

Job Referral Networks and the Determination of Earnings in Local Labor Markets

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Motivation: A Hypothetical Syllogism

WHO YOU KNOW



WHAT YOU EARN

Motivation: A Hypothetical Syllogism

WHO YOU KNOW



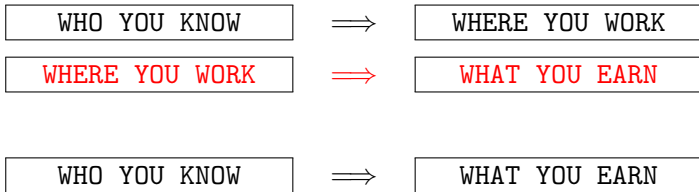
WHERE YOU WORK

WHO YOU KNOW

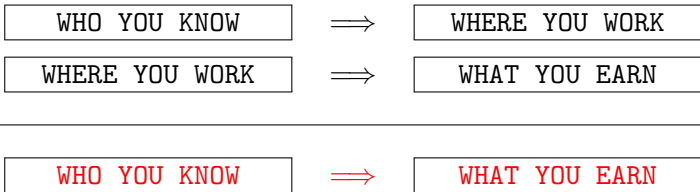


WHAT YOU EARN

Motivation: A Hypothetical Syllogism



Motivation: A Hypothetical Syllogism



What I Will Show Today

1

Search Model with Contagion

2

Two Stage Estimation

What I Will Show Today

1

Search Model with Contagion

2

Two Stage Estimation

- Employer affects earnings

What I Will Show Today

1

Search Model with Contagion

- Employer affects earnings
- Referral network affects job offers

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Two Stage Estimation

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- Employer affects earnings
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Two Stage Estimation

- Estim. employer wage premia, ψ

What I Will Show Today

1

Search Model with Contagion

- Employer affects earnings
- Referral network affects job offers

2

Two Stage Estimation

- Estim. employer wage premia, ψ
- Study effect of nbrs' wage premium on the wage premium received when workers change jobs.

- 1 Confirm predictions of job search model
 - 10% of offers through networks.
 - A 1 s.d. increase in network quality increases ψ by 25% for job changers.
 - Higher network quality increases probability of job-to-job transition.
 - Better networks 'stretch' the realized ψ distribution.
 - Better starting job 'compresses' the realized ψ distribution.
- 2 Evidence on Model Assumptions and Interpretation
 - Job ladder over measured earnings premia
 - Lots of sorting into neighborhoods. Very little sorting within neighborhoods
 - Evidence on direct referrals within neighborhoods.

- Evidence that local social interactions affect earnings by helping workers find better paying jobs
- Clean identification strategy.
- In context of an on-the-job search model.

Contributions and Related Literature

- 1 Models of social interactions in job search
 - Mortensen and Vishwanath (1994); Calvo-Armengol and Jackson (2004,2007) Fontaine (2007); Calvo-Armengol and Zenou (2005); Galenianos (2011); Loury(1983)
- 2 Empirical Literature:
 - **Unemployment:** Topa (2001); Conley and Topa (2008); Cingano and Rosolia (2012)
 - **“Where You Work”:** Bayer, Ross, and Topa (2008); Hellerstein et al. (2011); Dustmann et al. (2012)
 - **Local Spillovers in Labor Market Behavior and Outcomes:** Case and Katz (1991); Weinberg et al. (2004)
- 3 Models of Referral-use by employers: Montgomery (1991); Kugler (2003); Simon and Warner (2012); Dustmann et al. (2012); Galenianos (2012); Heath (2013)

Bayer, Ross, and Topa (2008)

- Evidence of local interactions in job finding
- People in the same block are more likely to be coworkers than people in the same neighborhood on different blocks

I show...

- Workers changing jobs more likely to become coworker of someone on same block than someone in the same neighborhood but different block
- This effect is stronger when the worker changing jobs is of higher ability and when neighbor is in a higher paying firm.

- 1 Methodology
 - Data
 - Motivational Framework
 - Two Stage Estimation
 - Identification Strategy
- 2 Evidence for Model Assumptions
 - Evidence that workers search for firms with better earnings premia
 - Support for identifying assumption
 - Evidence on direct referrals
- 3 Main Results
 - Verify implications of the job search model
 - Sensitivity to violations of identifying assumptions
 - robustness checks based on previous research
 - How much of the effect is due to direct referral
 - Results for non-employed workers
 - Agglomeration effects
- 4 Conclude

- Employer-employee matched data
- Source: Administrative data from Unemployment Insurance programs
 - 98% of all private non-farm employment
 - UI record provides employer ID, employee ID, and quarterly earnings
- Individual and Employer Characteristics linked from other sources
 - race, ethnicity, gender, age, place of birth, work history
 - Industry, size

- LEHD data from 30 states, 1990–2003
- Workers aged 18–70
- employed full time on dominant jobs
- 660 million wage records
- 190 million workers
- 10 million employers

- Match to administrative data on Census block of residence
- Workers with positive UI earnings in 2002-2003
- Lived in one of 30 large MSAs
- Identify quarter of transition between dominant jobs

- I workers with human capital e_{it}
- Continuum of employers with heterogeneous compensation p_j

Pay depends on e_{it} and p_j as follows:

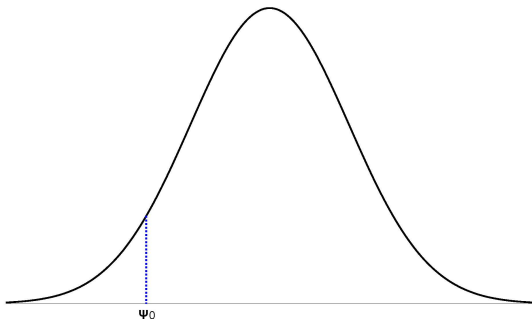
$$w_{ijt} = \kappa e_{it} p_j$$
$$\ln w_{ijt} = \ln \kappa + \ln e_{i,t} + \ln p_j$$

In anticipation of the empirical analysis,

$$e_{it} = \exp(X_{it}\beta + \theta_i) ; \psi_j = \ln p_j.$$

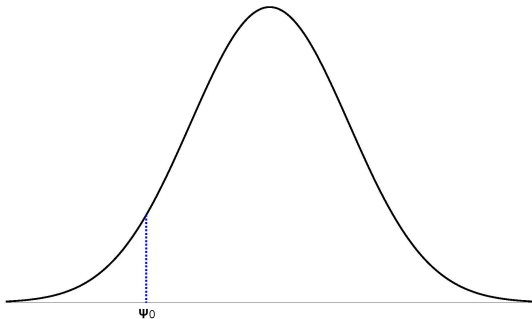
$$\ln w_{ijt} = \alpha + X_{it}\beta + \theta_i + \psi_j$$

Search and The Job Offer Distribution



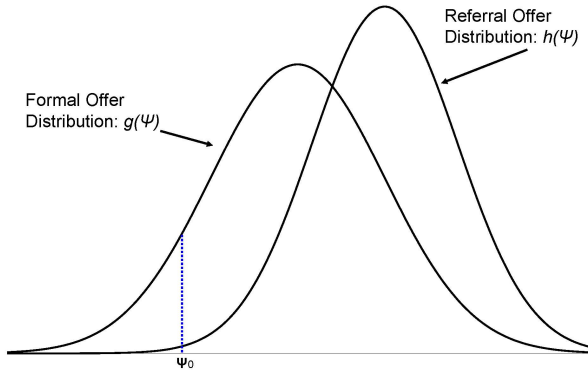
$$\text{OFFER : } \ln w_{it} = \alpha + X_{it}\beta + \theta_i + \square$$
$$\text{ACTUAL: } \ln w_{it} = \alpha + X_{it}\beta + \theta_i + \psi_{0,i}$$

Search and The Job Offer Distribution



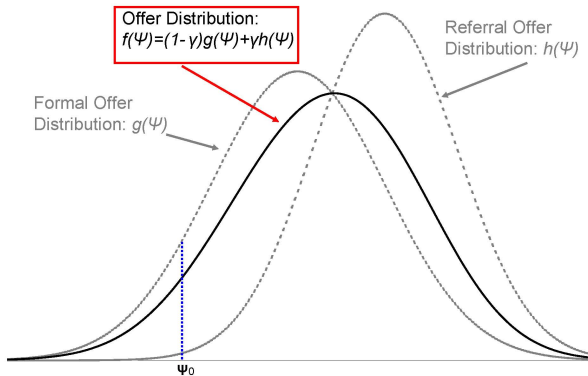
$$\begin{aligned} \text{OFFER : } \ln w_{it} &= \alpha + X_{it}\beta + \theta_i + \boxed{\psi^*} \\ \text{ACTUAL: } \ln w_{it} &= \alpha + X_{it}\beta + \theta_i + \psi_{0,i} \end{aligned}$$

Referral Networks in Job Offer Distribution



γ : the weight on referral use relative to formal search

Referral Networks in Job Offer Distribution



γ : the weight on referral use relative to formal search

Model Implications: Predictions of the Search Model

For workers making direct job-to-job transitions

1 Conditional Mean:

$E(\psi|\bar{\psi}, Z, \psi > \psi_0)$ is increasing in $\bar{\psi}$

2 Quantiles:

$Q(\psi|\bar{\psi}, Z, \psi > \psi_0)$ is increasing in ψ_0 and $\bar{\psi}$.

3 The above effects are

- decreasing across quantiles for an increase in ψ_0 ;
- increasing across quantiles for an increase in $\bar{\psi}$.

4 The probability of a job-to-job transition is

- increasing in $\bar{\psi}$;
- decreasing in ψ_0 (job ladder).

Contagion Model of the Referral Offer Distribution

- Wage premia of neighbors are ‘contagious’
- Draw ψ with probability proportional to frequency of network partners holding ψ .
- Interpretations:
 - Get a job with neighbor’s employer;
 - friends share information on search strategies (Dolnick 2011);
 - friends pass on rejected job offers (Calvo-Armengol and Jackson (2007)).

Two Stage Estimation

- 1 Estimate ψ from earnings decomposition (details below)
- 2 estimate using data for workers who experience a job-to-job transition models of the form:

$$\psi_i = Z_i\Pi + \gamma\bar{\psi}_{b(i)} + \beta\psi_{0i} + \kappa_{G(i)} + \varepsilon_i$$

Estimate ψ from the Abowd-Kramarz-Margolis decomposition

$$\ln W = X\beta + D\theta + F\psi + \epsilon$$

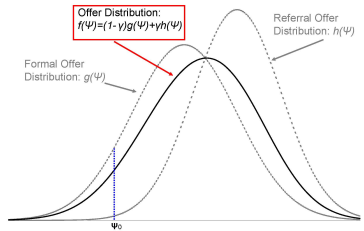
- Data: LEHD earnings histories
- D is the design matrix of person effects
- F is the design matrix of employer effects
- X includes time-varying factors
 - experience quartic
 - year effects
 - within-year employment history

Identification of the social interaction parameter, γ

Expected Offer:

$$\psi_{J(i)}^* = \mathbf{Z}_i \Pi + \gamma \bar{\psi}_{ob(i)} + \eta_i$$

- Simultaneity: the reflection problem
- Self-selection: sorting
- Omitted variables



Identification using Small Area Census Geography

Geographic Relationships – Small Area Statistical Entities
County-Census Tract-Block Group-Block

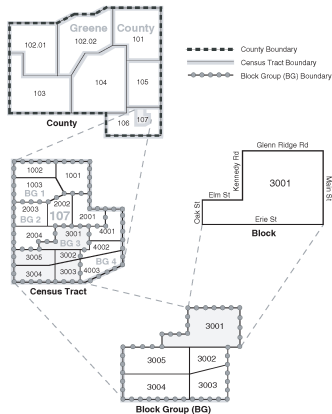


Figure 5: Evidence of a Job Ladder

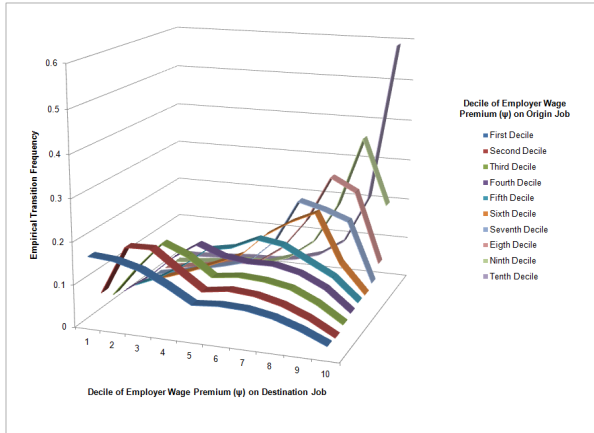
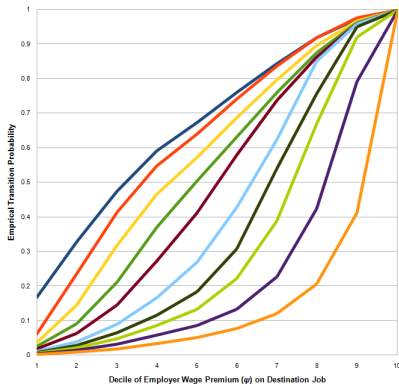


Figure: Probabilities of transition between deciles of the employer wage premium (ψ) distribution.

Figure 4: Evidence of a Job Ladder



Origin decile ψ_0^d	$Pr(\psi_1^d \geq \psi_0^d)$
1	1
2	0.94
3	0.85
4	0.79
5	0.73
6	0.73
7	0.69
8	0.61
9	0.58
10	0.59

Figure: Cumulative probability transition to each decile of the wage premium (ψ) distribution, by decile of origin ψ

Figures 2 and 3: Spatial Autocorrelation of AKM Wage Components

Spatial autocorrelation function for tract-(left) and block-(right) means of log earnings and its components.

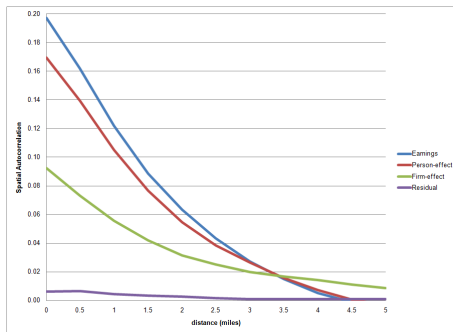
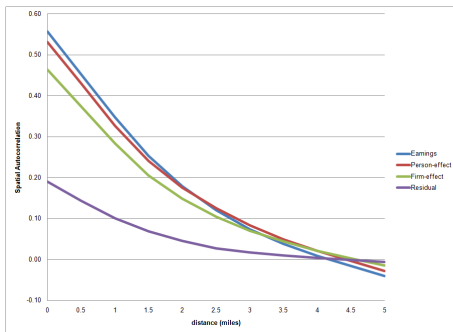


Table III: Sorting within Neighborhoods

Variable	Raw	Block Group Controls
White	.2915	.0132
Hispanic	.2859	.0125
Born U.S.	.2245	.0114
Age	.0301	.0067
ϵ	.0038	.0002

$N = 394,305$

Effect of ψ on True Referrals

Question: Does ψ affect the probability of taking a job with neighbor's employer?

Data are pairs, (i, j) such that

- i changed jobs between 2002 and 2003.
- j remained in the same job.
- i and j reside in the same neighborhood (block group), g .
- 1,558,400,000 pairs in the sample

To infer the presence of referral effects, estimate

$$W_{ij} = \rho_g + \alpha_0 R_{ij} + \varepsilon_{ij},$$

where ρ_g is a block group effect and

$$W_{ij} = \begin{cases} 1 & \text{if } i \text{ has the same employer as } j \text{ in 2003,} \\ 0 & \text{otherwise.} \end{cases}$$

$$R_{ij} = \begin{cases} 1 & \text{if } i \text{ resides on the same block as } j, \\ 0 & \text{otherwise.} \end{cases}$$

Table IV: 'True' Referrals

$$W_{\ell,m} = \rho_{G(\ell)} + \beta' X_{\ell,m} + (\alpha_0 + \alpha_1' X_{\ell,m}) R_{\ell,m} + \varepsilon_{\ell,m}, \quad (1)$$

		No Covariates (1)		Pair Covariates (2)	
	Variable	Coeff.	t-Stat.	Coeff.	t-Stat.
Reside on same block	R	0.02	27.81	0.013	36.10
Wage premium of non-changer	$R \times \psi_{ref}$			0.014	63.78
Wage effect of non-changer	$R \times \theta_{ref}$			0.023	46.73
Wage effect of changer	$R \times \theta$			0.018	33.47
Block Group Effects		YES		YES	
Sample Size		1, 558, 436, 893			

Table IV: 'True' Referrals

	Variable	No Covariates		With Covariates	
		Coeff.	t-Stat.	Coeff.	t-Stat.
Panel A: Block Group Controls					
Reside on same block	R	0.026	23.85	0.146	5.56
AKM Wage effects	$R \times \theta \times \theta_{ref}$			0.040	3.28
Wage premium	$R \times \psi \times \psi_{ref}$			-.006	-.32
Interaction	$R \times \theta \times \psi_{ref}$			0.036	1.64
Both white	$R \times white \times white_{ref}$			0.014	4.39
Both male	$R \times male \times male_{ref}$			-.018	-5.56
Both native-born	$R \times nat \times nat_{ref}$			0.076	5.58
Both hispanic	$R \times hisp \times hisp_{ref}$			0.019	4.69
Age	$R \times age \times age_{ref}$			0.000	3.04
Panel B: Individual Controls					
Reside on same block	R	0.029	38.37	0.108	11.30
AKM Wage effects	$R \times \theta \times \theta_{ref}$			0.028	4.25
Wage premium	$R \times \psi \times \psi_{ref}$			-.012	-1.42
Interaction	$R \times \theta \times \psi_{ref}$			0.029	2.51
Both white	$R \times white \times white_{ref}$			0.015	6.45
Both male	$R \times male \times male_{ref}$			-.018	-8.19
Both native-born	$R \times nat \times nat_{ref}$			0.052	9.63
Both hispanic	$R \times hisp \times hisp_{ref}$			0.022	7.29
Age	$R \times age \times age_{ref}$			0.000	3.85
Number of Obs.		1, 524, 733, 934			

Table 2: Descriptive Statistics

Variable	Full Sample	Quarterly Job Changers	Annual Job Changers
White	0.6572	0.6220	0.6495
Black	0.1151	0.1205	0.1129
Hispanic Origin	0.1167	0.1400	0.1274
Male	0.5098	0.4979	0.5886
Born in U.S.	0.8098	0.8026	0.8145
Age in 2002	40.5456	34.9561	37.0943
N	25,689,739	815,899	2,189,659

Table V: Main Offer Function Estimates

$$\psi_i = \gamma \bar{\psi}_{b(i)0} + \mathbf{Z}_i \Pi + \beta \psi_{0i} + \kappa_{G(b(i))} + \bar{X}_{b(i)} \Gamma + \nu_i.$$

	(4)	(5)	(6)
Initial ψ : ψ_0 (β)	0.46*** (.001)	0.45*** (.001)	0.45*** (.001)
Avg. ψ in block: $\bar{\psi}_{block}$ (γ)	0.34*** (.003)	0.11*** (.004)	0.11*** (.004)
Avg. ψ in block group: $\bar{\psi}_{bg}$ (ϕ)		0.34*** (.005)	
white	-.00*** (.001)	-.00*** (.001)	-.01*** (.001)
Hispanic origin	-.02*** (.001)	-.02*** (.001)	-.03*** (.001)
male	0.03*** (.000)	0.03*** (.000)	0.03*** (.000)
age in 2002	0.010*** (.000)	0.01*** (.000)	0.01*** (.000)
square of age in 2002	-.00*** (.000)	-.00*** (.000)	-.00*** (.000)
born in U.S.	0.00*** (.001)	0.01*** (.001)	0.01*** (.001)
θ from wage eqn.	-.00 (.001)	-.00*** (.001)	-.01*** (.001)
block group controls	no	no	yes
R^2	.275	.305	.278
N		2, 198, 659	

Table VI: Main Offer Function – Sensitivity

$$\psi_i = \gamma \bar{\psi}_{b(i)0} + Z_i \Pi + \beta \psi_{0i} + \kappa_{G(b(i))} + \bar{X}_{b(i)} \Gamma + \nu_i.$$

	Baseline	Alternative Specifications		
	(1)	(2)	(3)	(4)
Initial ψ : ψ_0 (β)	0.45*** (.001)	0.45*** (.001)	0.37*** (.001)	0.36*** (.001)
Avg. ψ in block: $\bar{\psi}_{block}$ (γ)	0.11*** (.004)	0.09*** (.004)	0.08*** (.004)	0.08*** (.004)
frac. white on block		0.02*** (.003)	0.02*** (.003)	0.01*** (.003)
frac. Hispanic on block		-.03*** (.004)	-.03*** (.004)	-.02*** (.004)
frac. male on block		-.02*** (.003)	-.02*** (.003)	-.01*** (.003)
avg. age on block		-.01** (.003)	-.01* (.003)	-.01 (.003)
frac. native born on block		0.00*** (.000)	0.00*** (.000)	0.00*** (.000)
avg. θ on block		0.06*** (.002)	0.06*** (.002)	0.06*** (.002)
block group controls	yes	yes	yes	yes
Industry of origin job controls	no	no	yes	yes
MSA \times initial industry controls	no	no	no	yes
R^2	.278	.305	.323	.334
N		2, 198, 659		

Figure 1a: Unconditional Quantial Partial Effects:
Wage Premium on Origin Job

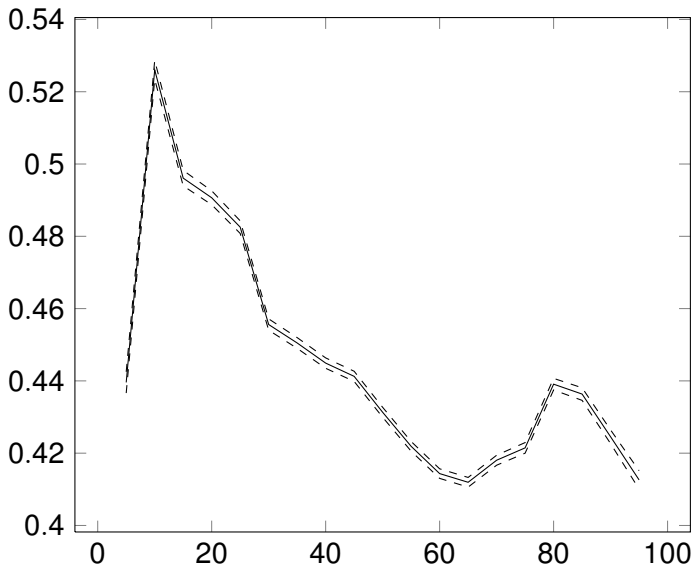
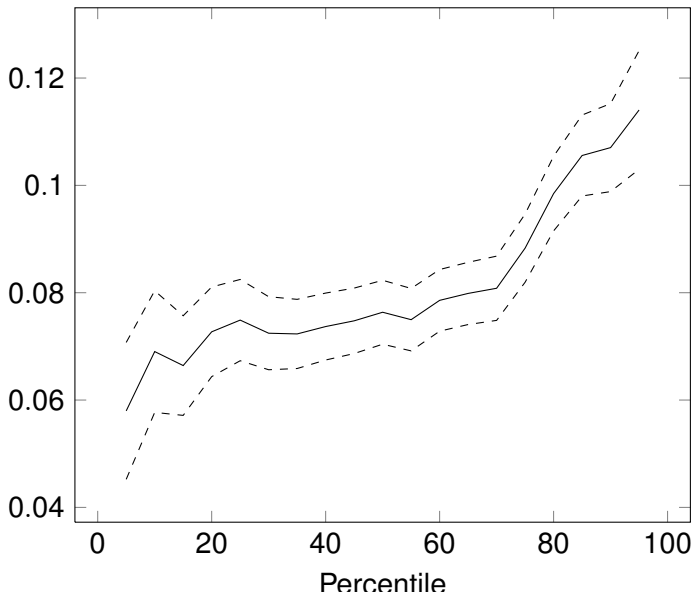


Figure 1b: Unconditional Quantial Partial Effects:
Block Mean Wage Premium



Selection Correction

Premium on next job, ψ Selection on job-to-job move	Offer Function	Selection Equation
Initial premium: $\psi_0 (\beta)$		-0.58* (.017)
Mean premium in block: $\bar{\psi}_{block} (\gamma)$	0.11* (.023)	0.10* (.020)
Mean premium in block group: $\bar{\psi}_{bg} (\phi)$	0.64* (.060)	0.32* (.069)
λ (Inv. Mills)	0.48* (.058)	
ρ	0.79	
σ	0.61	
N	1, 330, 475	
$\chi^2_{(9)}$	683.23	

Table VII: Demographic Heterogeneity in the Local Interaction Effect

Premium on next job, ψ	Baseline (1)	Native Workers (2)	Younger Workers (3)	Older Workers (4)
Initial ψ : ψ_0 (β)	0.37*** (.001)	0.37*** (.001)	.37*** (.001)	0.37*** (.032)
Avg. ψ in block: $\bar{\psi}_{block}$ (γ)	0.08*** (.004)	0.16*** (.006)	.07*** (.004)	0.09*** (.004)
Born in U.S. $\times \bar{\psi}_{block}$		-.09*** (.005)		
Younger Worker $\times \bar{\psi}_{block}$.04*** (.004)	
Older Worker $\times \bar{\psi}_{block}$				-.04*** (.005)
block group controls	yes	yes	yes	yes
block mean characteristics	yes	yes	yes	yes
Industry of origin job	yes	yes	yes	yes
N		2, 198, 659		
R^2	.323	.323	.323	.323

Table VIII: The Influence of Direct Referrals

Premium on next job, ψ	Baseline			
	(1)	(2)	(3)	(4)
Initial ψ : ψ_0 (β)	0.37*** (.001)	0.37*** (.001)	.37*** (.001)	0.37*** (.001)
Avg. ψ in block: $\bar{\psi}_{block}$ (γ)	0.08*** (.004)		.08*** (.004)	0.08*** (.004)
Move to same job (as a block-neighbor)		-.03*** (.001)	-.03*** (.001)	-.07*** (.002)
Move to same job $\times \bar{\psi}_{block}$.18*** (.009)
block group controls	yes	yes	yes	yes
block mean characteristics	yes	yes	yes	yes
Industry of origin job	yes	yes	yes	yes
N	2, 198, 659			
R^2	.323	.323	.323	.323

Analysis for the Non-Employed “Job Finders”

Premium on next job, ψ	(1)	(2)	(3)	(4)
Avg. ψ in block: $\bar{\psi}_{block}(\gamma)$	0.23*** (.007)	0.06*** (.010)	0.04*** (.010)	0.01 (.006)
block group controls	no	yes	yes	yes
control for block mean characteristics	no	no	yes	yes
control for industry of destination job	no	no	no	yes
N	223, 159			
R^2	.278	.305	.323	.334

Analysis for the Non-Employed “Job Finders”

Premium on next job, ψ	(1)	(2)	(3)	(4)
Initial ψ : ψ_0 (β)	0.37*** (.001)	0.38*** (.001)	0.33*** (.001)	0.32*** (.001)
Avg. ψ in block: $\bar{\psi}_{block}$ (γ)	0.08*** (.004)	0.08*** (.004)	0.07*** (.003)	0.06*** (.003)
block group controls	yes	yes	yes	yes
block mean characteristics	yes	yes	yes	yes
Industry of origin job	yes	yes	yes	yes
Cubic in destination firm size	no	yes	no	no
Industry of destination job	no	no	yes	yes
MSA \times Industry of destination job	no	no	no	yes
N		2, 198, 659		
R^2	.323	.325	.430	.45

- First direct estimates of spillovers in earnings that control for arbitrary heterogeneity in ability and selection into neighborhoods.
- Even with these stringent controls, evidence that the wage premia of neighbors affect one's own search outcomes
- Search outcomes are consistent with the predictions of a simple partial equilibrium model augmented to include referral networks.
- Taken literally, model implies 10% of offers come through the social network.
- A 1 s.d. increase in $\bar{\psi}$ increases destination wage premium by 25% (about \$400 annually).
- Results of Bayer, Ross, and Topa (2008) can be extended in a number of directions
- Suggestive evidence that referrals and job information networks attract high-ability workers to high-paying firms.

Thank You
Ian M. Schmutte