Web Appendix to: Unskilled Migration and Vertical Disintegration: Theory and Evidence from China

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1 Proposition 1

According to equation (20) in the main text, we know that the output Y depends on the aggregate labor input $[\phi H^{\frac{\sigma-1}{\sigma}} + (1-\phi)L^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}}$. We need to see the impact of the inflow of unskilled migrants on this term. With migrants, the relative demand and supply of skilled labor are:

$$\frac{H}{L'} = \left(\frac{w_H}{w_L}\right)^{-\sigma}\left(\frac{1-\phi}{\phi}\right)^{-\sigma} \tag{1}$$

$$\frac{H}{L'} = \left(\frac{w_H}{w_L}\right)^{\frac{\delta}{1-\delta}}\left(\frac{\bar{h}}{l}\right)^{\frac{1}{1-\delta}}\frac{L_D}{L_D+L_I} \tag{2}$$

The domestic labor market clearing condition gives:

$$N = L_D + H \tag{3}$$

We denote the $\left(\frac{1-\phi}{\phi}\right)^{-\sigma}$ as A, $\left(\frac{\bar{h}}{l}\right)^{\frac{1}{1-\delta}}$ as B. Equations (1) and (2) become:

$$\frac{H}{L'} = \left(\frac{w_H}{w_L}\right)^{-\sigma} A \tag{4}$$

$$\frac{H}{L_D} = \left(\frac{w_H}{w_L}\right)^{\frac{\delta}{1-\delta}} B \tag{5}$$

We plug equation (5) to equation (3) and get:

$$H = \frac{N}{1 + \left(\frac{w_H}{w_L}\right)^{-\frac{\delta}{1-\delta}} B^{-1}}$$

Knowing H, we can deduce L':

$$L' = \frac{\left(\frac{w_H}{w_L}\right)^{\sigma} A^{-1} N}{1 + \left(\frac{w_H}{w_L}\right)^{-\frac{\delta}{1-\delta}} B^{-1}}$$

It is obvious that both skilled labor force H and unskilled labor force L' increase with $\frac{w_H}{w_L}$. Thus the aggregate labor input $[\phi H^{\frac{\sigma-1}{\sigma}} + (1-\phi)L^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}}$ increases with $\frac{w_H}{w_L}$. As a result, we can conclude that the output Y increases with $\frac{w_H}{w_L}$. As we have shown that $\frac{w_H}{w_L}$ is higher with unskilled migrants, we can conclude that output Y is higher with unskilled migrants.

Now, we look at what will happen when the number of unskilled migrants increases. Knowing H, we can deduce L_D as:

$$L_D = \frac{\left(\frac{w_H}{w_L}\right)^{-\frac{\delta}{1-\delta}} B^{-1} N}{1 + \left(\frac{w_H}{w_L}\right)^{-\frac{\delta}{1-\delta}} B^{-1}}$$

Thus, we can deduce the relationship between L_I and $\frac{w_H}{w_L}$ in the equilibrium as:

$$L_I = \frac{\left[\left(\frac{w_H}{w_L}\right)^{\sigma} A^{-1} - \left(\frac{w_H}{w_L}\right)^{-\frac{\delta}{1-\delta}} B^{-1}\right] N}{1 + \left(\frac{w_H}{w_L}\right)^{-\frac{\delta}{1-\delta}} B^{-1}}$$

Clearly, their relationship is positive. Therefore, when L_I increases, $\frac{w_H}{w_L}$ increases in the equilibrium. By looking at H and L', we can conclude that as L_I increases, both H and L' increase, increasing Y. In addition, the wage of skilled workers relative to that of unskilled workers increases. We obtain the same conclusions when we increase the share of unskilled migrants $\frac{L_I}{N}$.

2 Additional Robustness Tests

Table A1 presents the robust results with alternative dependent variables and different samples. In Panel A, we merge our firm data with the custom data following Yu (2015) and use the HS 6-digit code to define the imported intermediate products following Feng et al. (2016). Here, we investigate whether the inflow of unskilled migrants increases international outsourcing. We use the firm-level imported intermediate inputs to measure the degree of international outsourcing, which has two advantages. First, international outsourcing is associated with higher search costs, prices, and quality (Alfaro et al., 2016; McLaren, 2000), which is more closely related to a firm's vertical disintegration strategy. Second, the decision to outsource internationally is less influenced by the domestic market and better for our identification.

Table A1: Unskilled Migration and Vertical Disintegration: Robustness Analysis

Panel A: Imported intermediate products

Dependent variable:	PII_{nj}_import : PII_x: imported intermediate products divided by sales revenue	PII_{nj}_ratio : PII_x: imported intermediate products divided by domestic intermediate products
	(1)	(2)
$Unskilled\_Migsh_j$	0.1072***	0.0932***
	(0.0102)	(0.0262)
Controls	Yes	Yes
Obs.	7,509	7,509
R^2	0.2077	0.0939

Panel B: Alternative dependent variable

Dependent variable:	PII_{nj}	$PII_{nj}\_2005 - PII_{nj}\_2000$
	(1)	(2)
$Unskilled\_Migsh_j\_a$	0.0622***	
	(0.0084)	
$Unskilled\_Migsh_j\_b$		0.0784***
		(0.0213)
Controls	Yes	Yes
Obs.	7,509	4,126
R^2	0.2107	0.0767

Note: In column (1) of Panel B, $Unskilled\_Migsh_j\_$ a is the ratio of unskilled migrants to all unskilled workers in the city j. In column (2) of Panel B, $Unskilled\_Migsh_j\_$ b is the historical migration pattern before 2000. Control and constant variables are not reported in this table. Standard errors are clustered at the 3-digit industry in each city and reported in parentheses; $*$, $**$, and $***$ represent significance at 10%, 5%, and 1% levels.

In Column (1) of Panel A, we construct the vertical disintegration measurement by calculating the ratio of imported intermediate inputs to sales revenue at the firm level as PII_x in equation (23) in the main text. The estimated magnitude is consistent and comparable to the baseline findings. In Column (2), we calculate the ratio of imported intermediate inputs to the domestic intermediate inputs at the firm level as PII_x for

dependent variable construction. The coefficient is still positive and statistically significant at the 1% level. The results suggest that the inflow of unskilled migrants significantly increases international outsourcing.

We provide another robustness test considering the potential measurement errors of our dependent and independent variables in the baseline setting. In Column (1) of Panel B, we use the ratio of unskilled migrants to the total unskilled labor force at the city level as the main independent variable (i.e., $Unskilled\_Migsh_{j}\_a$). In Column (2) of Panel B, to reduce the potential impact of reverse causality, we use the first difference of vertical disintegration between the years 2000 and 2005 as the dependent variable and use the historical unskilled migration share before 2000 (calculated by 2000 China 0.095% Population Census) as the independent variable (i.e., $Unskilled\_Migsh_{j}\_b$). From Columns (1) to (2) of Panel B, all results are consistent with our baseline findings.

References

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