Why Do Employees Exercise Stock Options Early?

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Marshall Vance
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Debunking Diversification

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Employees Exercise Early (S&P 1500)

		Expected Option Term (Years)			
	% of Firms	Mean	25th Percentile	50th Percentile	75th Percentile
5 Years	3.8%	4.0	3.5	3.8	4.3
6 Years	2.0%	4.4	4.0	4.3	4.6
7 Years	18.9%	4.6	4.2	4.6	5.0
8 Years	2.6%	5.4	5.0	5.2	5.9
9 Years	0.4%	5.4	5.0	5.5	6.0
10 Years	71.7%	5.7	5.0	5.8	6.3

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"Late" exercise used as a proxy for (irrational) managerial optimism

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No serious attempt to test whether diversification is, indeed, the primary driver of early-exercise decisions

We consider three broad explanations . . .

Diversification Hypothesis

Realized Utility Hypothesis

Liquidity Hypothesis

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Individuals derive utility from *realized* (rather than unrealized) gains and losses

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Especially following stock-price run-ups or passing historical thresholds

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Liquidity Hypothesis

Employees are liquidity constrained and want to buy stuff

(Potentially) testable implications

	Diversification Hypothesis	Realized Utility Hypothesis	Liquidity Hypothesis
Spread-to-Black Scholes Ratio			
Remaining Term of Option			
Pending Dividend			
Recent Vesting Event			
Recent Stock-Price Run-Up			
Stock Price surpasses milestone			

(Potentially) testable implications

	Diversification Hypothesis	Realized Utility Hypothesis	Liquidity Hypothesis
Spread-to-Black Scholes Ratio	>0	>0	>0
Remaining Term of Option	<0	<0	<0
Pending Dividend	>0	>0	>0
Recent Vesting Event	>0	>0	>0
Recent Stock-Price Run-Up	>0	>0	>0
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	Diversification Hypothesis	Realized Utility Hypothesis	Liquidity Hypothesis
Increase in illiquid “inside” wealth (i.e., new equity grant)	>0	n/a	>0
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Challenge: Need plausible proxy for change in illiquid outside wealth

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Plausible candidate: Employee home price

In this paper . . .

We attempt to distinguish among explanations for early exercise

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10-year panel of option exercises for 3,618 managers in 5 firms

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10-year panel of option exercises for 3,618 managers in 5 firms

Studies based on Publicly Available Data
(DEF 14A or Form 4's for Top Executives)

Hemmer Matsunga & Shevlin (JAE 1996)
Core & Guay (JFE 2001)
Bettis, Bizjak & Lemmon (JFE 2005)
Klein & Maug (WP, 2011)
Heron & Lie (MS 2011)
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Klein & Maug (WP, 2011)	Carpenter, Stanton & Wallace (JF 2019)
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Core & Guay (JFE 2001)	Heath, Huddart & Lang (QJE 1999)	7 Firms 58,000 employees
Bettis, Bizjak & Lemmon (JFE 2005)	Armstrong, Jagolinzer & Larcker (WP 2007)	10 Firms 23,000 employees
Klein & Maug (WP, 2011)	Carpenter, Stanton & Wallace (JF 2019)	88 Firms 290,000 employees
Heron & Lie (MS 2011)	Bova & Vance (JIBS 2019)	1 Firm 292 employees
Izhakian & Yermack (JFE 2017)		

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Rich data on *all* RSU and option grants

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Data on employee addresses (at ZipCode level)

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Data on employee addresses (at ZipCode level)

Home prices as proxy for outside wealth

ΔHome prices as proxy for shock to illiquid outside wealth

The Data

Data from five firms (chosen by a major "plan administrator")

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Five industries, mixture of large and small firms and option penetrations

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Crude Petroleum and Natural Gas Production (SIC 1311)
Industrial Chemicals (SIC 2811)
Petroleum Refining (SIC 2911)
Commercial Banks (SIC 6022)
Healthcare Services (SIC 8090).

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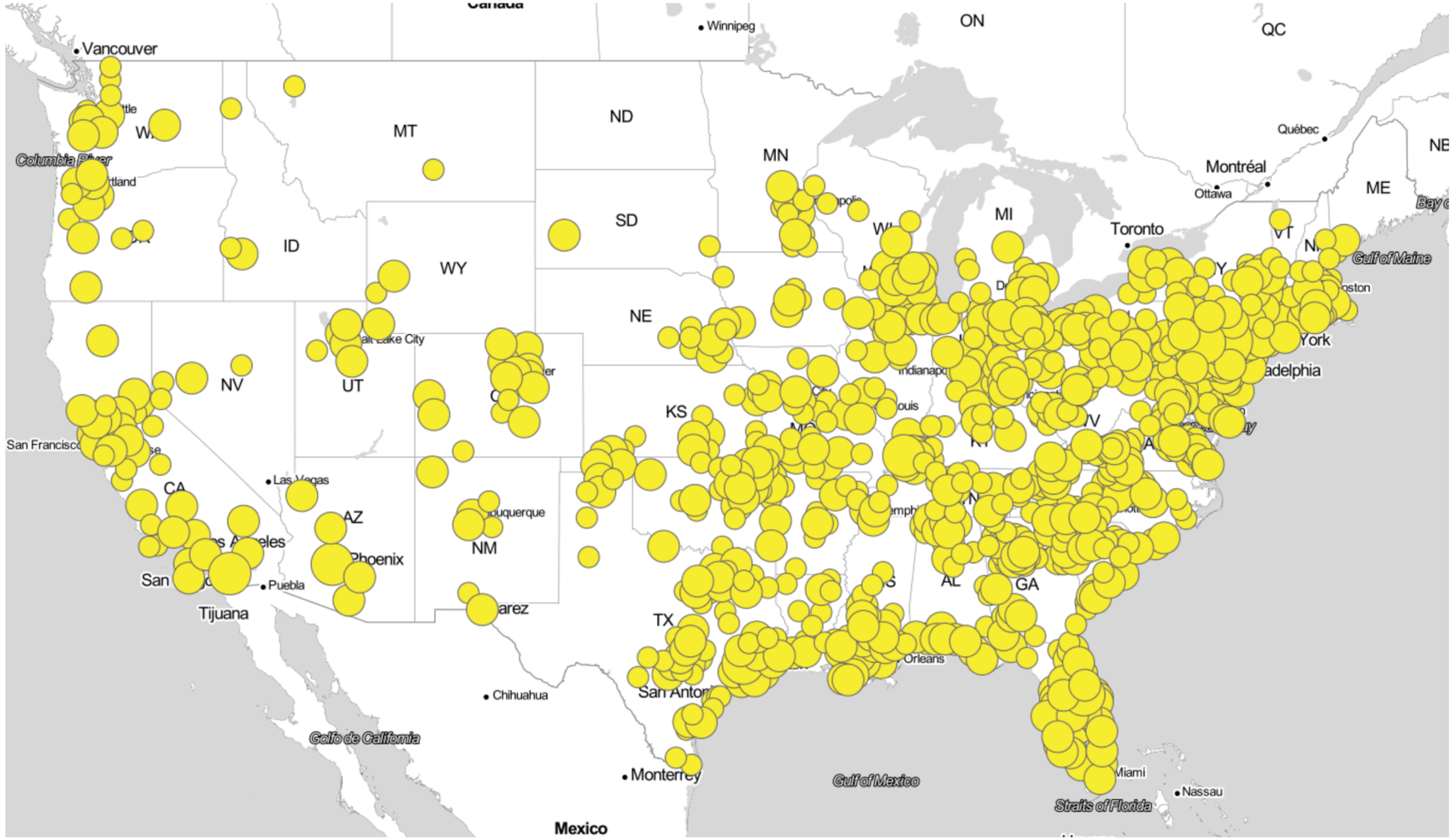
(Median average of about $1 billion).

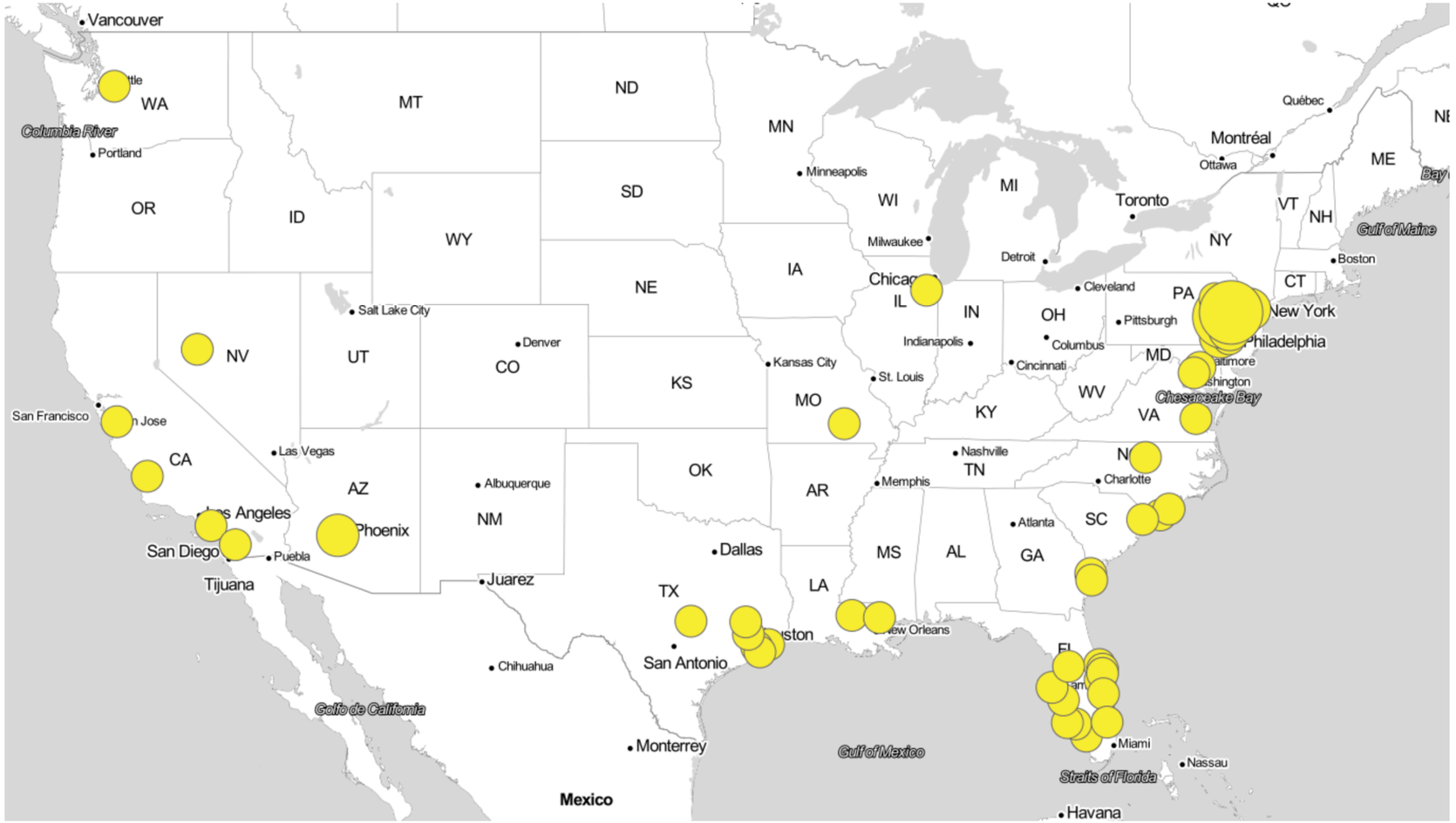
Result 1: Employees do not all live near company headquarters

Firm C1: *All* Employees



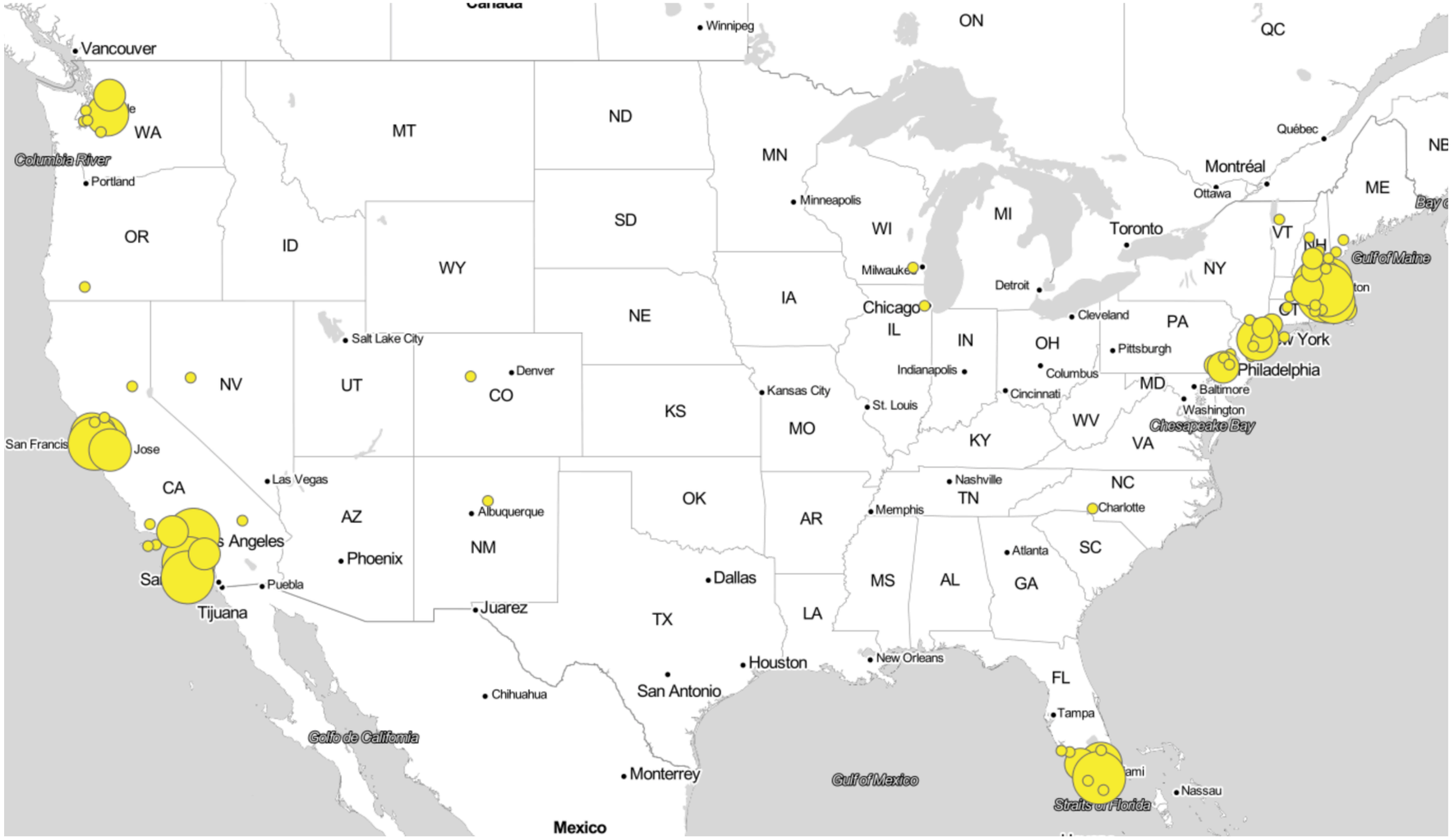
Headquarters: PA; Option holders: 844 (including 244 international)

Firm C1: Option Participants



Headquarters: PA; Option holders: 844 (including 244 international)

Firm C2: *All* Employees



Headquarters: Boston; Option holders: 614

Firm C2: Option Participants

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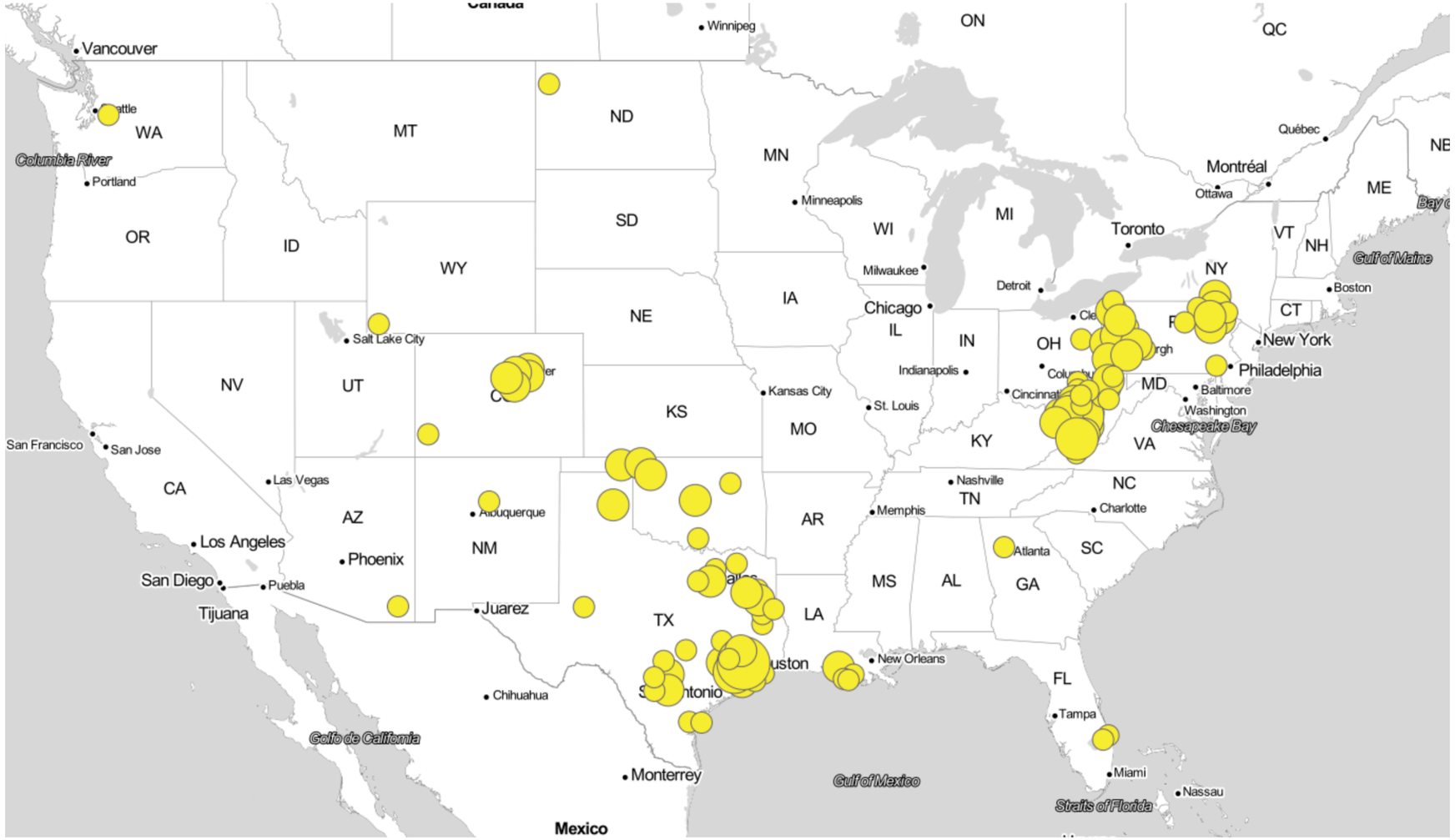
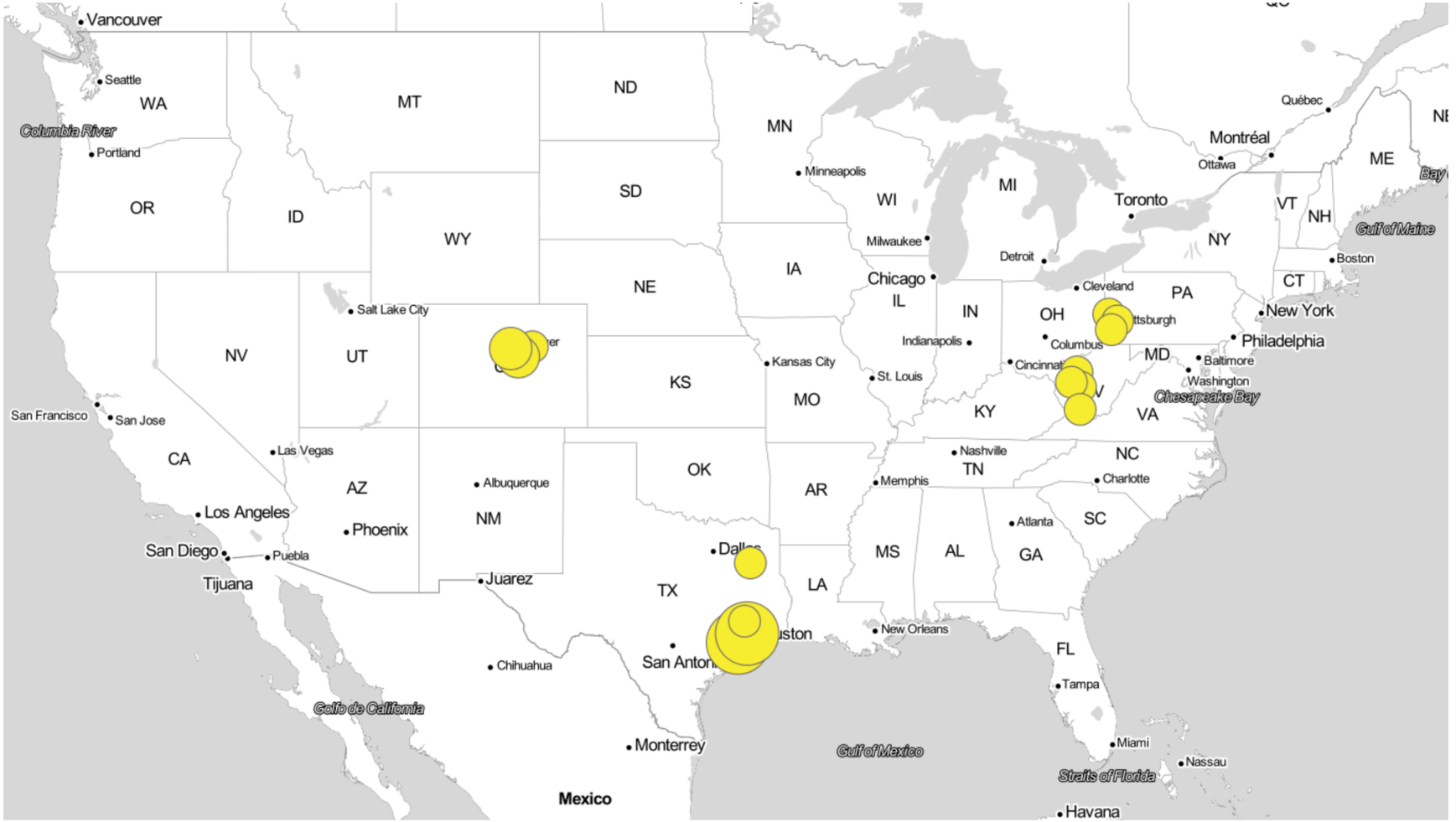
Firm C3: *All* Employees



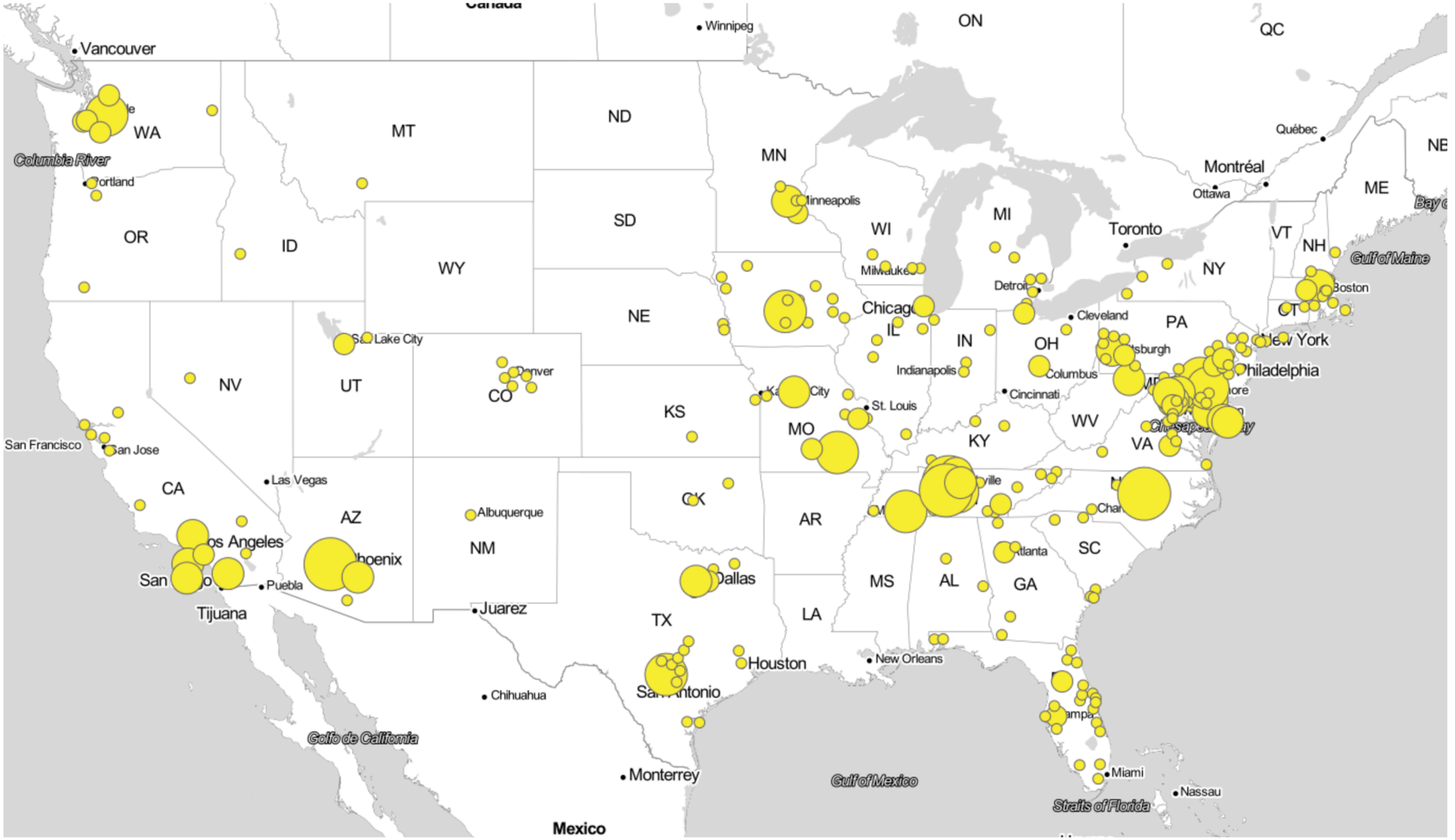
Headquarters: Houston; Option holders: 95

Firm C3: Option Participants



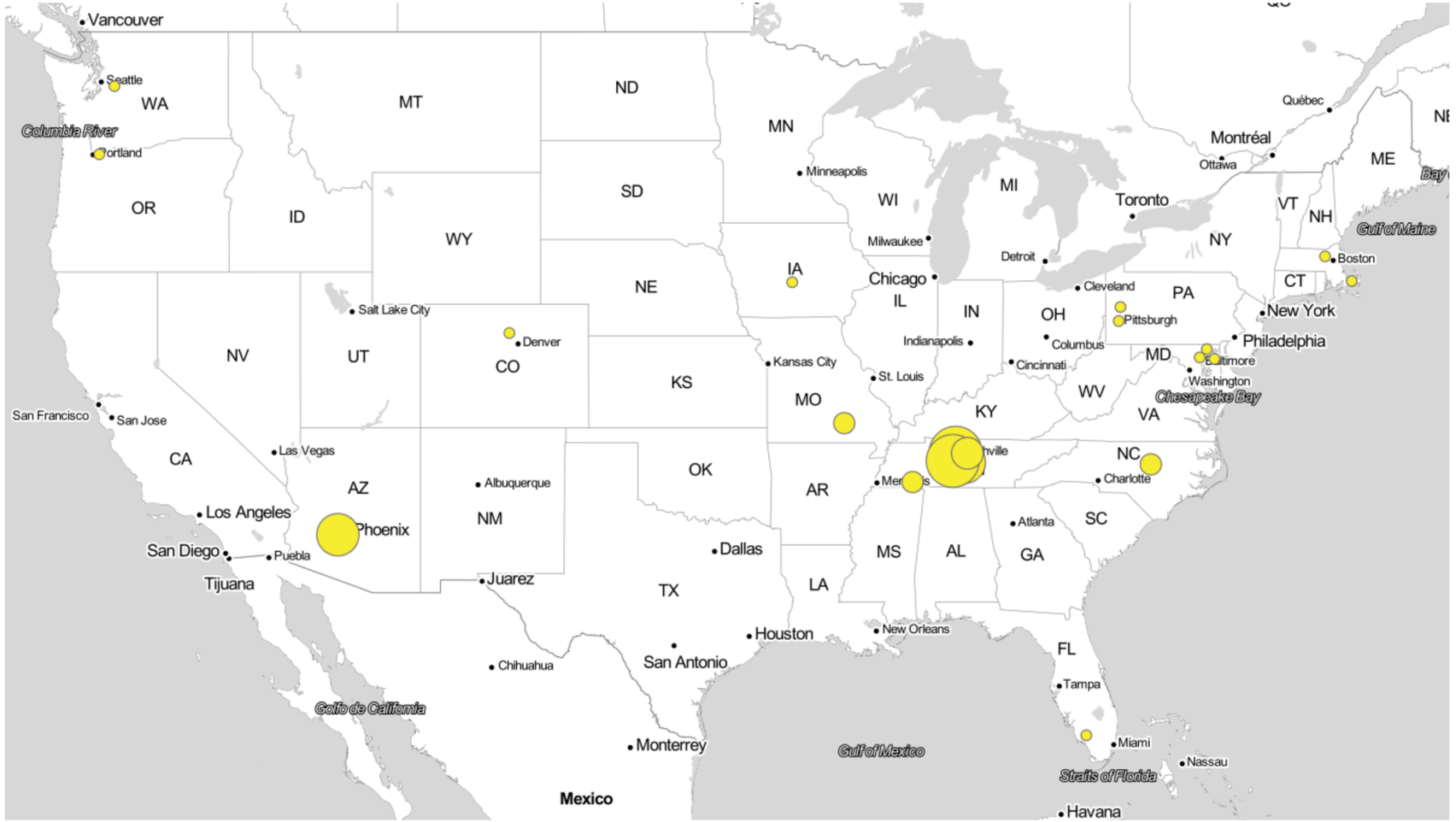
Headquarters: Houston; Option holders: 95

Firm C4: *All* Employees



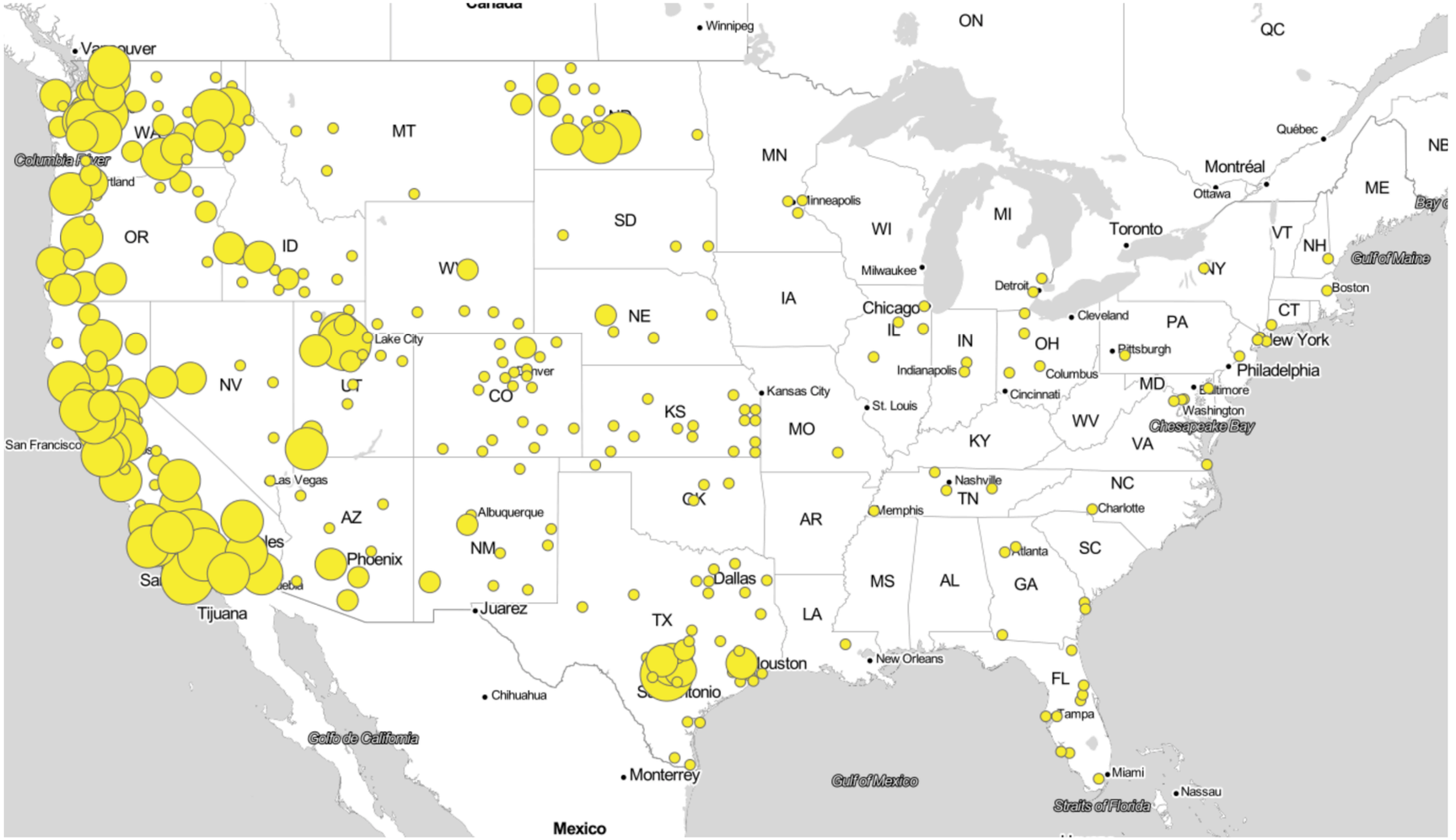
Headquarters: Tennesee; Option holders: 476 (including 10 in Hawaii and 1 international)

Firm C4: Option Participants



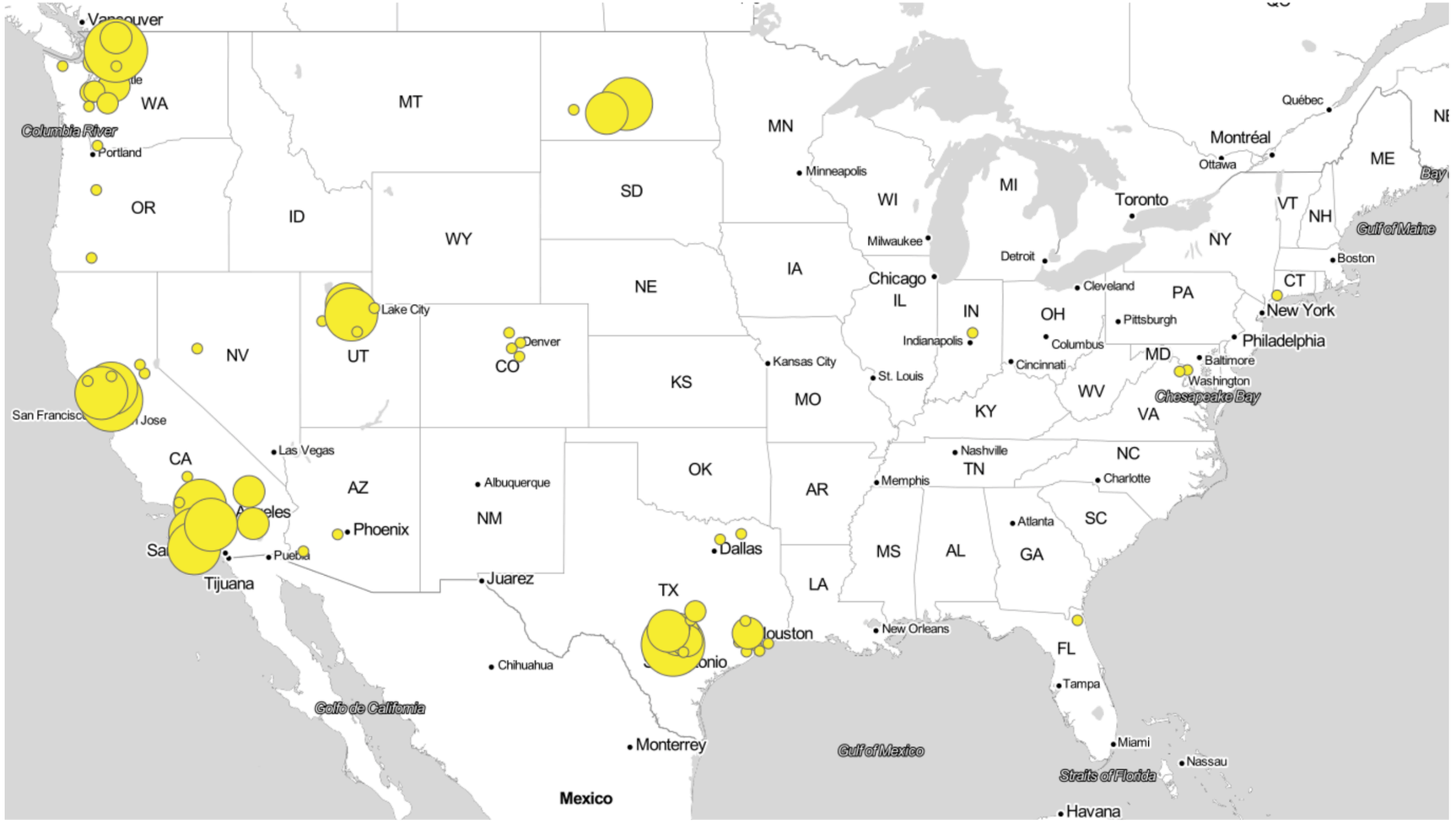
Headquarters: Tennesee; Option holders: 476 (including 10 in Hawaii and 1 international)

Firm C5: *All* Employees



Headquarters: San Antonio, TX; Option holders: 1,589
(including 165 in Alaska & Hawaii and 12 international)

Firm C5: Option Participants



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Sample Means for 10,570 Exercise Events

	Executives	Non-Executives
Sample Size	4,374	6,196
Ratio Spread-to-Black Scholes Value	88.2%	71.7%
Remaining Term (% of Full Term)	32.4%	47.0%
Exercise 100% of grant (“block exercise”)	52.6%	69.5%
Age	54.2	50.6
Tenure	19.2	11.8
Median Ratio of Inside Equity to Home Price	5.3 to 1	0.4 to 1

ΔHome Prices as shock to outside wealth

Home prices ↑ ⇒ Employee becomes more diversified

Home prices ↑ ⇒ Employee becomes wealthier, but houses are illiquid

No effect of Δ(Home Price) under Realized Utility Hypothesis

$$\text{Exercise Pct}_{i,j,t} = \alpha_i + \beta\Delta(\text{Home Price})_{i,t-T} + \text{Controls}_{i,j,t} + \varepsilon_{i,j,t}$$

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Exercise ↑ under Liquidity Hypothesis

No effect of Δ(Home Price) under Realized Utility Hypothesis

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Control Variables (Table 5)

DepVar: % of Options Exercised	ΔLn(Median Home Price) measured over past:							
	1 Month	3 Months	6 Months	12 Months	24 Months	36 Months	48 Months	60 Months
Spread:Value	0.2991***	0.2986***	0.2986***	0.2989***	0.2971***	0.2907***	0.2963***	0.3036***
Div Next 2 Weeks	0.0101*	0.0099*	0.0102*	0.0104*	0.0108**	0.0118**	0.0115**	0.0119**
Stock Return$_{t-1}$	0.6919***	0.6931***	0.6929***	0.6935***	0.6972***	0.6876***	0.6828***	0.6818***
Recent Vest	0.2030***	0.2047***	0.2057***	0.2058***	0.2051***	0.1978***	0.2032***	0.2034***
Age	0.0067***	0.0065***	0.0065***	0.0067***	0.0073***	0.0093***	0.0092***	0.0064***
Ln(Wealth)	-0.1063***	-0.1077***	-0.1094***	-0.1114***	-0.1171***	-0.1201***	-0.1168***	-0.1058***
Equity % Wealth	0.6734***	0.6751***	0.6808***	0.6939***	0.7133***	0.7049***	0.6962***	0.6738***
ΔHome Value over T months	1.0469***	0.4803***	0.2515***	0.1035**	0.0721***	0.0877***	0.0451**	-0.0069
Sample Size	4,215,878	4,204,504	4,184,695	4,141,932	4,057,280	3,969,382	3,868,046	3,853,215

Excludes data within 75% of full term; Regressions include employee FE, SE clustered by employee

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Equity % Wealth	0.6734***	0.6751***	0.6808***	0.6939***	0.7133***	0.7049***	0.6962***	0.6738***
ΔHome Value over T months	1.0469***	0.4803***	0.2515***	0.1035**	0.0721***	0.0877***	0.0451**	-0.0069
Sample Size	4,215,878	4,204,504	4,184,695	4,141,932	4,057,280	3,969,382	3,868,046	3,853,215

Excludes data within 75% of full term; Regressions include employee FE, SE clustered by employee

Recent Equity Grants

New Equity Grant ⇒ Employee becomes less diversified

⇒ Employee becomes wealthier

Distinguish between new grants of RSUs vs. Options

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Under Diversification Hypothesis:
β on Recent Options > β on Recent RSUs

Under Liquidity Hypothesis:
β on Recent Options = β on Recent RSUs

Under Realization Utility Hypothesis: β = 0

Effect of New Equity Grants (Table 6)

	All Observations	
Spread:Value	0.3003***	0.3003***
Div Next 2 Weeks	0.0102*	0.0102*
Stock Return$_{t-1}$	0.6922***	0.6926***
Recent Option Vest	0.1977***	0.1979***
Age	0.0072***	0.0071***
Ln(Wealth)	-0.1068***	-0.1067***
Equity % Wealth	0.6862***	0.6860***
Equity Grant in Past Month	0.0536	
RSU Grant in Past Month		0.1233
Option Grant in Past Month		0.0292
Sample Size	4,221,614	4,221,614

Excludes data within 75% of full term; Regressions include employee FE, SE clustered by employee

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Effect of New Equity Grants (Table 6)

	All Observations		Delete Obs with Vesting during Month	
Spread:Value	0.3003***	0.3003***	0.2185***	0.2188***
Div Next 2 Weeks	0.0102*	0.0102*	0.0134***	0.0135***
Stock Return$_{t-1}$	0.6922***	0.6926***	0.6401***	0.6378***
Recent Option Vest	0.1977***	0.1979***		
Age	0.0072***	0.0071***	0.0057***	0.0055***
Ln(Wealth)	-0.1068***	-0.1067***	-0.0431***	-0.0436***
Equity % Wealth	0.6862***	0.6860***	0.4523***	0.4543***
Equity Grant in Past Month	0.0536		0.1390**	
RSU Grant in Past Month		0.1233		0.3314**
Option Grant in Past Month		0.0292		-0.0043
Sample Size	4,221,614	4,221,614	3,989,020	3,989,020

Excludes data within 75% of full term; Regressions include employee FE, SE clustered by employee

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Spread:Value	0.3003***	0.3003***	0.2185***	0.2188***
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Relative Risk Aversion Under Diversification Hypothesis

Assume:

Compute for Each Exercise Event:

Relative Risk Aversion Under Diversification Hypothesis

Assume:

- Constant Relative Risk Aversion (CRRA) utility
- Outside Wealth = Home Price

Compute for Each Exercise Event:

Relative Risk Aversion Under Diversification Hypothesis

Assume:

Constant Relative Risk Aversion (CRRA) utility

Outside Wealth = Home Price

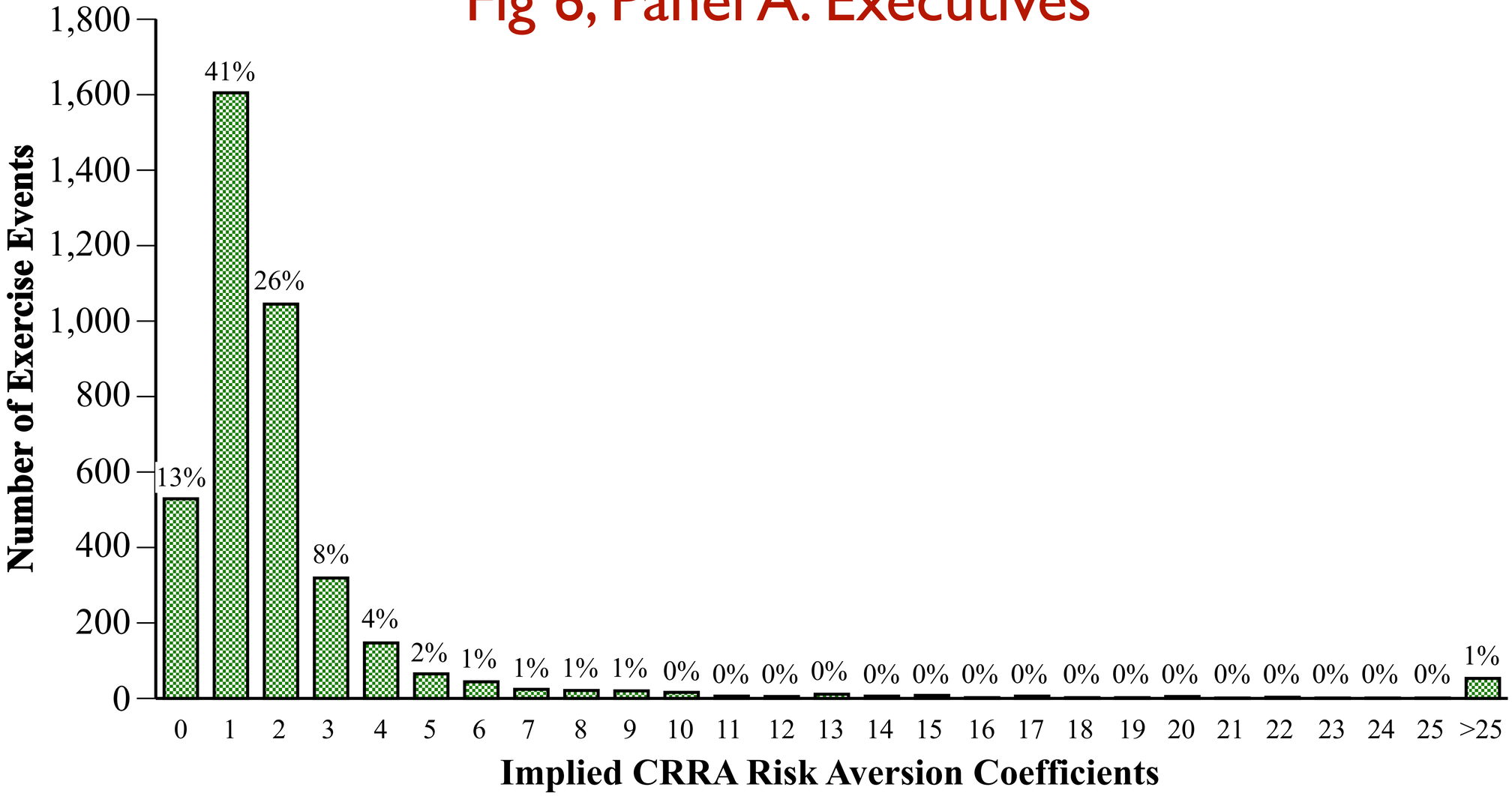
Compute for Each Exercise Event:

Lowest risk-aversion coefficient, ρ, that would predict exercise
given stock price, exercise price, remaining term, equity holdings,
and proxy for outside wealth

Based on modified binomial with 100 nodes from exercise event to expiration

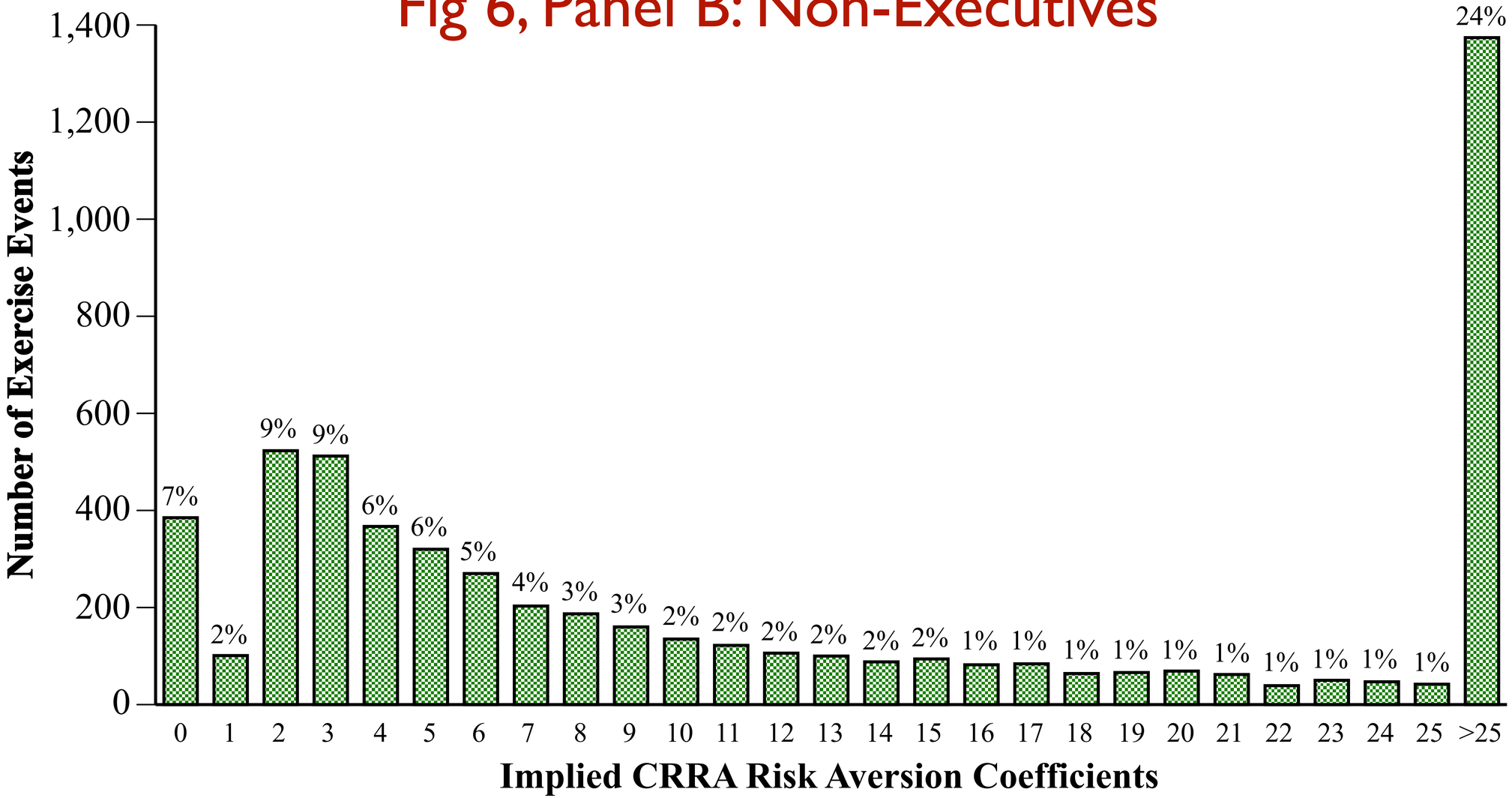
Relative Risk Aversion Under Diversification Hypothesis

Fig 6, Panel A: Executives



Relative Risk Aversion Under Diversification Hypothesis

Fig 6, Panel B: Non-Executives



Range in Implied Risk Aversion for Individuals

# Exercise Events	Executives		Non-Executives	
	75th to 25th Pctl	Max to Min	75th to 25th Pctl	Max to Min
2 Exercise Events	2.2	2.2	7.5	7.5
3 Exercise Events	3.1	3.1	12.1	12.1
4 Exercise Events	1.9	2.6	8.4	12.3
> 4 Exercise Events	1.6	4.5	6.9	14.3

Temporal Clustering of Exercises

Fact:
Employees likely to exercise options from different grants in same week, and often on same day

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Consistent with Realized Utility and Liquidity Hypothesis,
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Fact:
Conditional on exercise, employees likely to exercise 100% of available options from a particular grant

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For exercise events occurring upon vesting:
consistent with Diversification, Realized Utility, and Liquidity Hypotheses

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For exercise events occurring upon vesting:
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For exercise events *not* occurring upon vesting:
consistent with Realized Utility and Liquidity Hypotheses, but ***inconsistent*** with Diversification Hypothesis

Conclusion: Debunking Diversification

Early exercise interesting for three broad reasons

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Early exercise interesting for three broad reasons

Insights into how and why individuals make financial decisions

Implications for how employees subjectively value options, which in turn has implications for effectiveness of equity incentive plans

Implications for opportunity and accounting cost of options

Conclusion: Debunking Diversification

Most studies *assume* diversification is primary driver of early exercise decisions

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and, if not diversification, psychological factors (disposition)

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and, if not diversification, psychological factors (disposition)

We show that "liquidity" may be even more important than diversification or psychology in explaining early exercise