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Spillover Effects of Metro Academic R&D on Non-metro Labor Market Conditions

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Estimating spillover effects of metro university innovation on non-metro labor market conditions

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Introduction

- Universities impact innovation through academic research, funded through public and private sources. In Fiscal Year 2009, $54.9 billion spent on academic R&D, with funds coming from the federal government ($32.6 billion), state and local governments, private industry ($11.2 billion), institutional funds, and other sources (Britt 2010).
- There is a large literature capturing the spillover effects from academic R&D. Recent research have explored spillover effects on urban labor markets from innovation in academic centers (Beeson and Montgomery [1992], Abel and Deitz [2011], Kantor [2010], Saha [2012], Crispin, Saha and Weinberg [2012], Saha and Weinberg [2012]).
- However, Little attention has been paid to effect of such innovation on non-urban labor markets. Moreover, there is scarce research on how academic innovation diffuses through distance.
- Non-metro areas are often non urban and also are away from large metros.
- *To get a sense of how far urban academic innovation spreads and to find the impact of urban research on non-urban population, this research estimates the spillover effect from metro area university innovation on non-metro labor market conditions.*

Method and Data

• We use the variation of academic innovation from metros to explain the variation of non-metro labor market conditions across different US states, after controlling for individual education and experience

- Labor market conditions in non-metro areas are considered for individuals who live in a non-metro area, measured as individuals' log of real weekly earnings, employment status, and college enrollment status. The data used to determine labor market conditions, comes from the 2000 U.S. Census.
- Metro academic innovation is measured as the sum of spending on R&D, in real dollars, by all metro area institutions of higher learning inside a state.
- To control for differences in size of non metro areas across states, this aggregate spending across states is divided by the non-metro population of states, generating the metro academic R&D per non-metro capita.
- Because many non metro areas have universities that produce significant research, we control for per capita non-metro academic R&D within the state, in real dollars.
- Data on academic R&D data comes from National Science Foundation dataset (www.webcaspar.com) and is limited to the year 2000.
- For some states like New York, New Jersey, Delaware and Connecticut or Massachusetts and Rhode Island metro R&D is hard to observe separately. We aggregated data for these states together in the dataset.

Table 1: Descriptive statistics of experimental variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Log of weekly non-metro wages	716205	5.594	0.708	3.689	8.292
Individual non-metro employment	716205	0.884	0.321	0	1
Non-metro college enrollment	716205	0.093	0.290	0	1
Metro academic R&D per non-metro capita	712582	0.292	0.414	0.003	6.756
Non-metro academic R&D per non-metro capita	682235	0.037	0.056	0	0.194
Share of college graduate holders in metro	716205	0.196	0.033	0.148	0.316

Regression Model

Specification of main regression equation:

$$y_{is}=\alpha+\beta_{xs}+\gamma control_{is}+\varepsilon_{is}$$

where:

- y_{is} = The labor market outcome of individual *i* in state *s* when this individual resides in a non-metro area
- x_s = Innovation term from metro area for state *s*
- $control_{is}$ = Control term, which includes individual years of schooling, work experience, marital status, gender, race and ethnic identity, and population for states in non-metro areas, crime, mortgage payments, taxes, non metro R&D

To control for heteroskedasticity across states we obtain robust standard errors by using cluster option in the regressions.

Results

Wages

Table 2 contains the estimates for the clustered OLS regressions for weekly real wages and each of the different independent variables, as well as the robust standard errors for each coefficient and the adjusted r-squared value. For each model, the explanatory variable generates a positive coefficient: metro academic R&D has a higher coefficient than non-metro academic R&D, showing that metro R&D a greater impact on non-metro labor market conditions than non-metro, though neither coefficient is statistically significant. When both metro and non-metro R&D are regressed together as explanatory variables, the coefficient is even larger and is significant at the 10% level. When metro R&D, non-metro R&D, and metro share of college graduate degree holders are regressed together, there is the most impact on weekly wages is significant at the 1% level. It is reasonable to extrapolate a positive spillover effect on non-metro wages by metro academic R&D spending alone, but the greatest effect on non-metro wages occurs when metro academic innovation (R&D + college graduate degree holders) is considered alongside non-metro academic R&D spending.

Table 2: Innovation and Average Weekly Wages

VARIABLES	lw1	lw1	lw1	lw1
Metro academic R&D per non-metro capita	0.014		0.017+	0.030**
	(0.009)		(0.009)	(0.011)
Non-metro academic R&D per non-metro capita		0.005	0.011	0.145
		(0.114)	(0.117)	(0.156)
Share of metro college graduate degree holders				-0.730+
				(0.406)
Constant	-1,317.347+	-1,092.066	-1,462.908	-1,781.843
	(680.609)	(1,174.219)	(1,179.503)	(1,173.134)
Observations	712582	682235	682235	682235
Adjusted R-squared	0.318	0.319	0.320	0.320
Robust standard errors in parentheses				
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10				

Employment status

Table 3 presents the estimates for clustered OLS regressions for non-metro individual employment status. Regressing the same explanatory variables in the same combinations as before, the results are interesting in that each regression model generates a negative coefficient. Each one that pertains to metro innovation's impact on non-metro employment is significant: metro R&D, with the least negative coefficient, is significant at the 5% level; non-metro R&D, with the most negative coefficient, is not significant at even the 10% level; metro and non-metro R&D together produce a slightly negative coefficient that is significant at the 0.1% level; metro and non-metro R&D and share of metro college graduate degree holders regressed together produces a slightly more negative coefficient than metro and non-metro R&D that is also highly significant.

Table 3: Innovation and Employment Status

VARIABLES	e1	e1	e1	e1
Metro academic R&D per non-metro capita	-0.012*		-0.019***	-0.022***
	(0.005)		(0.003)	(0.004)
Non-metro academic R&D per non-metro capita		-0.055	-0.062	-0.084+
		(0.056)	(0.042)	(0.046)
Share of metro college graduate degree holders				0.120
				(0.084)
Constant	-145.591	-73.709	355.727	408.258
	(184.635)	(309.995)	(328.542)	(342.058)
Observations	712582	682235	682235	682235
Adjusted R-squared	0.041	0.041	0.042	0.042
Robust standard errors in parentheses				
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10				

Enrollment

Each of the models, as can be seen in Table 4, has a positive effect on non-metro college enrollment, and each is significant at some level: metro academic R&D is significant at the 0.1% level and produces the smallest coefficient; non-metro academic R&D produces the largest coefficient but is the least significant, at the 10% level; metro and non-metro R&D together produce a slightly larger coefficient than metro R&D alone, and it is significant at the 0.1% level; lastly, metro R&D, non-metro R&D, and metro share of college graduate degree holders produce a coefficient just in between metro R&D alone and metro and non-metro R&D, and is significant at the 1% level.

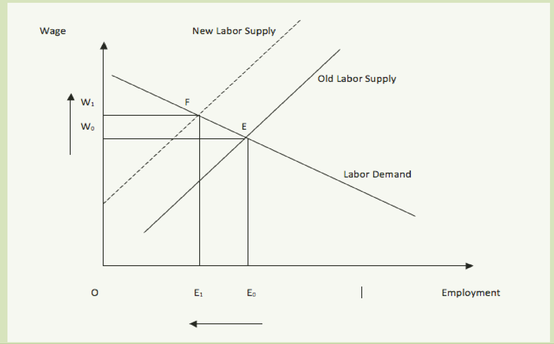
Results, continued

Table 4: Innovation and College Enrollment

VARIABLES	ENROL	ENROL	ENROL	ENROL
Metro academic R&D per non-metro capita	0.010***		0.012***	0.011**
	(0.002)		(0.003)	(0.003)
Non-metro academic R&D per non-metro capita		0.058+	0.062*	0.046
		(0.032)	(0.025)	(0.034)
Share of metro college graduate degree holders				0.088
				(0.104)
Constant	32.569	26.350	-247.862	-209.507
	(152.560)	(196.006)	(215.049)	(226.452)
Observations	712582	682235	682235	682235
Adjusted R-squared	0.238	0.241	0.241	0.241
Robust standard errors in parentheses				
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10				

Innovation and the Labor Supply Curve

One of the important avenues through which the spillover happens is through the labor supply curve. Suppose there is large innovation in Cleveland. It would draw labor from non-metro areas into Cleveland. This would reduce the size of the labor force in non-metro areas, shifting the labor supply curve to the left. This leftward shift increases wages at every level of employment in non-metro areas, which reduces employment in the non-metro areas. Whether the labor demand curve shifts to the left is hard to say. But whether or not it does, we can still expect for non-metro wages to increase and non-metro employment to decrease because of urban innovation.



Conclusion

This paper's aim is to estimate the metro area academic innovation spillover effect on non-metro area labor market conditions. We close the gap in the literature regarding innovation spillovers and their effects on nonurban areas and comment on the spatial spread of spillovers. We find that metro innovation significantly increases wages in non-metros and decreases employment. In addition, we find that metro innovation increases the likelihood of individuals in non-metro to be enrolled in college.

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