Urban First: USDA R&D Impact on Regional Personal Income

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Urban First

1. Discuss a little background and the way we thought about our research questions
2. Briefly discuss methods/data, and then get into the result and policy implications
3. Questions – Round One
4. Briefly discuss more about the technical aspect of the modeling and generated results
5. Questions – Round Two

Factors driving our research question

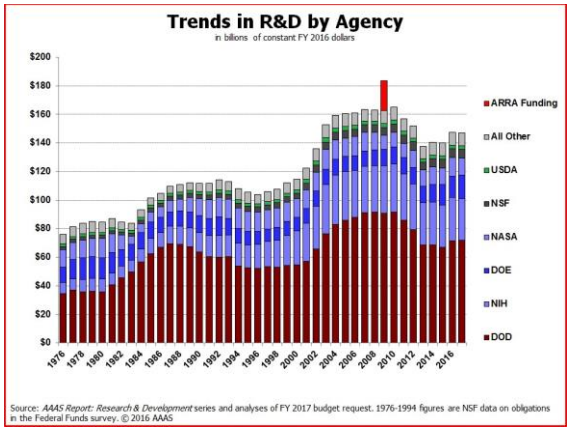
Challenges:

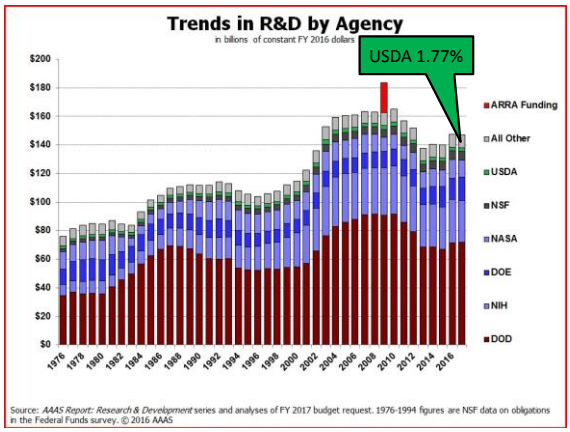
Small R&D budget in relative terms.

Ag industry stakeholder needs – technology to do more with less.

Rural = agriculture: trending away from this.

So, what is the impact of USDA R&D investments on rural wealth?


Trends in R&D by Agency
in billions of constant FY 2016 dollars
$200
$180
$160
$140
$120
$100
$80
$60
$40
$20
$0
1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016
ARRA Funding
All Other
USDA
NSF
NASA
DOE
NIH
DOD
Source: AAAS Report: Research & Development series and analyses of FY 2017 budget request. 1976-1994 figures are NSF data on obligations in the Federal Funds survey. © 2016 AAAS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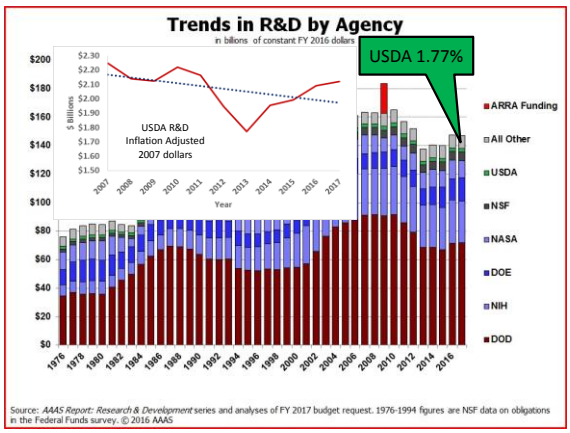
Trends in R&D by Agency
in billions of constant FY 2016 dollars
USDA 1.77%
$2.30
$2.20
$2.10
$2.00
$1.90
$1.80
$1.70
$1.60
$1.50
$ Billions
USDA R&D
Inflation Adjusted
2007 dollars
2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017
Year
$200
$180
$160
$140
$120
$100
$80
$60
$40
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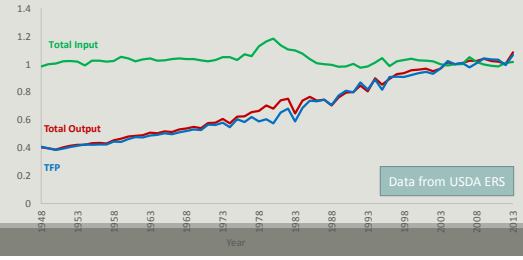
Past USDA R&D Framework

Much of the historic focus:

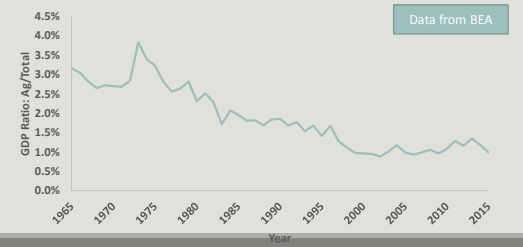
- Developing technology to improve the production process – in essence, do more with less.



One impact of agricultural technologies?

New technologies benefit producers ability to do more less

Also see a decline in share of agriculture's contribution to total GDP.



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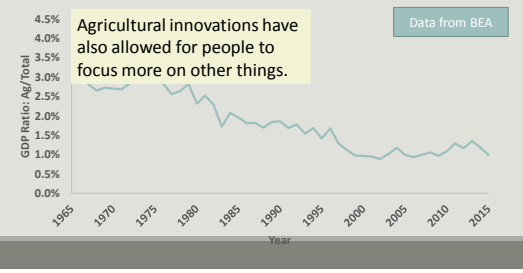

Consider this…

Other R&D Investments, e.g., from DOD, DOE, NASA, NIH, and NSF
- A lot of technology transfer positively impacting urban areas.

Is this a technical change a quandary resulting in the growing economic challenges rural areas face?

USDA R&D → Ag Innovations → Improved TFP
- clear benefits to agricultural producers and some rural economies

At the same time,

DOD,NIH,NSF R&D → Innovations → New Firms
- clear benefits to urban areas in terms of wealth

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What is less clear:

1. USDA R&D impact on urban areas
2. Other agency R&D impacts on rural areas
3. USDA R&D impacts broadly on rural wealth

Research question

We wanted to separate out the R&D impact:

1. Rural versus urban areas
2. USDA versus non-USDA

Contribution

Current Total Factor Productivity (TFP) model using data from the last 20 years 1995-2014 at the state-level

Separate Urban & Rural and consider both USDA & Non USDA funding

Endogenous multiple lag order selection (up to 20 years) using BIC rather than using fixed lag-lengths

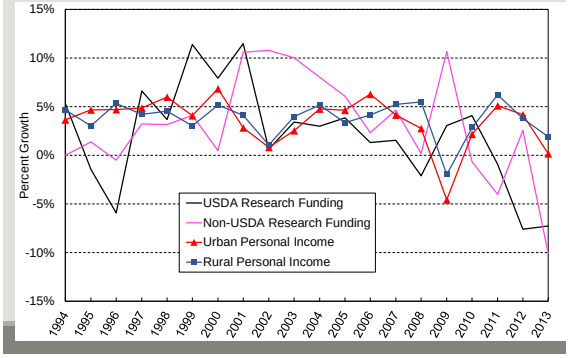
Rolling subsample analysis to correctly estimate the within-covariance of the data

Data

Personal Income, Employment, and Interest Income from BEA
- Rural & urban separation
- Sample period: 1995-2014
- 50 States + D.C.

USDA and Non USDA Federal R&D Funding NSF WebCASPAR
- Sample period: 1975-2014
- 50 States + D.C.

USDA Funding and Rural/Urban Personal Income



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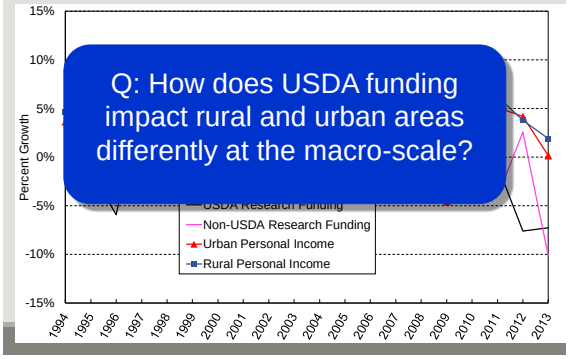
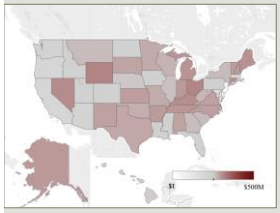
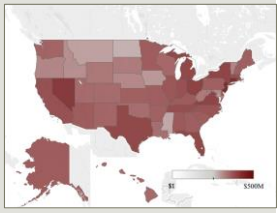


Predicted PV Benefit from $1M Fixed Cost Investment in USDA R&D Funding on the Margin assuming a 2.5% Interest Rate

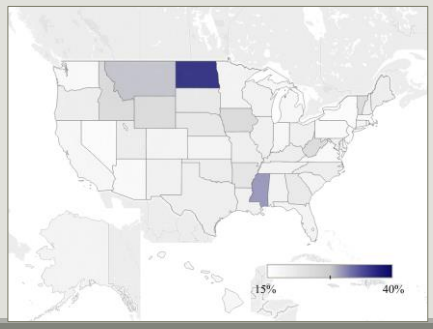


Rural Personal Income



Urban Personal Income

Sensitivity Analysis: Percent change in Net Benefit from 0-5% Discount Rate Assumption



Takeaways

1. USDA research funding has a long-run positive impact on both rural and urban areas at a 7 year lag
2. USDA research funding also has a short-run positive impact on urban areas
3. Funding the USDA may not decrease the rural-urban divide, but will contribute very positively to personal income growth in both areas

Predicted Total Benefit to Urban & Rural Personal Income from 1M USD Fixed Cost Investment in USDA R&D Funding on the Margin assuming a 2.5% Interest Rate (In M USD)

State	Urban	Rural	State	Urban	Rural	State	Urban	Rural
Alabama	37.61	2.50	Kentucky	34.35	4.87	North Dakota	1.72	0.56
Alaska	32.30	3.54	Louisiana	15.62	0.64	Ohio	119.47	6.43
Arizona	33.65	0.36	Maine	29.17	4.52	Oklahoma	15.75	1.74
Arkansas	25.85	3.25	Maryland	6.84	0.04	Oregon	6.35	0.27
California	54.06	0.24	Massachusetts	55.95	0.20	Pennsylvania	27.99	0.71
Colorado	16.75	0.56	Michigan	86.97	4.05	Rhode Island	217.40	0.00
Connecticut	392.19	4.58	Minnesota	32.74	2.00	South Carolina	33.78	1.30
Delaware	49.30	0.00	Mississippi	2.11	0.56	South Dakota	9.57	2.47
D.C.	1.10	0.00	Missouri	29.03	1.96	Tennessee	64.14	3.67
Florida	83.31	0.58	Montana	2.78	1.26	Texas	83.31	2.22
Georgia	30.28	1.23	Nebraska	6.02	0.86	Utah	17.49	0.58
Hawaii	18.00	0.80	Nevada	191.55	5.26	Vermont	6.68	2.96
Idaho	4.85	0.61	New Hampshire	26.43	3.54	Virginia	109.68	2.68
Illinois	42.15	1.09	New Jersey	486.02	0.00	Washington	23.34	0.51
Indiana	53.11	3.54	New Mexico	21.79	2.75	West Virginia	10.27	1.44
Iowa	3.63	0.64	New York	100.42	1.29	Wisconsin	19.90	1.57
Kansas	28.02	3.02	North Carolina	48.24	2.85	Wyoming	11.32	6.74

First Round of Questions

More on the modeling

Measuring Impact on Total Factor Productivity

Personal Income Cobb-Douglas:

$$Y_{it} = A_i L_{it}^{\beta_L} K_{it}^{\beta_K} Y_{it}^{o}$$

Transformed to Ln Variables:

$$y_{it} = \alpha_i + \beta_L l_{it} + \beta_K k_{it} + y_{it}^{o}$$

First-Differencing:

$$\Delta y_{it} = \beta_L \Delta l_{it} + (1 - \delta)\beta_K i_{it} + \Delta y_{it}^{o}$$

Total Factor Productivity (TFP)

$$\Delta y_{it}^{o} \equiv \Delta \ln(\mathrm{TFP}_{it})$$

Modeling Approach

Model TFP using USDA funding controlling for non USDA funding:

$$\Delta y_{it}^{o} = \sum_{j=1}^{\text{lags}} \beta_j \, \text{USDA}_{i,t-\text{lag}(j)} + \sum_{j=1}^{\overline{\text{lags}}} \gamma_j \, \text{NonUSDA}_{i,t-\overline{\text{lag}}(j)} + \epsilon_{it}$$

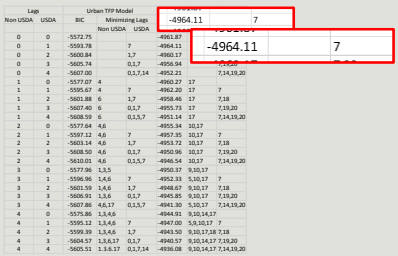
The number of lags and the choice of lags are endogenously estimated using the Bayesian Information Criterion (BIC):

$$\text{BIC} = -2 \ln \hat{L} + (\text{lags} + \overline{\text{lags}}) \ln nT$$

Bayesian Information Criterion Results

Lags		Urban TFP Model			Rural TFP Model		
Non USDA	USDA	BIC	Minimizing Lags		BIC	Minimizing Lags	
			Non USDA	USDA		Non USDA	USDA
0	0	-5572.75			-4961.87		
0	1	-5593.78		7	-4964.11		7
0	2	-5600.84		1,7	-4960.17		7,20
0	3	-5605.74		0,1,7	-4956.94		7,19,20
0	4	-5607.00		0,1,7,14	-4952.21		7,14,19,20
1	0	-5577.07	4		-4960.27	17	
1	1	-5595.67	4	7	-4962.20	17	7
1	2	-5601.88	6	1,7	-4958.46	17	7,18
1	3	-5607.40	6	0,1,7	-4955.73	17	7,19,20
1	4	-5608.59	6	0,1,5,7	-4951.14	17	7,14,19,20
2	0	-5577.64	4,6		-4955.34	10,17	
2	1	-5597.12	4,6	7	-4957.35	10,17	7
2	2	-5603.14	4,6	1,7	-4953.72	10,17	7,18
2	3	-5608.50	4,6	0,1,7	-4950.96	10,17	7,19,20
2	4	-5610.01	4,6	0,1,5,7	-4946.54	10,17	7,14,19,20
3	0	-5577.96	1,3,5		-4950.37	9,10,17	
3	1	-5596.96	1,4,6	7	-4952.33	5,10,17	7
3	2	-5601.59	1,4,6	1,7	-4948.67	9,10,17	7,18
3	3	-5606.91	1,3,6	0,1,7	-4945.85	9,10,17	7,19,20
3	4	-5607.86	4,6,17	0,1,5,7	-4941.30	5,10,17	7,14,19,20
4	0	-5575.86	1,3,4,6		-4944.91	9,10,14,17	
4	1	-5595.12	1,3,4,6	7	-4947.00	5,9,10,17	7
4	2	-5599.39	1,3,4,6	1,7	-4943.50	9,10,17,18	7,18
4	3	-5604.57	1,3,6,17	0,1,7	-4940.57	9,10,14,17	7,19,20
4	4	-5605.51	1.3.6.17	0,1,7,14	-4936.08	9,10,14,17	7,14,19,20

Bayesian Information Criterion Results



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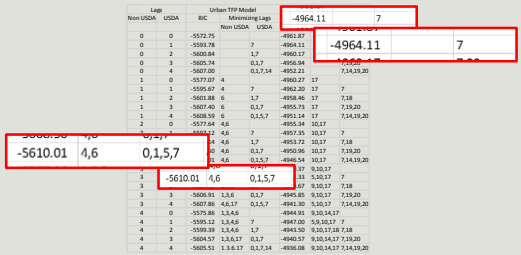

Rolling Subsample Analysis of Fitted Models on Rural and Urban Personal Income

Sample		Non USDA R&D		USDA R&D			
		Lag = 4	6	Lag = 0	1	5	7
Urban	1994-1999	0.00	0.00	0.01	0.02**	0.00	0.03*
Personal	1997-2002	0.00	0.00	-0.02**	0.01*	-0.01	0.02
Income	2000-2005	0.00	0.00	0.00	0.00	0.00	0.00
	2003-2008	-0.01	0.00	0.00	0.00	0.00	0.02**
	2006-2011	0.00	-0.01	0.00	0.00	0.01	0.02*
	2009-2014	-0.01	-0.01*	0.02*	0.03**	0.01*	0.02**
Rural	1994-1999						0.01
Personal	1997-2002						0.03**
Income	2000-2005						0.02
	2003-2008						0.01
	2006-2011						0.02*
	2009-2014						0.01**

*-denotes significance at the 5% level; **-denotes significance at the 1% level
Standard errors computed using robust HAC estimator

Contact information:

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