The Elasticity of the Migrant Labour Supply: Evidence from Temporary Filipino Migrants

SIMONE BERTOLI*, JESÚS FERNÁNDEZ-HUERTAS MORAGA** & SEKOU KEITA†
*CERDI, University of Auvergne and CNRS, Clermont-Ferrand, France, **Departamento de Economia, Universidad Carlos III de Madrid, Madrid, Spain, †CERDI, University of Auvergne, Clermont-Ferrand, France

Online appendix

This online appendix provides details on the model and the estimation equations discussed in the paper, as well as supplemental tables referenced in the main text.

A.1. The market for temporary migrant labor

Let m_{jt} represent the number of migrants that move on a temporary basis from an origin country to the destination country $j = 1, \ldots, N$ at time $t = 1, \ldots, T$, and let $\boldsymbol{w}_t = (w_{0t}, w_{1t}, \ldots, w_{Nt})'$ and $\boldsymbol{c}_t = (c_{0t}, c_{1t}, \ldots, c_{Nt})'$ be two vectors that gather migrants' wages and bilateral migration costs and time t.[1] The inverse demand function for temporary migrant labour is given by:

$$w_{jt} = a_j y_{jt}^{\alpha} m_{jt}^{-\phi}, \tag{A.1}$$

where y_{jt} is the real GDP in country j at time t, and a_j is a time-invariant parameter that shifts the inverse labour demand in destination j. The supply of migrant labour can be derived from an underlying static random utility maximisation model that describes the location-decision problem that potential migrants face, which represents the standard micro-foundation of a gravity equation for migration (Beine et al., 2016). Specifically, if the deterministic component of utility V_{jt} depends on the logarithm of the wage w_{jt} and on bilateral migration costs c_{jt}, that is, $V_{jt} = \beta \ln(w_{jt}) - c_{jt}$, then the distributional assumptions in Mcfadden (1974) on the individual-specific stochastic component ϵ_{ijt} allow to write the expected value of the labour supply m_{jt} as follows:[2]

$$E(m_{jt}) = w_{jt}^{\beta} e^{-c_{jt} - \Omega(\boldsymbol{w}_t, \boldsymbol{c}_t)} n_t, \tag{A.2}$$

where n_t is the size of the population at origin, and:

$$\Omega(\boldsymbol{w}_t, \boldsymbol{c}_t) = \ln\left(\sum_{k=0}^{N} w_{kt}^{\beta} e^{-c_{kt}}\right)$$

represents the expected value from the choice situation that potential migrants face at time t (Small and Rosen, 1981). The function $\Omega(\boldsymbol{w}_t, \boldsymbol{c}_t)$ in Equation (A.2), which describes the influence exerted by the attractiveness of all countries on the expected value of the migrant labour supply to destination j at time t, varies over time but it is invariant across destinations.

A.1.1. The elasticity of the labour supply. We can recover the elasticity of the migrant labour supply from Equation (A.2) assuming, by the law of large numbers, that $E\left(m_{jt}\right) = m_{jt}$. We have that:

$$\frac{\partial \ln\left(m_{jt}\right)}{\partial \ln\left(w_{jt}\right)} = \beta\left(1 - p_{jt}\right). \tag{A.3}$$

The elasticity in Equation (A.3) depends on the actual migration rate $p_{jt} \equiv m_{jt}/n_t$ between the origin and each destination at time t. In practice, p_{jt} will be very small for any $j = 1, \ldots, N$ and any $t = 1, \ldots, T$ since only a tiny fraction of the Filipino population migrates to a single destination in a given year, so that $\beta\left(1 - p_{jt}\right) \approx \beta$, and we will be referring to β as the labour supply elasticity, even though formally it is just an upper bound of the true elasticity.

We can rearrange the terms in Equations (A.1) and (A.2) to obtain (a logarithmic transformation of) the inverse demand function $D_j\left(y_{jt}\right)$ and the inverse supply function $S_j(\boldsymbol{w}_t, \boldsymbol{c}_t)$ for migrant labour in destination j, as:

$$D_j\left(y_{jt}\right) = \ln\left(\mathrm{a_j}\right) + \alpha \ln\left(y_{\mathrm{jt}}\right) - \phi \ln\left(m_{\mathrm{jt}}\right), \tag{A.4}$$

and:

$$S_j(\boldsymbol{w}_t, \boldsymbol{c}_t) = \beta^{-1}\left[\ln\left(m_{jt}\right) + c_{jt} + \Omega(\boldsymbol{w}_t, \boldsymbol{c}_t) - \ln(n_t)\right]. \tag{A.5}$$

We can observe from Equation (A.5) that $S_k(\boldsymbol{w}_t, \boldsymbol{c}_t) = S_j(\boldsymbol{w}_t, \boldsymbol{c}_t) + \beta^{-1}\left(c_{kt} - c_{jt}\right)$, that is, the inverse supply functions for two destinations differ only by a term which is proportional to the difference in the bilateral migration costs.

A.1.2. Reduced form regressions. We can derive the following reduced-form regression that gives us the elasticity of the scale of migration with respect to the real GDP at destination combining Equations (A.1) and (A.2) with $E\left(m_{jt}\right) = m_{jt}$:

$$\ln\left(m_{jt}\right) = \frac{\alpha\beta}{1+\phi\beta}\ln(y_{it}) - \frac{1}{1+\phi\beta}\left[\Omega(\boldsymbol{w}_t, \boldsymbol{c}_t) + c_{jt} - \ln(n_t)\right] + \frac{\beta}{1+\phi\beta}\ln\left(a_j\right) + \varepsilon_{jt}^{m}. \tag{A.6}$$

Similarly, the reduced-form regression that gives us the elasticity of migrants' wages with respect to the real GDP at destination can be written as:

$$\ln\left(w_{jt}\right) = \frac{\alpha}{1+\phi\beta}\ln(y_{it}) - \frac{\phi}{1+\phi\beta}\left[\Omega(\boldsymbol{w}_t, \boldsymbol{c}_t) + c_{jt} - \ln(n_t)\right] + \frac{1}{1+\phi\beta}\ln\left(a_j\right) + \varepsilon_{jt}^{w}. \tag{A.7}$$

Under the assumption that the bilateral migration costs can have different levels across destinations but follow an identical time profile,[3] then the two elasticities of interest can be identified through the estimation of the following two equations:

$$\ln(m_{jt}) = \psi_m \ln(y_{it}) + \boldsymbol{\beta}_m{}'\boldsymbol{d}_j + \boldsymbol{\gamma}_m{}'\boldsymbol{d}_t + \varepsilon_{jt}^{m}, \tag{A.8}$$

and:

$$\ln(w_{jt}) = \psi_w \ln(y_{it}) + \boldsymbol{\beta}_w{}' \boldsymbol{d}_j + \boldsymbol{\gamma}_w{}' \boldsymbol{d}_t + \varepsilon_{jt}^{w}, \tag{A.9}$$

where w_{jt} in Equation (A.9) is either the mean or the median wage earned by the m_{jt} migrants and $\boldsymbol{d}_j$ and $\boldsymbol{d}_t$ are two vectors of destination and time dummies. Destination dummies $\boldsymbol{d}_j$ control for the dyadic time-invariant component c_j of migration costs, and for the $\ln(a_j)$ in Equation (A.4) that influences the level of the demand for temporary migrant labour. Time dummies $\boldsymbol{d}_t$ control for the factors that exert a time-varying influence on $\ln(m_{jt})$ and $\ln(w_{jt})$ for any $j = 1, \ldots, N$, such as demographic factors at origin or variations in macroeconomic conditions in all potential destinations and at origin.

It is then immediate from Equations (A.6)–(A.9) to recover an estimate of the labour supply elasticity parameter β in Equation (A.3) as:

$$\hat{\beta} = \frac{\hat{\psi}_m}{\hat{\psi}_w}. \tag{A.10}$$

A.2. Additional specifications

Table A.1. Median wages

	Dependent variable:		
	ln(*median wages*)		
Specification	Restricted	Restricted	Unrestricted
Variables	(1)	(2)	(3)
Log GDP	–0.06	0.61**	0.78***
	[0.16]	[0.23]	[0.05]
Observations	967	967	967
Adjusted R^2	0.72	0.96	0.98
Country dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Weights	No	Yes	Yes
H_0: (2) nested in (3)[a]; *F*-test		5.73***	
(*p*-value)		(0.00)	
H_0: $\hat{\psi}_w^{(2)} = \hat{\psi}_w^{(3)}$; *Chi*^{2} test		0.49	
(*p*-value)		(0.48)	

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$; standard errors clustered at the country level in brackets for specifications (1) and (2); specification (1) corresponds to Table 2, Panel A in McKenzie et al. (2014); observations in specifications (2) and (3) are weighted by m_{jt}; [a] (2) and (3) refer to the specification in the table. The restricted version of the estimation equation assumes that all destination countries are equally substitutable for potential migrants. The unrestricted version allows for different patterns of substitution across destinations for potential migrants.
Source: Authors' elaboration on the replication data from McKenzie et al. (2014).

Table A.2. Mean wages by gender

		Dependent variable:		
		ln(*mean wages*)		
Specification	Restricted	Restricted		Unrestricted
Variables	(1)	(2)		(3)
Panel A: Male sample				
Log GDP	–0.03	0.46***		0.33***
	[0.12]	[0.13]		[0.09]
H_0: (2) nested in (3)[a]; *F*-test			8.47***	
(*p*-value)			(0.00)	
H_0: $\hat{\psi}_w^{(2)} = \hat{\psi}_w^{(3)}$; *Chi*^{2} test			0.64	
(*p*-value)			(0.42)	
Observations	930	930		930
Adjusted R^2	0.67	0.92		0.96
Panel B: Female sample				
Log GDP	0.04	0.46***		0.34***
	[0.21]	[0.16]		[0.05]
H_0: (2) nested in (3)[a]; *F*-test			4.89***	
(*p*-value)			(0.00)	
H_0: $\hat{\psi}_w^{(2)} = \hat{\psi}_w^{(3)}$; *Chi*^{2} test			0.46	
(*p*-value)			(0.50)	
Observations	901	901		901
Adjusted R^2	0.75	0.98		0.98
Country dummies	Yes	Yes		Yes
Year dummies	Yes	Yes		Yes
Weights	No	Yes		Yes

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$; standard errors clustered at the country level in brackets for specifications (1) and (2); specification (1) corresponds to Table 2, Panels B and C in McKenzie et al. (2014); observations in specifications (2) and (3) are weighted by the gender-specific number of migrants m_{jt}; [a] (2) and (3) refer to the specification in the table. The restricted version of the estimation equation assumes that all destination countries are equally substitutable for potential migrants. The unrestricted version allows for different patterns of substitution across destinations for potential migrants.
Source: Authors' elaboration on the replication data from McKenzie et al. (2014).

Table A.3. Median wages by gender

	Dependent variable:			
	ln(*median wages*)			
Specification	Restricted	Restricted		Unrestricted
Variables	(1)	(2)		(3)
Panel A: Male sample				
Log GDP	–0.02	0.45**		0.19*
	[0.15]	[0.18]		[0.10]
H_0: (2) nested in (3)[a]; *F*-test			8.93***	
(*p*-value)			(0.00)	
H_0: $\hat{\psi}_w^{(2)} = \hat{\psi}_w^{(3)}$; *Chi*^{2} test			1.66	
(*p*-value)			(0.20)	
Observations	930	930		930
Adjusted R^2	0.65	0.89		0.95
Panel B: Female sample				
Log GDP	-0.05	0.51***		0.35***
	[0.23]	[0.18]		[0.06]
H_0: (2) nested in (3)[a]; *F*-test			4.29***	
(*p*-value)			(0.00)	
H_0: $\hat{\psi}_w^{(2)} = \hat{\psi}_w^{(3)}$; *Chi*^{2} test			0.58	
(*p*-value)			(0.45)	
Observations	901	901		901
Adjusted R^2	0.74	0.97		0.98
Country dummies	Yes	Yes		Yes
Year dummies	Yes	Yes		Yes
Weights	No	Yes		Yes

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$; standard errors clustered at the country level in brackets for specifications (1) and (2); specification (1) corresponds to Table 2, Panels B and C in McKenzie et al. (2014); observations in specifications (2) and (3) are weighted by the gender-specific number of migrants m_{jt}; [a] (2) and (3) refer to the specification in the table. The restricted version of the estimation equation assumes that all destination countries are equally substitutable for potential migrants. The unrestricted version allows for different patterns of substitution across destinations for potential migrants.
Source: Authors' elaboration on the replication data from McKenzie et al. (2014).

Table A.4. Migration regression by gender

Dependent variable:			
	$\ln(m_{jt})$		
Specification	Restricted		Unrestricted
Variables	(1)		(2)
Panel A: Male sample			
Log GDP	1.15**		3.61***
	[0.53]		[0.69]
H_0: (1) nested in (2)[a]; *F*-test		5.72***	
(*p*-value)		(0.00)	
H_0: $\hat{\psi}_m^{(1)} = \hat{\psi}_m^{(2)}$; *Chi*^{2} test		7.14***	
(*p*-value)		(0.01)	
Observations	972		972
Adjusted R^2	0.82		0.89
Panel B: Female sample			
Log GDP	1.98***		1.37**
	[0.62]		[0.63]
H_0: (1) nested in (2)[a]; *F*-test		5.99***	
(*p*-value)		(0.00)	
H_0: $\hat{\psi}_m^{(1)} = \hat{\psi}_m^{(2)}$; *Chi*^{2} test		0.62	
(*p*-value)		(0.43)	
Observations	972		972
Adjusted R^2	0.90		0.93
Country dummies	Yes		Yes
Year dummies	Yes		Yes

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$; standard errors clustered at the country level in brackets for specification (1); specification (1) corresponds to Table 2, Panels B and C in McKenzie et al. (2014); [a] (1) and (2) refer to the specification in the table. The restricted version of the estimation equation assumes that all destination countries are equally substitutable for potential migrants. The unrestricted version allows for different patterns of substitution across destinations for potential migrants.
Source: Authors' elaboration on the replication data from McKenzie et al. (2014).

Table A.5. Mean wages, omitting Japan

	Dependent variable:		
	ln(*mean wages*)		
Specification	Restricted	Restricted	Unrestricted
Variables	(1)	(2)	(3)
log GDP	–0.07	0.58***	0.50***
	[0.14]	[0.15]	[0.07]
Observations	949	949	949
Adjusted R^2	0.73	0.90	0.94
Country dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Weights	No	Yes	Yes
H_0: (2) nested in (3)[a]; *F*-test		6.99***	
(*p*-value)		(0.00)	
H_0: $\hat{\psi}_w^{(2)} = \hat{\psi}_w^{(3)}$; *Chi*^{2} test		0.19	
(*p*-value)		(0.67)	

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$; standard errors clustered at the country level in brackets for specifications (1) and (2); observations in specifications (2) and (3) are weighted by m_{jt}; [a] (2) and (3) refer to the specification in the table. The restricted version of the estimation equation assumes that all destination countries are equally substitutable for potential migrants. The unrestricted version allows for different patterns of substitution across destinations for potential migrants.
Source: Authors' elaboration on the replication data from McKenzie et al. (2014).

Table A.6:. Median wages, omitting Japan

	Dependent variable:		
	ln(*median wages*)		
Specification	Restricted	Restricted	Unrestricted
Variables	(1)	(2)	(3)
log GDP	–0.09	0.79***	0.68***
	[0.16]	[0.18]	[0.08]
Observations	949	949	949
Adjusted R^2	0.70	0.89	0.94
Country dummies	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Weights	No	Yes	Yes
H_0: (2) nested in (3)[a]; *F*-test		9.03***	
(*p*-value)		(0.00)	
H_0: $\hat{\psi}_w^{(2)} = \hat{\psi}_w^{(3)}$; *Chi*^{2} test		0.25	
(*p*-value)		(0.62)	

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$; standard errors clustered at the country level in brackets for specifications (1) and (2); observations in specifications (2) and (3) are weighted by m_{jt}; [a] (2) and (3) refer to the specification in the table. The restricted version of the estimation equation assumes that all destination countries are equally substitutable for potential migrants. The unrestricted version allows for different patterns of substitution across destinations for potential migrants.
Source: Authors' elaboration on the replication data from McKenzie et al. (2014).

Table A.7. Migration regression omitting Japan

	Dependent variable:	
	$\ln(m_{jt})$	
Specification	Restricted	Unrestricted
Variables	(1)	(2)
log GDP	1.34***	3.45***
	[0.47]	[0.67]
Observations	954	954
Adjusted R^2	0.85	0.89
Country dummies	Yes	Yes
Year dummies	Yes	Yes
H_0: (1) nested in (2)[a]; *F*-test	4.77***	
(*p*-value)	(0.00)	
H_0: $\hat{\psi}_m^{(1)} = \hat{\psi}_m^{(2)}$; *Chi*^{2} test	5.97**	
(*p*-value)	(0.02)	

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$; standard errors clustered at the country level in brackets for specification (1); [a] (1) and (2) refer to the specification in the table. The restricted version of the estimation equation assumes that all destination countries are equally substitutable for potential migrants. The unrestricted version allows for different patterns of substitution across destinations for potential migrants.
Source: Authors' elaboration on the replication data from McKenzie et al. (2014).

Notes

1. We let w_{0t} denote the wage in the origin country at time t, and we normalise the cost of staying c_{0t} to zero.
2. We thus assume that ϵ_{ijt} follows an independent and identically distributed Extreme Value Type-1 distribution.
3. Formally, we assume that $c_{jt} = c_j + f_t$ for all $j \in D$; this assumption implies that the difference between $S_k(\boldsymbol{w}_t, \boldsymbol{c}_t)$ and $S_j(\boldsymbol{w}_t, \boldsymbol{c}_t)$, with $j, k \in D$, is time-invariant.

References

Beine, M., Bertoli, S., & Fernández-Huertas Moraga, J. (2016). A practitioners' guide to gravity models of international migration. *The World Economy*, *39*, 496–512. doi:10.1111/twec.2016.39.issue-4

McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. In P. Zarembka (Eds.), *Frontiers in econometrics* (pp. 105–142). New York, NY: Academic Press.

McKenzie, D., Theoharides, C., & Yang, D. (2014). Distortions in the international migrant labor market: Evidence from Filipino migration and wage responses to destination country economic shocks. *American Economic Journal: Applied Economics*, *6* (2), 49–75.

Small, K. A., & Rosen, H. S. (1981). Applied welfare economics with discrete choice models. *Econometrica*, *49*(1), 105–130. doi:10.2307/1911129