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Abstract

Applying a simple two-country model, we find that under mutual reaction by each country regarding the productive quality of migrants, the host country may be able to reduce the total number of illegal immigrants by changing the restriction policy toward illegal immigration. On the other hand, the host country has no effective policy method to improve the average quality of immigrants, but the relative population increase in the source country may realize this improvement.

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1. Introduction

Brander and Spencer's (1985) pioneering study provided a new framework of trade theory and proved that an optimal level of subsidy by one government to a domestic monopolistic firm that is competing with a foreign rival firm in the market of a third country can enhance domestic national welfare. Several extension studies on strategic trade policies have been accumulated since then, and this subject has become one of the main streams of trade theorists' research topics since the 1990s.

However, commonly intended to maximize economic welfare of the domestic economy, U.S. President D. Trump adopted a completely different trade policy. In 2018, he started a trade war against China. He unilaterally raised tariffs and set other trade barriers against China with the goal of forcing it to make changes to what the U.S. says are "unfair trade practices." He insisted that the targets that should be defeated are growing trade deficit, the theft of intellectual property, and the forced transfer of American technology to China. Countermeasures were immediately taken to cope with America's raising of duties, and these two countries have continued and escalated mutual hostilities since then. Academic studies have just started to analyze this current and ongoing topic. Crowley (2019) constructed a narrative of the US–China trade war as the outgrowth of long-brewing tensions in the multilateral trading system. She concluded that the prospects for the future of the multilateral trading system look grim, the list of potentially effective avenues for achieving substantive reform is short, and it will require concerted efforts and serious compromises. Amiti et al. (2019a) explored the negative impacts of the Trump administration's trade policy on the prices and welfare of U.S. residents. Amiti et al. (2019b) also empirically determined that U.S. tariffs continue to be almost entirely borne by U.S. firms and consumers.

The trade war is just one aspect of the current inward-looking American international economic policy. Trump started to introduce restricting immigration policies just after his inauguration. In 2017, he banned people from several countries, including Iran and Iraq, from entering the U.S. He also insisted on constructing a wall at the border between the U.S. and Mexico as he had publicly promised during the election campaign. This coincides with the EU's current immigration policy after the migration crisis in 2015. Both cases show that developed countries no longer intend to receive unskilled workers. On the other hand, both the U.S. and EU welcome highly skilled workers, such as medical doctors and scientists.

Remembering that Trump continuously emphasized "America first," these series of strategies surely do not consider improving world welfare but are just examples of precedence of the domestic economy. These strategies caused several negative distortions and inhumane results. Furthermore, different from an international trade war in which China can introduce effective reaction policy, in the case of international migration, there are almost no countermeasures for the source developing country, such as Mexico. All they can do is to appeal against such unfairness and try to place this topic on the agenda of related international organizations. At this point, trade war may be regarded as essentially bilateral, while friction due to migration is more unilateral. The source country of migration must endure unfair one-sided treatment, which currently seems to be a common understanding.

However, is this really true? The source country supplies not only unskilled workers who are sometimes prohibited legal entry by the host country but also highly skilled ones who are welcomed and contribute to the economic prosperity of the host country. For a developing country, outflow of these educated workers, such as medical doctors, implies outflow of the sunk cost of education at least partially financed by national tax revenue and thus, this "brain drain" surely causes economic loss. Although these skilled workers prefer to stay in a civilized, clean, and rich country where their income should be much higher than that in their home country, why does the government of the source country hesitate to stop the brain drain as a counter method to the attacking host country? Of course, to prevent trainees from moving abroad, many developing countries impose mandatory service periods such as those implemented in the Philippines. Following the Economist Intelligence Unit (2017), Thailand has a system whereby public medical school graduates are required to work in the country for at least three years, with an added incentive of US$250 per month for those who do not practice privately. Vietnam and Mongolia all have mandatory rural service as a prerequisite for a post-graduate medical degree, while India is discussing a similar idea.[1] Treating these restriction periods to prohibit the brain drain flexibly may be a good trump card for a developed country.

The justification for restricting the brain drain has been discussed in the academic field. Focusing on the host country side, Oberman (2013) investigated how immigration restrictions could help restrict the brain drain of skilled workers from poor countries; his

[1] On the other hand, China adopted an "overseas human resources recall policy" and accomplished certain results. Following the announcement by the Ministry of Education of China, the total number of international students from 1978 to 2018 was 5,857,100. Among these, 3,651,400 have returned to China. This can be counted as another success story regarding recovery from the loss of brain drain.

conclusion was negative. He concluded that for restrictions to be justified, a series of demanding conditions must be satisfied. On the other hand, Brock and Blake (2015) asserted the necessity of restrictions. The authors argued that all of these state policies were based on the assumption that individuals were under obligation to contribute to and promote the institutions of justice in their society. This obligation could be explained by the foundational role of social institutions in the realization of social justice. To protect institutions of social justice, they proposed that the rights of some to exit their countries of origin should be tied to duties of justice that need to be satisfied before benefiting from a right to exit. Particularly in the special case of access to health care, states may be justified in restricting liberty rights.

We construct a very simple economic model of the conflict of migration between two countries. The main purpose is to theoretically examine the effects of immigration policies under mutual strategic reactions, that is, the source country controls the brain drain while the host country controls the minimum skill level of legal immigration. It should be noted that in our model, we reflect the current situation in which both countries want to retain high-skilled workers who can contribute to economic promotion and improve per-capita national income, while low-skilled workers are not welcomed. There are no related theoretical studies that focused on the current topic of "scrambling for" and "palming off" workers between the two countries.

We found that the host country's introduction of stricter restriction policies toward illegal immigration that reduces the probability of success of illegal entry also implies that the host country welcomes former illegal lower productivity holders as legal workers. We also found that under certain conditions, the source country adopts a reaction policy that causes more restricted control of brain drain. In the above case, we can assert that the total number of illegal immigrants will surely decrease but the effect on the average quality of immigrants is not certain. Moreover, under certain conditions, a relative increase in population in the developing source country may contribute to the improvement of the average quality of immigrants in the host country.

The remainder of this paper is organized as follows. We present our model in section 2. Section 3 is devoted to the analysis, and concluding remarks are presented in section 4.

2. The Model

Assume that there are two countries in the world. Country A is a developed country like Italy or Japan, while Country B is a developing country like Albania or the Philippines. To focus

on international labor mobility, we assume that both countries produce the same single good and that there is no international trade. The primary factors of production are labor and capital. We also assume that there is no difference in production technology.

Supplying labor activity, all residents in both countries contribute to production. We assume the diversification of their skill, which causes an efficiency gap between workers. We also consider that a constant number of individuals is sufficiently large so that we may treat them as a continuum of individuals. Let $i \in [0,1]$ be the index of individuals and denote a worker's productivity. Index 1 (0) indicates that the highest (lowest) skill holder and their productivity is equal to 1 (0). Workers with different productivities are uniformly distributed. In autarky, we normalize the total real number of workers in Country B, L^B, as unity and total efficiency initial endowment of workers, L_E^B, can be expressed 1/2. In Country A, the total real number of workers, L^A, is α. Thus, the total efficiency stock of workers, L_E^A, is $\alpha / 2$.

The production function of each country is an ordinary Cobb-Douglas type, which can be expressed as

$$X^A = (K^A)^{\frac{1}{2}} (L_E^A)^{\frac{1}{2}}, \tag{1}$$

$$X^B = (K^B)^{\frac{1}{2}} (L_E^B)^{\frac{1}{2}}, \tag{2}$$

where X^A and X^B are outputs and K^A and K^B are capital endowments in Countries A and B, respectively. In autarky, we assume

$$K^A / L_E^A > K^B / L_E^B, \tag{3}$$

This implies that Country A is capital abundant, and under the assumption of perfect competition, this condition could cause international migration from Country B to Country A due to the wage gap.

We consider the case in which each country intends to optimally choose the amount and quality of migrants to maximize its per-capita national income. In each country, we

consider that there is no pure investor and all of the residents supply labor force. Thus, capital is owned by some of the rich residents with relatively high productivity and the total number of population in Country A (B) is α (1), which is equal to labor endowment.

Country B (the source country) chooses the lowest index i_1 that is prohibited from migrating. In the usual case, the developing labor-abundant country welcomes the outflow of labor. In our model, as each worker has different productivity, to maintain the so called "brain" of the country, Country B prohibits the emigration of higher productivity holders. Thus, a worker whose index is $i \in [i_1, 1]$ stays in Country B and one whose index is $i \in [0, i_1]$ intends to migrate with permission from the source country. To simplify our analysis, we assume that the government of Country B can enforce higher productivity holders not to migrate with no cost. As all of the capital in Country B is owned by higher productivity holders, international migration will not cause any capital outflow.

Country A (the host country) chooses the lowest index i_0 that permits legal immigration. We assume $i_0 < i_1$ that individuals $i \in [i_0, i_1]$ can migrate from Country B to Country A legally, but individuals $i \in [0, i_0]$ can migrate only illegal. Country A also chooses enforcement policies to exclude illegal lower productivity workers by using public servants. Stronger restriction policies are adopted, and a larger number of public servants is necessary, which reduces the number of workers employed in the production sector. Let $e\,(0 < e < 1)$ denote the probability of success of entry for illegal immigrants from Country B. If there is no restriction policy with no public servant, $e = 1$ and efficiency stock of labor for production in Country A is $\alpha / 2$. Here, we assume that to fulfill a perfect restriction policy, $e = 0$, it is necessary to employ all workers in Country A as public servants. Thus, in this case, the efficiency stock of labor for production is null. Considering the above situation, we reasonably define the efficiency stock of labor for production as a function of e and, to simplify our analysis, it can be expressed as $\alpha e/2$.

The real number of foreign workers in Country A can be expressed as $i_1 - (1-e)i_0$ and the efficiency stock of foreign workers can also be expressed as $[i_1^2 - (1-e)i_0^2]/2$.

Exogenously given e, the number of public servants or the level of disclosure, Country

B chooses the optimal level of i_1 regarding i_0 as exogenously given just for reaction toward the strategy of Country A. Country A chooses the optimal level of i_0 regarding i_1 as exogenously given just for reaction toward the strategy of Country B. Then, the Nash equilibrium (i_0^*, i_1^*) can be obtained.

It is widely known that in the case of homogeneous individuals, free migration is the most beneficial to maximize world GDP (the sum of GDP of both countries) in a simple 2-country 1-good 2-factor McDougal model. However, in this case, we consider that each country focuses on whether a worker's migration will increase or decrease the average national income. Even though workers are paid depending on their productivity and some of them gain capital income, the government must redistribute residents' aggregate income more equally through tax and social insurance policies. For this reason, the government prefers workers with higher productivity who can contribute to an increase in per-capita income.

Let $\tilde{L}^A, \tilde{L}^B, \tilde{L}_E^A$ and $\tilde{L}_E^B$ be the real number of workers (residents) in Countries A and B and the efficiency stock of labor after migration, respectively. Thus, we have,

$$\tilde{L}^A = \alpha + i_1 - (1-e)i_0, \tag{4}$$

$$\tilde{L}^B = 1 - i_1 + (1-e)i_0, \tag{5}$$

$$\tilde{L}_E^A = \frac{1}{2}[\alpha e + i_1^2 - (1-e)i_0^2], \tag{6}$$

$$\tilde{L}_E^B = \frac{1}{2}[1 - i_1^2 + (1-e)i_0^2], \tag{7}$$

3. Analysis

A Nash equilibrium solution can be obtained by maximizing the per-capita national income of Countries A and B with respect to i_0 and i_1, that is, $\partial(\tilde{X}^A/\tilde{L}^A)/\partial i_0 = 0$ and

$\partial(\tilde{X}^B/\tilde{L}^B)/\partial i_1 = 0$, respectively, where $\tilde{X}^A = (K^A)^{\frac{1}{2}}(\tilde{L}_E^A)^{\frac{1}{2}}$ and $\tilde{X}^B = (K^B)^{\frac{1}{2}}(\tilde{L}_E^B)^{\frac{1}{2}}$. Thus, we have the following two first-order conditions:

$$\alpha e + i_1^2 - (\alpha + i_1)i_0 = 0, \tag{8}$$

$$i_1 - 1 + (1-e)(i_1 - i_0)i_0 = 0. \tag{9}$$

Total differentiation of (8) and (9) yields

$$\begin{bmatrix} -(\alpha + i_1) & 2i_1 - i_0 \\ (1-e)(i_1 - 2i_0) & (1-e)i_0 + 1 \end{bmatrix} \begin{bmatrix} di_0 \\ di_1 \end{bmatrix} = \begin{bmatrix} -\alpha \\ i_0(i_1 - i_0) \end{bmatrix} de + \begin{bmatrix} i_0 - e \\ 0 \end{bmatrix} d\alpha. \tag{10}$$

and determinant of the LHS matrix of (10) is $\Delta = -\alpha - i_1 - (1-e)[\alpha i_0 + 2(i_1 - i_0)^2] < 0$.

3.1 The effects of strict restriction policy toward illegal immigration

From (10), we have

$$\Delta \frac{di_0}{de} = \begin{vmatrix} -\alpha & 2i_1 - i_0 \\ i_0(i_1 - i_0) & (1-e)i_0 + 1 \end{vmatrix} = -\alpha[(1-e)i_0 + 1] - i_0(2i_1 - i_0)(i_1 - i_0) < 0, \tag{11}$$

$$\Delta \frac{di_1}{de} = \begin{vmatrix} -(\alpha + i_1) & -\alpha \\ (1-e)(-2i_0 + i_1) & i_0(i_1 - i_0) \end{vmatrix} = \alpha(1-e)(i_1 - 2i_0) - i_0(i_1 - i_0)(\alpha + i_1). \tag{12}$$

The negative sign of (11) implies $di_0/de > 0$, that is, introduction of a strict restriction policy toward illegal immigration always reduces the minimum productivity index of legal migration from Country B to Country A in equilibrium. The sign of (12) is not clear. In the case that restriction policy toward illegal immigration is almost free entry, that is, e is close to unity, and/or the size of Country A is sufficiently small compared with Country B, that is, α is close to null, we can assert that the sign of (12) is negative. In addition, in the case that

$i_1 < 2i_0$ in equilibrium, (12) should be negative in sign. In the above cases, we can assert $di_1/de > 0$, that is, increasing restriction toward illegal immigration by Country A causes strict restriction of high productivity holders' brain drain as a reaction by source Country B.

We now have the following proposition.

PROPOSITION 1

Under mutual strategic migration reactions between the host and source countries, the host country's introduction of stricter restriction policies toward illegal immigration will cause reactions by the source country. Due to the increased employment of public servants, the host country can change the status of relatively lower productivity workers from legal to illegal in equilibrium. On the other hand, under certain conditions, outflow of higher productivity workers, that is, "brain drain," will be more restricted. As a result, the total number of illegal immigrants in the host country will surely decrease.

We find that there is a possibility that strict restriction policies can reduce the total number of illegal immigrants because of decreasing i_0 and e, while a change in the average productivity of the host country in that case is not clear. In other words, restricting the illegal entry of lower productivity workers may not contribute to the improvement of the average quality of total workers in the host country.

3.2 The effect of increasing population in the source country.

As we consider the case of international migration from a developing country to a developed country, a population increase in the source country (or a population decrease in the host country) is a realistic scenario. Here, we can examine this by analyzing the effects caused by a decrease in α, the relative population magnitude of the host country to the source country. From (10), we have

$$\begin{aligned} \Delta \frac{di_0}{d\alpha} &= \begin{vmatrix} i_0 - e & 2i_1 - i_0 \\ 0 & (1-e)i_0 + 1 \end{vmatrix} = (i_0 - e)[(1-e)i_0 + 1] \\ &= i_0 e^2 - [i_0^2 + i_0 + 1]e + i_0 + i_0^2, \end{aligned} \tag{13}$$

$$\Delta \frac{di_1}{d\alpha} = \begin{vmatrix} -(\alpha + i_1) & i_0 - e \\ (1-e)(-2i_0 + i_1) & 0 \end{vmatrix} = (i_1 - 2i_0)(1-e)(i_0 - e)$$
$$= (i_1 - 2i_0)[-e^2 + (1+i_0)e - i_0]. \tag{14}$$

The sign of (13) is not clear. If a restriction policy toward illegal immigration is almost free entrance, that is, e is close to unity, the sign of (13) is negative, that is, $di_0/d\alpha > 0$. On the other hand, if such a restriction policy is already sufficiently strict, that is, e is close to null, we can assert that the sign of (13) is positive, that is, $di_0/d\alpha < 0$. In a general case, if $e > i_0$ ($e < i_0$) in equilibrium, we can assert that the sign of (13) is negative (positive), that is, $di_0/d\alpha > (<)0$, respectively.

The sign of (14) is also unclear. If $i_1 < 2i_0$ $(i_1 > 2i_0)$ and a restriction policy toward illegal immigration is already sufficiently strict to satisfy $e < i_0$ in equilibrium, the sign of (14) is negative (positive), that is, $di_1/d\alpha > (<)0$, respectively. On the other hand, in the case where $i_1 < 2i_0$ $(i_1 > 2i_0)$ and a restriction policy toward illegal immigration is quite loose to satisfy $e > i_0$ in equilibrium, we can assert that the sign of (14) is positive (negative), that is, $di_1/d\alpha < (>)0$.

Summarizing the above results, under the condition of $i_1 > 2i_0$, which implies that each country's strategy toward the productive quality of migrants is relatively loose, if an initial restriction policy on illegal immigrants' entrance is sufficiently strict to satisfy $e < i_0$, increasing labor endowment of the source country, that is, a decrease in α, will enhance the average quality of workers in the host country due to the increasing i_1 and i_0. On the other

hand, if an initial restriction policy is sufficiently loose to satisfy $e > i_0$, increasing labor endowment of the home country, that is, a decrease in α, will reduce the average quality of workers in the host country.

We now have the following proposition.

PROPOSITION 2

Under mutual strategic migration reactions between the host and source countries, if each country's strategy toward the productive quality of migrants is relatively loose and the restriction policy toward illegal immigration is strict to satisfy $i_1 / 2 > i_0 > e$, then increasing the population of the source country will enhance the average quality of labor in the host country in equilibrium. On the other hand, if the initial restriction policy is sufficiently loose to satisfy $i_1 > 2i_0$ and $i_0 < e$, the result may be opposite.

It should be noted that in the above case with improving average quality of foreign workers, the number of illegal immigrants may increase. This is because, even though i_0 increased, the increased total population of the source country will enhance the total number of illegal immigrants of each index holder.

4. Concluding Remarks

Applying the aforementioned simple two-country model, we find that under mutual reaction by each country about the productive quality of migrants, the host country may be able to reduce the total number of illegal immigrants by changing the restriction policy toward illegal immigration. On the other hand, to improve the average quality of immigrants, the host country has no effective policy method, but the relative population increase in the source country may realize this improvement.

The remaining subjects are as follows. First, we consider the restriction policy of the host country with exogenous employment of public servants. While it may be reasonable to consider another scenario in which the host country optimally chooses e to maximize per-capita income at the first stage and after that, given e, the Nash equilibrium of i_1 and i_0

will be determined by both countries. Second, the objective function of each country could be replaced by maximizing the average income of domestic people that excludes migrants. For the host country, this assumption may be realistic. Third, it may be better to consider international trade and examine the effects of trade policies that may change the decision making of migrants.

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