THE EFFECT OF UNEMPLOYMENT ON VEHICLE MILES DRIVEN

GOOGLE SEARCH QUERIES AS PROXY FOR UNEMPLOYMENT

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ECN 576 Econometrics

Overview

- Motivation: Technology
  - Determine If Google Searches For Jobs Is A Good Predictor Of Vehicle Miles Driven (VMD)
  - Surprisingly, Yes.
- Methodology
  - Linear Regression Model
  - Time Series Data
- Results
  - Job Search Queries Negatively Correlated With Vehicle Miles Driven

Methodology

$$VMD = \alpha_i + \beta_1 Population_i + \beta_2 FuelPrices_i + \beta_3 JobSearches_i + \beta_4 Weather_i + \varepsilon_i$$

- Many Combinations Of RHS, Transformation, Change Of Scale

Data

- Dependent Variable
  - Vehicle Miles Driven (VMT)
- Independent Variables
  - Population
  - Price Of Fuel
    - Conventional Gas, Reformulated Gas, #2 Diesel
  - Google Job Search Queries
    - Total Of Multiple Search Line Inputs
  - Weather
    - Wet/Dry Anomalies As Percentage
    - Cold/Warm Anomalies As Percentage

Data

- Time Series
- N = 164
- Monthly Obs.
  - 2004-2017
- Transformation Square Root RHS

Descriptive Statistics

Statistic	N	Mean	St. Dev.	Min	Max
Month	164	5.5	3.4	0	11
Year	164	2,010.3	4.0	2,004	2,017
jobs	164	58.9	8.6	38	100
Monster.com	164	50.9	28.1	9	100
monster.com	164	46.9	34.3	3	100
Indeed.com	164	38.3	25.9	0	100
indeed.com	164	38.3	25.9	0	100
unemployment	164	39.7	19.5	18	100
job.listings	164	45.5	22.0	12	100
job_monthly_total	164	318.4	78.9	164	492
mi_month	164	251,451.2	16,380.0	210,635	283,498
mi_month_s	164	251,377.1	6,337.8	241,735	268,158
mi_yr_to_date	164	1,590,395.0	882,572.4	220,839	3,169,954
mi_12mo_avg	164	3,006,886.0	66,349.0	2,894,137	3,196,843
population	164	309,854.1	9,854.5	292,046	325,892
conv_gas	164	2.8	0.6	1.6	4.1
reform_gas	164	3.0	0.6	1.7	4.2
num2_diesel	164	3.0	0.7	1.6	4.7
very_warm	164	0.2	0.2	0.0	0.9
very_cold	164	0.04	0.1	0.0	0.5
very_wet	164	0.1	0.1	0.0	0.4
very_dry	164	0.1	0.1	0.0	0.3
miles	164	251.5	16.4	210.6	283.5
miles_s	164	251.4	6.3	241.7	268.2
pop	164	309.9	9.9	292.0	325.9
y_hat_reg_ssw	164	251.4	5.9	242.3	265.7

Results

	Dependent variable:						
	Miles Driven (1)	(2)	(3)	(4)	(5)	(6)	(7)
Population	0.166 (-0.157, 0.489)	0.330*** (0.269, 0.392)	0.320*** (0.260, 0.381)				
Conventional Gas				0.320*** (0.260, 0.381)			
Reformed Gas	1,524.904 (-40,927.360, 43,977.170)	12,999.650*** (4,927.409, 21,071.900)	12,571.310*** (4,761.872, 20,380.740)	12.571*** (4.762, 20.381)			
#2 Diesel	41,783.830** (3,321.541, 80,246.120)	-8,417.071** (-15,730.630, -1,103.517)	-8,518.900** (-15,640.010, -1,397.784)	-8.519** (-15.640, -1.398)			
Job Searches	-36,338.470*** (-47,454.190, -25,222.760)	-6,903.972*** (-9,017.611, -4,790.333)	-6,393.537*** (-8,492.691, -4,294.383)	-6.394*** (-8.493, -4.294)			
Very Wet	-55.835*** (-89.693, -21.978)	-46.980*** (-53.418, -40.542)	-44.769*** (-51.100, -38.438)	-0.045*** (-0.051, -0.038)			
Very Dry			182.346 (-4,793.922, 5,158.614)	0.182 (-4.794, 5.159)			
Very Cold			-2,519.597 (-8,831.634, 3,792.439)	-2.520 (-8.832, 3.792)			
Very Warm			-6,433.222*** (-11,109.250, -1,757.189)	-6.433*** (-11.109, -1.757)			
very_warm			2,571.946** (356.155, 4,787.736)	2.572** (0.356, 4.788)			
I(T * pop)					0.885*** (0.830, 0.940)	0.992*** (0.975, 1.009)	0.994*** (0.978, 1.011)
I(T * conv_gas)					4.724** (0.526, 8.922)	4.758*** (3.434, 6.081)	4.995*** (3.667, 6.323)
I(T * reform_gas)					-0.230 (-4.156, 3.696)	-4.084*** (-5.321, -2.846)	-4.264*** (-5.497, -3.031)
I(T * num2_diesel)					-4.126*** (-5.361, -2.890)	-1.259*** (-1.648, -0.869)	-1.303*** (-1.687, -0.919)
I(T * job_monthly_total)					-0.024 (-0.062, 0.014)	-0.023*** (-0.035, -0.011)	-0.023*** (-0.035, -0.011)
I(T * very_wet)					0.686** (0.070, 1.301)	0.117 (-0.078, 0.311)	
I(T * very_dry)					0.126 (-0.564, 0.816)	0.203* (-0.015, 0.420)	
I(T * very_cold)					0.059 (-0.395, 0.512)	-0.160** (-0.302, -0.017)	
I(T * very_warm)					0.236 (-0.117, 0.588)	-0.050 (-0.161, 0.061)	
Constant	199,959.700*** (102,051.400, 297,868.000)	173,544.600*** (154,927.400, 192,161.700)	175,703.800*** (157,328.800, 194,078.800)	175.704*** (157.329, 194.079)			
Observations	164	164	164	164	164	164	164
R^2	0.329	0.838	0.853	0.853	0.999	1.000	1.000
Adjusted R^2	0.308	0.833	0.844	0.844	0.999	1.000	1.000
Residual Std. Error	13,630.830 (df = 158)	2,591.885 (df = 158)	2,500.762 (df = 154)	2.501 (df = 154)	0.452 (df = 155)	0.142 (df = 155)	0.144 (df = 159)
F Statistic	15.476*** (df = 5; 158)	163.325*** (df = 5; 158)	99.216*** (df = 9; 154)	99.216*** (df = 9; 154)	22,442.590*** (df = 9; 155)	225,915.700*** (df = 9; 155)	395,200.000*** (df = 5; 159)

Note: *p<0.1; **p<0.05; ***p<0.01

Key Findings

Google Job Search Slopes

job_monthly_total	job_monthly_total.1	job_monthly_total.2	job_monthly_total.3	I(T * very_wet)	I(T * job_monthly_total)	I(T * job_monthly_total).1
-55.84	-46.98	-44.77	-0.04	0.69	-0.02	-0.02

- Job Searches Negatively Correlated With VMD
  - Fewer Commuters
  - Reduced Consumption
    - Retail Sales
    - Commercial (#2 Diesel)

Key Findings

- Seasonal VMT Includes Variation Due To Weather
  - Reduced Significance Of Weather RHS Variables
- Conventional Gas Positively Correlated
  - Population Growth => More Drivers ?
  - Lower MPG Vehicles => Freed $ To Drive/Spend ?
- **Searches Do Not Cause Fewer Miles To Be Driven**
  - But, They Do Measure Unemployment
    - Unemployment Causes Fewer Miles To Be Driven

Discussion/Thinking Forward

- Growth of Social Interactions In Digital Environments Increases Breadth & Scope Of ‘Clinical’ Setting
  - Observe Behaviors In Private Homes
  - New Behaviors: Gaming, VR, CryptoKitties
- Digital Tech Growth Increases Sensing Abilities
  - GPS, Accelerometers, Microphones, Computing Capabilities, Virtual Personalities