Skilled Migrants and Knowledge Transfer Across Borders

Two Studies

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Seminar at KNOMAD, World Bank
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Study 1
Return Migrants as "Knowledge Bridge"

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Indians head home in 'brain gain'

By John Sudworth
BBC News, Delhi

For much of the last century India suffered a "brain drain". Generations of Indians set off in search of a better life in other countries. Today, an estimated 25 million people of Indian origin live overseas. But could the tide be turning?

Around 35,000 overseas Indians have returned to Bangalore

"My dad was against me moving back to India," Manish Amin tells me in his new flat in Delhi where he lives with his wife and two sons.

Three decades ago Manish's parents moved from India to the UK. He has just moved back.

BusinessWeek

HOME FINANCE TECHNOLOGY INNOVATION

IN DEPTH September 4, 2008, 5:00PM EST

Chinese Scientists Build Big Pharma Back Home

In a reverse migration, U.S.-trained scientists are setting up biotech startups, contract-research companies, and university labs on the mainland

By Pete Engardio

Lab workers at Wuxi PharmaTech, which was founded by returnees

BW MAGAZINE
The Disposable Worker
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Endless Oil
Executive Summary
Blog: The Bloomberg BusinessWeek/YouGov Optimism Meter

THIS ISSUE
September 15, 2008
Launching Your Career? Discover

- Microsoft India R&D center incubated by 12 return migrants.
- Return migrants comprise 8% inventors in 2007

Motivation

- MNEs exist because of their ability to transfer and exploit knowledge more efficiently in the intra-firm context than through external market mechanisms (Caves, 1971)
- Two recent phenomenon – (1) MNE R&D centers in China and India, (2) Return migration of engineers and scientists
- **What is the role of return migrants in producing and transferring knowledge across borders?**

Prior literature on spatial agglomeration of knowledge

- Knowledge spillovers largely local in nature (Jaffe, et al. 1993)
  - Engineers and scientists unlikely to relocate geographically (Zucker et al., 1998)
  - Local non-market-based social ties facilitate this association (Saxenian, 1999; Agrawal et al., 2008)
- For MNE, knowledge likely to be localized within the larger, more established knowledge production centers
- **Implications for MNEs** - MNEs face constraints in producing/transferring knowledge across borders at newly established emerging market R&D centers

Prior literature on return migration

- Percentage of migrants who return to their home country within 10-20 years is 25% to 30% of the initial group (Borjas and Bratsberg, 1996; Dustmann et al., 2011)
- Related literature focused on role of diaspora in facilitating international knowledge transfers (Kerr, 2008)
- Theoretical work based on Roy (1951) model of self selection on which migrants likely to return (e.g. Borjas and Bratsberg, 1996)
- **Relatively under-studied area of research is how return migrants affect innovation and entrepreneurship in their home countries once they return**

Empirical questions

- **In the context of MNEs, what is role of return migrants in producing and transferring knowledge across borders?**
  - Do return migrants file disproportionately higher number of patents compared to local inventors?

    $E(Yi|Xi) \sim exp\ (\beta_1 is_returnee_i + \beta_2 T_i is_returnee_i + Zi\gamma)$

  - For local inventors, does reporting to return migrants lead to higher patenting?

    $E(Yi|Xi) \sim exp\ (\beta_1 is_manager_returnee_i + \beta_2 T_i is_manager_returnee_i + Zi\gamma)$

Empirical setting

- Data collected for 1315 inventors at Microsoft India

Employment and personal records

- Tenure
- Job title
- Organizational group
- Whether returnee?
- If returnee, relocation date
- Name of manager

Patenting records

- Patents granted (1994 - 2007)
- Patents filed (2004 - 2008)

Data on demographic similarities

- College
- Home town
- Ethnicity and sub-ethnicity

Summary statistics

Variable	Obs	Mean	Std. dev.	Min	Max
is_return migrant	1315	0.08	0.27	0	1
manager is return migrant	1118	0.33	0.47	0	1
returnee _tenure_at_subsidiary (years)	104	2.44	2.05	0	10
is_newly_hired_college_graduate	1315	0.18	0.38	0	1
fraction tenure < 1yr	1202	0.25	0.43	0	1
fraction tenure = 1-2 years	1202	0.34	0.47	0	1
fraction tenure = 2-4 years	1202	0.28	0.45	0	1
fraction tenure = 4-6 years	1202	0.04	0.20	0	1
fraction tenure = 6-10 years	1202	0.06	0.24	0	1
fraction tenure >10 years	1202	0.03	0.18	0	1

Summary statistics, continued

Variable	Obs	Mean	Std. dev.	Min	Max
number_patents_granted	1315	0.12	1.15	0	29
number_patents_filed	1315	0.20	0.93	0	21
has_been_granted_patent	1315	0.03	0.17	0	1
has_filed_patent	1315	0.10	0.29	0	1
manager_shares_college	1078	0.01	0.12	0	1
manager_shares_ethnicity	1078	0.01	0.12	0	1
manager_shares_homestate	1078	0.003	0.06	0	1

Patent filing by return migrants

	(1)	(2)	(3)
is_returnee	1.32*** (0.27)	1.13*** (0.29)	-
tenure between 6 and 10 years	-	-	2.06*** (0.39)
tenure more than 10 years	-	-	-14.48*** (0.84)
is_returnee * (tenure_less_than6yrs)	-	-	-0.21 (0.68)
is_returnee * (tenure_6-10yrs)	-	-	-0.55 (0.55)
is_returnee * (tenure_more_than10yrs)	-	-	16.25*** (0.88)
Dummies for org groups	No	Yes	Yes
N	1315	1202	1202

Prior patent grants by return migrants

	Dependent Variable = Number of patents granted			
	(1)	(2)	(3)	(4)
is_returnee	4.06*** (0.44)	3.84*** (0.43)	0.88* (0.49)	-
tenure between 6 and 10 years	-	-	2.37*** (0.65)	2.82*** (0.66)
tenure more than 10 years	-	-	4.55*** (0.65)	3.83*** (0.87)
is_returnee * (tenure_less_than6yrs)	-	-	-	1.59 (1.09)
is_returnee * (tenure_6-10yrs)	-	-	-	0.26 (0.66)
is_returnee * (tenure_more_than10yrs)	-	-	-	1.71** (0.79)
Dummies for org groups	No	Yes	Yes	Yes
N	1315	1202	1202	1202

Assignment of managers to new college graduates – Natural experiment

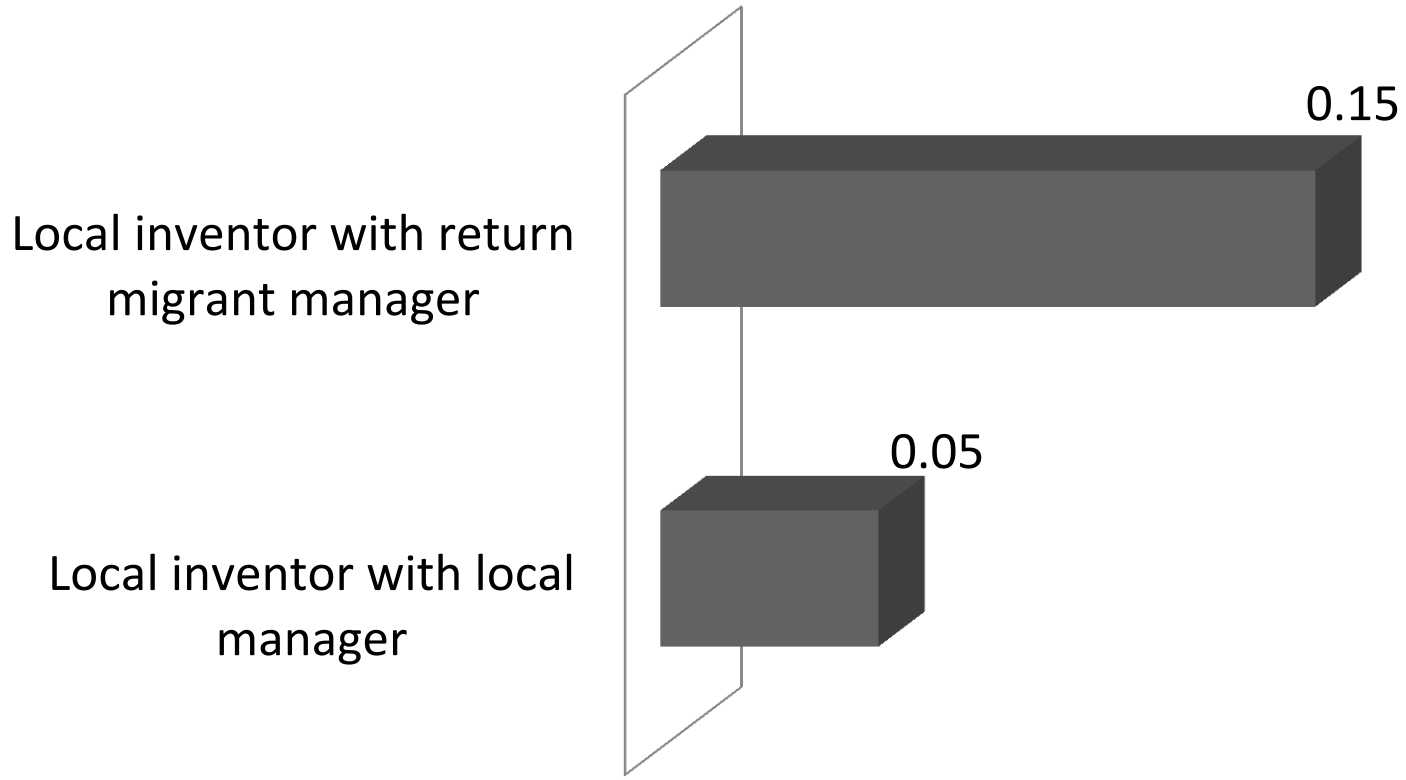
1. Consider new college graduates
2. Assignment of manager uncorrelated to observables
3. Compare grads with return migrant manager to grads with local manager

- Assignment prior to induction training
- HR partly located in different city
- Small number of grads, relative homogeneity

Validating Random Assignment

	Dependent variable - manager is a returnee			
	I	II	III	IV
Local employee studied at IIT	0.72 (0.51)	-	-	0.77 (0.52)
Local employee shares ethnicity with manager	-	1.10 (1.43)	-	1.32 (1.45)
Local employee shares social interest with manager	-	-	-0.02 (0.33)	0.24 (0.50)
N	115	215	215	115

Has filed a patent



Patenting by direct reports – Results of natural experiment with new college grads

	Dependent variable = Number of patents filed				
	(1)	(2)	(3)	(4)	(5)
manager is return migrant	2.30*** (0.81)	2.02** (0.79)	1.85** (0.73)	1.83** (0.71)	1.82*** (0.69)
prior patent grants of manager	-	-	-	-	-10.92*** (0.49)
Dummies for tenure	No	Yes	Yes	Yes	Yes
Dummies for org groups	No	No	Yes	Yes	Yes
Dummies for ties with manager	No	No	No	Yes	Yes
N	225	225	225	215	215

Patenting by direct reports – All direct reports

	Dependent variable = Number of patents filed			
	(1)	(2)	(3)	(4)
manager is a return migrant	0.65** (0.28)	0.72** (0.28)	-	-
manager is return migrant * (tenure of manager < 1 year)	-	-	1.08 (0.76)	1.06 (0.76)
manager is return migrant * (tenure of manager between 1 and 2 years)	-	-	1.56* (0.86)	1.64* (0.86)
manager is return migrant * (tenure of manager between 2 and 4 years)	-	-	-0.93 (0.97)	-0.88 (0.98)
manager is return migrant * (tenure of manager between 4 and 6 years)	-	-	0.39 (0.47)	0.43 (0.48)
manager is return migrant * (tenure of manager between 6 and 10 years)	-	-	0.74** (0.33)	0.71** (0.33)
manager is return migrant * (tenure of manager > 10 years)	-	-	0.70** (0.35)	0.84** (0.37)
prior patent grants of manager	-	-0.03 (0.03)	-	-0.04 (0.03)
Dummies for tenure	Yes	Yes	Yes	Yes
Dummies for org groups	Yes	Yes	Yes	Yes
Dummies for ties with manager	Yes	Yes	Yes	Yes
N	1045	1045	1045	1045

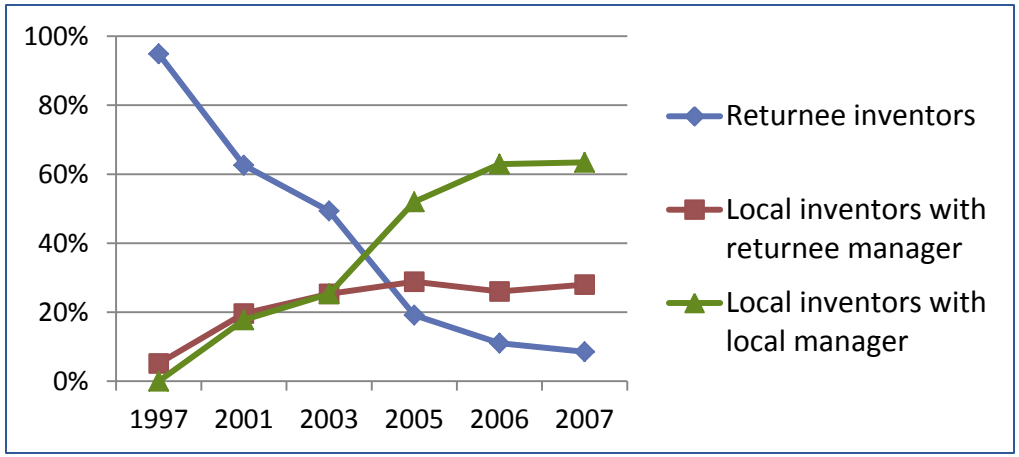
Key robustness checks

1. Check for validity of natural experiment using observables – no systematic correlation of manager assignment to whether or not direct report studied at Indian Institute of Technology; whether or not manager shares home state, ethnicity or college
2. Falsification test - effect of having a return migrant manager on higher patent filings positive and significant for groups involved in knowledge production; no effect for groups not involved in knowledge production (e.g., testers)
3. Alternate specifications and dependent variable

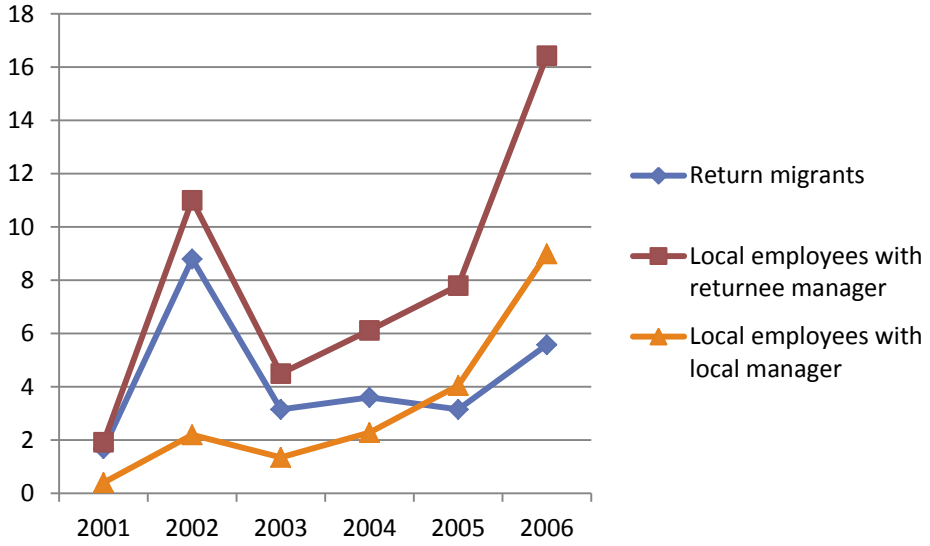
Analysis of patent citations – Patents with and without return migrant links

	Patents of local employees with returnee managers (N=33)	Patents of local employees with local managers (N=32)	Difference in means
Self-backward citations (i.e., citations to prior patents filed by inventors working at the TechMNE headquarters)	1.9	1.0	0.85*
Total backward citations (patent)	16.0	12.2	3.9
Total backward citations (non-patent)	3.9	2.8	1.1

- Fraction of total number of employees



- Fraction of inventor names on each patent



Summary of findings

- Return migrants with high organizational tenure drive patenting activity in the Indian R&D center of this MNE
- Local employees who report to return migrants managers file more patents (odds ratio is 6.2 for newly hired graduates and 2.4 for all local employees who report to return migrants)
- Patents with return migrants or return migrants direct reports exhibit higher backward and forward patent citation rates

Contributions

- Role of firms in facilitating skilled migration [To quote Kerr et al. (2013, 1), 'from an academic perspective, there is very little tradition for considering firms in analyses of immigration']
- Role of return migrants in facilitating expanding geography of innovation for MNEs. Heterogeneity in return migrant sample
- On the job learning by return migrant direct reports
- Early insights related to 'Internal Labor Markets' of MNEs

Study 2
Skilled Migrants and Transfer of Contextual Knowledge across Borders

NPN: 80024416
Curcumin Active
FAST RELIE
HELPS RELIEVE JOINT INFLAMMATIO
AIDE À SOULAGER L'INFLAMMATION DES ARTICULATIO
133.3 mg
60 Vegi-Caps
longvida
Puritan's Pride
TURMERIC CURCUMIN
1000 mg

Nature's Way
Neem
Leaves

NeemAura
NATURALS
Neem Leaf

- Estimated market size for herbal products in the U.S. was US$5.6 billion in 2012.
- 38 percent of adults and 12 percent of children in the U.S. use herbal, traditional medicine

Opposition to Herbal Patents – Select Examples

Herb	Country	Patenting Entity	Opposed by	Outcome
Neem	India	W.R. Grace	Group of international NGOs and representatives of Indian farmers	Patent revoked by European Patent office (EPO)
Maca Extract	Peru	Japanese firm Suntory Ltd and the University of Hiroshima.	National Institute for the Defense of Competition and Intellectual Property (INDECOPI) in Peru	Patent revoked by the Japanese Patent Office (JPO)
Basmati	India	U.S. based firm Rice Tec	Vandana Shiva and Indian activists	USPTO re-examined the patent and subsequently granted a narrower patent (i.e. patent with less claims)
Sacha Inchi	Peru	French firm Greentech	Peruvian commission against bio-piracy	Patent was revoked

Prior literature on migrants contribution to home and host country

- Rich prior literature on migrants and diaspora in economics (Borjas, 1994; Gould, 1994), sociology (Portes, Guarnizo, & Haller, 2002), and public policy (Saxenian, 1999)
- Positive contribution of diaspora to home and host country
  - Role of role of diaspora in outsourcing of work back to home country (Ghani, Kerr and O'Connell, 2014)
  - Role of ethnic communities in international communities in international technology diffusion (Kerr, 2008)
  - Migrants in host countries enhance new-venture funding and founding back home (Nanda and Khanna, 2010; Vaaler, 2011)

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No prior studies on role of migrants in transferring 'contextual' knowledge across borders

Case study of Dr. Hari Har P. Cohly of University of Mississippi

- Filed U.S. Patent no. 5401504 related to turmeric

Dr. Hari Har P. Cohly

- Originally from Dayalbagh, Agra, member of Radhaswami religious sect. Left India at age of 15 years in 1973
- Studied at University of Toronto (Undergraduate), SUNY at Buffalo (Graduate studies), then conducted research at NASA/Johnson space center and Baylor college of medicine. Finally moved to the University of Mississippi (UMC). Was trained in microbiology and biochemistry
- Upbringing in Dayalbagh formed interest in traditional medicine. Got exposed to turmeric from discourses by Guru Maharaj Dr. MB Lal Sahab. Dr. MB Lal Sahab was parasitologist and was educated in Edinburgh in parasitology and was the head of Indian Association of Parasitology.
- Dr. Cohly transferred knowledge of turmeric to lab of Dr. SK Das, plastic surgeon.
- Conducted clinical case study with Dr. Das with turmeric. There was a patient with wound that was not healing at all. The patient was affected by a condition known as "restenosis", where there is gap between two blood vessels. This was not curing and the decision was amputate. Dr. Cohly suggested using turmeric and it worked.
- Subsequently they jointly filed the turmeric patent

Empirical Question

- Is herbal patenting in western entities driven by scientists belonging to Indian and Chinese ethnic origin?

Identification Strategy – Exploit exogenous reduction in H1B visa quotas from 195,000 to 65,000 in 2004

Exploiting 2004 H1B visa regime change

- Dependent variable - Inventor list includes Indian inventor

	1	2	3
Is_herbal	0.61**	0.64**	1.09***
	(0.45)	(0.45)	(0.49)
Post_2004		1.64**	2.11***
		(0.78)	(0.79)
Is_herbal*post2004			-1.2***
			(0.42)
N	872	872	872

Placebo test

- Dependent variable - Inventor list includes European inventor

	1	2	3
Is_herbal	-0.55** (0.25)	-0.55** (0.25)	-0.32 (.29)
Post_2004		1.7 (1.56e7)	1.98 (1.28e7)
Is_herbal*post2004			-0.60 (0.38)
N	1005	1005	1005

Regression results

	Inventor list includes ethnic Chinese		Inventor list includes diaspora Chinese	
Is Chinese herbal patent	0.41*** (0.11)	0.62*** (0.12)	0.25** (0.12)	0.44*** (0.13)
Is Indian herbal patent	-	-1.16*** (0.19)	-	-1.01*** (0.19)
N	2298	2298	2298	2298

	Inventor list includes ethnic Indian		Inventor list includes diaspora Indian	
Is Indian herbal patent	1.28*** (0.13)	1.38*** (0.13)	0.09 (0.19)	0.24 (0.20)
Is Chinese herbal patent	-	-0.33** (0.13)	-	-0.59*** (0.20)
N	2298	2298	2298	2298

Other Results

Does intra-firm mobility across borders lead to higher patenting?

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- Matching analysis using data on child-birth and marriages
- Instrumental variable analysis
- Analysis of mechanism – seeking resources for patenting projects

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Matching analysis – treated and control groups

	Treated sample: Inventors who got married and/or had children in 2006-2007	Control group: Inventors who did not get married neither had children in 2006-2007
Percentage of inventors who have filed at least 1 patent in 2004-2005	2.7%	1.1%
Tenure between 0-4 years	87.7%	86.4%
Inventors who belong to Org groups 1-3	82.2%	80.0%
Percentage of inventors who are returnees	6.7%	8.0%
Percentage of inventors who travel to the headquarters in 2006-2007	2.9%	26.1%

Matching analysis - Results

#	Definition of treated sample	N	Panel A Difference in number of patents filed in 2004-2005 (ΔPatenting prior to the marriage/childbirth event)	Panel B Difference in number of patents filed in 2006-2008 (ΔPatenting post the marriage/childbirth event)
1	Employees who got married or had children in 2006 or 2007	68	0.01	-0.21
2	Employees who had children in 2006 or 2007	27	0.04	-0.37
3	Employees who got married in 2006 or 2007	44	0.00	-0.05

Does intra-firm mobility across borders lead to higher patenting?

- Matching analysis using data on child-birth and marriages
- Instrumental variable analysis – Product launch dates
- Analysis of mechanism – seeking resources for patenting projects

Results of IV regressions

	Dependent Variable: number of patents filed in 2006-2008						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	OLS	OLS	IV	IV
has_traveled_headquarters	0.26*** (0.07)	0.20*** (0.06)	0.20*** (0.07)	-	-	2.40*** (0.81)	2.42*** (0.81)
Number of HQ trips =1	-	-	-	0.17** (0.07)	0.17** (0.07)	-	-
Number of HQ trips =2	-	-	-	0.03 (0.07)	0.04 (0.07)	-	-
Number of HQ trips =3	-	-	-	-0.03 (0.13)	0.01 (0.14)	-	-
Number of HQ trips =4	-	-	-	0.57 (0.41)	0.58 (0.41)	-	-
Number of HQ trips =5	-	-	-	1.33 (1.24)	1.35 (1.24)	-	-
Number of HQ trips =6	-	-	-	1.56 (1.22)	1.56 (1.21)	-	-
Number of HQ trips =7	-	-	-	6.65 (5.35)	6.67 (5.27)	-	-
is_employee_returnee	-	-	-0.24 (0.20)	-	-0.23 (0.19)	-	-0.45 (0.27)
Dummies for tenure	No	Yes	Yes	Yes	Yes	Yes	Yes
Dummies for org groups	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1202	1202	1202	1202	1202	1202	1202

Does intra-firm mobility across borders lead to higher patenting?

- Matching analysis using data on child-birth and marriages
- Instrumental variable analysis
- Analysis of mechanism – seeking resources for patenting projects

Resource allocation calendar at Microsoft

- Requests to fund patentable ideas submitted. This is the first formal submission of requests during the fiscal year
- A large fraction of funds are dispersed by product teams during Oct Quarterly Business Review meeting (QBR)

- End of year push to disperse funds
- Funds not dispersed by product team by end of fiscal year taken out of budgetary allocation for next year

Month of travel regression

	Dependent Variable: Has Filed a Patent in 2006-2008	
Month of travel: January	0.07 (0.07)	0.08 (0.09)
Month of travel: February	0.14 (0.14)	0.15 (0.15)
Month of travel: March	0.10 (0.10)	0.11 (0.11)
Month of travel: April	0.17** (0.07)	0.17** (0.07)
Month of travel: May	0.07 (0.07)	0.07 (0.08)
Month of travel: June	0.10* (0.06)	0.11* (0.06)
Month of travel: July	0.12 (0.08)	0.13 (0.08)
Month of travel: August	0.11** (0.05)	0.11* (0.06)
Month of travel: September	0.14** (0.07)	0.14* (0.08)
Month of travel: October	0.16** (0.07)	0.17** (0.07)
Month of travel: November	0.05 (0.05)	0.05 (0.05)
Dummies for tenure	Yes	Yes
Dummies for org groups	Yes	Yes
N	238	238