Integration, Mobility, and Human Capital Formation

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Abstract

In this note, we show that labour market integration can be a double-edged sword. In the presence of local human capital externalities, integration and the ensuing agglomeration of skilled labour can cause a decline in human capital and the total wage sum (net of education costs). In particular, integration depresses the incentives for some talented but immobile individuals to become skilled.

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1 Motivation

According to the conventional wisdom, labour market integration promotes overall efficiency. Integration enables mobile skilled workers to get employed where they are most productive, and induces agglomeration of skill-intensive industries, thereby enhancing aggregate income. In this note we qualify this line of reasoning. We show that in the presence of local human capital externalities, labour market integration and the ensuing agglomeration of skilled workers can cause a decline in human capital and the total wage sum (net of education costs). In particular, agglomeration reduces the incentives for some talented but immobile individuals to invest in education.

Thus integration affects not only the location of human capital, but also its overall stock. This feature distinguishes our note from the literature on the new economic geography, which considers total human capital as given when analysing the implications of integration (e.g., the recent papers Gallo, 2010; Pflüger and Südekum, 2008). By endogenising human capital formation, our approach is somewhat closer to that in the literature on the brain drain, which explores how the opportunity of emigrating to rich countries affects human capital in poor countries (e.g., Stark et al., 1998). Our focus is different, however: we are interested in the impact of integration and the ensuing agglomeration on two ex-ante identical regions, and analyse the implications for overall welfare in the two regions together.

2 The Model

Regions and Industries Consider two ex-ante identical regions, each with a population of unity. In each region, a continuum of symmetric firms in the interval $[0, 1]$ produces a high-quality good with skilled workers only. The production technology is characterised by constant returns-to-scale at the firm level and increasing returns to scale at the regional industry level. More precisely, the output of firm k in region i is

$$y_i^k = A(H_i) \cdot h_i^k, \tag{1}$$

where h_i^k and H_i, $H_i = \int_0^1 h_i^k dk$, denote the number of skilled workers employed by firm k in region i and the regional human capital stock, respectively. Regional productivity $A(H_i)$ is a positive, increasing and strictly concave function of the human capital employed in the regional industry, i.e., $A(0) > 0$, $\partial A(H)/\partial H_i > 0$, and $\partial^2 A(H_i)/\partial H_i^2 < 0$.

The product's world market price is normalised to unity. Then profit maximisation implies that the regional skilled wage w_i equals each firm's marginal product $A(H_i)$, which is exogenous from the perspective of a single firm. The resulting inverse aggregate demand for skilled labour in region i

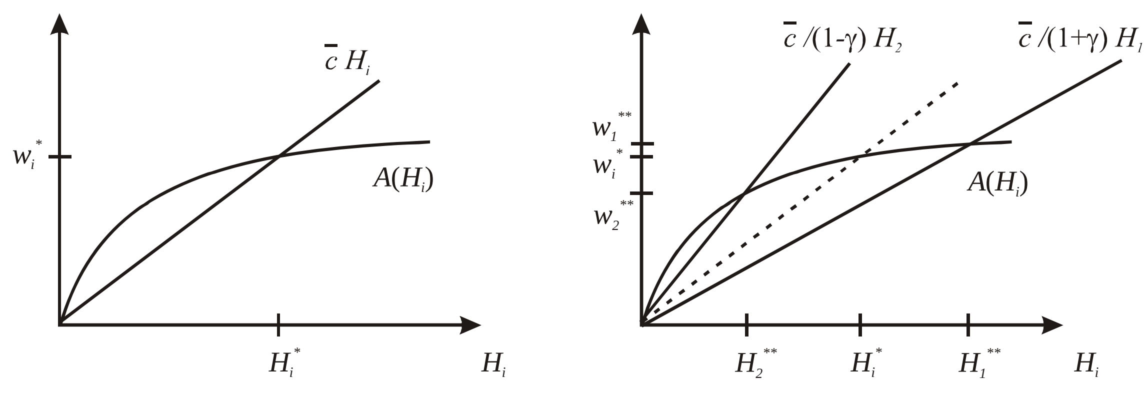
$$w_i = \frac{\partial y_i^k}{\partial h_i^k} = A(H_i) \tag{2}$$

is an increasing and concave function (see Figure 1). These properties stem from a human capital externality and set the stage for a simple agglomeration mechanism.

Figure 1: Labour Market Equilibrium

Figure 1a) Non-Integrated Economy

Figure 1b) Integrated Economy



Individual Characteristics and Options Individuals differ in their ability and mobility. Ability is captured by individual education costs, i.e., the costs of becoming a skilled worker. Let c_i^j denote the education costs of native j of region i, and let us assume that these education costs c_i^j are uniformly distributed in the interval $[0, \overline{c}]$, $\overline{c} > A(H_i)|_{H_i=2}$.[1]

We further assume that γ natives of each region are perfectly mobile and can move to the other region at no cost, with $\gamma \in (0, 1)$. By contrast, $(1 - \gamma)$ natives are perfectly immobile and will never leave their home region. The distribution of education costs is the same across the mobile and immobile groups.

Individuals make two decisions. Firstly, each individual chooses whether to become skilled or not. While skilled individuals can work for firms and earn wage income, unskilled individuals are not employable and cannot receive any income (and thus will be ignored in the following). Secondly, if labour markets are integrated, each individual chooses whether to stay in their home region or to migrate to the other region.

3 Education, Migration, and Labour Markets

Non-Integrated Labour Markets Consider the benchmark case of non-integrated labour markets. Then, individuals can decide on their education only. Native j of region i will become skilled if and only if the skilled wage w_i exceeds the individual education costs c_i^j, i.e., $w_i \geq c_i^j$. Thus, the aggregate supply of skilled workers in region i is

$$S_i = \frac{w_i}{\overline{c}} \quad \Leftrightarrow \quad w_i = \overline{c} S_i. \tag{3}$$

Jointly, the supply function (3) and the demand function (2) determine the stable

[1] The assumption $\overline{c} > A(H_i)|_{H_i=2}$ ensures that some individuals remain unskilled.

labour market equilibrium (see Figure 1a),[2] implicitly defined by

$$H_i^* = S_i^*, \qquad A\left(H_i^*\right) = \bar{c}H_i^*, \qquad \text{and} \qquad w_i^* = \bar{c}H_i^*. \tag{4}$$

Integrated labour markets Next, consider the case of integrated labour markets. There exists an agglomeration equilibrium with a high-wage ('winning') region and a low-wage ('losing') region, referred to as region 1 and 2: that is, $w_1 > w_2$. Since moving to the winning region enables individuals to reap higher returns on human capital, education and migration choices are now intertwined, with the decision on education depending on both ability and mobility.

Mobile natives of the losing region will move to the high-wage region if they are skilled, and will thus base their education decision on the skilled wage in the winning region. That is, mobile individual j of region 2 will become skilled if and only if the wage w_1 exceeds the education costs c_2^j, i.e., $w_1 \geq c_2^j$. Thus, the skilled labour supply of immigrants in the winning region is $M = \gamma w_1/\bar{c}$. In contrast to the mobile individuals, immobile individuals of the losing region stay put. They will become skilled if and only if the wage w_2 exceeds their education costs c_2^j, i.e., $w_2 \geq c_2^j$. Overall, the number of skilled workers native to the losing region is $S_2 = \left[\gamma w_1 + (1-\gamma)\, w_2\right]/\bar{c}$, of whom $S_2 - M = (1-\gamma)\, w_2/\bar{c}$ stay in region 2.

In the winning region, individuals have no incentive to leave, and the domestic labour supply function of the natives remains the same as in the case of non-integrated markets, i.e., $S_1 = w_1/\bar{c}$. Thus the aggregate supply in the winning region is $S_1 + M =$

[2] The stability of the equilibrium follows directly from the concavity of the demand function (2) and the linearity of the supply function (3).

$(1+\gamma)\,w_1/\overline{c}$. To sum up,

$$S_1 + M = (1+\gamma)\,\frac{w_1}{\overline{c}} \quad \Leftrightarrow \quad w_1 = \frac{\overline{c}}{(1+\gamma)}\,(S_1 + M) \qquad \text{and} \tag{5}$$

$$S_2 - M = (1-\gamma)\,\frac{w_2}{\overline{c}} \quad \Leftrightarrow \quad w_2 = \frac{\overline{c}}{(1-\gamma)}\,(S_2 - M)\,. \tag{6}$$

The demand for skilled labour in each region is still given by (2). Jointly, the regional supply and demand functions determine a stable agglomeration equilibrium (see Figure 1b), with

$$H_1^{**} = S_1^{**} + M^{**}, \quad A\left(H_1^{**}\right) = \frac{\overline{c}}{(1+\gamma)} H_1^{**}, \quad w_1^{**} = \frac{\overline{c}}{(1+\gamma)} H_1^{**}, \tag{7}$$

$$H_2^{**} = S_2^{**} - M, \quad A\left(H_2^{**}\right) = \frac{\overline{c}}{(1-\gamma)} H_2^{**}, \quad w_2^{**} = \frac{\overline{c}}{(1-\gamma)} H_2^{**}. \tag{8}$$

Comparison Labour market integration and human capital externalities trigger the agglomeration of skilled labour, boosting productivity and the skilled wage in the winning region. As a result, the incentive to invest in education increases not only for the natives of region 1, but also for the mobile natives of region 2, who can easily move to the high-wage region. The share of skilled workers among these groups increases from $w_i^*/\overline{c}$ to $w_1^{**}/\overline{c}$, and more skilled workers are employed in the winning region.

In the losing region, the outflow of human capital depresses productivity and the skilled wage. Consequently, fewer immobile natives find it beneficial to become skilled, and the share of skilled workers among them drops from $w_i^*/\overline{c}$ to $w_2^{**}/\overline{c}$. Thus, fewer skilled individuals work in the losing region. Importantly, agglomeration distorts the education decision. Talented but immobile natives shy away from education, whereas more of the less talented but mobile individuals become skilled.

4 Impact on Human Capital and the Wage Sum

We are now able to assess the overall impact of integration on total human capital $H_{1+2} = H_1 + H_2$ and the total wage sum $W_{1+2} = w_1 H_1 + w_2 H_2$. There is no need to consider the net wage sum, i.e., the wage sum minus education costs, separately because the net wage sum exactly equals one half of the wage sum.[3] Our comparison of the stable equilibrium in the benchmark case and the agglomeration equilibrium is summarised in

Proposition 1 *Labour market integration leads to one of the following three outcomes: (i) Total human capital increases, i.e.,* $H^{**}_{1+2} \geq H^{*}_{1+2}$. *Then, the total wage sum also rises, i.e.,* $W^{**}_{1+2} > W^{*}_{1+2}$. *(ii) Total human capital declines, but the total wage sum increases, i.e.,* $H^{**}_{1+2} < H^{*}_{1+2}$ *and* $W^{**}_{1+2} > W^{*}_{1+2}$. *(iii) The total wage sum decreases, i.e.,* $W^{**}_{1+2} \leq W^{*}_{1+2}$. *Then, human capital also declines, i.e.,* $H^{**}_{1+2} < H^{*}_{1+2}$.

Proof. See the Appendix. ■

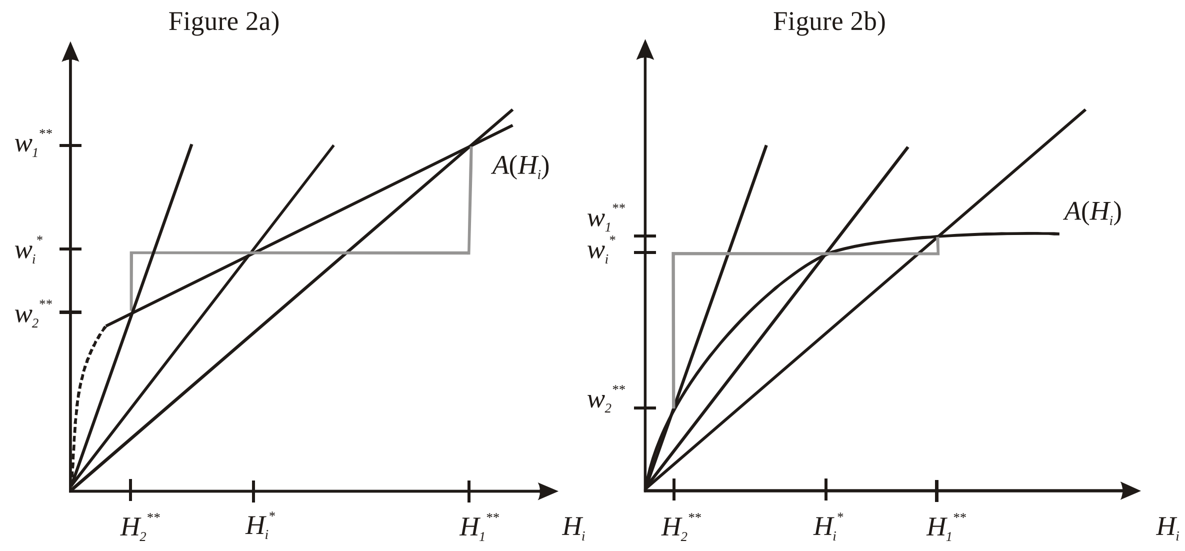
If agglomeration causes a substantial productivity gain and wage rise in region 1 relative to the losses in region 2, then integration strengthens the overall incentives to invest in education, and total human capital grows. If this happens, the total wage sum surges for sure, and so does the net wage sum. This scenario is illustrated in Figure 2a, with an almost linear productivity function $A(H)$.

Importantly, the (net) wage sum may increase even if human capital declines. So we cannot infer from the fact that there are fewer skilled people that there are no overall benefits from agglomeration. In this scenario, the wage rise for some individuals not only compensates for the loss of others, but also makes up for the fall in the total number of skilled workers.

However, if the wage decline in region 2 is sufficiently drastic relative to the improvement in region 1, the (net) wage sum will decrease, and such a drop will always be accompanied by a decrease in human capital. This scenario is illustrated in Figure 2b, which shows a strongly curved productivity function $A(H)$.

[3] As education costs of those who become skilled are uniformly distributed in the interval $[0, w_i]$, the average education costs of skilled workers is $0.5w_i$.

Figure 2: Impact of Integration on Human Capital and Wages



Our second proposition sums up how mobility affects the benefits from agglomeration.

Proposition 2 *There exists a critical value* $\gamma^{crit} < 1$ *such that integration boosts total human capital and the total wage sum (i.e.,* $H^{**}_{1+2} > H^{*}_{1+2}$ *and* $W^{**}_{1+2} > W^{*}_{1+2}$*) if* $\gamma > \gamma^{crit}$.

Proof. See the Appendix. ■

Integration will always generate overall gains if individuals are sufficiently mobile: that is, if enough individuals are able to join the winners. However, these overall benefits conceal severe distributional conflicts. The larger the share γ of mobile individuals is, the greater the income gains of those employed in the winning region, but also the greater the income losses of those working in the losing region.

5 Concluding Remarks

The outlook for the losing region would be less gloomy if skilled workers emigrated with a probability smaller than one, as is often assumed in the literature on brain drain (e.g., Stark and Wang, 2002). This modification would dilute the impact of integration, but it would not change the effects qualitatively. Still, labour market integration can depress human capital and total labour income. As argued, a decline in human capital itself does not necessarily indicate that the total wage sum has also fallen. The complex picture that emerges from even such a simple model cautions against simple policy recommendations.

Appendix

Proof of Proposition 1: Part (i): First, we show that $H^{**}_{1+2} > H^{*}_{1+2}$ is possible. To this end, we consider the boundary case where $A(H_i) = d + \delta H_i$ for $H \in \left[\underline{H}, \overline{H}\right]$, $\underline{H} < H_2^{**}$, $\overline{H} > H_1^{**}$, and $\overline{c} > d + 2\delta$ (see Figure 2b). Then, $H^{*}_{1+2} = 2d/\left(\overline{c} - \delta\right)$, $H_1^{**} = \left[\left(1+\gamma\right)d\right]/\left[\overline{c} - \left(1+\gamma\right)\delta\right]$, and $H_2^{**} = \left[\left(1-\gamma\right)d\right]/\left[\overline{c} - \left(1-\gamma\right)\delta\right]$, implying that $H^{**}_{1+2} > H^{*}_{1+2} \Leftrightarrow \gamma^2\delta\overline{c} > 0$. Finally, we can slightly manipulate $A(H_i)$ such that $A(H_i)$ is strictly concave and still yields $H^{**}_{1+2} > H^{*}_{1+2}$.

Second, we show that $H^{**}_{1+2} \geq H^{*}_{1+2} \Rightarrow W^{**}_{1+2} > W^{*}_{1+2}$. Note that

$$\begin{aligned} W^{**}_{1+2} &= \left(1+\gamma\right)\frac{\left(w_1^{**}\right)^2}{\overline{c}} + \left(1-\gamma\right)\frac{\left(w_2^{**}\right)^2}{\overline{c}} \\ &> \left(1+\gamma\right)^2\frac{\left(w_1^{**}\right)^2}{2\overline{c}} + \left(1-\gamma\right)^2\frac{\left(w_2^{**}\right)^2}{2\overline{c}} + \left(1+\gamma\right)\left(1-\gamma\right)\frac{w_1^{**}w_2^{**}}{\overline{c}} = \frac{\overline{c}}{2}\left(H^{**}_{1+2}\right)^2 \\ &\Leftrightarrow \left(w_1^{**} - w_2^{**}\right)^2 > 0 \end{aligned}$$

Thus, $W^{**}_{1+2} > \left[\overline{c}\left(H^{**}_{1+2}\right)^2\right]/2$. We also know that $H^{**}_{1+2} \geq H^{*}_{1+2} \Leftrightarrow \left[\overline{c}\left(H^{**}_{1+2}\right)^2\right]/2 \geq \left[\overline{c}\left(H^{*}_{1+2}\right)^2\right]/2 = 2\frac{\left(w_i^*\right)^2}{\overline{c}} = W^{*}_{1+2}$. To sum up, $W^{**}_{1+2} > \left[\overline{c}\left(H^{**}_{1+2}\right)^2\right]/2$ and, if $H^{**}_{1+2} \geq H^{*}_{1+2}$, $\left[\overline{c}\left(H^{**}_{1+2}\right)^2\right]/2 \geq W^{*}_{1+2}$. Hence, $H^{**}_{1+2} \geq H^{*}_{1+2} \Rightarrow W^{**}_{1+2} > W^{*}_{1+2}$.

Part (iii): First, the logical relationship $H^{**}_{1+2} \geq H^{*}_{1+2} \Rightarrow W^{**}_{1+2} > W^{*}_{1+2}$ implies $W^{**}_{1+2} \leq W^{*}_{1+2} \Rightarrow H^{**}_{1+2} < H^{*}_{1+2}$. Second, we show that $W^{**}_{1+2} < W^{*}_{1+2}$ is possible. Comparing equilibrium values yields $w_1^{**} > w_i^{*} > w_2^{**}$. Thus we can write $w_1^{**} = w_i^{*} + \varepsilon$ and $w_2^{**} = w_i^{*} - \eta$, with $\varepsilon > 0$ and $0 < \eta < w_i^{*}$. By choosing $A(H)$ appropriately, ε can be infinitesimally small. Moreover, $H_1^{**} > (1+\gamma)H_i^{*}$, $\lim_{\varepsilon \to 0} H_1^{**} = (1+\gamma)H_i^{*}$, and

$H_2^{**} < (1-\gamma)H_i^*$ follows from (4), (7), and (8). Thus, $\lim_{\varepsilon\to 0} w_1^{**}H_1^{**} = (1+\gamma)\, w_i^* H_i^*$ and $w_2^{**}H_2^{**} < (1-\gamma)\,(w_i^* - \eta)H_i^*$, implying that $\lim_{\varepsilon\to 0} W_{1+2}^{**} < 2w_i^*H_i^* - (1-\gamma)\,\eta H_i^* < 2w_i^*H_i^* = W_{1+2}^*$.

Part (ii): By choosing $A(H)$ appropriately, we have $W_{1+2}^{**} = W_{1+2}^*$, implying that $H_{1+2}^{**} < H_{1+2}^*$. But then, we can slightly manipulate $A(H)$ such that $w_1^{**new} = w_1^{**} + \mu$ (with an infinitesimally small μ), $W_{1+2}^{**new} > W_{1+2}^{**} = W_{1+2}^*$, and still $H_{1+2}^{**new} < H_{1+2}^*$.

Proof of Proposition 2: As $w_1^{**} > w_i^*$, we can write $w_1^{**} = w_i^* + \varepsilon$, $\varepsilon > 0$. Jointly with $H_1^{**} > (1+\gamma)H_i^*$, this leads to $W_{1+2}^{**} > (1+\gamma)\,(w_i^* + \varepsilon)\,H_i^*$. Also, $(1+\gamma)\,(w_i^* + \varepsilon)\,H_i^* > 2w_i^*H_i^* \Leftrightarrow \gamma > (w_i^* - \varepsilon)\,/\,(w_i^* + \varepsilon)$. As $W_{1+2}^* = 2w_i^*H_i^*$ and $(w_i^* - \varepsilon)\,/\,(w_i^* + \varepsilon) < 1$, we can conclude that for all $\varepsilon > 0$, $\exists\gamma^{crit} < 1 : W_{1+2}^{**} > W_{1+2}^*$ for all $\gamma \geq \gamma^{crit}$.

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