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The Effects of Deregulation of the Immigration Policy on Study Migrants' Human Capital Formation*

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This study attempts to clarify whether deregulated immigration policy is compatible with the study migrants' acceptance policies. In particular, this study analytically investigates how opening skilled and unskilled jobs to non-natives affects study migrants' human capital formation. This study shows that the deregulated immigration policy is compatible with the study migrants' acceptance policy. In other words, study migrants do not reduce the formation of skilled human capital, even if immigration policy is deregulated. This study provides theoretical support for simultaneously conducting the study migrants' acceptance policy and deregulated immigration policy.

JEL Classification: F22, J24, O15
Keywords: migration, study migrants' acceptance policy, immigration policy, skilled human capital, deregulation

1. INTRODUCTION

This study addresses the problem of study migrants' human capital formation under a deregulated immigration policy. In particular, this study investigates the effects of the deregulation of immigration policy on study migrants' skilled human capital formation analytically, assuming that skilled labour is traded in a frictional labour market.

Many countries suffer from an outflow of skilled workers and able students because workers and students go abroad to obtain better jobs or education. In addition, study migration tends to cause labour migration. However, better job opportunities abroad encourage workers and students to build larger human capital, and domestic human capital may increase as many of those who build larger human capital end up with non-migration. In many countries, the former effects are stronger

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than the latter effects, and as a result, they experience a net outflow of human capital, especially skilled human capital.

Countries enthusiastically imported skilled human capital to overcome this situation by implementing a skilled labour migrants' acceptance policy. They also implemented study migrants' acceptance policies to generate skilled human capital. Host countries provide international students with education and encourage them to remain in those countries after graduation as skilled workers. Countries implemented these two policies simultaneously, implicitly assuming that they were independent and compatible.

Moreover, countries suffered not only from skilled labour shortages but also from unskilled labour shortages. To fill the gap of unskilled labour, they relied on non-natives.

For this reason, some developed countries formally accepted unskilled labour migrants in addition to skilled ones. They also did not prevent the study migrants from taking unskilled jobs after completing their education. In other words, these countries deregulated immigration policy and attempted to fill the vacancies of skilled and unskilled jobs by employing non-natives.

The problem with such a deregulated immigration policy is whether the deregulation of immigration policy and the study migrants' acceptance policy are compatible. Countries can easily increase unskilled labour by relaxing labour migrants' acceptance policies. As mentioned, the study migrants' acceptance policy has been conducted to increase domestic skilled human capital, although this is not the sole objective. They usually do not try to increase unskilled labour by accepting study migrants. If the deregulation of immigration policies negatively affected the study migrants' human capital formation, their acceptance policy would not attain its primary objective. This would not complement the acceptance policy of skilled labour migrants. Therefore, it is meaningful and essential to show that the study migrants' acceptance policy is compatible with deregulated immigration policies for increasing domestic skilled human capital. This study does not directly deal with welfare, as discussed in the study on immigration policy by Phillips (2012) but focuses on migrants' skilled human capital formation under different immigration policies.

For this purpose, unlike other studies on migrants' human capital formation, this study introduces friction into the labour market of skilled migrants. The migration literature often assumes that labour is traded competitively, without friction. However, friction is more likely involved in the skilled labour market. A skilled migrant cannot easily find a firm that employs him, and a firm with a skilled migrant's job vacancy cannot find a skilled migrant to fill it immediately. This study utilises the search-matching framework introduced by Pissarides (2000) and other related studies.

This study shows that if unskilled job wages do not differ in the host country and migrants' home country, the sum of employed skilled human capital in the host country remains unchanged even if the immigration policy is deregulated. However, if unskilled job wages are higher in the host country than in the migrants' home country, it decreases by deregulating immigration policy. However, the host country can remedy this situation by increasing the number of study migrants and lowering unskilled job wages. Therefore, the deregulation of immigration policy and the study migrants' acceptance policy are compatible. In other words, we can deregulate immigration policy

and simultaneously accomplish the study migrants' acceptance policy's objective. This result is contrary to our intuition, according to which, by deregulating immigration policy, it becomes possible for study migrants to get jobs even if they did not build skilled human capital. For this reason, they likely lose their incentive to build skilled human capital by deregulation.

This study contributes to research on study and labour migrations by showing the compatibility of the study migrants' acceptance policy and the deregulated immigration policy. Another contribution is that this study provides host countries' governments with theoretical support to implement these two policies simultaneously.

The rest of the paper is structured as follows: Section 2 reviews the related literature. Section 3 builds a two-country model with study migration. Section 4 models how study migrants build human capital when they receive an education. Section 5 describes the skilled and unskilled labour markets and wage bargaining in the labour market of skilled migrants. Section 6 deals with study migrants' human capital formation under regulated and deregulated immigration policies. Section 7 clarifies the effects of the deregulation of immigration policy on the incentive of study migrants to build skilled human capital and the total employed skilled migrants' human capital in the host country. It also derives a policy that alleviates the adverse effects on their skilled human capital formation arising from deregulation and considers whether the host country can conduct the deregulated immigration policy and study migrants' acceptance policy consistently. Finally, section 8 provides concluding remarks.

2. LITERATURE REVIEW

This section reviews the literature on labour migration, study migration, and analyses of human capital formation under labour and study migrations. Of course, it is not exhaustive.

2.1. Labour Migration

An increasing number of workers are crossing borders. The International Labour Organization (ILO) (2021) estimated that the stock of international migrant workers was 169 million in 2019.

Labour migration has various effects. The labour-sending country reduces domestic human capital when workers emigrate. This argument goes back to those of Bhagwati and Hamada (1974) and Hamada and Bhagwati (1975). However, as Mountford (1997) and Stark et al. (1997) point out, the labour-sending country may also increase domestic human capital. Workers in labour-sending countries are encouraged to build skilled human capital, given the higher wages in foreign countries. If the former negative effect is stronger, the net change in domestic human capital is negative. We refer to this situation as a brain drain. However, the net change is positive if the latter positive effect is stronger. This situation is known as brain gain.

According to Beine et al. (2008), migration prospects positively affect human capital formation if countries have less human capital and low skilled migration rates. Beine et al. (2011) also found positive effects. In addition, Ngoma and Ismail (2013) found evidence of the beneficial effects of brain drains. According to them, it is true that brain drain causes leakage of human capital, but remittances can counterbalance it.

Marchiori et al. (2013) derived results suggesting the negative effects of emigration in the short and long run. Similarly, Docquier (2014) found that more countries among developing ones experienced brain drain rather than brain gain. Zhang and Lucey (2019) found that less developed countries are likely to lose highly educated workers. Abdulloev et al. (2020) demonstrated the possibility that the brain gain mechanism does not work.

Although the results are mixed, many countries experienced brain drain. For this reason, they introduced the skilled labour migrants' acceptance policy. However, it took much work to increase domestic skilled human capital.

This was not only because competition to receive skilled labour migrants was fierce among countries but also because labour migrants cannot fully transfer their human capital to host countries (Chiswick and Miller, 1992, 2009, 2010; Docquier and Rapoport, 2012; Basilio et al., 2017; Boyd and Tian, 2018). Of course, when exploring transferability, it must be considered in spatial contexts (Lulle et al., 2021).

2.2. Study Migration

The Organisation for Economic Co-operation and Development (OECD) (2021) estimated that the number of mobile students enrolled in tertiary education programs worldwide was 6.1 million in 2019.

Some countries have accepted international students to increase their domestic human capital (Kuptsch, 2006; Adnett, 2010; Grimm, 2019). The host countries provided study migrants with education and induced them to remain after education as workers so that study migrants could drive innovation and increase economic performance (OECD, 2021). They expect that study migrants will turn into labour migrants. Shimada (2021) considered how the host country can effectively increase study migrants' human capital. Also, study migrants may negatively affect natives' human capital formation by disturbing native students' education. However, Shimada (2022b) showed that the host country can turn the brain drain into a brain gain by manipulating the number of study migrants.

Study migration also benefits the study migrants themselves. Many students go abroad to receive an education seeking economic benefits. According to Oosterbeek and Webbink (2006), Di Pietro (2012, 2015, 2021), Burmann and Delius (2017), Iriondo (2020), and d'Hombres and Schnepf (2021), studying abroad tends to increase employment probability. In contrast, Wiers-Jenssen and Støren (2021) found tiny differences in labour market outcomes between graduates with and without study migration.

Therefore, both host countries and study migrants pursue economic benefits from study migration, expecting the transition of study migrants into labour migrants. This suggests that study migration is closely related to labour migration. In this sense, study migration cannot be analysed separately from labour migration.

2.3. Analyses of Labour and Study Migrations

Even with their close connection, study and labour migrations have been mostly analysed independently, except for some studies. Bergerhoff et al. (2013) combined these migrations in an identical dynamic context and examined the effects of the study migrants' acceptance policy on the host country's human capital. Brezis (2016, 2019) analysed individuals' decisions on where to get an education and where to work and showed that brain drain can be an optimal solution. Shimada (2019) examined how labour-sending countries should manipulate education subsidies to prevent brain drain using a two-period model. Shimada (2022a, 2022c) dealt with the problem of study migrants' human capital formation by assuming study and labour migrations in a single model with non-frictional labour markets.

Labour migration tended to be analysed in the competitive framework. For example, Borjas (2003), Card (2001, 2005, 2009), Ottaviano and Peri (2012) and Lee and Park (2021) examined the effects of immigration using a standard neoclassical labour supply and demand framework.

However, unlike natives, non-natives do not quickly encounter firms that employ them, especially if they are skilled. It is also difficult for firms to find skilled non-natives to fill vacancies. These facts suggest that a frictional framework is more suitable than a competitive one for analysis.

Actually, some studies employed a search-matching framework. To cite a few examples, Ortega (2000) showed the existence of multiple steady-state equilibria, assuming a dynamic two-country economy in which workers decide whether to search in their native country or look for a job abroad. Based on this research, Moreno-Galbis and Tritah (2016) found that immigrants increase the employment prospects of competing natives in the short run. They reversed the conclusions derived from a competitive labour market. Immigrants may crowd *in* rather than crowd *out* natives in the sectors and occupations to which they contribute. Zenou (2008) assumed an economy comprising the formal sector characterised by search frictions and the competitive informal sector and examined the effects of different policies on these sectors.

However, labour and study migrations have rarely been analysed simultaneously in an identical model with frictional labour markets.

3. THE TWO-COUNTRY ECONOMY WITH STUDY MIGRATION

This section presents the economic framework. The economy comprises the study migrants' sending country, that is, the study migrants' home country, and the study migrants' receiving country, that is, the host country. Study migrants may become labour migrants in the host country after education. We implicitly assume that the former is a developing country with limited education and job opportunities. In contrast, the latter is a developed country with many opportunities, although they may regulate migrants' participation in the labour market. Study migration and return migration connect these two countries. The host country does not accept migrants who come only to provide labour.

As in Zenou (2008), skilled and unskilled jobs exist in the host country, with corresponding labour markets. Skilled labour markets are divided into skilled natives' and skilled migrants' labour markets. This is because natives and non-natives do not usually possess or build completely the same kinds of skills. Firms treat them as different labour inputs and are often traded in different labour markets. For this reason, a firm attempting to fill a skilled job vacancy by a skilled migrant (a skilled native) does not seek a skilled native (a skilled migrant). Since we focus on study migrants' human capital formation, the natives' skilled labour market does not appear explicitly in the model.

Unskilled natives and unskilled study migrants who finished their education participate in a single unskilled labour market. Firms that employ skilled (unskilled) labour do not employ unskilled (skilled) labour. This is not to assume a specific relation (e.g., substitutes or complements) between skilled and unskilled labours a priori. It is a matter that must be confirmed empirically. In addition, although firms usually employ both skilled and unskilled workers, we often observe that skilled workers dominate a firm's employment or unskilled workers dominate employment. This assumption approximates the observation.

Accordingly, in the host country, there are three types of firms: those that employ skilled natives, those that employ skilled migrants, and those that employ unskilled natives and/or migrants. In the migrants' home country, only an unskilled job and a corresponding unskilled labour market exist.

The skilled labour market is frictional, and the unskilled labour market is frictionless in either country. There is only one generation in the economy. The economy begins in the first period and ends in the second period.

The migrants' home country sends study migrants by $\bar{M} > 0$. These migrants are heterogeneous in their innate abilities. An individual study migrant i has an innate ability $a_i \in [\underline{a}, \bar{a}]$, where $0 < \underline{a} < \bar{a}$. Innate abilities are uniformly distributed. The host country can manipulate the number of study migrants.

Study migrants enter the host country to receive education at a young age. In old age, they may turn into labour migrants in the host country; that is, they may continue to work in the host country after education, or they may return to their home country and work there. This depends on the

study migrants' human capital formation, the immigration policy of the host country and unskilled jobs wages in the two countries. The host country manipulates its immigration policy. In particular, when they regulate immigration, they admit only a skilled job to study migrants who have finished their education. When they deregulate, they admit skilled and unskilled jobs to study migrants. As modelled by Snower (1996), study migrants (*workers* in his study) determine whether to build skilled or unskilled human capital by comparing utility at the beginning of a young age. To obtain a skilled job, study migrants need to receive sufficient education at a young age to build skilled human capital. Education is necessary even to work in an unskilled job in this study (whereas in his study, workers receive an education if they are to get a skilled job).

4. STUDY MIGRANTS' HUMAN CAPITAL FORMATION

This section discusses how the study migrants build human capital. Study migrants decide how seriously they receive education at the beginning of a young age. If study migrants seek a skilled job after their education, they build skilled human capital. For this purpose, they receive school education, that is, attending class, and, in addition, they exert an effort, that is, for example, self-study after class. An individual study migrant with an innate ability a_i builds skilled human capital by $(\bar{e}a_i)^{\alpha}$, where $0 < \alpha < 1$, by receiving school education for 1 hour and exerting an effort for $\bar{e} - 1$ hours, where $\bar{e} > 1$ is a constant and does not change throughout the analysis. We assume that a skilled migrant with innate ability a_i produces output by $(\bar{e}a_i)^{\alpha}$ if he is employed in a skilled job. Since the skilled migrants' labour market is frictional, even if a study migrant built skilled human capital, he does not necessarily get a skilled job. We determine wages and employment in the skilled migrants' labour market by assuming a search-matching framework. This is discussed in the next section.

If study migrants seek an unskilled job after education, they do not have to build skilled human capital. They only receive a school education. They do not put in any effort. In such a case, their human capital is unskilled, being equal to a_i^{α}. As we will assume since the unskilled labour market is frictionless and competitive, wages are unique for all unskilled workers. All unskilled workers receive the same wages, regardless of their human capital level.

The study migrants finance school fees by themselves. Its pecuniary cost per hour is 1. If study migrants spend $\bar{e} - 1$ hours on self-study, seeking a skilled job, their time available for non-academic activities is $\bar{L} - \{1 + (\bar{e} - 1)\} = \bar{L} - \bar{e}$. If they do not exert an effort, seeking an unskilled job, they can spend $\bar{L} - 1$ hours on non-academic activities. They do not incur any opportunity costs by receiving education at a young age. We assume that young age is when study migrants do not provide labour. It is also assumed that receiving an education does not generate utility. Education only increases an individual's human capital.

5. LABOUR MARKETS

This section models the labour markets. First, we assume the skilled migrants' labour market in the host country. Second, we build the models of the unskilled labour market in the host country and the migrants' home country. Third, we determine skilled migrants' wages via wage bargains.

5.1. The Skilled Migrants' Labour Market

In the skilled migrants' labour market, the number of unemployed skilled migrants and the number of skilled migrants' job vacancies determine the number of skilled migrants' job matches via the following matching function:

$$mL_S = m(uL_S, vL_S),$$

where L_S is the skilled migrants' labour force, m is the matching rate in the skilled migrants' labour market, u is the skilled migrants' unemployment rate (the fraction of unmatched skilled migrants among all skilled migrants) and v is the skilled migrants' vacancy rate (the fraction of vacant skilled migrants' jobs among all skilled migrants). The matching function increases in both arguments, concave and homogenous of degree 1. The number of migrants who build skilled human capital depends on their individual decisions regarding human capital formation.

By dividing the number of skilled migrants' job matches by the number of vacant skilled migrants' jobs, we can express the rate at which vacant skilled migrants' jobs become filled as a function of the ratio of the skilled migrants' vacancy rate to the skilled migrants' unemployment rate, that is v/u

$$\frac{m(uL_S, vL_S)}{vL_S} = m\left(\frac{u}{v}, 1\right) \equiv q(\theta),$$

where $\theta(\equiv v/u)$ measures the skilled migrants' labour market tightness. Skilled migrants' vacancies become less likely to be filled as the skilled migrants' vacancy rate increases relative to the skilled migrants' unemployment rate, that is $dq(\theta)/d\theta < 0$. Notice that $q(\theta) = m(1/\theta, 1)$.

The rate at which unemployed skilled migrants move into employment, that is, an unemployed skilled migrant obtains a skilled job, is:

$$\frac{m(uL_S, vL_S)}{uL_S} = m\left(\frac{u}{v}, 1\right)\frac{v}{u} \equiv \theta q(\theta).$$

Unemployed skilled migrants become easily employed as the skilled migrants' vacancy rate increases relative to the skilled migrants' unemployment rate, $d\{\theta q(\theta)\}/d\theta > 0$. Notice that $\theta q(\theta) = m(1, \theta)$.

5.2. Unskilled Labour Markets

We assume that the aggregate production function of firms in the host country that employ unskilled labour is $F(L_{US}^{demand})$, $F' > 0$, $F'' < 0$, where L_{US}^{demand} is the aggregate demand for unskilled labour in the host country. Unskilled labour is demanded in the host country such that $w_{US} = F'(L_{US}^{demand})$, where w_{US} is wages for unskilled labour in the host country.

Unskilled labour is supplied inelastically with respect to wages in the host country. A fixed number of unskilled natives $\overline{N}_{US}$ is in the host country's unskilled labour market. When immigration policy is regulated, and an unskilled job is not available to study migrants after education in the host country, the supply of unskilled labour in the host country L_{US}^{supply} is equal to $\overline{N}_{US}$. When the immigration policy is deregulated, and an unskilled job is also available to study migrants after education, L_{US}^{supply} comprises unskilled natives and unskilled migrants who remain in the host country to participate in the unskilled labour market.

Because the host country's unskilled labour market is competitive, wages and employment are determined to satisfy:

$$w_{US} = F'(L_{US}), \tag{1}$$

where $L_{US}^{demand} = L_{US}^{supply} \equiv L_{US}$.

The unskilled labour market in the migrants' home country is also competitive. Thus, in principle, wages are determined to equalise demand for and supply of unskilled labour in their country. However, we assume that unskilled job wages in that country w_{US}^{*} do not change to simplify the analysis. However, in practice, the migrants' home country is a developing country, and the demand for unskilled labour there is limited and remains mostly the same. Also, even if some study migrants returned to their home country and participated in that country's unskilled labour market, their amount is too small compared to the existing unskilled labour in that country to affect the equilibrium wages.

5.3. Wage Bargain in the Skilled Labour Market

Skilled migrants' wages result from a Nash bargain between a firm in the host country that employs a skilled migrant and each employee.

Under a regulated immigration policy, skilled migrants have two job opportunities. One is a skilled job in the host country, and the other is an unskilled job in their home country. The net return of a skilled migrant with innate ability a_i is $w_{Si} - w_{US}^*$, where w_{Si} is wages paid by the firm that employs a skilled migrant with innate ability a_i. The firm's net return of employing a skilled migrant with a_i and paying wages by w_{Si} is $(\bar{e}a_i)^{\alpha} - w_{Si}$, where the product price is assumed to be 1.

Under the deregulated immigration policy, a study migrant may also be employed in an unskilled job in the host country. Accordingly, the net return of a skilled migrant is $w_{Si} - w_{US}^*$ or $w_{Si} - w_{US}$. The firm's net return of employing a skilled migrant is the same as the one under the regulation.

The Nash bargaining problem involves maximising the Nash product $(w_{Si} - \tilde{w}_{US})^{\beta}\{(ea_i)^{\alpha} - w_{Si}\}^{1-\beta}$ with respect to w_{Si}, where $\tilde{w}_{US} = w_{US}^*, w_{US}$. Its solution is:

$$w_{Si} = \beta(\bar{e}a_i)^{\alpha} + (1-\beta)\tilde{w}_{US}, \tag{2}$$

where $0 \le \beta \le 1$ is a constant and interpreted as a relative measure of all skilled migrants' bargaining strength.

6. SKILLED HUMAN CAPITAL FORMATION

This section looks into study migrants' human capital formation. First, we examine it under a regulated immigration policy. Next, we examine this under a deregulated immigration policy.

6.1. The Regulated Immigration Policy

Under the regulated immigration policy, study migrants seek a skilled job in the host country or return to their home country to work as unskilled workers after their education.

If a study migrant with innate ability a_i seeks a skilled job in the host country, his lifetime utility is:

$$\theta q(\theta) w_{Si} + \{1 - \theta q(\theta)\} w_{US}^* + \bar{L} - \bar{e} - 1 (\equiv U_S^{reg}), \tag{3}$$

where the time discount factor is disregarded. The first term represents expected wages earned by providing skilled labour in the host country. The second term represents the expected wages earned by providing unskilled labour in the home country. Time for non-academic activities generates utility by $\bar{L}-\bar{e}$ and the school fee reduces utility by 1. We assume that coming to the host country and returning to the home country do not incur a cost that reduces utility.

Under the regulated immigration policy, if a study migrant does not seek a skilled job after education, he has no way other than to return to the home country to engage in unskilled labour at an old age. A study migrant's lifetime utility is:

$$w_{US}^{*}+\bar{L}-2(\equiv U_{US}^{reg}). \tag{4}$$

Utility stems from wages earned in the home country at an old age and time for non-academic activities $\bar{L}-1$ in the host country at a young age, whereas the school fee reduces utility by 1.

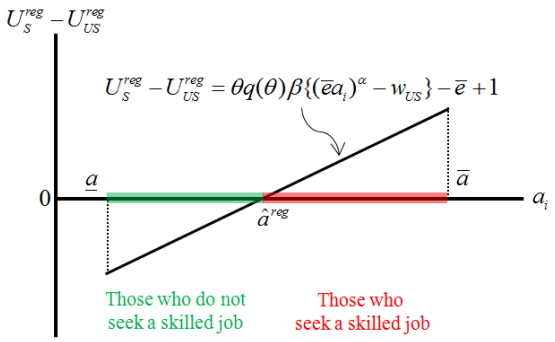
Utilising equations (3), (4) and (2), the difference in utility between the two cases is:

$$U_{S}^{reg}-U_{US}^{reg}=\theta q(\theta)\beta\{(\bar{e}a_i)^{\alpha}-w_{US}^{*}\}-\bar{e}+1.$$

As figure 1 illustrates, those with $U_{S}^{reg}\geq U_{US}^{reg}$ build skilled human capital and seek a skilled job, whereas those with $U_{S}^{reg}<U_{US}^{reg}$ do not build skilled human capital and do not seek a skilled job. Since the difference in utility increases with a_i, those with $\hat{a}^{reg}\leq a_i\leq\bar{a}$ build skilled human capital and those with $\underline{a}\leq a_i<\hat{a}^{reg}$ do not build skilled human capital, where $\hat{a}^{reg}$ is such that $U_{S}^{reg}=U_{US}^{reg}$, i.e.

$$\theta q(\theta)\beta\{(\bar{e}\hat{a}^{reg})^{\alpha}-w_{US}^{*}\}-\bar{e}+1=0. \tag{5}$$

Figure 1 Individual Migrants' Human Capital Formation under the Regulated Immigration Policy



The degree of skilled labour market tightness under the regulated immigration policy θ, that satisfies equation (5) and will be defined as θ^{reg} shortly is consistent only with $\hat{a}^{reg}$, i.e. an innate ability that makes seeking a skilled job indifferent to not seeking it. If θ were consistent with $a_A(<\hat{a}^{reg})$, some migrants with $a_A \le a_i < \hat{a}^{reg}$ would change their choice to seek an unskilled job and θ would change. If θ were consistent with $(\hat{a}^{reg} <)a_B$, some migrants with $\hat{a}^{reg} \le a_i \le a_B$ would change their choice to seek a skilled job and θ would still change.

A firm incurs cost by c if they keep a vacancy to be filled with a skilled migrant, where c is a constant and does not change throughout the analysis. However, they expect a return by creating a skilled vacancy for a skilled migrant. This return is represented by $q(\theta)\{(\overline{e}\hat{a}^{reg})^{\alpha} - w_{Si}\}$, where θ is consistent only with $\hat{a}^{reg}$. By assuming free entry of firms, the firm's profit becomes 0, i.e.

$$q(\theta)\{(\overline{e}\hat{a}^{reg})^{\alpha} - w_{Si}\} = c\,.$$

We rewrite this condition using equation (2).

$$q(\theta)(1-\beta)\{(\overline{e}\hat{a}^{reg})^{\alpha} - w^{*}_{US}\} = c\,. \tag{6}$$

By combining equations (5) and (6), the degree of labour market tightness under the regulated immigration policy is:

$$\theta = \frac{1-\beta}{\beta}\frac{\overline{e}-1}{c}(\equiv \theta^{reg})\,. \tag{7}$$

The labour market is tighter as a skilled migrant has weaker bargaining power. In that case, since his wages are lower, the firm's net return is larger, and thus, the firm is more likely to keep a vacancy. It is also tighter when the cost of keeping a vacancy is lower because they can easily keep a vacancy. When a skilled worker's education is larger, his human capital is larger, and the firm's net return is larger. Accordingly, a vacancy is more likely to occur.

We determine $\hat{a}^{reg}$ by equations (5) and (7).

$$\hat{a}^{reg} = \frac{1}{\overline{e}}\left[w^{*}_{US} + c\left\{ q\left(\frac{1-\beta}{\beta}\frac{\overline{e}-1}{c} \right)(1-\beta) \right\}^{-1} \right]^{\frac{1}{\alpha}}. \tag{8}$$

According to equation (8), a weaker skilled worker's bargaining power makes a skilled migrant more likely to get a skilled job. As a result, a migrant with lower innate ability derives higher

utility from seeking a skilled job. However, if a skilled worker has weaker bargaining power, the firm is less likely to fill a vacancy in a skilled job. Accordingly, the effects of a skilled worker's bargaining power on $\hat{a}^{reg}$ cannot be determined. In addition, when the amount of education is larger, a skilled migrant is more likely to obtain a skilled job, whereas the firm is less likely to fill a vacancy, suggesting that effects on $\hat{a}^{reg}$ cannot be determined. Furthermore, the higher cost of keeping a vacancy makes a skilled migrant less likely to obtain a skilled job, but the firm is more likely to fill a vacancy. Thus, the effects on $\hat{a}^{reg}$ are ambiguous. However, the effects of unskilled job wages in the migrants' home country are unambiguous. They raise $\hat{a}^{reg}$. This is because if study migrants can earn higher wages in their home country, that is, if their earnings are higher even without skilled human capital, migrants with a lower innate ability do not build skilled human capital.

The sum of employed skilled migrants' human capital under the regulated immigration policy MH^{reg} is:

$$\begin{aligned} MH^{reg} &= \int_{\hat{a}^{reg}}^{\bar{a}} q(\theta)\theta(\bar{e}a_i)^{\alpha}\, da_i \\ &= q\left(\frac{1-\beta}{\beta}\frac{\bar{e}-1}{c}\right)\frac{1-\beta}{\beta}\frac{\bar{e}-1}{c}\bar{e}^{\alpha}\,\frac{\bar{a}^{\alpha+1}-(\hat{a}^{reg})^{\alpha+1}}{\alpha+1}\ . \end{aligned} \tag{9}$$

6.2. The Deregulated Immigration Policy

Under the deregulated immigration policy, a study migrant seeks a skilled job in the host country or does not seek a skilled job and works as an unskilled worker in the host country or his home country.

When study migrants did not build skilled human capital at a young age, they supply unskilled labour in one of these two countries at an old age. If unskilled job wages are higher in the host country than in the home country, they work as unskilled workers in the host country. If unskilled job wages are equal in the two countries, the unskilled migrants are indifferent between working in the host country and their home country.

We implicitly assumed that the host country is a developed country and that the migrants' home country is a developing country. Under this assumption, the possibility can be excluded from the outset that unskilled job wages are higher in the migrants' home country than in the host country. Accordingly, unskilled migrants' wages under deregulation w_{US}^{der} are equal to

$$\max[w_{US}, w_{US}^{*}],$$

where $w_{US} \geq w_{US}^{*}$.

Utility differs by

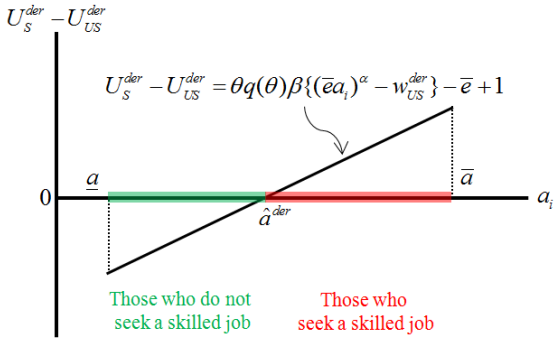
$$U_S^{der} - U_{US}^{der} = \theta q(\theta)\beta\{(\overline{e}a_i)^{\alpha} - w_{US}^{der}\} - \overline{e} + 1,$$

when seeking a skilled job and when an unskilled job, where U_S^{der} is utility derived from seeking a skilled job under deregulation and U_{US}^{der} is utility derived from seeking an unskilled job under deregulation.

As figure 2 illustrates, those with $\hat{a}^{der} \le a_i \le \overline{a}$ seek a skilled job by building skilled human capital under deregulation, and those with $\underline{a} \le a_i < \hat{a}^{der}$ do not seek a skilled job and do not build skilled human capital, where $\hat{a}^{der}$ is such $U_S^{der} = U_{US}^{der}$, i.e.

$$\theta q(\theta)\beta\{(\overline{e}\hat{a}^{der})^{\alpha} - w_{US}^{der}\} - \overline{e} + 1 = 0. \tag{10}$$

Figure 2 Individual Migrants' Human Capital Formation under the Deregulated Immigration Policy



The degree of skilled labour market tightness under the deregulated immigration policy θ, that satisfies equation (10) and will be defined as θ^{der} shortly is consistent only with $\hat{a}^{der}$, i.e. an innate ability that makes seeking a skilled job indifferent to seeking an unskilled job under deregulation.

By assuming free entry of firms, we derive a condition similar to equation (6).

$$q(\theta)(1-\beta)\{(\overline{e}\hat{a}^{der})^{\alpha} - w_{US}^{der}\} = c. \tag{11}$$

From equations (10) and (11), we can determine the degree of the skilled labour market tightness under deregulated immigration policy θ^{der}.

$$\theta = \frac{1-\beta}{\beta}\frac{\overline{e}-1}{c} (\equiv \theta^{der}) . \tag{12}$$

Labour market tightness does not differ under the regulated immigration policy and the deregulated immigration policy.

Now, we determine $\hat{a}^{der}$ by equations (10) and (12).

$$\hat{a}^{der} = \frac{1}{\overline{e}}\left[w_{US}^{der} + c\left\{ q\left(\frac{1-\beta}{\beta}\frac{\overline{e}-1}{c} \right)(1-\beta) \right\}^{-1} \right]^{\frac{1}{\alpha}} . \tag{13}$$

When $w_{US} > w_{US}^{*}$, an innate ability that makes seeking a skilled job indifferent to not seeking it is

$$\hat{a}^{der} = \frac{1}{\overline{e}}\left[w_{US} + c\left\{ q\left(\frac{1-\beta}{\beta}\frac{\overline{e}-1}{c} \right)(1-\beta) \right\}^{-1} \right]^{\frac{1}{\alpha}} (\equiv \hat{a}^{der}\Big|_{w_{US} > w_{US}^{*}}) .$$

In this case, none of the study migrants returns to their home country. Those who did not build skilled human capital at a young age enter the unskilled labour market of the host country at an old age. Unskilled job wages in the host country are:

$$w_{US} = F'\left(\overline{N} + \frac{\hat{a}^{der}\Big|_{w_{US} > w_{US}^{*}} - \underline{a}}{\overline{a} - \underline{a}}\overline{M} \right) .$$

Substituting this equation into equation (13), we find that $\hat{a}^{der}\Big|_{w_{US} > w_{US}^{*}}$ is determined to satisfy:

$$\hat{a}^{der}\Big|_{w_{US} > w_{US}^{*}} = \frac{1}{\overline{e}}\left[F'\left(\overline{N} + \frac{\hat{a}^{der}\Big|_{w_{US} > w_{US}^{*}} - \underline{a}}{\overline{a} - \underline{a}}\overline{M} \right) + c\left\{ q\left(\frac{1-\beta}{\beta}\frac{\overline{e}-1}{c} \right)(1-\beta) \right\}^{-1} \right]^{\frac{1}{\alpha}} . \tag{14}$$

Therefore, the sum of employed skilled migrants' human capital in this case $MH^{der}\Big|_{w_{US} > w_{US}^{*}}$ is:

$$MH^{der}\Big|_{w_{US}>w_{US}^*} = \int_{\hat{a}^{der}\Big|_{w_{US}>w_{US}^*}}^{\bar{a}} q(\theta)\theta(\bar{e}a_i)^{\alpha}\,da_i$$

$$= q\left(\frac{1-\beta}{\beta}\frac{\bar{e}-1}{c}\right)\frac{1-\beta}{\beta}\frac{\bar{e}-1}{c}\bar{e}^{\alpha}\,\frac{\bar{a}^{\alpha+1}-(\hat{a}^{reg}\Big|_{w_{US}>w_{US}^*})^{\alpha+1}}{\alpha+1},$$

where $\hat{a}^{der}\Big|_{w_{US}>w_{US}^*}$ satisfies equation (14).

When $w_{US}=w_{US}^*$, for those who did not build skilled human capital, working in the host country or their home country does not matter. An innate ability that makes seeking a skilled job indifferent to not seeking it is

$$\hat{a}^{der} = \frac{1}{\bar{e}}\left[w_{US}^* + c\left\{q\left(\frac{1-\beta}{\beta}\frac{\bar{e}-1}{c}\right)(1-\beta)\right\}^{-1}\right]^{\frac{1}{\alpha}} \left(\equiv \hat{a}^{der}\Big|_{w_{US}=w_{US}^*}\right).$$

Therefore, the sum of employed skilled migrants' human capital in this case $MH^{der}\Big|_{w_{US}=w_{US}^*}$ is

$$MH^{der}\Big|_{w_{US}=w_{US}^*} = \int_{\hat{a}^{der}\Big|_{w_{US}=w_{US}^*}}^{\bar{a}} q(\theta)\theta(\bar{e}a_i)^{\alpha}\,da_i$$

$$= q\left(\frac{1-\beta}{\beta}\frac{\bar{e}-1}{c}\right)\frac{1-\beta}{\beta}\frac{\bar{e}-1}{c}\bar{e}^{\alpha}\,\frac{\bar{a}^{\alpha+1}-(\hat{a}^{der}\Big|_{w_{US}=w_{US}^*})^{\alpha+1}}{\alpha+1}.$$

7. THE EFFECTS OF DEREGULATION

This section examines the effects of deregulation on skilled migrants' human capital and considers whether the immigration policy and the study migrants' acceptance policy are compatible or not.

Clearly, when $w_{US}=w_{US}^*$, $\hat{a}^{der}\Big|_{w_{US}=w_{US}^*}$ is equal to $\hat{a}^{reg}$. Accordingly,

$$MH^{der}\Big|_{w_{US}=w_{US}^{*}} = MH^{reg}.$$

Deregulation does not affect the study migrants' decisions regarding human capital formation. Those who seek a skilled job under the regulated immigration policy maintain their incentive to build skilled human capital even if the immigration policy is deregulated. This suggests that deregulation does not harm the study migrants' acceptance policy in terms of skilled human formation. Therefore, in this case, the deregulated immigration policy and the study migrants' acceptance policy are compatible.

On the other hand, when $w_{US} > w_{US}^{*}$, $\hat{a}^{der}\Big|_{w_{US}>w_{US}^{*}} > \hat{a}^{reg}$. Accordingly

$$MH^{der}\Big|_{w_{US}=w_{US}^{*}} < MH^{reg}.$$

Deregulation lowers the sum of employed skilled migrants' human capital. Some who seek a skilled job under a regulated immigration policy do not do so under a deregulated immigration policy. This is because it is profitable for some study migrants with a low innate ability to seek an unskilled job when even without skilled human capital, they can earn higher wages in the host country than those in their home country, which are equal to wages under the regulation. This means that deregulation negatively affects the study migrants' acceptance policy by lowering skilled human capital formation. Therefore, in this case, the deregulated immigration policy and the study migrants' acceptance policy are not compatible.

Can a host country overcome this situation? Is it possible to make the immigration policy and the study migrants' acceptance policy compatible?

The total differentiation of equation (14) gives:

$$\underbrace{\left[1-\frac{1}{\bar{e}}F''\left(\bar{N}+\frac{\hat{a}^{der}\Big|_{w_{US}>w_{US}^{*}}-\underline{a}}{\bar{a}-\underline{a}}\bar{M}\right)\frac{\bar{M}}{\bar{a}-\underline{a}}\right]}_{+}d\hat{a}^{der}\Big|_{w_{US}>w_{US}^{*}} = \underbrace{\frac{1}{\bar{e}}F''\left(\bar{N}+\frac{\hat{a}^{der}\Big|_{w_{US}>w_{US}^{*}}-\underline{a}}{\bar{a}-\underline{a}}\bar{M}\right)\frac{\hat{a}^{der}\Big|_{w_{US}>w_{US}^{*}}-\underline{a}}{\bar{a}-\underline{a}}}_{-}d\bar{M},$$

so that

$$\frac{d\hat{a}^{der}\Big|_{w_{US}>w_{US}^{*}}}{d\bar{M}} < 0.$$

Accordingly, by increasing the acceptance of study migrants, the host country can decrease $\hat{a}^{der}\left| w_{US} > w_{US}^{*} \right.$ to the level determined by equation (8). This is because such a policy increases the supply of unskilled migrants, and the host country's unskilled job wages decrease, making it less profitable for study migrants not to build skilled human capital, even if their innate ability is low. Consequently, the sum of employed skilled migrants' human capital under deregulation becomes equal to or larger than that under regulation. Although employed skilled migrants' human capital may be temporarily smaller when unskilled job wages are higher in the host country, it can end up with the same or larger amount as that built under the regulation by increasing the number of study migrants. Even if $\hat{a}^{der}\left| w_{US} > w_{US}^{*} \right.$ is still higher than $\hat{a}^{reg}$, the sum of employed skilled migrants' human capital can be equal to that under regulation since the total number of study migrants increases.

Therefore, we conclude that the deregulated immigration policy and the study migrants' acceptance policy are compatible or can be made compatible.

This conclusion gives us the following policy implications: when deregulating immigration policies, governments should *increase* the number of study migrants when unskilled job wages are higher in their countries than in the migrants' home country. Governments should not decrease it, based on the intuition that they do not contribute to skilled human capital formation under deregulation. On the contrary, by increasing their number, governments can increase employed skilled migrants' human capital. This is because by increasing the number, unskilled job wages decrease. Study migrants are discouraged from building unskilled human capital. Accordingly, they maintain the incentive to build skilled human capital even after deregulation.

8. CONCLUDING REMARKS

Assuming that skilled labour is traded in the frictional labour market, this study investigated the effects of the deregulation of immigration policy on study migrants' skilled human capital formation.

This study stems from the fact that many developed countries simultaneously suffer from the outflow of skilled workers and the shortage of unskilled workers. For this reason, some of these countries formally opened skilled and unskilled jobs to non-natives while encouraging study migrants to build skilled human capital. Moreover, this study reflects that migrants experience friction in finding skilled jobs, and firms are also often troubled with friction when employing them.

This study found that the host country's government can conduct the study migrants' acceptance policy and deregulate the immigration policy in a compatible manner by manipulating the number of study migrants. Study migrants do not lose the incentive to build skilled human capital, even if deregulation makes unskilled jobs available to them.

We can extend the analyses by relaxing the assumptions in this study, particularly regarding the search-matching framework. We assumed that skilled natives' and skilled migrants' labour markets

are separated in the host country. Clearly, we can assume a different situation where the skilled labour market is single, and skilled natives and migrants are in the same market. In addition, in determining skilled job wages, it is more likely that a skilled migrant with larger human capital have a larger bargaining strength. This study assumed that bargaining strength is identical across all skilled migrants, irrespective of their human capital. Furthermore, we assumed that firms that demand skilled (unskilled) labour do not demand unskilled (skilled) labour. Although it may complicate the analysis, we can simultaneously include skilled and unskilled labour in the firms' production function by assuming specific relations between them.

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