also greatly affect the labor market interactions in Iran, and that is the government. The government, along with its very important role in the existence or absence of trade unions, plays a key role in the labor force's life by using instruments like monetary and financial policies. The monetary and fiscal inconsistency of the government, which has been a major contributor to the spread of inflation in the community, has a direct and, of course, negative impact on the livelihoods of the workforce. Reducing purchasing power and individual welfare because of the growth of the price index along with issues such as the lack of productivity, lack of meritocracy, and sometimes lack of conscientiousness has a negative impact on the Iranian economy. However, the denial of trade unions, which is another factor that rises problems related to labor and government, should not be forgotten. In some cases, the government, because of the support of the worker, enforces the employer to increase the salary of the labor force, and because of the lack of labor organizations (which is the most important factor for protection of workers), employers fire some of the workers. These conditions signal the government's adoption of a two-way policy that, on the one hand, can improve the conditions of business by placing the producer on a higher margin and, on the other hand, can improve the workforce in order to increase productivity.

The purpose of this study is to provide a comprehensive perspective of the Iranian labor market and analyze the interaction between workers, employers, and the government in this market. Owing to many problems in the labor market and the unwillingness of the government to solve them, there are few studies in this regard in Iran; therefore, there is a deep gap in the literature on the Iranian labor market. A comprehensive analysis of the interactions of market participants can help to better understand it.

In this paper, the interaction of labor market factors in Iran is discussed using game theory. In fact, the methodology used for analysis is game theory, which is one of the innovations of this research.

Static and dynamic analyses of interactions are additional innovations of the study. Government intervention in the labor market is also being considered, which is an innovation for the research. In the literature, in the theoretical discussion of the game between worker and employer, the government is not considered as a player; instead, it is presented as a judge that has little effect on the outcome of the game. In contrast, in this article, the government has come into play as a player, and some strategies have been defined for it. It is assumed that the government has the same effect as (or even more effect than) the other two players, because the current state of the Iranian economy is far from that of a developed economy or even a normal developing economy. In this regard, first, the static game is analyzed in the modes of government intervention and non-intervention, and then the dynamic game is examined in the two modes.

2. LITERATURE REVIEW

2.1 Labor Market in Iran

The labor market conditions in the Iranian economy are different from those of a free economy. In the Iranian labor market, there is a powerful factor influencing supply and demand, causing disequilibrium in the market. This factor that has an important role in determining the level of wages and employment is the government. The factors affecting the Iranian labor market are the (1) government, (2) employer, and (3) employee.

By employing nearly 3.5 million people, the Iranian government is the largest employer in the country, reflecting the government's unreliable role in the labor market. The intervention of the government in Iranian economy is weak and inefficient, causing the economy to be in an abnormal situation (Ghanbari and Sadeghi, 2007).

The Iranian economy has been under pressure from sanctions and ineffective management in recent decades. It suffers from problems such as corruption, poor productivity in all sectors, lack of responsibility of the Executive and the Legislative, lack of transparency, laws and regulations, etc.

Meanwhile, the government does not allow forming trade unions and, moreover, plays a very important role (using monetary and fiscal policies) in labor life. The monetary and fiscal discrepancies of the government, which have a major impact on inflation, have a direct and, of course, negative impact on the living conditions of workers. Decline in purchasing power and individual welfare as a result of inflation, along with issues such as lack of productivity, lack of meritocracy, dominance of relations rather than the rules, and sometimes lack of conscience, has negative effects not only on labor life but also on the economy. Every year, the government increases the wages in order to support the workforce, which, owing to the absence of labor unions (which is the most important factor in coordinating workers), results in employers firing some workers.

Figure 1 shows the growth of real wages in the Iranian economy over the period 2005-2018. As can be seen, the growth of real wages has been negative for some years, indicating a decline in the purchasing power of the labor force and worsening their livelihoods. During the period 2013-2017, the government controlled the inflation and therefore increased the purchasing power of the labor force, but in 2018, with a significant rise in the inflation, growth in real wages declined again and the purchasing power of the labor force also declined.

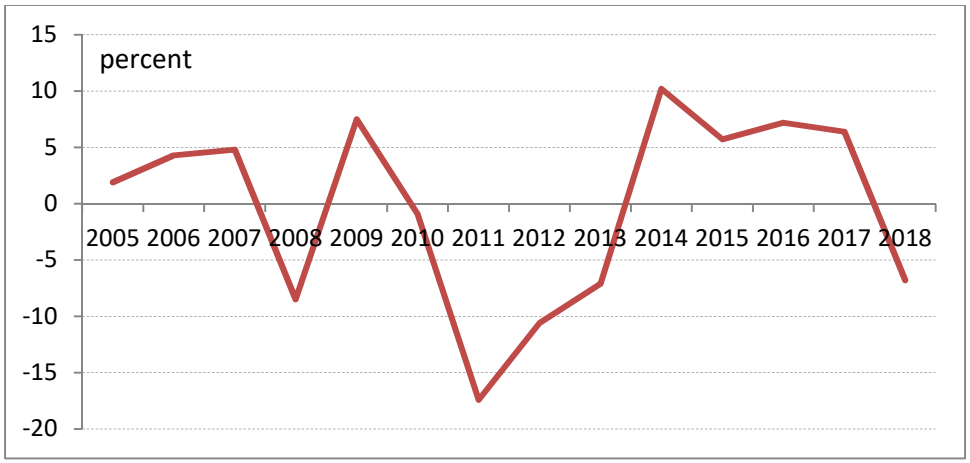

Figure 1. Growth in real minimum wages in Iran over the period of 2005-2018

Despite real wage declines in some years, the unemployment rate in Iran has always been more than 10%. Figure 2 illustrates the changes in the unemployment rate in the Iranian economy over the years 2005-2018.

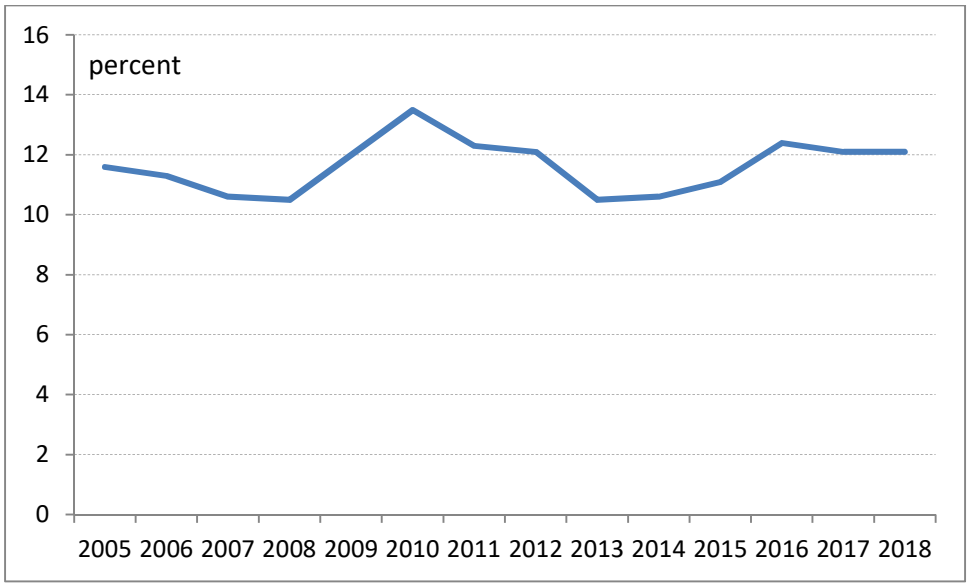

Figure 2. Unemployment rate changes in the Iranian economy over the period 2005-2018

The existence of some structural problems, coupled with the intensification of international sanctions, has prevented the Iranian economy to move toward sustainable development. Therefore, even though the labor force is cheaper for firms, these firms have not been able to employ it, so the unemployment rate of the Iranian economy has always been high. The high unemployment rate and the large number of jobseekers have made the labor force want to work even at lower wages. Under such circumstances, the workforce is always threatened with layoffs and replacements. Thus, the workforce is likely to work below the minimum wage, and it would be natural for their productivity to be low.

2.2 Study Background

The labor force, as one of the main factors of production, has a growing role in sustainable

economic growth. In particular, in recent decades, development theories have shown the relative advantage of countries with regard to their human capital.

The low profitability of economic firms in Iran is because of the low productivity of labor that is operating in these firms. The reason for the low level of productivity is the lack of motivation for work, the lack of concentration, and the lack of welfare, most of which are due to insufficient income. The wage of workers is not enough to cover all of their initial living expenses. This reduces the productivity of the labor force in the workplace (Sadeghi and Brumand, 2012).

This study hypothesizes that if employers pay attention to this issue and increase the levels of laborers' wages, the intellectual concerns regarding the labor force – the lack of concentration and mental relaxation – will reduce; as a result, productivity can be increased. Many factors can be effective at a low level of labor productivity (such as having advanced technology), but for simplification and according to the standards of economics, it is assumed that such factors are constant. It is also assumed that the level of wages is a standard criterion for the workforce's utility, because with the increase in the wages of the workforce, their concerns about living expenses are reduced. In the next section, this subject is further elaborated.

In Iranian economic literature, less attention has been paid to worker-employer relations, and research has focused on factors affecting labor productivity or the impact of productivity on economic growth. Among the articles emphasizing factors affecting labor productivity, we can refer to al-Badawi and Ali Janni's research (2008). In their article, they have investigated the relationship between e-learning and employee productivity and have found a positive relationship between these two variables. Mahmoudzadeh and Asadi (2007) have focused on the impact of information and communication technology (ICT) on the growth of labor productivity in the Iranian economy. According to the research, total productivity and non-IT capital have the most impact on labor productivity in the Iranian economy. In addition, the effect of human capital and ICT capital on labor productivity has been positive and significant. The work of Mohammadi and Akbari Fard (2008) is notable among the studies being conducted on the relationship between productivity and growth. In their article, they discussed the impact of productivity shocks on Iran's economic growth and concluded that supply shocks (productivity shocks) had a significant effect on economic growth. Komeijani and Memar Nejad (2004) examined the impact of human resource quality on economic growth and recognized the positive impact of labor on economic growth. Rabiee (2009) focused on the effects of innovation and human capital on economic growth and concluded that labor has a positive impact on increased production in the Iranian economy.

Articles published abroad are more focused on the relations between the workers and the employer, and even the government, than internal articles. The following are some articles that discuss interactions between the worker and the employer through the game theory. Flesch et al. (2009) studied the so-called production games and categorized their production games on the basis of the Markov transition structure. Mitrou and Karyda (2006) emphasized employability criteria, which includes the collection of accurate information about the worker; this information is essential for the employer. Jones and Simon (2005) determined the earnings of the workforce according to their skill and education. Dufwenberg and Kirchsteiger (2000) suggest two types of games in which two workers struggle for a job, and ultimately the employer employs the worker who has asked higher wages. All of these articles examine the game between the worker and the employer, each one in a way. In none of the above articles, the government has entered a game as a player, and if it has entered the discussion, it is more of an observer and has not had a significant impact on the

outcome. This is due to the fact that the economy studied by these scholars is free economics and has normal conditions that do not require government intervention. According to the authors' information, there are few papers about government involvement in the game of worker and employer, one of which is by Wang (2008). In his article, Wang discussed the insurance of rural migrant workers working in urban institutions, in which the government forces the institutions to insure these workers and, in the event of refusing to insure them, impose heavy fines on institutions. In this case, because an abnormal economic situation occurs unlike the market mechanism (insecure workers), the government enters the game.

Araujo and Souza (2010) have studied dynamics of the labor market in developing countries using game theory. They say a stylized fact of the labor market in developing countries is that it is highly segmented in informality. One of the main factors that induce workers and firms into informality is an excessive regulatory system that makes formal economy attractive. They analyze the dynamics of workers and firms' entrance and withdrawal of the formal and informal economy, assessing the impact of taxes by using an evolutionary game theory approach in which economic agents decide for one these markets according to the expected payoff. Moreover, they have evaluated the optimal relation between regulatory and enforcement action by the government.

Benjamin (2015) has studied a gift-exchange game, in which a profit-maximizing firm offers a wage to a fair-minded worker, who then chooses how much effort to exert. The worker judges a transaction fairer to the extent that his own gain is more nearly equal to the firm's gain. The worker calculates both players' gains relative to what they would have gained from the reference transaction, which is the transaction that the worker most recently personally experienced. His model explains several empirical regularities such as rent sharing, persistence of a worker's entry wage at a firm, insensitivity of an incumbent worker's wage to market conditions, and – if the worker is loss averse and the reference wage is nominal – downward nominal wage rigidity. The model also makes a number of novel predictions. Whether the equilibrium is efficient depends on which notion of efficiency is used in the presence of the worker's fairness concern, and which is appropriate to use depends partly on whether loss aversion is treated as legitimate for normative purposes.

Chen (2019) investigated how externalities from downstream competition shape sorting in upstream labor markets. He models this as a two-stage game: an initial stage of simultaneous one-to-one matching between firms and managers, and a second stage of Cournot competition among matched pairs. If a firm's technology and human capital are strategic complements, it is rational for each firm-manager pair to expect that the remaining agents will form a positive assortative matching (PAM), and the PAM on the grand market is a stable matching under rational expectations. The PAM remains stable even when they are strategic substitutes, but the substitutive effect is moderate. However, if the substitutive effect is sufficiently strong, a negative assortative matching is stable. Chen also discussed social welfare induced by stable matchings.

As noted earlier, the purpose of this study is to analyze the relationship between the worker, employer, and government using game theory. In other words, our goal is to find the equilibrium among these three players in the current situation in the Iranian economy. The game among these three factors has not been fully explored in Iran so far, in both static and dynamic games; what can be deduced from previous studies is that the current situation in the Iranian labor market is not favorable and the workers lack motivation, which leads to reduced labor productivity and employer profits. The model presented in the next section seeks to obtain labor market equilibrium using game theory and compare that with the current conditions.

3. MODEL

This paper seeks to analyze the behavior of the factors of the Iranian labor market using game theory. In this regard, the static and dynamic analyses of the game are examined. It is assumed that the information is complete.

Each player follows a series of short- and long-term benefits that are not necessarily opposite each other. Because of the lack of unemployment insurance, workers are extremely worried about losing their jobs, and as a result, maintaining jobs is important to them. Changing the current conditions will result in an increase of the unemployment rate in the short run, but if the employer is allowed to maximize profits, his profit will increase in the long run and he will therefore expand the organization and seek to hire more workers (including expelled workers) with higher wages. In other words, changing the current condition will be better for workers in the long run but will harm them in the short run.

The long-term benefits of the firm, such as increasing production capacity and increasing profits, require the current situation to change, but changing the situation results in severe resistance from the workers and sometimes even the government, which may lead to the closure of the firm. Safeguarding from workers' strikes is one of the most important and crucial options for the employer (even if its profit is low). Therefore, the short-term benefits of the employer require him to be satisfied with the status quo.

Increasing the productivity and production is very beneficial for the government. Such a situation could, in case of occurrence, be a way to achieve the goals of long-term plans by the government. However, maintaining employment for the government is vital, and the government's short-term benefits are secured if the current situation of the market is sustained.

With regard to the above issues, the long-term benefits of the three players are in contrast to their short-term interests. In the following discussion, we want to show that these three players prefer their short-term interests to their long-term benefits.

This section has two sub-sections. In sub-section 3.1, the static game with complete information is studied with both non-intervention and intervention of the government. In sub-section 3.2, the dynamic game with complete information is examined with both non-intervention and intervention of the government.

3.1 Static Game

A static game with complete information refers to a game in which players simultaneously make their own choices and the game payoffs are common knowledge for all players. The first step in studying static games with complete information is to understand how to represent a game. A game can usually be shown in two ways: normal form and extensive form presentations. Extensive form presentation is mainly used in dynamic games. Static games are usually displayed in normal form presentation. However, both types of games can be shown in both forms.

We now examine the static game with complete information of the Iranian labor market with cases of intervention and non-intervention of government.

3.1.1 Static game when the government does not intervene in the market

The normal form representation of the static game between the worker and the employer can be expressed as follows.

The set of players

This game has two players, namely the employer (E) and the worker (W).

$$N = \{E, W\} \qquad (1)$$

The set of strategies

To determine the strategies of each player, we must first determine what each player wants.

Employer

Employer seeks to maximize his profits and thus performs any action that leads to an increase in profits and avoids actions that reduce his profits. It is assumed that the firm is not satisfied with the current output, and the output produced by its labor

force does not have much benefit to the employer. Therefore, in order to increase profits, the employer must encourage his workforce to produce more. We assume that the way the employer chooses to encourage his/her workers is by increasing their wages. In such a situation, the costs of the employer will also increase. Indeed, although the employer expects that this strategy will increase only the workforce's profits, the costs of the firm will increase too. Therefore, stimulating workers to work more by increasing their wages brings with it the risk of lowering profits compared with before. In other words, it is a risk for the employer to take such an action because workers may not increase their production by increasing wages. Therefore, the employer has two options: either he should be convinced by the current benefits and willing to maintain the status quo, or he should increase the wages of workers in the hope of increasing production and expect to escape from the existing situation and increase profits. Therefore, employer's strategies can be written in the form of a change in the status quo (C) and maintaining the status quo (K). So, the set of employer strategies is as represented below:

$$S_E = \{C, K\} \quad (2)$$

Worker

The worker seeks to maximize his utility. It is assumed that the utility of the worker increases when his wage increases permanently, because the increase in the wages of the worker means that he can afford more life expenses. It is also assumed that the wage level of the worker is low and does not allow him to cover all his living expenses, and that the worker is therefore not satisfied with the current level of his wages; hence, he tries to increase his productivity to increase the firm's production in the hope that the employer will increase his wages in exchange for increased production. In such a situation, the worker gradually loses his physical ability, and his permanent salary may not increase. In other words, the employer may give him a temporary remuneration in order to increase labor productivity and may not increase his wages permanently. Therefore, an increase in the worker's effort, which leads to an increase in the employer's production, has the risk of not increasing the permanent wage for the worker. So, the worker has two options: either he should be satisfied with the current wage and continue to produce a low level of productivity and have a tendency to maintain the status quo, or he should increase his effort in the hope of increasing his permanent wage and try to be relieved of the status quo. Therefore, the worker strategies can be expressed in terms of changing the status quo (C) and maintaining the status quo (K). Therefore, the set of worker strategies is as given below:

$$S_W = \{C, K\} \quad (3)$$

Players' payoffs

In general, in a two-player game between the worker and the employer, there are four situations for player i:

1. Player i selects Strategy C, player j chooses Strategy C.
2. Player i selects Strategy C, player j chooses Strategy K.
3. Player i selects Strategy K, player j chooses Strategy C.
4. Player i selects Strategy K, player j chooses Strategy K.

We can use the numbers 1 to 4 to rank the possible consequences for each player, so that the best situation is represented with the number 4 and the worst case is represented by the number 1. The goal of evaluating situations with numbers 1 to 4 is to give only one priority to each player, and these numbers can be any other number with the condition of observing the order. This preference is not too unfamiliar to players in the game theory. For example, there is such an argument in the prisoner's dilemma.

The worst case for each player is when he chooses strategy C and the other player chooses strategy K (situation 2). If this happens to the employer, its costs will increase (through wage increases)

without increasing its production and its profit will be less than before. If this happens to the worker, he will have to work more without raising his wages. This is the case for both players with the number 1.

The best case for each player is when he chooses strategy K and the other player chooses strategy C (situation 3). In this case, the employer will generate more profits without increasing costs because the worker will increase his productivity. In this case, the employer's profit is higher than in all other situations. If this happens to the worker, he will be able to earn more wages and achieve a higher level of welfare with the same effort. This situation is estimated for the worker and the employer with the number 4.

If both players choose strategy C (situation 1), the employer achieves higher profits and the worker gets more wages, but because the choice of strategy by both players costs them, it is better than situation 3. So, we rate this for both players with number 3. Nevertheless, situation 4, in which both players tend to maintain their position, will be ranked with number 2.

In brief, we can write the normal form of a two-player game between the worker and the employer as follows:

1. The set of players

$$N = \{E, W\} \tag{4}$$

2. The set of strategies

$$S_E = \{C, K\}$$
$$S_W = \{C, K\} \tag{5}$$
$$S = S_E \times S_W = \{C, K\} \times \{C, K\}$$
$$= \{(C, C), (C, K), (K, C), (K, K)\}$$

3. Players' payoffs

$$u_E(C, C) = 3 \quad u_E(C, K) = 1 \quad u_E(K, C) = 4 \quad u_E(K, K) = 2 \tag{6}$$
$$u_W(C, C) = 3 \quad u_W(C, K) = 4 \quad u_W(K, C) = 1 \quad u_W(K, K) = 2$$

The matrix form of this game is as follows:

Table 1: Static game between worker and employer without government intervention

		Worker (W)	
		C	**K**
Employer (E)	C	3,3	1,4
	K	4,1	2,2

Reference: Research calculations

The game is a prisoner's dilemma, and the Nash equilibrium can be found through the best answer. To find the Nash equilibrium, we obtain the best responses of each player to the opponent's strategies.

The best responses of player E to each strategy selected by rival W are as represented below.

$$B_E(s_W = C) = K$$
$$B_E(s_W = K) = K \tag{7}$$

Therefore, the best response of player E to any strategy selected by rival W is strategy K. That is, the employer will always have the tendency to maintain the status quo, regardless of whether the worker wishes to change or maintain the status quo. The strategy K for employer is actually a strictly dominant strategy.

The best responses of player W to each opponent's strategy are represented below.

$$B_W(s_E = C) = K$$
$$B_W(s_E = K) = K \quad (8)$$

So, like the employer, the dominant strategy of the worker is the tendency to maintain the status quo (i.e., K). The best response of each player is shown by a line drawn under the payoff of that player in Table 1. The strategy profile (K, K) is the Nash equilibrium. But what is the reason for this equilibrium? Why is the worker and the employer happy with an equilibrium with lower productivity, when both can gain a better payoff by choosing strategy C simultaneously? The main reason is the lack of trust between the worker and the employer. In fact, neither party can trust its opponent and therefore chooses strategy C.

The equilibrium outcome is not a Pareto's optimal, and as noted, players can increase their payoffs through cooperation. If the game is repeated between the two players, both players should better coordinate their actions based on Pareto's optimal outcome and get rid of the prisoner's dilemma by choosing a cooperative strategy. If it is possible that the worker and the employer agree or trust each other, they will be better off than the Nash equilibrium. In fact, if both players can stay loyal to each other, they will achieve outcome (3,3) rather than outcome (2,2).

3.1.2. Static game with government intervention

Nash equilibrium of a static game between the worker and the employer is a low-level equilibrium in which both players tend to maintain the status quo. What will happen if the government also intervenes in the labor market and enters the game? Can the government direct the game from a low-efficiency equilibrium to a high-efficiency equilibrium?

The role of the government in the economy became more prominent after the Great Depression of 1929 and Keynes' views about the greater intervention of the government. In Iran, from the beginning of the development programs, the government has played a significant role in guiding economic activities and has always had a heavy shadow over the markets in the country's economy. The labor market is also one of a variety of markets that have not been immune to the government's intervention. Reducing unemployment and creating more occupation opportunities is one of the most important goals of various states in Iran during the past years. Reviewing the performance of the government in development programs shows that the government has not succeeded in achieving the goals of the programs.

Here, the government is assumed to be playing as a player, and simultaneously, together with the worker and the employer, chooses a strategy. In order to define government strategies, we must first understand the goals of the government. The government must achieve the goals of development programs. It is assumed that the unemployment rates and per capita income are different from those defined in the development program. This difference means that the goals of the program are not fulfilled, which is not desirable for the government. Hence, the government is looking for a way to not only increase per capita income but also lower unemployment. The solution that the government finds for this is to set the minimum wage above the wages paid to the workers and force the employer to pay the wage. If this decision is made, the purchasing power of the workforce will increase, and the labor force can cover more costs of living. In this case, the workers' mental concerns also decrease, and they can work with more concentration and more peace of mind, which may also lead to increased production and profitability of the firm. By increasing profits, the firm develops its business to make more profit; it invests more and recruits more. As the process continues, not only will the incomes of workers in the whole society, as well as per capita income, increase, but more employment will also be created, and unemployment will decrease. Thus, the government will be able to achieve its goal.

On the contrary, it is likely that even with the increase in wages, the work force will not increase

its efforts and productivity, and only employer costs will increase owing to a rise in wages. In this case, the employer will be forced to expel a number of workers. With the dismissal of workers by enterprises, unemployment will increase, and the labor market will get worse, which is not politically acceptable for the government.

However, the government's decision to raise the minimum wage would be risky. Therefore, the government must accept the risk of social and political moves to change the current situation. Moreover, the government can tolerate the current situation and decide not to change production and per capita income. So, the government has two choices (or strategy): the decision to change the status quo (strategy C) or to be satisfied with the current situation (strategy K).

The set of government (G) strategies is as follows:

$$S_G = \{C, K\} \quad (9)$$

If any of the players wants to think and evaluate the game results, then they should consider the possible scenarios. From the perspective of each player, there are six situations, which are the following:

1. Chooses strategy C and the other two players both choose C.
2. Chooses strategy K and the other two players both choose C.
3. Chooses strategy C and the other two players both choose K.
4. Chooses strategy K and the other two players both choose K.
5. Chooses strategy C and one of the players chooses C and the other chooses K.
6. Chooses strategy K and one of the players chooses C and the other chooses K.

We can use the numbers 1 to 6 to rank the possible results for each player, so that the best situation is represented by the number 6 and the worst case by the number 1. The worst case for each player is when he chooses strategy C and the two other players both choose strategy K (situation 3). If this happens to the employer, its costs will increase (by raising wages) without increasing its production, and earnings will be less than before. If this happens to the worker, he works more without a raise in his wages. If the government chooses strategy C, and the worker and the employer both choose strategy K, then the government adopts a policy that has no positive consequences, in which not only the program's goals will not be realized, but the government will also incur the costs of adopting the policy. This situation is valued for every player by the number 1.

The best situation for each player is when he chooses strategy K and the two other players both choose C (situation 2). In this case, the employer achieves higher profits without raising costs, as the worker increases his productivity, and the government also seeks to change the status quo and meet the goals of the development plans to help the firm increase its production. If this happens to the worker, he will be able to earn more wages and achieve a higher level of welfare with the same effort. If the government chooses strategy K, and the worker and the employer both choose C, the government can achieve the goals of the program without any risk. This is the case for all three players with number 6.

If all three players choose strategy C (situation 1), the employer will profit more, the worker will pay more, and the program's goals will be met, but because choosing this strategy is with risk, this situation will cost all three players. In addition, it is more expensive than situation 2. This situation is indicated by number 5.

Of the remaining three modes, mode 6 is preferred for each player. Therefore, the result of this situation is indicated by number 4. Although it costs all three players, they prefer the fifth situation to the fourth. As a result, situations 4 and 5 are ranked with numbers 2 and 3, respectively.

We can represent the strategic form of the game among the worker, employer, and government as follows:

The set of players

$$N = \{E, W, G\} \quad (10)$$

2. The set of strategies

$$S_E = \{C, K\}$$
$$S_W = \{C, K\}$$
$$S_G = \{C, K\} \quad (11)$$
$$S = S_E \times S_W \times S_G = \{C, K\} \times \{C, K\} \times \{C, K\}$$
$$S = \{(C,C,C),(C,C,K),(C,K,C),(C,K,K),(K,C,($$

3. Players' payoffs

$$\begin{array}{lll} u_E(C,C,C) = 5 & u_W(C,C,C) = 5 & u_G(C,C,C) = 5 \\ u_E(C,C,K) = 3 & u_W(C,C,K) = 3 & u_G(C,C,K) = 6 \end{array} \quad (12)$$

$$\begin{array}{lll} u_E(C,K,C) = 3 & u_W(C,K,C) = 6 & u_G(C,K,C) = 3 \\ u_E(C,K,K) = 1 & u_W(C,K,K) = 4 & u_G(C,K,K) = 4 \\ u_E(K,C,C) = 6 & u_W(K,C,C) = 3 & u_G(K,C,C) = 3 \\ u_E(K,C,K) = 4 & u_W(K,C,K) = 1 & u_G(K,C,K) = 4 \\ u_E(K,K,C) = 4 & u_W(K,K,C) = 4 & u_G(K,K,C) = 1 \\ u_E(K,K,K) = 2 & u_W(K,K,K) = 2 & u_G(K,K,K) = 2 \end{array}$$

The game can be written in the form of a matrix, in which the player G (government) is shown as a page, and each page corresponds to a player's strategy.

1. Player G chooses strategy C:

Table 2: Static game among players, if the government chooses strategy C

		Player (W)	
		C	K
Player (E)	C	5,5,5	3, 6, 3
	K	6, 3,3	4, 4, 1

Reference: Research calculations

2. Player G chooses strategy K:

Table 3: Static game among players, if the government chooses strategy K

		Player (W)	
		C	K
Player (E)	C	3,3, 6	1, 4, 4
	K	4, 1, 4	2, 2, 2

Reference: Research calculations

In Tables 2 and 3, the first number to the right is the payoff of player E (employer), the middle number is the payoff of player W (worker), and the number on the left side is the payoff of player G (government).

The Nash equilibrium can be found through the best response. To do this, we obtain the best responses of each player to the opponent's strategies.

1. The best responses of player E:

$$\begin{array}{ll} B_E(s_{-E} = (C,C)) = K & B_E(s_{-E} = (C,K)) = K \\ B_E(s_{-E} = (K,C)) = K & B_E(s_{-E} = (K,K)) = K \end{array} \quad (13)$$

2. The best responses of player W:

$$\begin{matrix} B_W(s_{-W} = (C,C)) = K & B_W(s_{-W} = (C,K)) = K \\ B_W(s_{-W} = (K,C)) = K & B_W(s_{-W} = (K,K)) = K \end{matrix} \quad (14)$$

3. The best responses of player G:

$$\begin{matrix} B_G(s_{-G} = (C,C)) = K & B_G(s_{-G} = (C,K)) = K \\ B_G(s_{-G} = (K,C)) = K & B_G(s_{-G} = (K,K)) = K \end{matrix} \quad (15)$$

The best response of each is indicated by a line under the payoff of that player in Tables 2 and 3. The strategy profile (K, K, K) is the Nash equilibrium of this game.

The equilibrium outcome states that all three players tend to maintain the status quo, although this outcome does not have the most payoffs for them. This means they prefer their short-term interests to long-term interests. This equilibrium is the equilibrium in low productivity. An economy with low labor productivity can never achieve its development goals. Low productivity results in lower per capita income, followed by a decline in purchasing power and lower demand, resulting in a deep recession and a lack of sufficient investment and, consequently, a low level of productivity. In other words, the production process is caught in a vicious circle, which results in economic backwardness.

3.2 Dynamic Game

3.2.1 Dynamic game when the government does not intervene in the market

In the static game, all players choose at the same time, whereas in the dynamic game, each player chooses his strategy after the other player's move.

In the dynamic game between the worker and the employer (without government intervention), it is assumed that the employer starts the game. He initially chooses one of the strategies of changing the status quo or keeping the status quo, and then the worker selects a strategy by observing the employer's moves.

From the perspective of each player, four situations can be considered:

1. Player *i* chooses strategy K and player *j* chooses Strategy C.
2. Player *i* chooses strategy C and player *j* chooses Strategy K.
3. Both players choose strategy K.
4. Both players choose strategy C.

These situations are rated from 1 to 4, where number 1 shows the worst situation and number 4 shows the best situation for each player. The best situation for each player occurs when he chooses the strategy of keeping the status quo (i.e., strategy K) and the opponent chooses the strategy of changing the status quo (i.e., strategy C). In this case, the player achieves his goal (increased profit or utility) without enduring any cost or risk. Therefore, situation 1 is evaluated for each player with number 4. The worst situation occurs when the player chooses strategy C and the opponent chooses strategy K, because in this case, not only does the player not aim at his goal but he also incurs risks and costs. So, we rate situation 2 with number 1. Given that both players tend to change the situation even in the face of risk, they prefer to change the existing situation with risk (if both players want to change) to maintain the status quo. So, situation 4 is evaluated with number 3 and situation 3 with number 2.

The extensive form of the dynamic game between the worker and the employer, assuming there is no government intervention in the labor market, is presented in Figure 3. In this figure, it is assumed that the employer starts the game. One must exercise care regarding how the situations for the players are rated; even if the worker starts game, the outcome of the game does not differ.

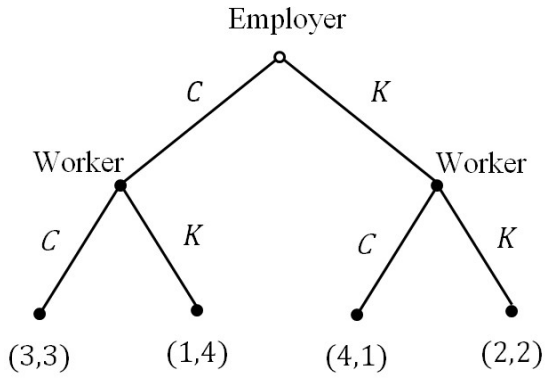

Figure 3. Dynamic game between the worker and the employer, without government intervention

In Figure 3, if the employer chooses strategy C, then the worker chooses strategy K because this strategy has a higher payoff than strategy C (4> 3). Therefore, the Nash equilibrium of the left sub-game is strategy K by the worker. The choice of this strategy will reduce the employer's payoff to 1. On the contrary, if the employer chooses strategy K, then the worker, observing the employer's move, chooses strategy K (with valuation 2) because it has a higher payoff than strategy C (with valuation 1). So, the Nash equilibrium of the right side of the game is also strategy K by the worker. In this case, the employer will gain a payoff of 2. By comparing this payoff with the payoff derived from the Nash equilibrium of the left sub-game (i.e., 1), the employer chooses a higher-valued strategy, that is, strategy K. As a result, the sub-game perfect equilibrium is as follows:

"The employer chooses strategy K in the first stage, and then, in the second stage, the worker observing the employer's move, will choose strategy K."

The equilibrium achieved in this dynamic game, like the static game, is low-level productivity equilibrium.

3.2.2 Dynamic game assuming government intervention

Consider the circumstances in which the government becomes a player in the game between the worker and the employer. In this case, can the government affect and improve the equilibrium of the game between the worker and the employer, which has a low level of productivity? To answer this question, the rules of the three-player game must be clearly defined and the various situations facing each player must first be assessed.

For each player, four situations can be considered as follows:

1) Player chooses strategy K and the two other players choose strategy C.

2) Player chooses strategy C and one or both other players choose strategy C.

3) Player chooses strategy K and one or both players choose strategy K.

4) Player chooses strategy C and both of the other players choose strategy K.

For each player, there are only 4 situations; therefore, the scenarios are rated from 1 to 4, where 1 means the worst and 4 means the best situation for each player. The best situation for each player is situation 1 because the player achieves whatever he wants without taking risks and costs. This situation is then evaluated with number 4. The worst case is situation 4, in which the player takes the risky strategy and at the same time does not achieve his goal. Between situations 2 and 3, situation 2 is better than 3 because although the player chooses a risky strategy, he achieves what he wants. Therefore, this situation is rated with number 3. Situation 3 is therefore rated with number 2 and states that although the player has not reached his goal, there is no risk for him.

The extensive form of the worker-employer-government dynamic game in the labor market is shown in Figure 4. As the game is conducted dynamically, players decide their moves successively. The government is supposed to start the game at first, then the employer chooses his strategy, and eventually, the worker must finish the game. One must exercise care regarding how the situations for the players are rated; no matter which player starts the game, the outcome does not differ.

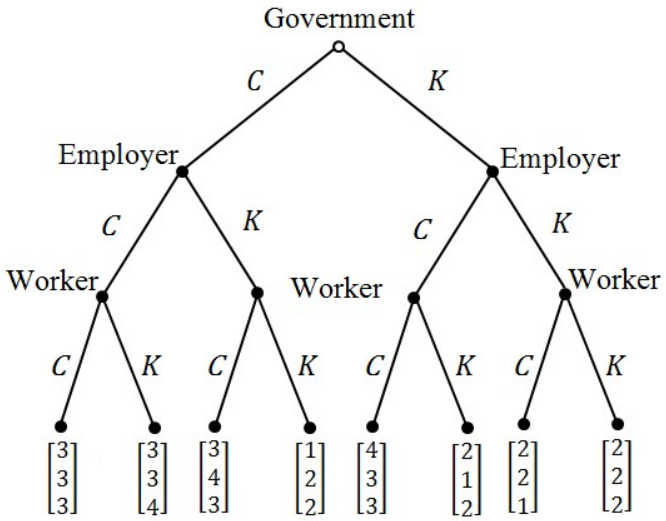

Figure 4. Dynamic game among worker-employer-government

In Figure 4, the upper number shows the government's payoff, the number in the middle shows the employer's payoff, and the lower number shows the worker's payoff. The sub-game perfect Nash equilibrium is obtained through backward induction. In Sub-game Perfect Equilibrium (SPE) of this game, the government will choose strategy K, the employer will choose strategy C, and the worker will choose strategy C. Of course, no matter which player starts the game, the same result would be achieved; if the first player is reluctant to change the status quo, the other two players still choose the strategy of changing the status quo. These results come with the assumption that the risk level of the three players is the same. If the government is supposed to have more risk-taking power than the other two players and will want to change the status quo (strategy C), then the employer will choose strategy K and the worker will choose strategy C. Even then, one of the players chooses strategy K and the rest choose strategy C. In fact, the outcome of the game is that one of the players will definitely choose strategy K. In other words, if the government chooses strategy K, the two other players will choose strategy C, and if the government chooses strategy C then the employer chooses strategy K and the worker chooses strategy C. Of course, if the government chooses strategy K, production will get better, because if the two other players (i.e., employer and worker) choose strategy C, the incentive for the worker and the employer will increase, which will lead to higher production and national income.

The equilibrium achieved in a dynamic game among the worker, employer, and government is better than the equilibrium achieved in a dynamic game between the worker and the employer. In addition, the sub-game perfect equilibrium of the dynamic game among three players in the labor market is better than the Nash equilibrium achieved in the static three-player game. In both the dynamic two-player game and the static three-player game, players tend to maintain the current situation and shape low-level productivity equilibrium. In such a

situation, the level of productivity and production is not very favorable, and the lack of mobility and dynamism in the labor market leads to lower levels of production and investment in manufacturing enterprises. However, in the three-player dynamic game, the equilibrium will improve, the worker will increase his productivity, and the employer will increase his profit. By paying part of his profits as a worker's salary, the employer actually decreases the workers' mental concerns and raises his concentration, which causes the worker to increase his efforts to increase production and thus increase the employer's profit, and this cycle continues. In dynamic equilibrium, the government chooses the same strategy that it had chosen in the static game, but because the game is played sequentially, the outcome of the game differs from that of the static game.

4. CONCLUSION

The current conditions of the Iranian economy and its encounter with various issues such as unemployment and recession led the authors to look for the root causes of these problems; therefore, the labor market survey was targeted. The labor market is very important in terms of structure. An economy with a healthy job market will not face structural problems in other markets. However, if the labor market is faced with a problem, it will affect all markets and make them even more inefficient. If labor productivity is low, production will be low, and low production will reduce profits, lead to lack of investment, and lower wages of the labor force, which, in turn, will reduce labor productivity. Therefore, vicious cycles are formed, resulting in stagnation and decline of the economy.

The main purpose of this study was to investigate the relationships among the actors who created demand and supply in the labor market, namely the worker and the employer. Of course, the behavior of the third factor (i.e., the government, which is very influential on this market) has been analyzed. The worker and the employer are always struggling to divide profits from the sale of goods, because providing one's interests is in contradiction with the other's interests. To analyze such a situation, a tool was needed to analyze labor market relations in situations of conflict. Game theory is the best tool for solving such issues.

In this paper, the factors affecting the labor market in both static and dynamic situations, with the assumption of intervention and non-intervention of the government in the market, were analyzed. For each player, two strategies called changing the status quo and keeping the status quo are defined. Choosing a strategy to keeping the status quo is risk-free and cost-effective and in the same direction as the short-term interests of the players. However, the strategy of changing the status quo has risks and costs but was defined to be in the same direction as long-term interests of the players. If the players had selected the strategy of changing the status quo, the economy would probably have been out of recession. The status quo for the employer was defined as low profit, for worker as low wages, and for government as low per capita income and high unemployment. To solve the game of the labor market and compare different scenarios, four different games on the market were assessed: a static game of employer and worker without government intervention; a static game of the worker, employer, and government; a dynamic game of worker and employer without the presence of the government; and a dynamic game of the worker, employer, and government.

In the static two-player game between worker and employer (without government intervention), both players choose the strategy of keeping the status quo in equilibrium, which is a low-productivity equilibrium. This equilibrium is achieved in the static game among the worker, employer, and government, and the three players choose the strategy of keeping the status quo as it is. The sub-game perfect equilibrium of dynamic game between worker and employer (without the presence of the government) also represents an equilibrium with low productivity, and in this type of game, the worker and the employer will choose

the strategy of keeping the status quo. However, in the dynamic game among three players, the conditions will change. In this game, the player starting the game tends to keeping the status quo, but the other two players both choose strategies of changing the status quo. Therefore, if the government starts the game, the best possible situation in the economy will be formed because, on the one hand, the government will be able to increase per capita income without bearing risk, and, on the other hand, production, productivity, and wages will increase. In this case, it can be concluded that the worst situation in the economy is when the worker starts the game.

One of the reasons for achieving a low productivity level in the games above is the uncertainty of the strategy of other players. In fact, no player wants to accept the risk of choosing the strategy of changing the status quo, and thus chooses a risk-free strategy (i.e., keeping the status quo). The labor market in Iran has a number of structural weaknesses; if some were eliminated, the labor market would be better. Some of these weaknesses are the lack of work morale, the absence of labor unions in support of workers' rights, inappropriate policies of the government in the domestic and international arenas, lack of due attention to workers by employers, especially in social security, and so on. For example, if all workers decide to increase their productivity and increase the company's production, then the firm will not be able to ignore this labor movement because of a strong labor force (i.e., the union) and will have to pay them more wages.

In sum, achieving equilibrium with high productivity in the labor market requires the co-ordination of all the factors affecting this market, and if there is not just one factor, the other factors will lose this motive. The most important step is for the government to build partnerships, increase working spirit, improve mutual trust, and adopt the right policy.

Appendix

Game theory is a mathematical tool for analyzing situations in which the behavior of individuals is influenced by others and their profits depends on each other's decisions. There are several basic concepts in game theory, which will be briefly mentioned here.

Definitions

- Player: Individuals involved in the game are called players. The players are supposed to be wise people who remember all the events that happened in the past. The goal of each player is to play the game and select an action, maximize its payoff according to the game's conditions.
- Strategy: Action sets of players in the game called strategy. In simultaneous-move games, the concept of action (or movement) is the same with strategy, but in sequential-move games, these two concepts are not the same and the strategy consists of a set of player moves (or actions).
- Outcome: Each outcome includes a set of strategies for all the players in the game, which is determined after the game finishes.
- Payoff: Each player's payoff includes the benefits he earns from each outcome of the game.

Games are generally divided into two categories, co-operative games and non-cooperative games. In co-operative games, players co-ordinate each other to maximize their payoff, while in non-cooperative games, players will maximize payoffs without coordinating each other. The emphasis of this article is the non-cooperative games.

Non-cooperative games are divided into two main groups of simultaneous-move games (or static games) and sequential-move games (or dynamic games). Static games mean games that players choose to move at the same time or without knowing the rival movement. In dynamic games, time is entered into the model and the players pick their moves in their particular order. Usually static games are represented in the strategic (normal or

matrix) form and dynamic games are represented in the extensive form.

Static and dynamic games are also divided into two major categories of games with complete information and games with incomplete information. Games with complete information refer to games in which players have all information about the movements of other players and their payoffs from the beginning of the game. In contrast, games with incomplete information are games in which at least one player does not have information about the actions of some players and their payoffs in some outcomes.

Equilibrium

Game theory is a set of tools for predicting outcomes of a group of interacting factors that affects each other's payoffs (Shy, 1995). The concept of equilibrium is very broad. In fact, different concepts of equilibrium are proposed for different games, but in general, equilibrium can be defined as a set of strategies that represent the best response to each other. In relation to any type of game, a new concept of equilibrium is defined.

Normal form

The normal form presentation of game includes:

1. The set of players: We represent the set of players with N and if a game contains n players, the set of players will be as follows:

$$N = \{1,2,\dots,n\} \qquad (16)$$

2. The set of strategies: The number of strategies for each player is called the strategy set by that player. We show the set of strategies for player i with S_i. If player i has k strategies, then it can be written:

$$S_i = \{s_1^i, s_2^i, \dots, s_k^i\} \qquad (17)$$

The set of strategies of the game (with n player) is represented by S and consists of:

$$S = S_1 \times S_2 \times \cdots \times S_n = \{(s_1^1, s_1^2, \dots, s_1^n), \dots, (s_k^1, s_k^2, \dots, s_k^n)\} \qquad (18)$$

3. The payoffs: Each player's payoff is subject to the player's and his opponent's strategies. We will show the player i's payoff with u_i and define it as follows:

$$u_i: S \to R \qquad \forall i \in N \qquad (19)$$

Hence, the normal form of a game can be written as follows:

$$G = \{S_1, S_2, \cdots, S_n; u_1, u_2, \cdots, u_n\} \qquad (20)$$

Nash equilibrium

In the theory of games, it is assumed that players are wise, that is, their chosen strategy is in a direction with their own interests. As a result, the decision of a player comes as follows:

$$\max_{s_i \epsilon S_i} : u_i(s_i, s_{-i}) \qquad (21)$$

In which s_i is the player i's strategy and s_{-i} is the strategy profile of all players (except player i).

In Nash equilibrium each player's choice have maximum payoff to player with respect to opponent's choices. Furthermore, the player's belief about the strategy profile of other players is correct. The Nash equilibrium has a major feature and that is the choice of players does not necessarily result in more payoffs.

Nash equilibrium is mainly based on the best response. The best response of player i in a game in the form of normal form is defined as follows:

$$B_i(s_{-i}) = \{s_i \epsilon S_i : u_i(s_i, s_{-i}) \geq u_i(s_i', s_{-i}) \quad \forall s_i' \epsilon S_i\} \qquad (22)$$

For each $s_{-i} \epsilon S_{-i}$ there is a set $B_i(s_{-i})$ that may be a single-member set or greater (Gibbons, 1992).

Game tree

Dynamic games are games in which players move sequentially; that is, each player must make his choice after observing the previous player move. Dynamic games are usually presented by extensive forms (game tree). In brief, the components of the game tree can be summarized as follows:

1. Initial node: The node that represents the beginning of the game. This node is represented by a hollow circle.

2. Decision nodes: The nodes represent the starting point of each player's decision in the game. Each decision node represents the player's turn.

3. Final nodes: The nodes representing the end of the game, in which the players' payoffs are displayed in terms of their order of movement in the game tree.
4. Branches: Each non-final node may have multiple branches, each branch representing a move for the player moving on that node. Each branch may end with a final node or another decision node.
In Figure 1, a game tree is shown with all its components. In the figure, player 1 starts the game and the decision node of him (initial node) is the primary node of the game, which is a hollow circle. The initial node has two branches with the names A and B, which indicate the player's choices in the game. After player 1 chooses his strategy, player 2 will choose his strategies. In this game, player 2 has two decision nodes that correspond to the player 1 moves. After player 2 chooses one of the strategies C or D, the final nodes will come out and the game will end. The payoff of each player is written down all the final nodes. The player 1's payoff is the left-hand side number and the player 2's payoff is the right-hand side number. For example, if player 1 chooses strategy B and player 2 chooses strategy D, then the player 1's payoff is 3 and the player 2's payoff is 4.

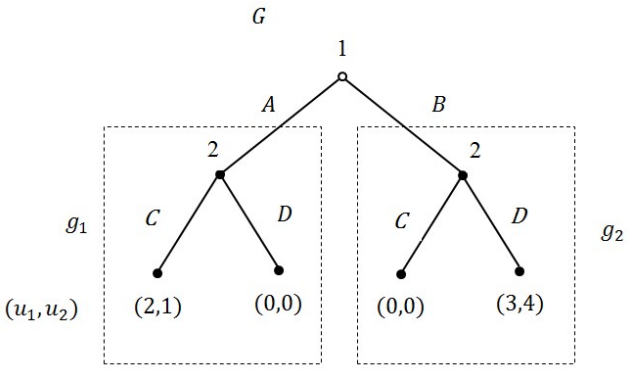

Figure A1. Game Tree

Sub-game perfect equilibrium (SPE)

To find the equilibrium in dynamic games, the SPE method is used. In this method, the whole game is divided into several sub-games. Every sub-game is a formidable game and is part of the original game. The players of each sub-game are the players of the original game. The whole game is also considered a sub game. In Figure A1, the sub games are g_1, g_2, and G; of course, G is the original game.

The sub-game perfect equilibrium for games of complete information is obtained through backward induction. To find the SPE of the game, first start with the last sub-games that end up in the final nodes (for example, g_1 and g_2 in figure 1) and find the equilibrium of these sub-games. Then, we back one step and find the equilibrium of sub-game before it, and so we go from the tree up to the tree to find the last sub-game (or the original game). The Nash equilibrium of the biggest sub-game is the SPE of the game.

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