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U JEDNOJ GODINI TRI NOBELOVE ZVEZDE IZ EKONOMIJE - III DEO

Džon F. Neš

Nobelova nagrada za 1994.

Rezime

Nobelovu nagradu iz ekonomije za 1994. godinu "za pionirsku analizu ravnoteže u teoriji nekooperativnih igara" dobili su Džon Čarls Haršanji, Džon F. Neš i Rajnhard Zelten. Džon Neš je rođen 13. juna 1928. godine u mestu Blufild, u američkoj državi Zapadna Virdžinija. Na Karnegi univerzitetu diplomirao je matematiku, a doktorat je odbranio na univerzitetu Princeton. Njegova teorija nekooperativnih igara može da se posmatra kao jedan od najznačajnijih intelektualnih postignuća u proteklom veku, a može se reći da Nešova ravnoteža ima isti značaj kao i otkriće DNK.

Ključne reči: Džon F. Neš, teorija igara, teorija nekooperativnih igara, Fon Nojman, Morgenštern, Kurnoa, Brauerova teorija, Ališa, Blufild, Virdžinija, univerzitet Princeton, M. I. T, Karnegi univerzitet

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John F. Nash
Nobel Prize for 1994

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Summary

1994 Nobel Prize in Economics “for their pioneering analysis of equilibrium in the theory of non-cooperative games” was awarded to John Charles Harsanyi, John F. Nash, and Reinhard Selten. John Nash was born on 13 June 1928, in Bluefield, West Virginia. He majored in mathematics at the Carnegie University, and gained his PhD at the Princeton University. His theory of non-cooperative games can be seen as one of the most significant intellectual achievements in the past century, whereas the so-called Nash equilibrium can be said to bear the same importance as the discovery of DNA.

Key words: John F. Nash, game theory, non-cooperative game theory, von Neumann, Morgenstern, Cournot, Brauer’s theorem, Alicia, Bluefield, Virginia, Princeton University, M.I.T, Carnegie University

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IN ONE YEAR
THREE NOBEL
STARS IN
ECONOMICS
- PART THREE

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Snaga genija

Nobelovu nagradu iz ekonomije za 1994. godinu "za pionirsku analizu ravnoteže u teoriji nekooperativnih igara" dobili su Džon Čarls Haršanji, Džon F. Neš i Rajnhard Zeltlen. Ono što je zajedničko za ovu trojicu nobelovaca jeste oblast rada iz ekonomije i teška životna iskušenja kroz koja su prošli i uspešno ih prebrodili. Među njima, najveća su iskušenja s kojima je morao da se izbori Džon Neš, snagom svoga genija, ali je uprkos teškoj bolesti uspeo da nastavi bavljenje naukom postižući pritom vrhunske rezultate.

Džon Neš je rođen 13. juna 1928. godine u mestu Blufild, u američkoj državi Zapadna Virdžinija. Dobio je ime po ocu, koji je bio elektroinženjer. Njegova majka, Margaret, radila je kao profesor engleskog, a povremeno i latinskog jezika, ali je zbog gubitka sluha rano prestala da predaje. Još u najranijem detinjstvu Džon je voleo da čita i provodio je mnoge sate uz knjige "edukativne vrednosti" koje je mogao da nađe u svojoj i kući njegove bake. Dok je pohađao srednju školu, pročitao je knjigu *Veliki matematičari*, E. T. Bela i zahvaljujući njoj zavoleo matematiku. U to vreme se bavio i eksperimentima iz oblasti elektronike i hemije i želeo je da bude elektro-inženjer kao i njegov otac.

Na Karnegiju, u Pitsburgu, Neš je studirao hemijski inženjering. Posle samo jednog semestra, prešao je da studira matematiku, iako ga je mentor savetovao da to ne čini jer je gotovo namoguće imati dobru karijeru matematičara u Americi tog vremena. Nakon što je diplomirao, dobio je ponude za doktorske studije na Harvardu i Princetonu, dva velika i prestižna univerziteta. Opredelio se za Princeton, a u tome mu je pomogao subjektivni osećaj da su sa ovog univerziteta pokazali veću zainteresovanost da bude njihov student. U preporuci, njegov profesor sa Karnegija napisao je samo jednu jedinu rečenicu: "Ovaj čovek je genije!" Još na Karnegiju slušao je kurs "Međunarodna ekonomija" o ekonomskim idejama i problemima. Kasnije, na doktorskim studijama na Princetonu privukli su mu pažnju radovi o teoriji igara dva velika autora, Fon Nojmana i Morgenšterna. Počeo je da razvija svoje ideje iz ove oblasti koje su, kako se kasnije ispostavilo, vodile ka

"teoriji nekooperativnih igara". Konačan oblik ta teorija je dobila u knjizi *Nešova ravnoteža*, koja je objavljena 1950. godine. Iste godine, objavljena je i knjiga *Nešovo rešenje za problem pregovaranja*, u kojoj je predstavljeno rešenje kooperativne igre dva igrača. U nekoliko narednih godina došao je do niza izvanrednih rezultata, kako iz oblasti teorije igara i ekonomije, tako i matematike. Postao je poznat i van stručnih krugova kao velika "zvezda".

Godine 1956-1957. dobio je posao predavača na M. I. T-u (Njujork), gde je upoznao svoju buduću ženu, Ališu, koja je u to vreme završavala studije fizike. Sa nepunih trideset godina, Neša je na vrhuncu blistave karijere sputala bolest. Dijagnoza je bila zastrašujuća, paranoidna šizofrenija (opsednutost tajnim službama). Bolest je bila naročito intenzivna početkom 1959. godine, u vreme kada je Ališa bila u drugom stanju. Ališa se maksimalno trudila da mu pomogne, ali je Neš nju dugo krivio, smatrajući da ga je ona poslala na lečenje, što je bio glavni razlog raspada njihovog braka. Dao je ostavku na posao i naredne dve decenije prošle su mu u borbi sa bolešću. Posle besciljnih putovanja po Evropi i Americi, najzad se vratio na Princeton, gde je dobio nadimak "Fantom svečane dvorane". Početkom osamdesetih, bolest je počela da jenjava i Neš se vratio radu. Uspostavio je prijateljski odnos sa Ališom sa kojom ima sina Džona Čarlsa Martina Neša, a nešto kasnije su obnovili i bračnu zajednicu. U stvari, Neš je uspeo da spoji "svoje ludilo" sa svojim životom, da živi sa bolešću na jednom "ultralogičnom nivou". Taj ogroman podvig uspeo je da napravi zahvaljujući snazi svog genija. Silvija Nazar napisala je po Nešovom životu

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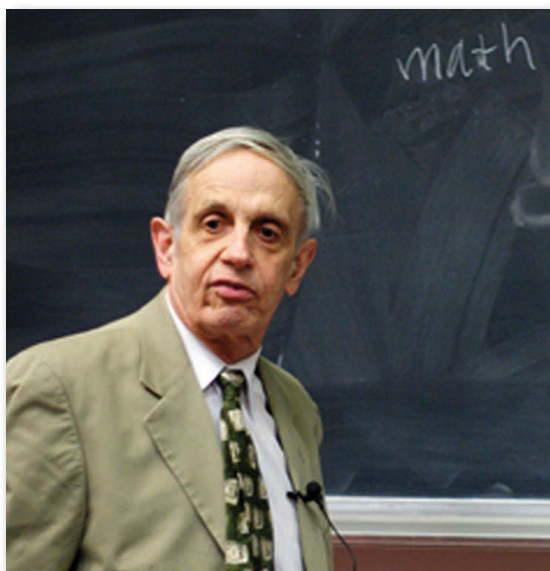
Power of a Genius

1994 Nobel Prize in Economics “for their pioneering analysis of equilibrium in the theory of non-cooperative games” was awarded to John Charles Harsanyi, John F. Nash, and Reinhard Selten. What these three Nobel Prize winners have in common is the field of economics they studied, as well as the hardships that they had undergone and successfully overcome during their lifetime. Among them, it was John Nash who had to face the biggest challenges and fight them with the power of his genius. Despite his serious illness, however, he managed to continue with his scientific work, having achieved some extraordinary results.

John Nash was born on 13 June 1928, in Bluefield, West Virginia. He was named after his father, who was an electrical engineer. His mother, Margaret, was a teacher of English, and sometimes Latin, but due to a partial loss of hearing she was forced to retire early. Even as young boy, John loved to read and spent many hours reading books of educational value, which he found either in his house or the house of his grandmother. While in highschool, he read the classic *Men of Mathematics* by E.T.Bell, which triggered his love for mathematics. At the time he also did electrical and chemistry experiments, wishing to become an electrical engineer, like his father.

At the Carnegie University in Pittsburgh, Nash studied chemical engineering. After just one semester, he shifted to mathematics, despite his mentor’s advice not to do that, because it was practically impossible to make a solid career as a mathematician in the USA at the time. Upon graduation, he was offered fellowships for

doctoral studies both at Harvard and Princeton, two big and prestigious universities. He opted for Princeton, partly because of his subjective feeling that this university was more interested in getting him to come there as their student. Writing him a recommendation, his professor from Carnegie wrote a single sentence: “This man is a genius!” While he was still in Carnegie, he took a course in “International Economics”, where he was exposed to economic ideas and problems. Later on, as a doctoral student at Princeton, his attention was drawn to the

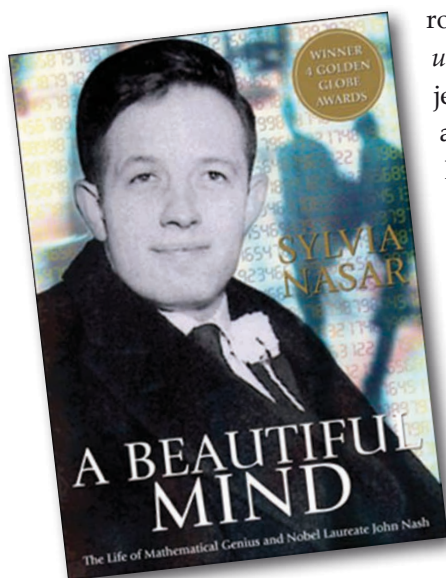


papers on game theory by two great authors, Von Neumann and Morgenstern. He started to develop his own ideas in this field, which, as it turned out later, led to the “non-cooperative games theory”. This theory got its final shape in the book *Nash Equilibrium*, published in 1950. The same year he published the book *Nash Bargaining Solution*, in which he presented a solution for two-person cooperative games. In the following years, he achieved a series of extraordinary results, both in game theory and economics, and in mathematics. He became famous even outside the professional circles, having gained the status of a “star”.

In 1956-1957 he was hired as a lecturer at M.I.T. (New York), where he met his future wife, Alicia, who had graduated as a physics major. At the age of thirty, at the peak of his brilliant career, Nash was held back by an illness. The diagnosis was terrifying – paranoid schizophrenia (obsession with secret intelligence agencies). The illness was

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roman *Blistavi um*, koji je kasnije adaptiran kao scenario za istoimeni holivudski film. Film je doživio veliki uspeh, kod publike i kritike. Neš je postao poznat

širom sveta i van stručnih krugova, a njegov život i rad fasciniraju ljude širom planete.

Naučni rad

Radovi Džona Neša predstavljaju istinsku prekretnicu u razvoju teorije igara. Čuvena knjiga Fon Nojmana i Morgenšterna *Teorija igara i ekonomsko ponašanje* bila je osnovni podsticaj njegovom proučavanju problematike teorije igara. Sledeći podsticaj bila je ekonomija jer je Neš, zahvaljujući jednom kursu o međunarodnoj ekonomiji, uočio osnovne ekonomske probleme i shvatio logiku na kojoj se zasnivaju ekonomski modeli. Zahvaljujući tome uspešno je razvio igre pregovaranja.

U novembru 1949. godine Neš je u Nacionalnoj akademiji nauka objavio kratak tekst koji predstavlja opštu definiciju ravnoteže za igru u normalnoj formi. U radu iz 1951. dokazuje postojanje ravnoteže u igrama u kojima učestvuju (n) igrača. Dokaz je zasnovan na Brauerovoj teoriji o fiksnoj tački. Ona je nazvana Nešova ravnoteža. Kako se ovim područjem bavio i francuski matematičar Kurnoa, pri analizi ravnoteže duopola koristi se i termin Kurnoa-Nešova ravnoteža. Dve godine kasnije, Neš je objavio rad u kojem obrazlaže način svođenja kooperativnih igara na nekooperativne igre. Ovaj rad je doprineo kompletiranju opšte metodologije teorije igara: Fon Nojmanov model igara u normalnoj formi i Nešov koncept ravnoteže u nekooperativnim igrama.

Nešova ravnoteža može se interpretirati na

dva načina:

1. Prvi polazi od pretpostavke o racionalnom i potpuno obaveštenom igraču. Koncept ravnoteže Fon Nojmana i Neša zasniva se na pronalaženju odgovora na pitanje kako bi trebalo da izgleda racionalno ponašanje igrača. Pošli su od stava da racionalno predviđanje kod svakog igrača treba da bude zasnovano na jedinstvenim kriterijumima. Odnosno, da su igrači sposobni da, s obzirom na poznatu strukturu igre, predvide racionalno ponašanje njihovih protivnika.
2. Drugi se zasniva na tzv. masovnoj akciji. U doktorskoj tezi Neš je dokazivao da pretpostavka o strogoj racionalnosti igrača nije neophodna za opravdanje koncepta ravnoteže. On je uveo i interpretaciju dolaska do ravnoteže masovnom akcijom.

Nešov doprinos razvoju teorije igara je ogroman. Zapravo, svojim radovima doprineo je formiranju opšteg okvira za teoriju igara, odnosno uveo je neke termine i postupke koji će postati standardni u savremenom rečniku teorije igara. Nešova ravnoteža predstavlja, po rečima Roberta Aumana, bez sumnje najčešće upotrebljavan teorijski koncept u ekonomiji. Koncept je doživio primenu u brojnim oblastima ekonomske nauke: teoriji oligopola, analizi ulaska i izlaska iz grane, analizi tržišne ravnoteže, kolektivnom pregovaranju, principal - agent analizi, javnim dobrima, obrazovanju, sankcijama i sl. Majerson smatra da Nešova teorija nekooperativnih igara može da se posmatra kao jedan od najznačajnijih intelektualnih postignuća u proteklom veku, a da Nešova ravnoteža ima isti značaj kao i otkriće DNK.

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particularly intense in early 1959, at the time when Alicia was pregnant. She did her best to help him, but Nash blamed her for a long time for having put him in medical treatment, which was the main reason for the dissolution of their marriage. Nash quit his job and spent the following two decades fighting his illness. After his aimless journeys across Europe and the USA, he finally returned to Princeton, where he soon got the nickname “Phantom of Fine Hall”. In early 1980s, the illness started to subside, and Nash went back to work. He re-established friendly relations with Alicia, with whom he has a son John Charles Martin Nash, and some times later they even renewed their marriage vows. In fact, Nash managed to merge “his insanity” with his normal life, i.e. to live with his illness in an “ultra-logical level”. This huge endeavour came as a result of the power of his genius. Inspired by Nash’s life, Sylvia Nasar wrote a novel *A Beautiful Mind*, which was later adapted as a script for a Hollywood movie of the same title. The movie was a huge success, well received by both the audience and the critics. Nash became famous worldwide, even outside professional circles, and his life and work continue to fascinate people all around the globe.

Scientific Work

The works of John Nash are a real turning point in the development of game theory. The famous book by Von Neumann and Morgenstern *Theory of Games and Economic Behaviour* was the main incentive for his studying of issues related to game theory. Another incentive was economics itself, given that Nash, after a course in international economics, spotted the main economic problems and understood the logics on which economics models are based. It was thanks to this that he successfully developed the bargaining games.

In November 1949 Nash published a brief text at the National Academy of Sciences, presenting the general definition of equilibrium in normal form games. In his 1951 paper he proved the existence of equilibrium in n-person games. The proof was based on Brauer’s fixed-point theorem. This equilibrium was called Nash equilibrium. Given that the French

mathematician Cournot also dealt with this field, the term Cournot-Nash equilibrium is used in the analysis of duopoly equilibrium. Two years later, Nash published a paper in which he explained the way to reduce cooperative games to non-cooperative games. This paper contributed to the completion of general methodology in game theory, including Von Neumann’s model for normal form games and Nash’s equilibrium concept for non-cooperative games.

Nash equilibrium can be interpreted in two ways:

1. The first starts from the assumption about a rational and fully informed player. Von Neumann’s and Nash’s equilibrium concept is based on finding the answer to the question what a player’s rational behaviour should look like. They started from the position that rational anticipation by each player should be based on uniform criteria. In other words, the players should be capable, given the known structure of the game, to anticipate rational behaviour of their opponents.
2. The second is based on the so-called mass action. In his doctoral thesis, Nash proved that the assumption about the strict rationality of a player is not necessary to justify the equilibrium concept. He also introduced the interpretation of reaching equilibrium by means of mass action.

Nash’s contribution to the development of game theory is huge. In fact, his works have facilitated the formation of the general framework for game theory, by introducing some terms and procedures that have become standard in the contemporary jargon of game theory. According to Robert Aumann, Nash equilibrium is indisputably the most frequently used theoretical concept in economics. This concept has been implemented in numerous fields of economic science: oligopoly theory, analysis of branch entries/exits, analysis of market equilibrium, collective bargaining, principal-agent analysis, public welfare, education, sanctions, etc. Myerson believes that Nash’s theory of non-cooperative games can be seen as one of the most significant intellectual achievements in the past century, whereas the so-called Nash equilibrium can be said to bear the same importance as the discovery of DNA.