

Demand Side Drivers of Broadband Adoption



Thomas M. Koutsky
Resident Scholar
Phoenix Center

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Understanding Differences in Adoption Rates is Key to Sensible Policy

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Why do we see different rates of broadband adoption in different communities?

Are these differences all policy-driven?

How can we tell the extent to which differences are policy-driven and those that are not?

If we identify policy-relevant demographic factors, can that help make policy more effective?

OECD Broadband—Variation in Adoption

(Broadband Subs per 100 population, Dec. 2007)

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#	Name	BB Subs	#	Name	BB Subs	#	Name	BB Subs
1	Denmark	35.1	11	United Kingdom	25.8	21	Spain	18.0
2	Netherlands	34.8	12	Belgium	25.7	22	Italy	17.2
3	Iceland	32.2	13	France	24.6	23	Czech Republic	14.6
4	Norway	31.2	14	Germany	23.8	24	Portugal	14.4
5	Switzerland	31.0	15	United States	23.3	25	Hungary	13.6
6	Finland	30.7	16	Australia	23.3	26	Greece	9.1
7	Korea	30.5	17	Japan	22.1	27	Poland	8.8
8	Sweden	30.3	18	Austria	19.6	28	Slovak Republic	7.6
9	Luxembourg	26.7	19	New Zealand	18.3	29	Turkey	6.0
10	Canada	26.6	20	Ireland	18.1	30	Mexico	4.3

Broadband Adoption in the U.S.

(Broadband Subscription per Household, June 2006)

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#	Name	BB Subs	#	Name	BB Subs	#	Name	BB Subs
1	New Jersey	0.87	18	New Hampshire	0.64	35	Vermont	0.45
2	Nevada	0.82	19	Texas	0.59	36	Louisiana	0.44
3	California	0.82	20	Kansas	0.57	37	Idaho	0.43
4	DC	0.81	21	Illinois	0.57	38	Wyoming	0.43
5	Connecticut	0.79	22	Alaska	0.56	39	Oklahoma	0.42
6	Maryland	0.75	23	Minnesota	0.56	40	South Carolina	0.42
7	Massachusetts	0.74	24	Pennsylvania	0.55	41	Kentucky	0.40
8	Arizona	0.73	25	Ohio	0.54	42	Montana	0.39
9	Colorado	0.70	26	Nebraska	0.53	43	Iowa	0.39
10	Florida	0.70	27	Delaware	0.53	44	New Mexico	0.37
11	Washington	0.69	28	Tennessee	0.52	45	Alabama	0.35
12	New York	0.69	29	North Carolina	0.51	46	Arkansas	0.35
13	Georgia	0.68	30	Indiana	0.51	47	West Virginia	0.33
14	Rhode Island	0.68	31	Wisconsin	0.50	48	South Dakota	0.29
15	Utah	0.67	32	Maine	0.48	49	North Dakota	0.27
16	Virginia	0.66	33	Michigan	0.47	50	Mississippi	0.25
17	Oregon	0.64	34	Missouri	0.46			

Possible Explanations...

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- ✓ Does population density matter?
- ✓ Does household size matter?
- ✓ What about income?
- ✓ Or income inequality?
- ✓ Does education level matter?
- ✓ What about population age?
- ✓ How much does the price of broadband matter?

We have “gut” expectations about each of these factors—but which are more important?

Expectations

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$$\text{BB/POP} = f(\text{Price, Income, Inequality, Education, Age, Density, etc})$$

Using several observations (OECD nations, U.S. states) over time, we can develop a function f that translates these demographic and economic “endowments” of communities into an expected level of broadband adoption

We can use this function to get an expected broadband subscription rate—something like a golf handicap

*We also can use this function to identify **which** demographic and economic conditions impact broadband the most*

Two Empirical Approaches

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Least Squares Approach:

$$\ln B_i = \beta_0 + \sum_{j=1}^k \beta_j \ln X_j + v_i$$

$$BPI = \hat{v}_i / \max(|\hat{v}_i|)$$

Stochastic Frontier Analysis:

$$\ln B_i = \beta_0 + \sum_{j=1}^k \beta_j \ln X_j + v_i - u_i$$

$$BEI = \exp(-u_i)$$

OECD Data

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- **3 Semesters of subscription data (90 Observations)**
 - December 07, June 07, December 06
- **Regressors:**
 - PRICE (“average” price for broadband)
 - GDP per capita (income)
 - GINI Coefficient (income inequality)
 - EDUC (% tertiary education)
 - AGE65 (% over 65)
 - DENSITY (population/km²)
 - BIGCITY (% pop in biggest city)
 - PHONE (telephones/population; demand for traditional communications services)
 - HHSIZE (population/households)
 - BUSSIZE (population/business establishments)
 - Period dummies

OECD Results

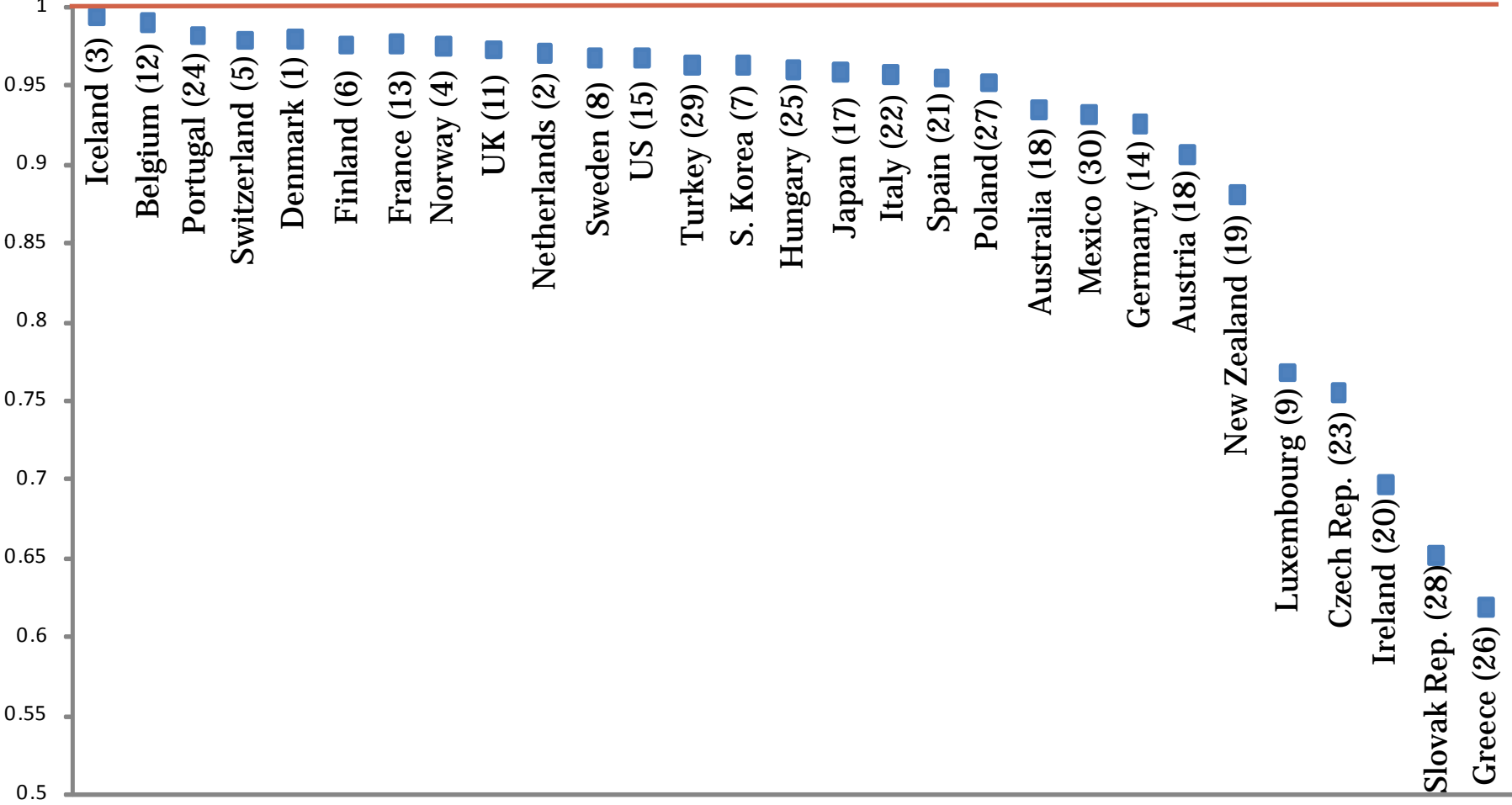
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- **Demographic and Economic Factors explain 91% of variation in broadband adoption ($R^2 = 0.91$)**
- **Marginal Effects (elasticities, using least squares)**
 - PHONE +2.0
 - GINI -1.2
 - GDPCAP +0.58
 - AGE65 -0.55
 - PRICE -0.39
 - HHSIZE +0.35
 - BUSSIZE -0.23
 - EDUC +0.20
 - BIGCITY -0.20
 - DENSITY +0.03

Technical Efficiency

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THE FRONTIER



Domestic Data

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- **2 Semesters of subscription data (100 Observations)**
 - June 05, December 05
 - Acknowledged questions regarding mobile broadband figures precludes using any more recent data
- **Demographic and Economic conditions explain 91% of variation in broadband adoption ($R^2 = 0.91$)**
- **Regressors:**
 - INCOME (average household income)
 - GINI (income inequality)
 - CITY100 (percentage of population living in cities >100,000)
 - RURAL (percentage of rural households)
 - FARM (percentage of farm households)
 - ENGLISH (percentage of families where English is primary language)
 - IMMIG (percentage of foreign-born population)
 - EDUC (percentage of population with college degree or higher)
 - INSCHOOL (percentage of households with at least one child in some level of school)
 - RETIRE (percentage of households receiving retirement income)

Domestic Results

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- **Demographic and Economic Factors explain 91% of variation in broadband adoption ($R^2 = 0.91$)**
- **Marginal Effects (elasticities; least squares)**
 - INSCHOOL +2.81
 - GINI -1.51
 - RETIRE -0.40
 - ENGLISH +0.39
 - INCOME +0.38
 - EDUC +0.24
 - IMMIG +0.14
 - FARM -0.08
 - RURAL -0.07
 - CITY100 +0.06

What it Means...

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Increasing the factor 10% affects broadband subscription by...

OECD Factor	Effect	Domestic Factor	Effect
Income Inequality (GINI)	-12.0%	Income Inequality (GINI)	-15.1%
Income	5.8%	Income	3.8%
% Tertiary Education	2.0%	% College degree	2.4%
		% HH w/children in school	28.1%
% Population over 65	-5.5%	% Retired Households	-4.0%
Population Density	0.3%	% Rural Households	-0.7%
		% Farm Households	-0.8%
% Population in Biggest City	-2.0%	% Population in Cities >100k	0.6%
Household Size	3.5%	% English-Speaking HH	3.9%
Business Size	-2.3%	% Foreign-Born Population	1.4%
Telephone Penetration	20.0%		

Possible Surprises

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- **Income Inequality is highly significant**
- **Education is enormously significant—particularly families in schools**
- **Immigrant population in U.S. more likely to adopt broadband, all other things being equal**
- **Age matters**
- **Density matters—but not as much as other factors**
 - Impact of density-related factors is non-linear
 - Urban, Rural, and Farm factors interact—the marginal value of a city decreases significantly as relative Rural and Farm populations grow
 - That said, other factors are greater than Rural and Farm factors

Policy Implications

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A Formula for Sound, Effective Broadband Policy...

- **Leverage factors that positively impact broadband adoption...**
 - Children in school
 - Immigrant communities
 - Younger population age communities
- **Seek to mitigate factors that negatively impact broadband adoption...**
 - Effect of income inequality
 - Retired and older populations
 - English language
- **Examples of programs that possibly may deliver “bang for the buck”**
 - In an area with high immigrant population, host a computer donation and training program for low-income families with children enrolled in school
 - Computer training for immigrant communities in Spanish and other foreign languages

Phoenix Center Research

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Ford, Koutsky, and Spiwak, *The Broadband Efficiency Index: What Really Drives Broadband Adoption Across the OECD?*, Phoenix Center Policy Paper No. 33 (May 2008), <http://www.phoenix-center.org/pcpp/PCPP33Final.pdf>

Ford, Koutsky, and Spiwak, *The Demographic and Economic Drivers of Broadband Adoption in the United States*, Phoenix Center Policy Paper No. 31 (Nov. 2007), <http://www.phoenix-center.org/pcpp/PCPP31Final.pdf>

Contact Information...

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Thomas M. Koutsky

Resident Scholar

Phoenix Center for Advanced Legal and Economic Public Policy Studies

5335 Wisconsin Ave., N.W.

Suite 440

Washington, DC 20015

(202) 777-3624

tom@phoenix-center.org