Moving ideas across borders: Migrant inventors, patents and FDI

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If I were a country.....would I be a big one?

Population

1. China 1,366,900,000
2. India 1,249,620,000
3. United States 318,787,000
4. Indonesia 252,164,800
5. Migrants 215,000,000
6. Pakistan 188,020,000
7. Nigeria 178,517,000
8. Bangladesh 157,019,000
9. Russia 146,149,200
10. Japan 127,040,000
11. Mexico 119,713,203

21. Skilled Migrants 71,000,000

...

50. Migrants Managers 28,000,000

114. Inventor Migrants 11,610,000

GDP (billions of $)

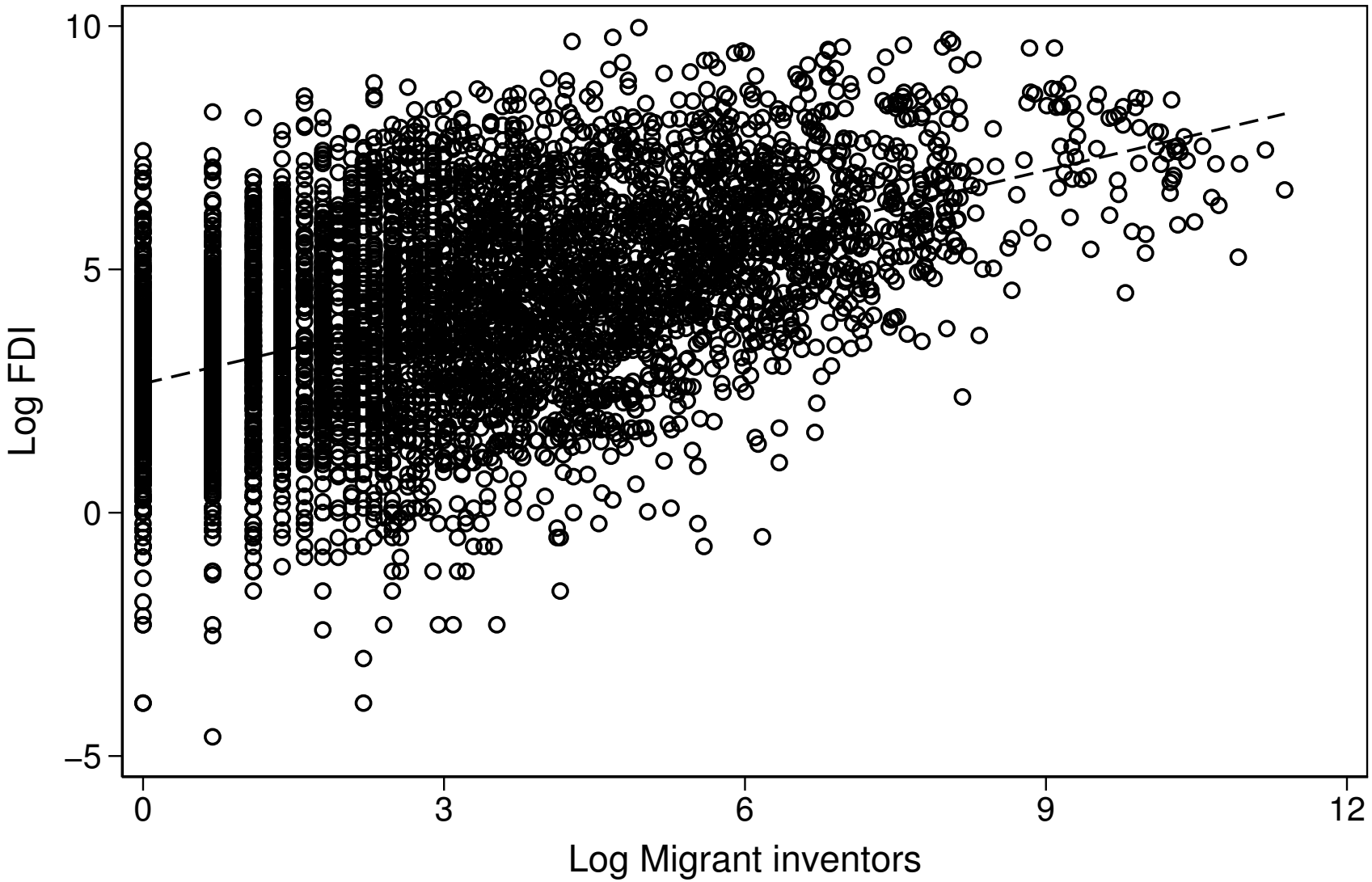
1. United States 18,036
2. Trade 16,576
3. Japan 4,383
4. Germany 3,363
5. United Kingdom 2,861
6. France 2,419
7. India 2,419
8. FDI 2,136
10. Brazil 1,804
11. Canada 1,553
12. Korea 1,378
13. Russia 1,366
14. Australia 1,339
15. Spain 1,193
16. Mexico 1,144

Smoking gun

- One third of migrants have tertiary education
  - 13% of migrant work as managers
  - 3% of migrants have patented an invention
- Skilled migrants promote trade (Iranzo & Peri, 2009, Bahar et al., 2018) & FDI (Kugler and Rapoport, 2007; Javorcik et al, 2011)

  More lit.
  - Managers boost exports (Bloom et al., 2018; Martín-Montaner, 2014) & FDI (Cuadros et al., 2019)
- ¿Do migrant inventors promote FDI?
  - Foley and Kerr (2013): Long-run evidence of ethnic innovators on the activity of US multinational firms.
- What do all these talented individuals have in common?

Smoking Bazooka



Outline

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Some ideas

- Out theoretical framework ⇒Firms have ideas, but they to invest in adapting them to increase the success in the destination market.
  - To penetrate the Chinese market, in 2009 Mondelez (Oreo's owner) undertook research on the right combination of color, crunchiness and bitterness of the Oreo biscuit to appeal to Chinese tastes (Czinkotta et al. 2015)
  - Ford currently is employing Chinese researchers to eliminate the smell of "new" of its cars. Unlike Western consumers, Chinese consumers dislike the smell of new cars
    `https://www.forbes.com/sites/joannmuller/2010/08/18/smelled`
- Migrants could provide an invaluable source of knowledge regarding how to better target consumer needs in the destination market.
  - We focus on migrant inventors as those may have the necessary knowledge to translate this destination-specific knowledge into changes in product design or the production process that allow the firm to adapt better the product to the local tastes.

Autobiographical paper

Previous contributions

- Migrants' contribution to innovation activity is still rather limited and confined largely to the US (Kerr, 2007, 2008; Grossman, 2016; Hunt and Loiselle, 2011).
  - Foley and Kerr (2013): Evidence for US The higher knowledge and experience of innovators from a certain ethnicity are crucial for developing products and services targeted at customers in countries associated with that ethnicity.
- Anecdotal evidence suggest that:
  - International migration exposes a country to the creative ideas of different people and may result in more innovation (Ortega and Peri, 2014).
  - Increase in the share of migrants' inventors over time (Miguelez, 2018)
    - Strong relationship between inventor diasporas and different forms of international co-patenting. This study uses direct nationality information of the inventors listed in patent applications: A 10% increase in the investor diaspora abroad is associated with a 2.0-2.2% increase in international patent collaborations

Our Contributions

1. To the best of our knowledge, our paper is the first one to provide a theoretical framework to explain the role played by migrants in promoting *FDI* through innovation: We build a multi-country, multi-sector model based on Helpman, Melitz and Yeaple (2004) and Chaney (2008) in which firms invest in product quality to better target their destination markets.
2. In addition, we use the latest gravity techniques (i.e., structural gravity) to quantify the model's predictions.
    1. We use data on patents and migrant inventors rather than ethnic innovators
    2. We also use a panel analysis which allows us to control for both origin and destination determinants of *FDI* & multilateral resistance.

A few words about the model

- Our world is composed of J small open economies with K+1 final goods.
- Preferences across goods described by the following Cobb-Douglas utility function and preferences across different varieties are ra standard *CES* utility function:

$$U_j = \prod_{k=0}^{K} C_{kj}^{\mu_k}, \quad \sum_{k=0}^{k} \mu_k = 1,$$

$$C_{kj} = \left[\int_{\omega \in \Omega_k} \left(\left(q_{kj}(\omega) \right)^{\phi_k} c_{kj}(\omega) \right)^{\frac{\sigma_k - 1}{\sigma_k}} d\omega \right]^{\frac{\sigma_k}{\sigma_k - 1}}, \ \sigma_k > 1, \ 0 \leq \phi_k < 1,$$

where $c_{kj}(\omega)$ denotes the consumption of variety ω, in sector k in country j and $q_{kj}(\omega) > 0$ its the perceived quality of variety ω in sector k and country j.

Production

- Firms in each sector produce using a Cobb-Douglas technology:

$$x_k(\omega) = \varphi \left(\frac{K_k(\omega)}{\gamma} \right)^{\gamma} \left(\frac{L_k(\omega)}{1-\gamma} \right)^{1-\gamma},$$

where φ denotes the firms' *TFP*. $x_k(\omega)$ is the total quantity produced of variety ω and $K_k(\omega)$ and $L_k(\omega)$ are respectively the capital and labor used in the production of variety ω. Each firm, when entering, draws their productivity from a common productivity distribution which follows a Pareto functional form.

$$\Pr(\varphi \leq \varphi_0) = 1 - (\varphi_0)^{-\kappa}, \ \varphi_0 \geqslant 1, \ \kappa > \sigma - 1.$$

Investment in quality

- Firms can also invest to increase the consumer's perceived quality at each destination market. The perceived quality depends on the number of ideas created to tailor the product close to their customer's needs. The mapping of ideas into quality is described by the following functional form:

$$q_{kj}(\omega)^{\sigma_k - 1} = z_{kj}(\omega),$$

  where $z_{kj}(\omega)$, is the number of specific ideas.
- Ideas are produced using the following technology:

$$z_{kj}(\omega) = \frac{\theta_{ij} L_{kij}}{\varphi^{\sigma-1}},$$

  where L_{kij}, represents the number of workers devoted to research (inventors) in country i for targeting market j and θ_{ij}, represents the productivity of $R\&D$ workers in country i making ideas applicable to the destination country j.
- The variable $\theta_{ij} > 1$ represents the increase in productivity that comes through the interaction between the researchers network that depends on the worker's cultural distance.

Solution. Some features of the model

- Consider now the possibility that firms have to invest f_{Ij} units of capital in a foreign plant for production while undertaking its R&D activities in the headquarters at home.
- The optimal investment in product quality is given by

$$z_{ij} = {q_{ij}}^{\sigma-1} = \left(\frac{\phi \left(\tau_{ij}\right)^{1-\sigma} B_{ij} \theta_{ij}}{\varepsilon_i} \right)^{\frac{1}{1-\phi}}$$

  which is increases in the extent of the market (B_{ij}), the the productivity of the inventors associated with market j,θ_{ij} and decreases with market remoteness $\left(\tau_{ij}\right)^{1-\sigma}$.
- Investment in quality to a specific destination increases with the productivity of inventors. Native inventors will have the highest productivity in creating ideas for their own domestic market.
- If θ_{ij} is decreases with on the geographical distance, FDI decline with the distance $\Rightarrow$ A stylized fact in this literature.

Migration

- When we allow for migration our production function for the creation of new ideas is given by:

$$z_j(\omega) = \frac{\tilde{\theta}_{ij} \sum_{k=1}^{n} L_{ij}^k}{\varphi^{\sigma-1}}$$

- The productivity of the research lab is a weighted average productivity of all the workers in the research lab.

$$\tilde{\theta}_{ij} = \sum_{k=1}^{n} \beta_{ij}^k \theta_{ij}^k$$

- We assume that the $R\&D$ investment is undertaken in the home country and is transferred without costs.

Investment margins

- The equation for the intensive margin of *FDI* is given by:

$$rK_{klj}(\varphi) = \left\{ \begin{array}{ll} \lambda''_{kj} (Y_j)^{\frac{\sigma_k - 1}{\kappa}} \bar{\eta}_{kj}^{\frac{1}{\phi_k - 1}} \left(\frac{\theta_{ij}}{\varepsilon_i} \right)^{\frac{\phi_k}{1-\phi_k}} \varphi^{\sigma_k - 1} & \text{if } \varphi \geqslant \varphi^*_{klj} \\ 0 & \text{otherwise} \end{array} \right\}$$

- The gravity equation for *FDI* at the extensive margin is given by:

$$N_i rf_{lj}(\varphi^*_{klj})^{-\kappa} = Y_i Y_j \bar{\eta}_{kj}^{\frac{\kappa}{(\phi_k - 1)(\sigma_k - 1)}} \left(\frac{\theta_{ij}}{\varepsilon_i} \right)^{\frac{\phi_k \kappa}{(1-\phi_k)(\sigma_k - 1)}} \lambda^{iv}_{kij},$$

Empirics

Estimation

2 stage least square estimation strategy:

$$\ln FDI_{ijkt} = \beta_1 \ln \hat{\text{Patents}}_{ijkt} + \lambda_{it} + \lambda_{jt} + \lambda_{ij} + \lambda_k + e_{kijt} \quad (1)$$

$$\ln Patents_{ikt} = \beta_2 \ln \text{Migrantinventors}_{jikt} + \lambda_{it} + \lambda_{jt} + \lambda_{ij} + \lambda_k + e_{kijt} \quad (2)$$

We use the the Pseudo-Poisson Maximum likelihood (PPML) estimator proposed by Silva and Tenreyro (2006) using Larch's et al. (2017) procedure:

$$FDI_{ijkt} = \exp\begin{pmatrix} \beta_1 \ln \hat{\text{Patents}}_{ijkt} \\ \lambda_{it} + \lambda_{jt} + \lambda_{ij} + \lambda_k \end{pmatrix} + e_{ijkt}. \quad (3)$$

Data

Data

FDIMarkets: firm level greenfield investments

- Patents: Patstat
- Migrant inventors: Fink and Miguelez (2013)
- 1450 firms from 34 Home countries (north-developed), 145 Host countries (mixed)
- 18 activity sectors
- Period: 2003-2012

Table: Migrant type and firm sector matching

Migrant type	Firm Sector
Mechanical engineers	Industrial Machinery Automotive Components Automotive OEM Business Machinery
Electrical engineers	Communications Electronic Components Software & IT Consumer Electronics Semiconductors
Chemists	Chemicals Plastics Pharmaceuticals

Baseline

Dep. Variable →	(1) Int. Margin	(2) Ext. Margin	(3) Int. Margin	(4) Ext. Margin	(5) Int. Quota	(6) Ext. Quota
$\ln \text{PatStock}_{ki\tilde{j}t}$	0.165***	0.095***	0.137***	0.147***	0.136***	0.139***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Observations	4455	4455	5967	5967	5967	5967
R^2	0.593	0.753	0.730	0.693	0.174	0.134
Home*Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Host*Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by country pair

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(2SLS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	First stage (OLS)	Second stage (OLS)			Second stage (PPML)		
Dep. Variable →	$\ln \text{PatStock}_{kij\tilde{t}}$	Int. Margin	Ext. Margin	Int. Margin	Ext. Margin	Int. Quota	Ext. Quota
$\ln \text{MigraInvStock}_{kjit}$	0.574***						
	(0.04)						
$\ln \widehat{\text{PatStock}}_{kij\tilde{t}}$		0.243***	0.089**	0.300**	0.372***	0.273**	0.295***
		(0.09)	(0.04)	(0.12)	(0.05)	(0.11)	(0.05)
Observations	6153	4455	4455	5967	5967	5967	5967
R^2	0.769	0.030	0.066	0.720	0.680	0.176	0.131
Home*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Host*Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cragg-Donald Wald F	92.915						
Anderson LM statistic	116.540***						

Robust standard errors in parentheses, clustered by country pair

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

2SLS

	(1)	(2)	(3)	(4)	(5)	(6)
	Second stage (OLS)		Second stage (PPML)			
Dep. Variable→	Int. Margin	Ext. Margin	Int. Margin	Ext. Margin	Int. Quota	Ext. Quota
$\ln \widehat{\text{PatStock}}_{kij\tilde{t}}$	0.203**	0.081**	0.209*	0.357***	0.198*	0.290***
	(0.09)	(0.04)	(0.12)	(0.06)	(0.11)	(0.05)
$\ln \text{MigraInv}_{kijt}$	0.130***	0.025	0.216***	0.029	0.192***	0.011
	(0.04)	(0.02)	(0.04)	(0.02)	(0.04)	(0.02)
Observations	4455	4455	5967	5967	5967	5967
R^2	0.039	0.066	0.725	0.680	0.177	0.131
Home*Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Host*Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by country pair

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Sectoral results

	(1)	(2)	(3)	(4)	(5)	(6)
	Chemistry		Electrical engineering		Mechanical engineering	
$\ln \widehat{\text{PatStock}}_{kij\tilde{t}}$	-0.013	-0.417	1.681*	0.568*	-0.330	-0.521
	(1.56)	(0.55)	(0.99)	(0.32)	(1.15)	(0.49)
$\ln \text{MigraInv}_{kijt}$	0.068	0.013	-0.153	0.088**	0.026	0.023
	(0.13)	(0.04)	(0.13)	(0.04)	(0.14)	(0.06)
Observations	1353	1353	1858	1858	947	947
Home*Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Host*Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by country pair

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Placebo

	(1)		(2)	(3)	(4)	(5)
	First stage		Second stage (Migrants)		Second stage (Labor Migrants)	
Dep Variable:	$\ln \text{PatStock}_{ij\tilde{t}}$		Intensive Margin	Extensive Margin	Intensive Margin	Extensive Margin
$\ln \text{Migrants}_{jit}$	-0.003					
	(0.06)					
$\ln \text{LaborMigrants}_{jit}$		-0.028				
		(0.15)				
$\ln \hat{\text{PatStock}}_{ij\tilde{t}}$			0.982	-16.880	-5.993	-3.097
			(26.22)	(252.57)	(33.66)	(17.03)
Observations	8,242	1,326	8,242	8242	1,326	1326
R^2	0.98	0.98	0.620	-0.22	0.73	0.11
Home*Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Host*Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Cragg-Donald Wald F:	0.034	0.005				
Anderson LM statistic:	0.067	0.007				

Robust standard errors in parentheses, clustered by country pair

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Take-away

1. Migrant inventors may enhance the innovative performance of multinational firms
   1. We develop a model to explain how
   2. We estimate how much and for which sectors. Separate evidence for the extensive and intensive margin of Greenfield FDI.
   3. Novel channel with respect to those previously analyzed in the migration-FDI studies
   4. Focused on a very specific set of skilled migrants: migrant inventors (homogenous group/we rely directly on the migratory background)
2. Our hypothesis: Migrants help to create a competitive advantage at the firm level and this increases the chances of establishing a plant and lowers investment costs
   1. We find evidence supporting this hypothesis:
      1. Patent activity of multinational firms at the source country as well as migrant inventors have a positive effect on greenfield FDI in the host country at both the intensive as well as the extensive margins, although the impact of the former is greater.
      2. Differential impact of patents and migrant inventors across activities

Any more ideas??

Thanks!

Related literature

STUDY	COUNTRY / PERIOD	MAIN RESULTS
Kugler and Rapoport (2007)	United States 1990 and 2000	Higher unskilled emigration in 1990 is associated with higher growth of total FDI inflows over the following decade.
Docquier and Lodigiani (2010)	Cross section 114 countries. Panel data/ 83 countries	Strong network externalities mainly associated with the skilled diaspora
Ivlevs and De Melo (2010)	1990-2000 103 migration-sending countries	If exports are low skill intensive, emigration of high-skilled labour leads to positive FDI
Flisi and Murat (2011)	Immigrant networks for France, Germany, UK, Italy and Spain	Skilled immigrants increase bilateral FDI in UK, France and Germany. In Italy and Spain, FDI is influenced by their emigrant diaspora network. Negative impact for unskilled migrants: substitution effect between low-skilled immigration and investment abroad
Javorcik et al. (2011)	United States 1990 and 2000	Outward FDI (stock) positively related with the presence of migrants in US (stock). Stronger effect for the share of tertiary educated migrants
Leblang (2011)	26 OECD reporting countries and 120 destination countries 2000 and 2001	Migrant networks encourage cross-border investments (FDI and portfolio). The effect on FDI is substantially larger. Stronger for migrants with tertiary education
Foad (2012)	50 US states, 10 source countries 1990 and 2000 for immigration	Presence of immigrants leads to new FDI from immigrants' native countries. This effect is stronger for skilled migrants and might take a few years to occur
Gheasi et al. (2013)	United Kingdom 2001-2007	FDI abroad positively related with the presence of migrants. More educated migrants have a higher positive effect on FDI.
Tomohara (2017b)	Japan 1996-2011	FDI inflows become more dominant compared to imports when skilled immigration flows increase and less dominant when unskilled immigration flows increase
Tomohara (2017a)	Japan 1996-2011	Contemporaneous negative relationship between low-skilled migration and FDI
Cuadros et al. (2019)	OECD 2004-2008	Positive effect of migrant managers

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