

Measuring Professional Skill Development in US Cities Using Internet Search Queries

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Skill Development Using Internet

Is internet-based skill development an equalizing force for economic opportunity?

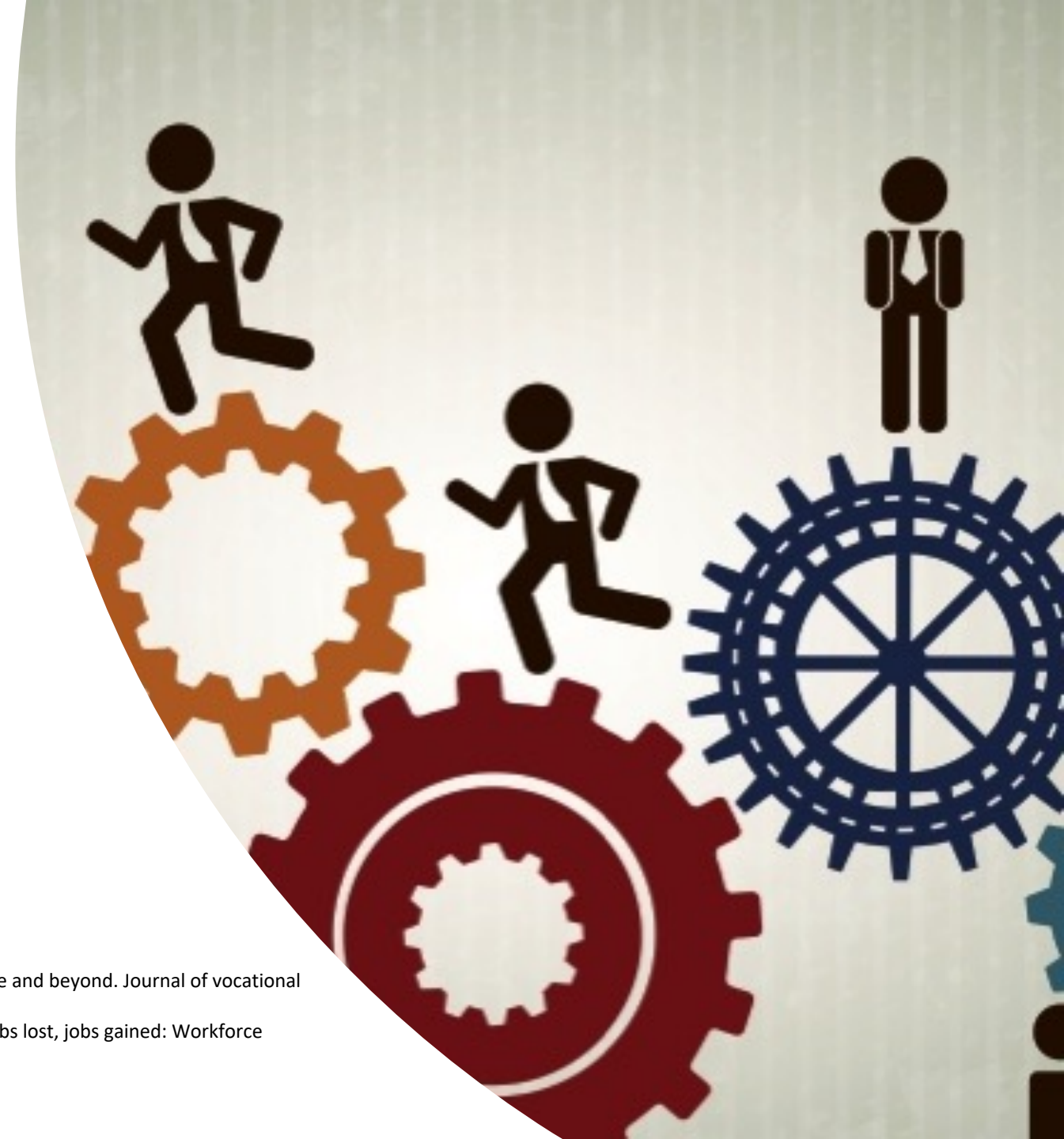
Background

Skill Development

-
- Critical to success in the current economy.
 - Flexibility for evolving job demands.
 - Many cycles of learning stages or continuous learning (Hall & Mirvis 1995).
 - Economic trends forecast continued importance
 - Automation will force 375 million workers will need to learn new skills (Manyika et al. 2017).
 - Crucial that displaced workers have skills needed to be re-employed.

Hall, D. T., and Mirvis, P. H. 1995. The new career contract: Developing the whole person at midlife and beyond. *Journal of vocational behavior* 47(3):269–289.

Manyika, J.; Lund, S.; Chui, M.; Bughin, J.; Woetzel, J.; Ba- tra, P.; Ko, R.; and Sanghvi, S. 2017. Jobs lost, jobs gained: Workforce transitions in a time of automation. McKinsey Global Institute.



Internet-based Skill Development

- Internet Search Engines (Kuhn & Mansour 2014).
- Search engines support skill development through:
 - Online universities
 - Bootcamp-style courses
 - Online tutorials
 - Research and locate offline programs
- Skill-seeking important for economy.
- Used unequally across geographies?



Economic Inequalities in the US

- Geographic disparities in the US (Kneebone 2014).
- Economic growth is concentrated in a few cities (EIG 2017).
- Rest of the country left behind
- How are internet-based technologies affecting this?



Research Questions

- How do people use search engines for skill development?
- What is the relationship between online skill searches and economic outputs at city level?
- Do search engines serve as an equalizer across different cities?

Data

Skill Search Queries

- Developed a corpus of skills list - CareerOneStop/US Dept. of Labor.
 - 17k skills (e.g., javascript, human resources)
- Selected Bing queries from 2012-16 containing:
 - at least one of: “*course(s)*”, “*tutorial(s)*”, “*certificate(s)*” and “*certification(s)*”.
 - and**
 - at least one of the skills from our skills list.

Examples of Skill Search Queries

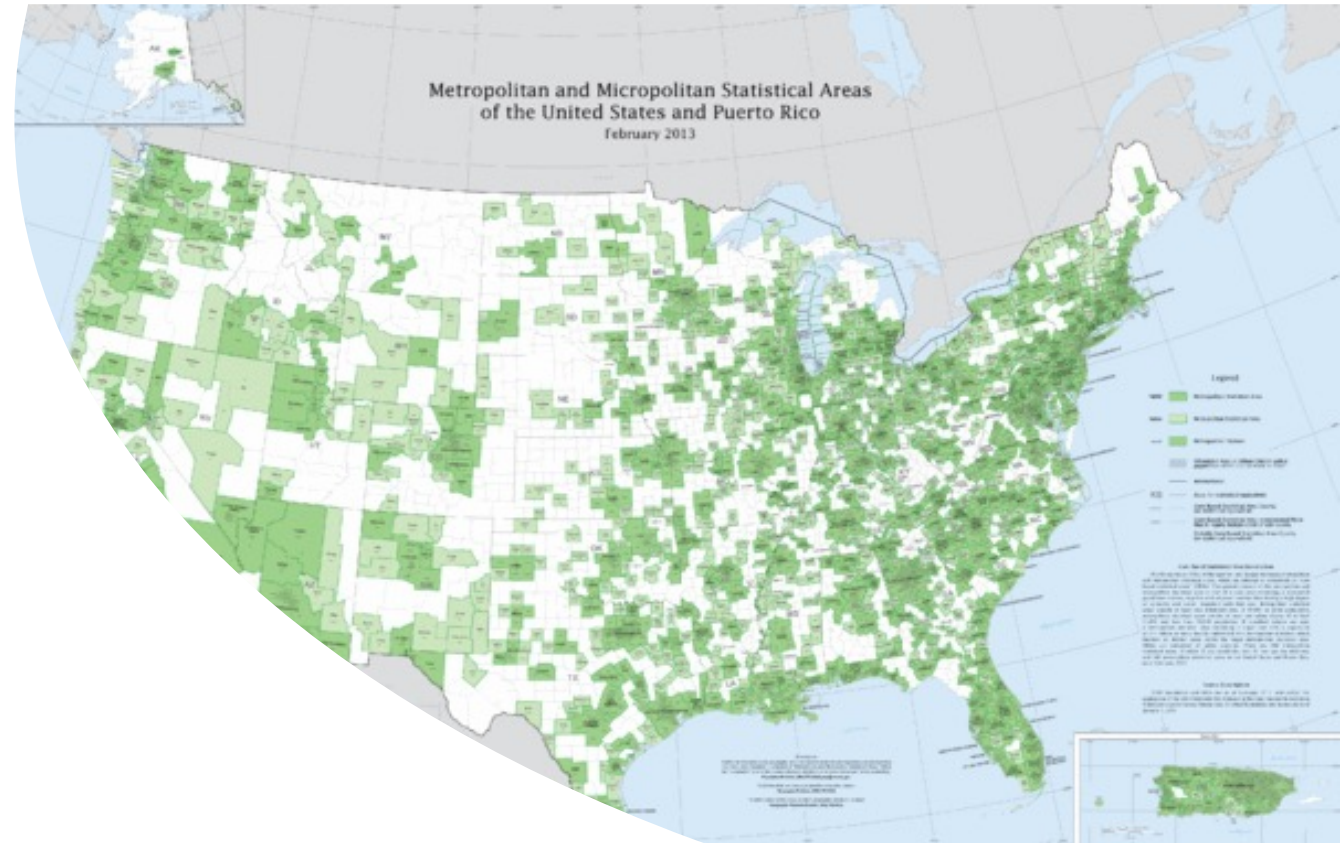
javascript video tutorials; blender tutorials; medical assistant certification; social media marketing course; google spreadsheet tutorial; hvac certification; cpa review courses; android development tutorial; human resources certificate; estate planning courses; how do i get a typing certificate;

Skill Search Queries

- 11 million search queries.
- Mapped search queries to the MSA (Metropolitan Statistical Area) level.
- Data was anonymized & raw queries discarded after aggregation.

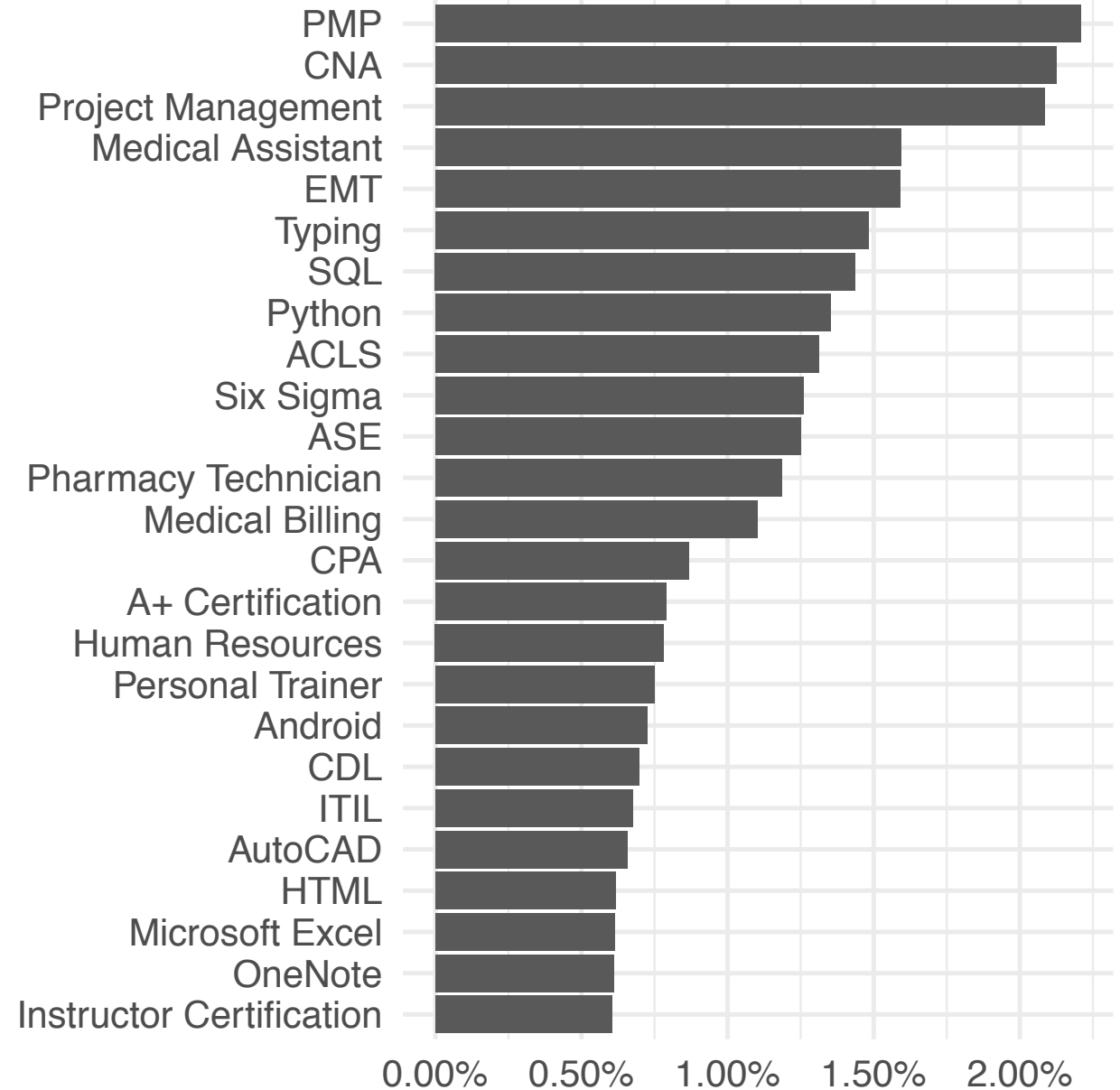
Economic Indicators of MSAs (Metropolitan Statistical Areas)

- For each of the years 2012-2016 and for each MSA:
 - Unemployment rate (*Bureau of Labor Statistics*)
 - GDP per capita (*Bureau of Economic Analysis*)
 - Population (*US Census Bureau*)
 - Poverty (*US Dept. of Agriculture*)



RQ 1: How do people use search engines for skill development?

Top 25 Most Searched Skills



MSAs with Highest GDP Per Capita

Top 10 MSAs in Per Capita GDP

Midland, TX
San Jose-Sunnyvale-Santa Clara, CA
Bridgeport-Stamford-Norwalk, CT
San Francisco-Oakland-Hayward, CA
Boston-Cambridge-Newton, MA-NH
Seattle-Tacoma-Bellevue, WA
Washington-Arlington-Alexandria, DC-VA
Trenton, NJ
Casper, WY
Durham-Chapel Hill, NC

Top Five Most Searched Skills

CDL, CNA, Pharmacy Tech., Medical Asst., Typing
Python, Android, SQL, Typing, Javascript
EMT, CNA, SQL, PMP, Python
Typing, Python, SQL, PMP, Project Management
EMT, CNA, SQL, PMP, Project Management
SQL, PMP, Python, Project Management, ACLS
PMP, Project Management, SQL, ITIL, CNA
EMT, PMP, SQL, Python, Project Management
Operator, CNA, Medical Asst., ASE, ACLS
CNA, Project Management, PMP, ACLS, Python

MSAs with Lowest GDP Per Capita

Bottom 10 MSAs in Per Capita GDP

Grants Pass, OR
Prescott, AZ
Brownsville-Harlingen, TX
Ocala, FL
Homosassa Springs, FL
McAllen-Edinburg-Mission, TX
Punta Gorda, FL
The Villages, FL
Lake Havasu City-Kingman, AZ
Sebring, FL

Top Five Most Searched Skills

Blender, Medical Asst., Medical Billing, Flagger, Typing
CNA, ASE, EMT, Android, Medical Asst.
CNA, Medical Asst., Pharmacy Tech., ASE, ACLS
CNA, ASE, Typing, Medical Billing, Medical Asst.
CNA, Medical Asst., Medical Billing, Pharmacy Tech., EMT
CNA, Medical Asst., ACLS, ASE, Typing
CNA, Personal Trainer, ASE, Medical Asst., ACLS
CIW, CNA, Medical Asst., ASE, Medical Billing
CNA, Typing, EMT, Medical Billing, ASE
CNA, Operator, Medical Billing, Typing, Pharmacy Tech.

RQ2: What is the relationship between online skill searches and economic outputs at city level?

Measures of Skill Searches in MSAs

- Skill Searches Per Capita
- Skill Search Geographic Specialization
 - Captures uniqueness of skills searched in each city relative to other cities.
 - Higher score => Greater proportion of skill searches for more specialized skills.

Search & Specialization Ranks for MSAs with Highest & Lowest GDP per Capita

Search Rank	Spec. Rank	Top 10 MSAs in Per Capita GDP
235	311	Midland, TX
6	1	San Jose-Sunnyvale-Santa Clara, CA
83	19	Bridgeport-Stamford-Norwalk, CT
49	5	San Francisco-Oakland-Hayward, CA
48	25	Boston-Cambridge-Newton, MA-NH
1	12	Seattle-Tacoma-Bellevue, WA
9	3	Washington-Arlington-Alexandria, DC-VA
26	16	Trenton, NJ
185	367	Casper, WY
36	56	Durham-Chapel Hill, NC

Search Rank	Spec. Rank	Bottom 10 MSAs in Per Capita GDP
368	169	Grants Pass, OR
320	324	Prescott, AZ
331	331	Brownsville-Harlingen, TX
303	316	Ocala, FL
342	357	Homosassa Springs, FL
360	297	McAllen-Edinburg-Mission, TX
354	352	Punta Gorda, FL
294	54	The Villages, FL
302	364	Lake Havasu City-Kingman, AZ
367	317	Sebring, FL

Correlation
across MSAs
2012-16

	Searches Per Cap	Specialization
Population	0.25	0.36
GDP Per Cap	0.46	0.43
Unemployment	-0.25	-0.23
Poverty	-0.30	-0.35
Searches Per Cap	1.00	0.65
Specialization	0.65	1.00

RQ3: Do search engines serve as an equalizer across different cities?

Before & After Relationships

- How does economic health relate to future skill searching?
- How does skill searching relate to future economic growth?

Skill Searches, Past & Future Economic Strength

2012

2014

2016



How do rich and poor cities differ in future skill searches?

2012

2014

2016



Economic
Measures
2012

Skill Searches 2012-14

How do rich and poor cities differ in future skill searches?

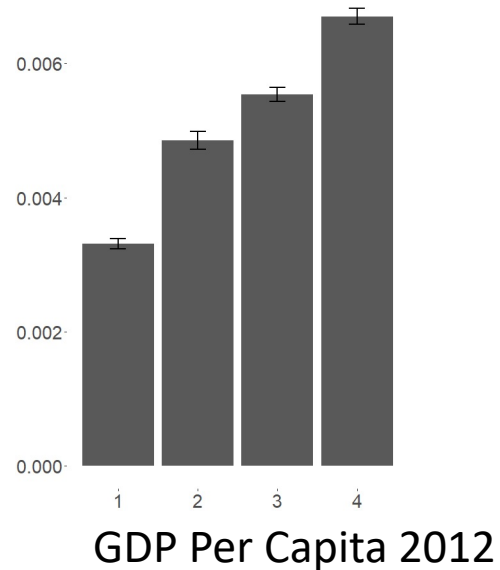
2012

2014

2016



Skill Searches
Per Capita
2012-14



How do rich and poor cities differ in future skill searches?

2012

2014

2016



Higher GDP
Per Capita



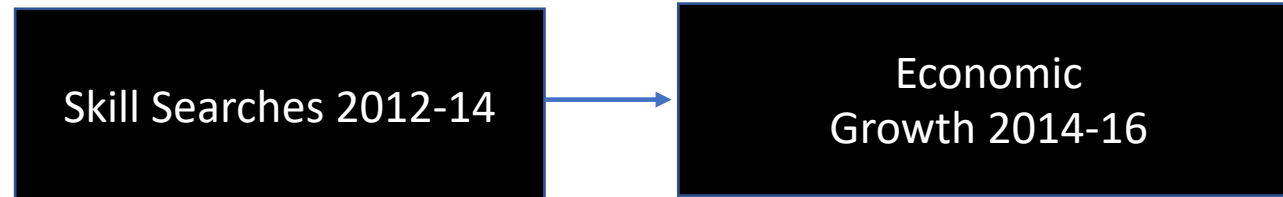
More Future
Skill Searches

How do cities with high and low skill searches per capita differ in future economic growth?

2012

2014

2016



How do cities with high and low skill searches per capita differ in future economic growth?

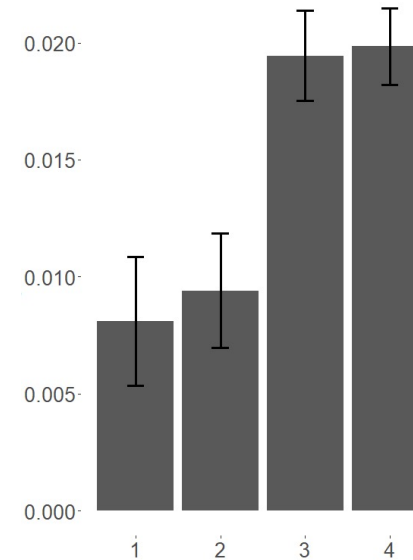
2012

2014

2016



% Change in GDP
2014-16



Skill Searches Per Capita 2012-14

How do cities with high and low skill searches per capita differ in future economic growth?

2012

2014

2016



Skill Searches, Past & Future Economic Strength

2012

2014

2016



Higher GDP
Per Capita

More Future
Skill Searches

Higher GDP Growth

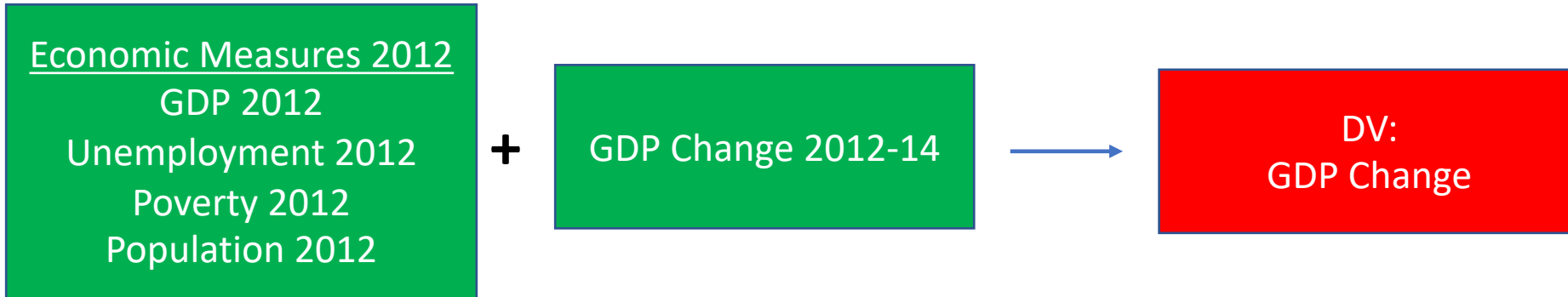


Regression for GDP Change 2014-16

2012

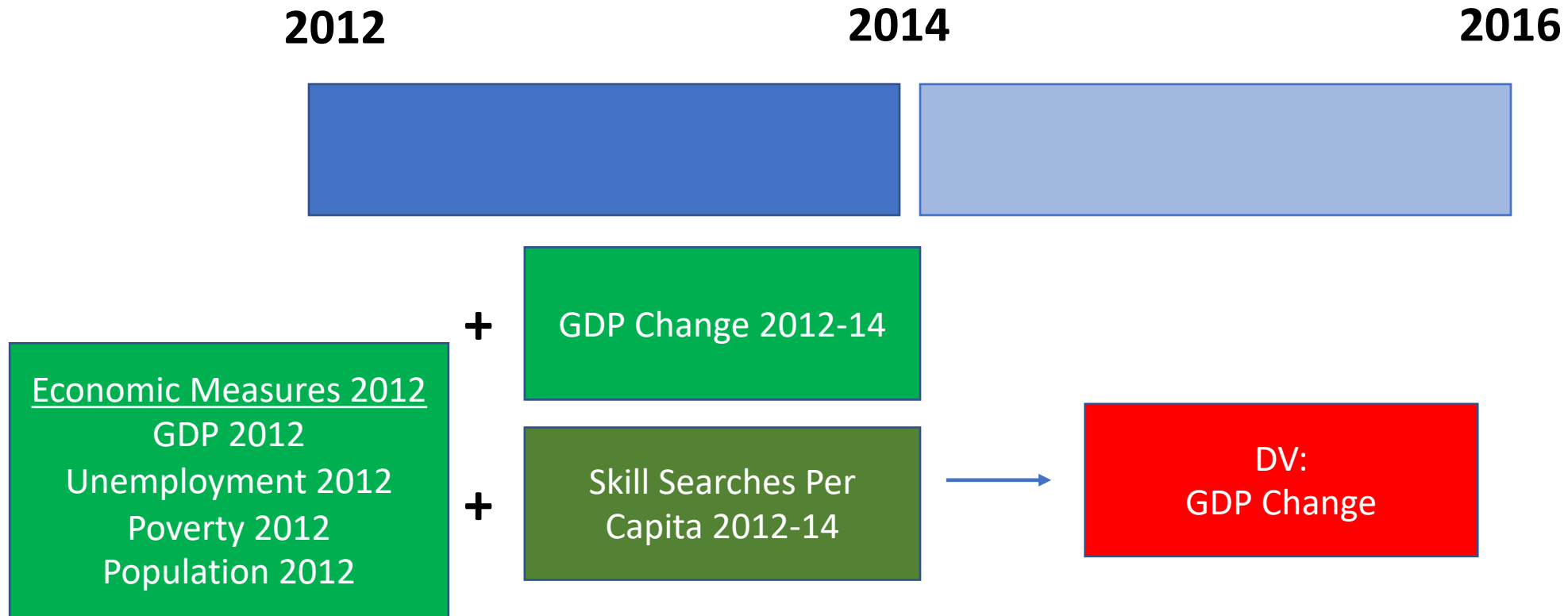
2014

2016



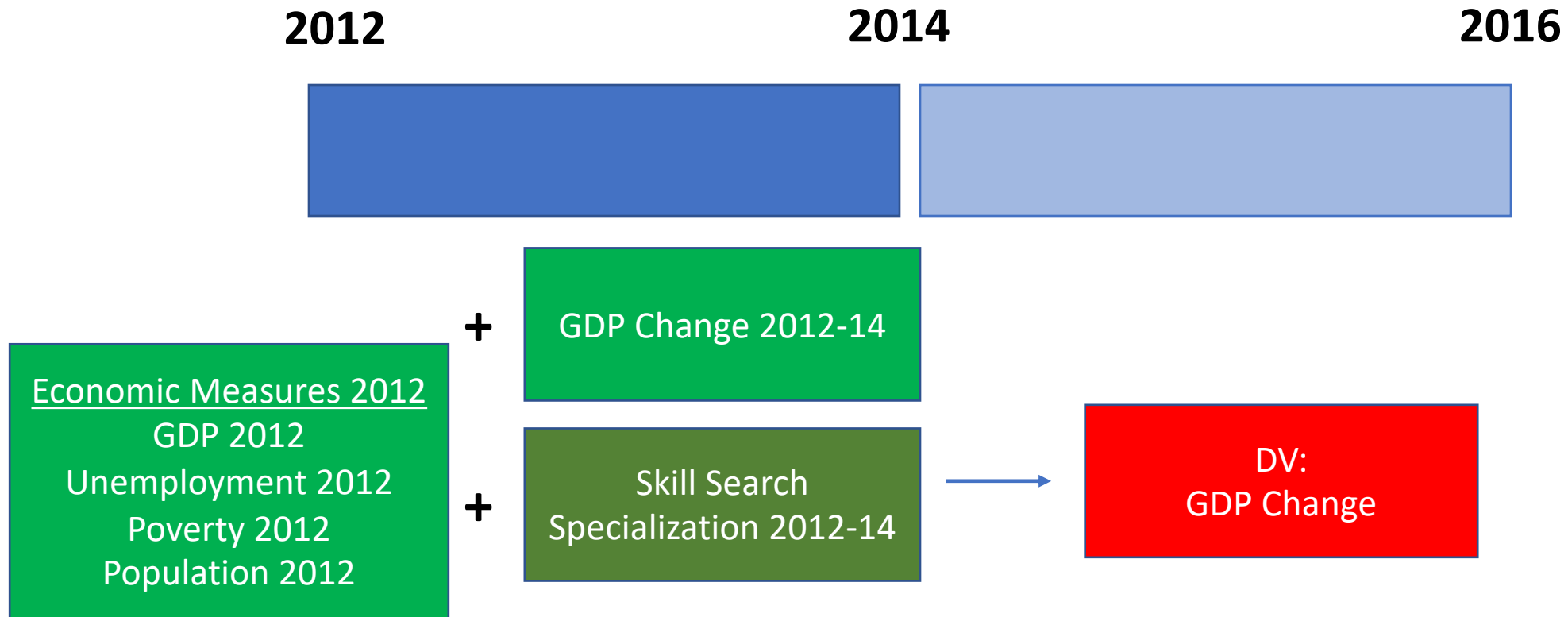
Baseline Model

Regression for GDP Change 2014-16



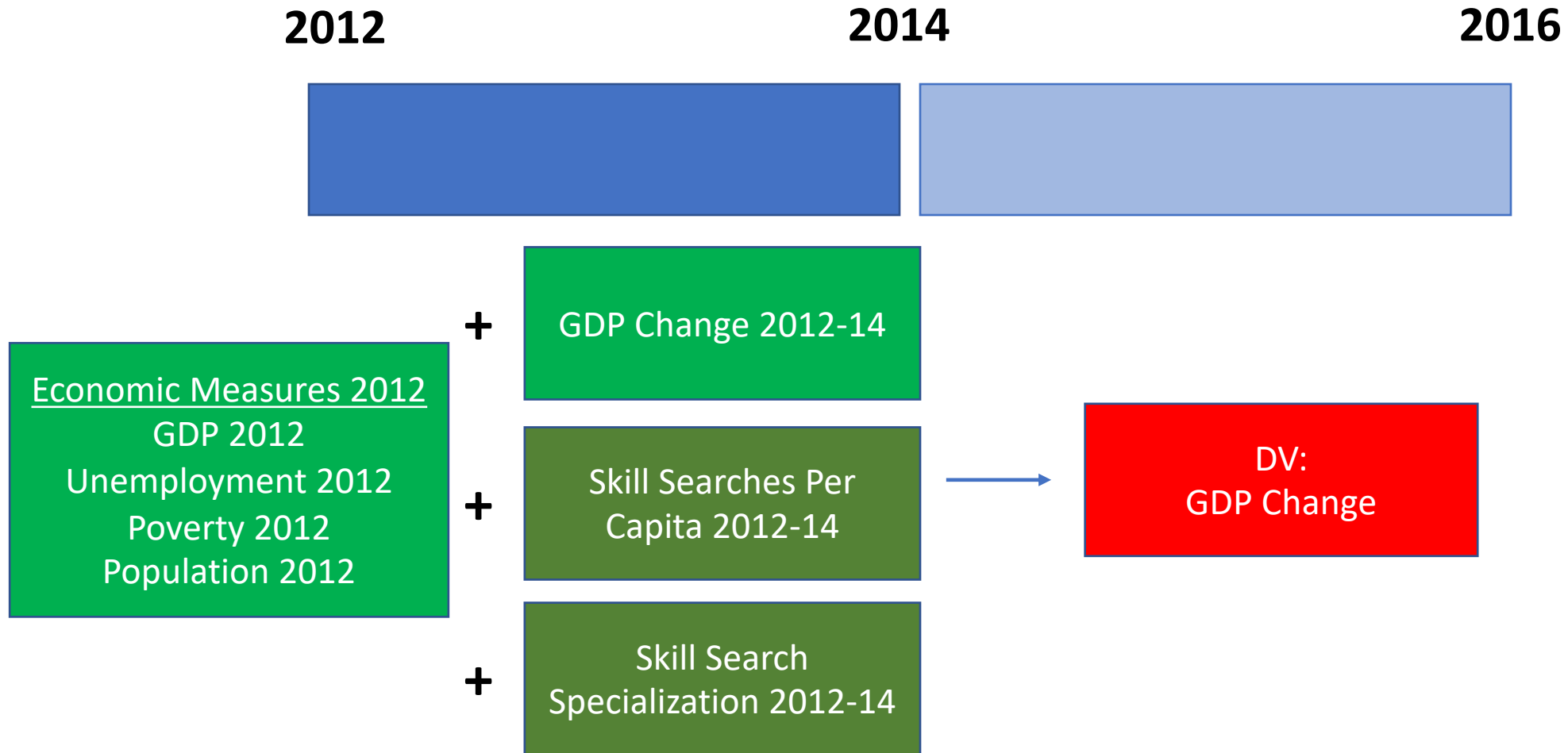
Baseline + Searches

Regression for GDP Change 2014-16



Baseline + Specialization

Regression for GDP Change 2014-16



Baseline + Both

Regression for GDP change 2014-16

Model	Variables	Adj. R ²	F Stat.	P Value
Baseline	GDP Change 2012–2014* GDP 2012 Unemployment 2012* Population 2012* Poverty 2012*	0.047	4.69 (5, 366)	0.0004
Baseline+Searches	Skill Searches Per Capita 2012–2014**	0.063	5.15 (6, 365)	< 0.0001
Baseline+Specialization	Skill Search Specialization 2012–2014***	0.076	6.09 (6, 365)	< 0.0001
Baseline+Both	Skill Searches Per Capita 2012–2014 Skill Search Specialization 2012–2014**	0.080	5.58 (7, 364)	< 0.0001

Regression for GDP change 2014-16

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Is internet-based skill development an equalizing force for economic opportunity?

Takeaways

- Rich gets richer dynamic in online skill development.
- Digital divide in:
 - Internet Access
 - Internet Use
- Sensor for real-time measurement of online skill development.

Questions?

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Search Queries

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Summary

- Use of Bing for Professional Skill Development.
- 400 US Cities
- 5 years period: 2012-16
- Relate skill searches in each city to its GDP & unemployment