Brain Drain:

In a Game theoretical Model

Comprehensive analysis and review externalities of Brain Drain through Game Theory

Vaani Garg- 1265, Section 1, Second Year

Submitted to Professor Animesh Naskar

Hansraj College, University of Delhi

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ABSTRACT

Brain Drain is "the movement of highly skilled and qualified people to a country where they can work in better conditions and earn more money". A brain drain is usually regarded as an economic cost, since emigrants usually take with them the value of their higher education and training sponsored by the Government.

The Government of India estimated that there are 30 million Indian human resources who are working for the developed countries are highly educated and skilled and even though this has a positive impact on our economy in the short run, it is meager for our developing country.

India cannot afford an exodus of highly valued professionals since this leads to a detrimental long term effect where the home country is deprived of reaping the benefits from the very same human asset it has invested in. Therefore this paper will research deeper on this issue through ***game theoretical*** *aspects along with the* ***associated externalities.***

Keywords: Brain Drain, Game Theory, Externalities, Skilled Professionals

Author : Vaani Garg

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RESEARCH METHODOLOGY

Brain drain refers to the emigration of skilled and talented individuals from one country to another, which can lead to a loss of valuable human capital, intellectual property, and economic growth potential. We are going to study this topic from the perspective of the home and destination countries which will form as the players for our game theoretical model.

The study is game theoretical in nature and attempts to get to study Brain Drain through it and uncover the externalities and balanced approach of the countries.

This study is based on an assessment of key literature of secondary data. Sources such as independent studies, technical journals, news articles, research publications, and various websites were referred to for administering an immense amount of data mining. Most recent research studies/e-databases available on Google Scholar, ProQuest, etc. have been selected for the purpose of review.

LITERATURE REVIEW

The literature on brain drain is vast and multifaceted. Some studies suggest that brain drain can be a positive force for both the sending and receiving countries. For example, brain drain can lead to increased remittances and technology transfer, as well as the development of global networks of highly skilled professionals. Other studies, however, argue that brain drain can have significant negative consequences, such as a loss of talent and expertise, brain waste, and reduced innovation in the sending countries.

Previous research on brain drain and game theory has focused on modeling the decision-making processes of skilled workers, as well as the policy implications of brain drain for both the home and destination countries. Concepts such as Nash equilibrium, mixed strategies, and repeated games have been used to analyze the strategic interactions between skilled workers and policymakers. For example, some studies have shown that offering incentives to skilled workers to stay in their home country (such as higher salaries or better working conditions) can be an effective way to reduce brain drain.

With all of this information, we will condense it to a game theoretical model, study the balanced approach through the Nash equilibrium and as well as focus on the externalities.

WHY IS BRAIN DRAIN A CONCERN?

This concern is that valuable human capital from high end Indian professional institutions like IITs,IIMs and top ranked national universities are generated with the money collected from the taxpayers but it is very unfortunate that these professionals and skilled human resource are permitted to work for the development of developed countries without the home country reaping the long term benefits from the very same human asset. In the entirety it is not wrong for our citizens to work abroad. There are various benefits which come across such as

- Cultural exchange and strengthening of international ties
- Income from abroad

However these benefits outweigh the long term costs.Since India is a developing country and it is becoming a major supplier of human capital for the advanced economies, this issue should be more researched upon and solutions must be enacted upon.

WHAT CAUSES BRAIN DRAIN?

- *Better career opportunities*: Many skilled workers migrate to other countries in search of better job prospects, higher salaries, and better working conditions. They may feel that their skills and qualifications are not recognized or rewarded in their home country, and may seek better opportunities elsewhere.

- *Political instability and economic hardship*: Political instability, economic hardship, and social unrest in the home country can be a significant push factor for skilled workers to migrate to more stable and prosperous countries.

- *Lack of investment and funding*: Some countries may not have the necessary infrastructure, resources, and funding to support research and development in certain industries. This can lead to a lack of opportunities for skilled workers and drive them to seek employment in other countries.

- *Cultural and social factors*: Cultural and social factors can also contribute to brain drain. Skilled workers may feel that their lifestyle and values are not aligned with the dominant culture in their home country, and may seek a more inclusive and accepting environment elsewhere.

- *Better education and healthcare facilities*: Skilled workers with families may choose to migrate to countries with better education and healthcare facilities for their children and family members.

GAME THEORETICAL MODEL

The game theory model for brain drain can be represented using a two-player game, where Player 1 represents the home country and Player 2 represents the destination country.
Each player has two possible strategies: to stay in their current country or to accept the skilled workers. The payoffs for each player depend on the combination of strategies chosen by both players. The payoff matrix for the game is as follows:

	Accept	**Not Accept**
Retained	**2,2**	4,0
Emigrate	0,4	0,0

Assumptions

- Player 1 is the Home Country which has the option of retaining its skilled workers or emigrating. If the skilled workers choose to stay then it is a positive impact for the home country whereas if the skilled workers choose to emigrate then a negative.
- Player 2- represents the destination country. It is looking for skilled laborers. If it accepts then the destination country will benefit and if it does not accept the

citizens then the destination country faces shortage of workers hence a negative impact.

-Case 1 -(Retained, Accept), (2,2)

If both players choose to retain and accept they receive their 2,2, The home country will benefit from retaining most of its skilled laborers and even if some emigrate, it is going to benefit the destination country, This is a balanced approach and is the nash equilibrium as if either of the players deviate then the countries can lose the skilled workers. Therefore there is no incentive for both the players to deviate.
The flow of skilled workers is present but limited. This is a case where there will be income from abroad for the home country as well as in house generation of value through retention of skilled workers.

-Case 2 - (Retained, Not Accept), (4,0)

If Skilled are retained however if they are not accepted, then the home country can benefit the most as its skilled workforce will contribute to the home country. However, the destination country can suffer since the industries will not benefit from the skilled emigrants. Hence this payoff will be (4,0). The destination country can deviate through accepting the workers. This is not the Nash equilibrium.

-Case 3- (Emigrate, Accept),(0,4)

The skilled workers are not retained by the home country hence leads to negative impact since it can not enjoy the benefits of its skilled workforce. The destination country however will benefit by having an influx of skilled workers to boost its economy. This is not a nash equilibrium as the home country can deviate by retaining its workers.

-Case 4 - (Emigrate, Not Accept), (0,0)

Here both the players are at loss since neither can the home country retain its workers and neither can the destination country employ them. Therefore there is no productive value for both the players here. In fact the skill of the workers will be a waste since it is contributing to no value generation. This is definitely not a Nash equilibrium since both of the players have the incentive to change their strategies in order to get a higher payoff.

Results and analysis

The Nash equilibrium for this game is (2,2,), where both players choose to Retain and Accept . This outcome is a balanced approach for both for the home and destination country, as it results in both profiting from the flow of skilled workers. The home country retains some, get the former income from abroad and the existing retained workers. Similarity, the destination country benefits since it gets the skilled workers to perform in its economy.

Therefore, policy makers in the home country may want to consider offering incentives for skilled workers to stay, such as higher salaries or opportunities for professional development. Alternatively, the destination country could implement policies that limit the number of skilled workers who are allowed to emigrate, such as visa quotas or residency requirements.

EXTERNALITIES

POSITIVE

- *Knowledge and skills transfer*: When skilled workers migrate to other countries, they bring their knowledge and skills with them, which can benefit the host country's economy. They can share their expertise and experience with local workers and transfer new technologies and methods.

- *Remittance inflow*: Highly skilled workers who migrate to other countries often send money back home to their families, which can have a positive impact on the source country's economy.

- *Improvement in education and training*: Brain drain can lead to an increase in demand for higher education and training in the source country, as individuals seek to improve their skills and qualifications to compete in the global labor market.

NEGATIVE

- *Loss of human capital:* Brain drain results in the loss of highly skilled and talented individuals from the source country, which can result in a shortage of skilled labor and a decrease in the country's overall human capital.

- *Reduction in innovation and productivity*: Brain drain can reduce innovation and productivity in the source country, as highly skilled workers are more likely to engage in research and development activities that can lead to new products and services.

- *Economic and social costs*: Brain drain can lead to a loss of government revenue and taxes, as highly skilled workers are more likely to earn higher salaries in their new countries of residence. Additionally, brain drain can have a negative impact on the social fabric of the source country, as families are separated and communities are disrupted.

CONCLUSION

In conclusion, brain drain is not to be blamed at its entirety. As an individual it is natural to seek better opportunities outside one's home country, however one should remember that its country has spent its valuable resources to craft them into skilled workers, hence it is equally important for those citizens to give the benefit of their skills to their home

countries . However, at the same time , the home country should improve its educational and job market opportunities to incentivise its skilled workers to not leave the country so that they can contribute to its economy. If such policies are not crafted then there can be a huge brain drain from any country.

We studied through the game theoretical model that it is best to take up a balanced approach where there is a balanced retention rate by the home country and acceptance rate by the destination country too. There should be a proper framework for understanding the incentives and outcomes of brain drain. The model presented in this project highlighted the potential benefits and costs of skilled worker migration, as well as the importance of policy interventions to encourage skilled workers to stay in their home country. Overall, the game theoretical model for brain drain highlights the importance of strategic thinking and cooperation between countries to achieve mutually beneficial outcomes. Along with this, various externalities and causes of brain drain have been highlighted.

The crux is that a policy framework can make or break the workforce of skilled laborers. There should be enough incentivisation such that none of the countries or players deviate from the nash equilibrium of a balanced approach. Every country should invest in its labor force because education and human development are the greatest ways to increase the productive value of an economy. However such costs on skill transformation can also be benefited when the countries have a suitable policy framework to retain its workforce;

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