Migration Under Information Asymmetry and Employer Learning

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Information Asymmetry in the Labour Market

Information asymmetry in the labour market arises because an employer cannot know a worker's quality with certainty at the time of hiring. The asymmetry exists between workers and potential employers, but can also exist between a worker's current employer and other potential employers. Having had time to observe the worker, a current employer knows more about the worker's quality than other employers in the labour market. Such asymmetry, Greenwald (1986) argues theoretically, keeps workers of high quality from switching jobs. Transnational migrants face analogous asymmetries. Kwok and Leland (1982) propose a theoretical model assuming employers in destination countries can accurately assess the quality of an international student educated in the destination country whereas employers in home countries can not. Such information asymmetry, they argue, can lead to high quality migrants staying in the destination country, regardless of whether they entered the destination country with the intention to stay permanently. Seemingly contradicting Kwok and Leland (1982), Katz and Stark (1987) assume that employers in destination countries have less accurate information about a migrant worker's quality compared to employers in home countries. However, Katz and Stark (1987) model the initial decision of migration while Kwok and Leland (1982) model the return of emigrants. Both approaches are consistent in that they assume that employers are better informed in the country where a worker decides whether to relocate. Katz and Stark (1987) predict that, if employers in the destination country cannot accurately assess the quality of migrant workers, workers of high quality are less likely to migrate.

Conversely, reducing information asymmetry can reduce adverse selection. Spence (1973) proposes that education serves as a signal[1] of worker quality, reducing information asymmetry. The author argues that employers decide whether to hire a worker based on their education, among other factors, and then update their beliefs about the accuracy of the signal after observing the performance of those hired. Implicitly, the author acknowledges the value of the initial period of employment in gauging the quality of workers. Katz and Stark (1987) acknowledge it explicitly.

Indeed, several sources of evidence in the literature largely confirm that employers learn more about workers over time[2]. Using data from the US, Farber and Gibbons (1996) as well as Altonji and Pierret (2001) find empirically that the correlation

[1]For further discussion on education's value as a signal, see: Hungerford and Solon (1987), Jaeger and Page (1996), Frazis (2002), Hussey (2012), and Arteaga (2018).

[2]For further discussion on employers' learning of worker quality over time, see: Waldman (1996), and Schönberg (2007).

between wages and measures of quality (test scores) unobservable to employers at the time of hiring increases with time. Bauer and Haisken-DeNew (2001) find evidence that employer learning occurs for blue-collar workers but not white-collar workers in Germany. The authors, however, limit their analysis to male workers and proxy unobserved quality using parental education. Lange (2007) finds that the error in US employers' initial estimate of workers' productivities declines by 50 percent in three years. Likewise, Demurger, Hanushek, and Zhang (2019) find that the premium of graduating from an elite Chinese university falls with labour market experience.

It follows, then, that allowing employers more time to observe workers prior to making final wage commitments ought to reduce information asymmetry and attract workers of higher quality into the labour market. I put this prediction to the test. Below, I develop a more formal model of the selection of migrant workers under employer learning, where the prediction appears as Proposition 1.

A Model of Migrant Worker Selection Under Employer Learning

Suppose there are two labour markets m_0 and m_1. Let q be the quality of a worker in m_0 such that $q \in [\underline{q}, \bar{q}]$. Assume quality does not change over time. The worker can work for the duration of their lifetime $l \in (0, \infty)$. Suppose employers in both m_0 and m_1 can fully observe q. Then, the worker with quality q at m_0 receives a wage rate— wage per unit time— of $w_0(q)$ such that $\frac{\delta w_0(q)}{\delta q} > 0$. In m_1, after deducting any cost of migration, the worker receives the wage rate $w_1(q)$ such that $\frac{\delta w_1(q)}{\delta q} > 0$. In deciding whether or not to migrate, the worker compares their earnings over their lifetime l in m_0 and m_1. The worker opts to migrate if and only if:

$$w_1(q)l > w_0(q)l$$

If the wage rate in neither labour market changes over time, the worker need only compare the wage rates. So, I can write the migration condition as:

$$w_1(q) > w_0(q)$$

Introducing Information Asymmetry: Suppose that employers in m_1 do not fully observe q. They believe that the quality of workers from m_0 is $q^* \in (\underline{q}, \bar{q})$; q^* may be the average or median quality of migrant workers in m_1, for instance. So, the employers offer the same wage rate $w_1(q^*)$ to all workers from m_0. Then, a worker from m_0 with quality q migrates to m_1 if and only if:

$$w_1(q^*) > w_0(q)$$

Introducing Employer Learning: Let the continuous function $\Phi \in [0, 1]$ represent the degree of information an employer in the destination labour market m_1 can possess about the quality of individual migrant workers; $\Phi = 1$ means the employer is fully informed, and $\Phi = 0$ means that the employer is entirely uninformed. Here, $\Phi \in [0, \infty)$ is a function of time t such that $\frac{\delta\Phi(t)}{\delta t} > 0$. At time t, the employer takes the worker's quality to be $\hat{q}(q, q^*, t) = q^* + (q - q^*)\Phi(t)$. So, with time, the employer observes the quality of the worker more accurately. Since $\frac{\delta\Phi(t)}{\delta t} > 0$, $\frac{\delta\hat{q}}{\delta t} = (q - q^*)\frac{\delta\Phi(t)}{\delta t} > 0$ for workers of high quality $q \in (q^*, \bar{q}]$, and $\frac{\delta\hat{q}}{\delta t} = (q - q^*)\frac{\delta\Phi(t)}{\delta t} < 0$ for workers of low quality $q \in [\underline{q}, q^*)$.

Now, I allow the employer to hire the worker under the wage rate $w_1(q^*)$ before making a final wage revision. Suppose the employer may initially observe the worker for a maximum period of $t^* \leq l$ prior to finalising a wage offer. The employer may not change wage rates beyond t^*. I define $\hat{w}_1(q, q^*, t) = w_1(\hat{q}(q, q^*, t))$[3]. I can, then, decompose a migrant worker's earnings into that which the worker earns in the initial period of observation leading up to t^*, and that which the worker earns in the period after t^* leading up to l. The migration condition[4] becomes:

$$\int_0^{t^*} \hat{w}_1(q, t|q^*)\delta t + \hat{w}_1(q|q^*, t^*)(l - t^*) > w_0(q)l$$

Lemma. *A worker who migrates for a certain lifetime l does not necessarily migrate for a shorter lifetime.*

Proof of Lemma. *I provide a proof by construction.*

Take a worker of quality $q = 1/e$, and the parameters $q^* = 1/2e$, $w_0(q) = 2q/e$, $w_1(q) = q$, $\Phi(t) = 1 - \frac{1}{e^t}$, and $t^* = 1$.

Then, the migration condition holds for $l > \frac{e-2}{2e-5}$ but not for $l < \frac{e-2}{2e-5}$, where $l > t^*$.

[3]Here, $\hat{w}_1(q|q^*, t^*)$ is a monotonic transformation of $w_1(q)$ for $q^* \in (\underline{q}, \bar{q})$ and $t^* \in (0, \infty)$.

[4]Here, I assume the employer can continuously update wage offers until t^*. Consider the special case where the initial wage rate lasts throughout the interval $t \in [0, t^*]$. The migration condition for this special case is: $w_1(q^*)t^* + \hat{w}_1(q|q*, t^*)(l - t^*) > w_0(q)l$

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Introducing Permanent Migration: Consider decisions of permanent migration, where the worker compares earnings over an indefinite lifetime in m_0 and m_1. Evaluating the limit of the migration condition as $\lim_{l\to\infty}$, I get:

$$\lim_{l\to\infty}\left[\int_0^{t^*}\hat{w}_1(q,t|q^*)\delta t+\hat{w}_1(q|q^*,t^*)(l-t^*)\right]>\lim_{l\to\infty}w_0(q)l$$

which simplifies to:

$$\hat{w}_1(q|q^*,t^*)>w_0(q)$$

The full migration decision function becomes:

$$\begin{cases}\text{migrate} & \text{if } \hat{w}_1(q|q^*,t^*)>w_0(q);\\ \text{not migrate} & \text{if } \hat{w}_1(q|q^*,t^*)<w_0(q);\\ \text{undefined} & \text{if } \hat{w}_1(q|q^*,t^*)=w_0(q)\end{cases}$$

Let S be the set of all solutions to $w_1(q)=w_0(q)$, $\hat{S}$ be the set of all solutions to $\hat{w}_1(q|q^*,t^*)=w_0(q)$, and $C=S\cup\hat{S}\cup\left\{\underline{q},q^*,\bar{q}\right\}$. Assume that $\exists q\in S$ such that $q\notin\left\{\underline{q},q^*,\bar{q}\right\}$. Assume also that S has a finite number of elements; that is, $w_1(q)$ intersects $w_0(q)$ at points, but not over intervals. The model now leads to a set of propositions.

Proposition 0. *Given information asymmetry and employer learning with a finite initial period of observation t^*, either fewer workers of high quality $q\in(q^*,\bar{q}]$ migrate, or more workers of low quality $q\in[\underline{q},q^*)$ migrate, or both.*

Proof of Proposition 0. *First, note that $\hat{w}_1(q)<w_1(q)\ \forall\ q\in(q^*,\bar{q}]$, and $\hat{w}_1(q)>w_1(q)\ \forall\ q\in[\underline{q},q^*)$. So, there may not be more workers of high quality $q\in(q^*,\bar{q}]$ who migrate under information asymmetry than under full information symmetry, and there may not be fewer workers of low quality $q\in[\underline{q},q^*)$ who migrate under information asymmetry than under full information symmetry.*

*By assumption, $\exists\ q\in S$ such that $q\notin\left\{\underline{q},q^*,\bar{q}\right\}$. So, either **Case 1**, or **Case 2**, or both must hold.*

Case 1: *$\exists\ q' \in S \subset C$ such that $q' \in (q^*, \bar{q})$.*

Case 2: *$\exists\ q' \in S \subset C$ such that $q' \in (\underline{q}, q^*)$.*

Now, I show by exhaustion that either $\exists\ q \in (q^*, \bar{q})$ such that $w_1(q) > w_0(q) > \hat{w}_1(q)$, or $\exists\ q \in (\underline{q}, q^*)$ such that $w_1(q) < w_0(q) < \hat{w}_1(q)$, or both. In other words, I show that either some worker of high quality $q \in (q^*, \bar{q})$ who migrates under full information symmetry does not migrate under information asymmetry, or some worker of low quality $q \in (\underline{q}, q^*)$ who does not migrate under full information symmetry migrates under information asymmetry, or both.

Case 1A: *Suppose $\exists\ q' \in S \subset C$ such that $q' \in (q^*, \bar{q})$, and $w_1(q)$ intersects $w_0(q)$ from above at q'.*

Take $q'' \in C$ such that $q'' < q'$, and $\nexists\ \dot{q} \in C$ such that $\dot{q} \in (q'', q')$. In other words, q'' is the largest element of C smaller than q'. I know that at least one such q'' may exist; namely, $q^* \in C$.

First, I prove by contradiction that $w_1(q) > w_0(q)\ \forall\ q \in (q'', q')$. In other words, all workers of quality $q \in (q'', q')$ migrate under full information symmetry. Assume $\exists\ \ddot{q} \in (q'', q')$ such that $w_1(\ddot{q}) = w_0(\ddot{q})$. Since, $\ddot{q} \in S \subset C$, it violates the definition of q''. Now, assume $\exists\ \ddot{q} \in (q'', q')$ such that $w_1(\ddot{q}) < w_0(\ddot{q})$. I know that $w_1(q)$ is continuous, and intersects $w_0(q)$ from above at q'. So, by the intermediate value theorem, $\exists\ \dddot{q} \in S \subset C$ such that $\dddot{q} \in (q'', q')$, violating the definition of q''.

Now, I prove by contradiction that $\hat{w}_1(q) < w_0(q)\ \forall\ q \in (q'', q')$. In other words, no worker of quality $q \in (q'', q')$ migrates under information asymmetry. Assume $\exists\ \ddot{q} \in (q'', q')$ such that $\hat{w}_1(\ddot{q}) = w_0(\ddot{q})$. Since, $\ddot{q} \in \hat{S} \subset C$, it violates the definition of q''. Now, assume $\exists\ \ddot{q} \in (q'', q')$ such that $\hat{w}_1(\ddot{q}) > w_0(\ddot{q})$. Since $\hat{w}_1(q)$ is a monotonic transformation of $w_1(q)$, it is continuous. Moreover, $\hat{w}_1(q') < w_1(q')$. So, by the intermediate value theorem, $\exists\ \dddot{q} \in \hat{S} \subset C$ such that $\dddot{q} \in (q'', q')$, violating the definition of q''.

Therefore, $w_1(q) > w_0(q) > \hat{w}_1(q)\ \forall\ q \in (q'', q') \subset (q^*, \bar{q}]$.

Case 1B: *Suppose $\exists\ q' \in S \subset C$ such that $q' \in (q^*, \bar{q})$, and $w_1(q)$ intersects $w_0(q)$ from below at q'.*

Take $q'' \in C$ such that $q'' > q'$ and $\nexists\ \dot{q} \in C$ such that $\dot{q} \in (q', q'')$. In other *words, q'' is the smallest element of C larger than q'. I know that at least one such q'' may exist; namely, $\bar{q} \in C$.*

First, I prove by contradiction that $w_1(q) > w_0(q)\ \forall\ q \in (q', q'')$. In other words, all workers of quality $q \in (q', q'')$ migrate under full information symmetry. Assume $\exists\ \ddot{q} \in (q', q'')$ such that $w_1(\ddot{q}) = w_0(\ddot{q})$. Since, $\ddot{q} \in S \subset C$, it violates the definition of q''. Now, assume $\exists\ \ddot{q} \in (q', q'')$ such that $w_1(\ddot{q}) < w_0(\ddot{q})$. I know that $w_1(q)$ is continuous, and intersects $w_0(q)$ from below at q'. So, by the intermediate value theorem, $\exists\ \dddot{q} \in S \subset C$ such that $\dddot{q} \in (q', q'')$, violating the definition of q''.

Now, I prove by contradiction that $\hat{w}_1(q) < w_0(q)\ \forall\ q \in (q', q'')$. In other words, no worker of quality $q \in (q', q'')$ migrates under information asymmetry. Assume $\exists\ \ddot{q} \in (q', q'')$ such that $\hat{w}_1(\ddot{q}) = w_0(\ddot{q})$. Since, $\ddot{q} \in \hat{S} \subset C$, it violates the definition of q''. Now, assume $\exists\ \ddot{q} \in (q', q'')$ such that $\hat{w}_1(\ddot{q}) > w_0(\ddot{q})$. Since $\hat{w}_1(q)$ is a monotonic transformation of $w_1(q)$, it is continuous. Moreover, $\hat{w}_1(q') < w_1(q')$. So, by the intermediate value theorem, $\exists\ \dddot{q} \in \hat{S} \subset C$ such that $\dddot{q} \in (q', q'')$, violating the definition of q''.

Therefore, $w_1(q) > w_0(q) > \hat{w}_1(q)\ \forall\ q \in (q', q'') \subset (q^*, \bar{q})$.

Case 2A: *Suppose $\exists\ q' \in S \subset C$ such that $q' \in (\underline{q}, q^*)$, and $w_1(q)$ intersects $w_0(q)$ from above at q'.*

Take $q'' \in C$ such that $q'' > q'$, and $\nexists\ \dot{q} \in C$ such that $\dot{q} \in (q', q'')$. In other words, q'' is the smallest element of C larger than q'. I know that at least one such q'' may exist; namely, $q^* \in C$.

First, I prove by contradiction that $w_1(q) < w_0(q)\ \forall\ q \in (q', q'')$. In other words, no worker of quality $q \in (q', q'')$ migrates under full information symmetry. Assume $\exists\ \ddot{q} \in (q', q'')$ such that $w_1(\ddot{q}) = w_0(\ddot{q})$. Since, $\ddot{q} \in S \subset C$, it violates the definition of q''. Now, assume $\exists\ \ddot{q} \in (q', q'')$ such that $w_1(\ddot{q}) > w_0(\ddot{q})$. I know that $w_1(q)$ is continuous, and intersects $w_0(q)$ from above at q'. So, by the intermediate value theorem, $\exists\ \dddot{q} \in S \subset C$ such that $\dddot{q} \in (q', q'')$, violating the definition of q''.

Now, I prove by contradiction that $\hat{w}_1(q) > w_0(q)\ \forall\ q \in (q', q'')$. In other words, all workers of quality $q \in (q', q'')$ migrate under information asymmetry. Assume $\exists\ \ddot{q} \in (q', q'')$ such that $\hat{w}_1(\ddot{q}) = w_0(\ddot{q})$. Since, $\ddot{q} \in \hat{S} \subset C$, *it violates the definition of* q''. *Now, assume* $\exists\ \ddot{q} \in (q', q'')$ *such that* $\hat{w}_1(\ddot{q}) < w_0(\ddot{q})$. *Since* $\hat{w}_1(q)$ *is a monotonic transformation of* $w_1(q)$, *it is continuous. Moreover,* $\hat{w}_1(q') > w_1(q')$. *So, by the intermediate value theorem,* $\exists\ \dddot{q} \in \hat{S} \subset C$ *such that* $\dddot{q} \in (q', q'')$, *violating the definition of* q''.

Therefore, $w_1(q) < w_0(q) < \hat{w}_1(q)\ \forall\ q \in (q', q'') \subset [\underline{q}, q^*)$.

Case 2B: *Suppose* $\exists\ q' \in S \subset C$ *such that* $q' \in (\underline{q}, q^*)$, *and* $w_1(q)$ *intersects* $w_0(q)$ *from below at* q'.

Take $q'' \in C$ *such that* $q'' < q'$ *and* $\nexists\ \dot{q} \in C$ *such that* $\dot{q} \in (q'', q')$. *In other words,* q'' *is the largest element of* C *smaller than* q'. *I know that at least one such* q'' *may exist; namely,* $\underline{q} \in C$.

First, I prove by contradiction that $w_1(q) < w_0(q)\ \forall\ q \in (q'', q')$. *In other words, no worker of quality* $q \in (q'', q')$ *migrates under full information symmetry. Assume* $\exists\ \ddot{q} \in (q'', q')$ *such that* $w_1(\ddot{q}) = w_0(\ddot{q})$. *Since,* $\ddot{q} \in S \subset C$, *it violates the definition of* q''. *Now, assume* $\exists\ \ddot{q} \in (q', q'')$ *such that* $w_1(\ddot{q}) > w_0(\ddot{q})$. *I know that* $w_1(q)$ *is continuous, and intersects* $w_0(q)$ *from below at* q'. *So, by the intermediate value theorem,* $\exists\ \dddot{q} \in S \subset C$ *such that* $\dddot{q} \in (q'', q')$, *violating the definition of* q''.

Now, I prove by contradiction that $\hat{w}_1(q) > w_0(q)\ \forall\ q \in (q'', q')$. *In other words, all worker of quality* $q \in (q'', q')$ *migrate under information asymmetry. Assume* $\exists\ \ddot{q} \in (q'', q')$ *such that* $\hat{w}_1(\ddot{q}) = w_0(\ddot{q})$. *Since,* $\ddot{q} \in \hat{S} \subset C$, *it violates the definition of* q''. *Now, assume* $\exists\ \ddot{q} \in (q'', q')$ *such that* $\hat{w}_1(\ddot{q}) < w_0(\ddot{q})$. *Since* $\hat{w}_1(q)$ *is a monotonic transformation of* $w_1(q)$, *it is continuous. Moreover,* $\hat{w}_1(q') > w_1(q')$. *So, by the intermediate value theorem,* $\exists\ \dddot{q} \in \hat{S} \subset C$ *such that* $\dddot{q} \in (q'', q')$, *violating the definition of* q''.

Therefore, $w_1(q) < w_0(q) < \hat{w}_1(q)\ \forall\ q \in (q'', q') \subset [\underline{q}, q^*)$.

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Proposition 1. *Given information asymmetry and employer learning with maximum initial period of observation* t^*, *a large enough increase in* t^* *causes either more workers of high quality* $q \in (q^*, \bar{q}]$ *to migrate, or fewer workers of low quality* $q \in [\underline{q}, q^*)$ *to migrate, or both.*

Proof of Proposition 1. *Since* $\Phi(t)$ *is continuous over* $t \in [0, \infty)$, $\hat{q}(q, q^*, t)$ *is also continuous in* t *over the domain, and so is* $\hat{w}_1(q, q^*, t)$. *Since,* $\lim_{t\to\infty} \Phi(t) = 1$, *I know* $\lim_{t\to\infty} \hat{q}(q, q^*, t) = q$, *and* $\lim_{t\to\infty} \hat{w}_1(q, q^*, t) = w_1(q)$.

From Proposition 0, I know that either $\exists\ q \in (q^*, \bar{q}]$ *such that* $w_1(q) > w_0(q) > \hat{w}_1(q, q^*, t^*)$, *or* $\exists\ q \in [\underline{q}, q^*)$ *such that* $w_1(q) < w_0(q) < \hat{w}_1(q)$, *or both.*

Suppose $\exists\ q \in (q^*, \bar{q}]$ *such that* $w_1(q) > w_0(q) > \hat{w}_1(q, q^*, t^*)$. *That is, the worker of quality* $q \in (q^*, \bar{q}]$ *migrates under full information symmetry, but not under information asymmetry with maximum initial duration of employment* t^*.

> *Let* $\Delta \in (0, w_1(q) - w_0(q))$. *Then, by the intermediate value theorem,* $\exists\ t^{**} \in (t^*, \infty)$ *such that* $\hat{w}_1(q, q^*, t^{**}) = w_0(q) + \Delta > w_0(q) > \hat{w}_1(q, q^*, t^*)$.

Suppose $\exists\ q \in [\underline{q}, q^*)$ *such that* $w_1(q) < w_0(q) < \hat{w}_1(q, q^*, t^*)$. *That is, the worker of quality* $q \in [\underline{q}, q^*)$ *does not migrate under full information symmetry, but migrates under information asymmetry with maximum initial duration of employment* t^*.

> *Let* $\Delta \in (0, w_0(q) - w_1(q))$. *Then, by the intermediate value theorem,* $\exists\ t^{**} \in (t^*, \infty)$ *such that* $\hat{w}_1(q, q^*, t^{**}) = w_0(q) - \Delta < w_0(q) < \hat{w}_1(q, q^*, t^*)$.

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