### Does Cluster Activity Enhance Entrepreneurial Activity?

Empirical evidence from the UK

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# Agenda

- Research Interest and Justification
- Theoretical Background
- Research Methodology
- Model
- Results
- Discussion



# **Research Questions**

- Do clusters enhance entrepreneurship?
- Do more innovative clusters affect entrepreneurship further?

Application:

• Can policy makers argue that promoting cluster development will also promote entrepreneurship?



#### **Research Interest**

- Cluster and entrepreneurship support together.
- Last two decades:







### **Clusters: Location Paradox**

- New influences of clusters are taking on growing importance in an increasingly <u>complex, knowledge-based, and dynamic</u> <u>economy</u>.
- "Anything that can be easily accessed from a distance no longer is a competitive advantage." (Porter, Businessweek 21 Aug 2006)
- => LOCATION MATTERS





- It is not new to link clusters to economic growth (See for example Marshall, 1966; Becattini, 1979; 1990; Sforzi, 1990; Cooke, 2002; Cooke et al., 2007; Akundi, 2003; vom Hofe and Chen, 2006; European Commission, 2008)
- or to link entrepreneurship to economic growth (Casson, 1982; 2003; Storey, 1982, 1994; Baumol, 1990; Geroski, 1995; Acs and Audretsch, 2003; Parker, 2004; Reynolds et al., 2004a; Mueller, 2006).



### **Problem**

- Because
- A (clusters) => C (economic development) and
- **B** (entrepreneurship) => **C** (economic development),
- does it imply

A (clusters) => B (entrepreneurship) ? (innovation)



# Porter on Clusters

- Marshall offered the underlying principles for cluster formation
  - through his original idea of specialised 'industrial districts' i.e. "concentration of <u>small</u> businesses of a similar character in particular localities" (1890; 1966, p. 230).
- Porter's (1990) book "The Competitive Advantage of Nations"
  - attributed with revival of cluster theory.
- Diamond of Competitive Advantage model,
  - One of the most important ideas in Porter's overall regional competitiveness theory is
  - the concept of **<u>clusters</u>**.



### Diamond Model of Competitive Advantage for Nations



Source: Porter (1990)



- Porter explains how clusters affect competition in three broad ways:
  - First, by increasing the productivity of companies based in the area;
  - second, by driving the direction and pace of innovation; and
  - third, by stimulating the formation of new businesses within the cluster.



European Commission study (2008):

- In many countries cluster efforts emerged out of SME policies and thus cluster efforts tend to focus on smaller companies and start-ups.
- It is also popular to associate innovation with entrepreneurship as well as with clusters.



- Stinchcombe (1965): Clusters help to overcome the "<u>liability of</u> <u>newness</u>" that new firms face due to new roles to be learnt, unknown work force, lack of ties with customers and suppliers, and lack of other resources.
- Porter (1990): Alluded to the <u>lower entry and exit barriers</u> in clusters due to reduced uncertainty in terms of price, cost, and other norms and practices of doing businesses.
- Krugman (1991): External economies and the resulting demand effects within industrial clusters benefits the <u>creation of new firms</u> because proximate customers not only increases the likelihood of sales but also minimises transportation costs.
- Rocha and Sternberg (2005): Vertical disintegration within the same region creates new demands and reduces transactions costs, therefore fostering the <u>creation of businesses</u>.



- 1. Positive externalities
- 2. Shared resources and availability
- 3. Lower entry and exit barriers
- 4. Lower transaction costs
- 5. Institutional support
- 6. Availability of capital
- 7. Knowledge spillovers
- 8. Common skilled labor pool
- 9. Closer relationships
- 10. Spinoffs
- 11. Large market size



# **Counter-Justification**

- 1. Mature and intense competition
- 2. Proprietary clout of large firms
- 3. Large firms have established linkages
- 4. Barriers to entry for SMEs
- 5. Depletion of shared resource pool
- 6. Difficult to access small-scale capital
- 7. Culture of long-term secure employment that favors large established firms



# **Research Approach**

#### Table 3.1 Components of Research Process Adopted for this Study

Research Process	Adopted for this study	Versus not adopted
		$\sim$
Research Philosophy	Positivism	Realism, Interpretivism
Research Approach	Deductive	Inductive
Research Strategy	Survey (based on secondary data conducted by GEM, Eurostat, ECO, ONS)	Experiment, Case Study, Grounded Theory, Ethnography, Action Research
Time Horizon	Longitudinal	Cross-sectional
Data Collection	Secondary Data, Literature	Sampling, Observation,
Method	Review, (and later in doctoral work ethnographic observation and interviews)	Interviews

Adapted from Saunders, Lewis, and Thornhill (2003)



# **Definitions**

- CLUSTER: A geographically proximate group of firms and associated institutions in related industries (Porter, 1988), linked by economic and social interdependencies (Rocha, 2002).
- ENTREPRENEURSHIP: As "the creation of new organizations" (Gartner, 1989, p.62; cf. Drucker, 1985; Reynolds and White, 1997)



# Early Stage Entrep Activity



GEM TEA combines an estimate of

- i) the proportion of the working age population (18-64) that are trying to start a new business for themselves, including self-employment, or for their employer (intrapreneur) which they will own in whole or in part (potential and nascent entrepreneurship), and
- ii) the proportion of the working age population that are managing their own new business that has been paying wages for at least three months but less than three and a half years (new business ownership).



# **Research Strategy**





### Data

- 1. Global Entrepreneurship Monitor: www.gemconsortium.org;
- 2. European Union Cluster Observatory: www.clusterobservatory.eu;
- 3. European Innovation Scoreboard: www.proinno-europe.eu/metrics
- 4. Eurostat: ec.europa.eu/eurostat
- 5. UK Office of National Statistics: www.statistics.gov.uk



# **EU Cluster Definition**

- Based on cluster definitions developed at the Institute for Strategy and Competitiveness, HBS (Porter's)
- 1. Size: if employment reaches a sufficient share of total European employment.
- 2. Specialization: if a region is more specialised in a specific cluster category than the overall economy across all regions.

 $\frac{({\rm Employment \ in \ a \ region \ in \ a \ category) \ / \ ({\rm Total \ employment \ in \ a \ region)}}{({\rm Employment \ in \ a \ category \ in \ Europe)} \ / \ ({\rm Total \ employment \ in \ Europe)} \ > 2$ 

3. Focus: if a cluster accounts for a larger share of a region's overall employment.



#### **EU Cluster Mapping**



- blue background indicates that the cluster is situated in a region with high innovation



http://www.clusterobservatory.eu/index.php?id=&country\_ID=United Kingdom&presentationselect=map

### **EU Cluster Mapping**

	Cluster Mapping Database										
Home	Data Type		Cluster category	Cluster category			Regio	Region			
Cluster Mapping	Statistical Clusters	;	All				Uni	ted Kingdo	m, all		
Cluster Organisations	» Select Data Type		» Select cluster cate	iony			» Se	lect country/regio	n		
Library	map t	able									
Classroom											
News Archive	All regional clust	ers in United King	lom								
Help - Instructions	Region	Cluster category	Employees	Size	Spec.	Focus	St <u>a</u> rs	Innovation	Exports	Notes	
	Inner London	Finance	254 760	3.58%	2.77	10.71%	***	High	Very strong		
Methodology	Inner London	Business Services	186 696	4.32%	3.35	7.85%	***	High	Strong		
Join the Observatory	Outer London	Transportation	117 606	1.91%	2.10	7.03%	***	High	Strong		
	Outer London	Business Services	105 373	2.44%	2.68	6.30%	***	High	Strong		
Contact	Berks, Bucks and Oxe	on Business Services	3 73 865	1.71%	2.87	6.73%	***	High	Strong		
About the Observatory	Surrey, E and W Suss	ex Business Services	66 558	1.54%	2.51	5.88%	***	High	Strong		
	Berks, Bucks and Oxe	on Education	61 200	1.72%	2.89	5.57%	***	High	N/A		
	Greater Manchester	Business Services	54 394	1.26%	2.00	4.69%	***	High	Strong		
Search	Beds and Herts	Business Services	53 807	1.25%	3.10	7.26%	***	High	Strong		
	Hants and Isle of Wigl	ht Business Services	50 972	1.18%	2.62	6.14%	***	High	Strong		
	Gloucs, Wilts and N Se	om Business Services	50 581	1.17%	2.05	4.82%	***	High	Strong		
Carach	Berks, Bucks and Oxo	on IT	45 071	2.19%	3.68	4.10%	***	High	Weak		
» Search	Leics, Rut and Northan	nts Business Services	39 895	0.92%	2.31	5.41%	***	High	Strong		
	E Anglia	Education	38 150	1.07%	2.07	4.00%	***	High	N/A		
	W Midlands	Automotive	37 913	1.46%	2.26	3.20%	***	High	Weak	-	
	•									•	
	Innovation: Data is f Exports: Data is national	or region, regardless onal export data for t	of cluster catego he cluster catego	ry. Base v. regar	ed on 20 rdless of	06 Europe region, P	ean Reg Based c	gional Innov Internatio	ation Scoreboa nal Cluster	ard, MERIT	

http://www.clusterobservatory.eu/index.php?id=&country\_ID=United Kingdom&presentationselect=table

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# **EU Innovation Scoreboard**

- The EIS attempts to benchmark the innovation performance of Member States drawing on
  - statistics from a variety of sources,
  - primarily the Community Innovation Survey.
- Includes:
  - knowledge creation ; intellectual property
  - innovation activity by firms and expenditure
  - product and process innovation
  - innovation activity and expenditure
  - effects of innovation
  - innovation co-operation
  - public funding of innovation, etc



# **Quality of Datasets**

- European Commission report (2008) claims that
  - for the first time, the European Cluster Observatory provides a quantitative analysis of European clusters
  - based on a fully comparable and consistent methodology across all EU countries.
- From GEM, a comparable TEA index emerges from all individual national surveys (over 60)
  - which are painstakingly validated and harmonized into one master dataset (GEM, 2008).



### Unit of Analysis & Measurement

Unit of Analysis: UK 37 NUTS2 - Regions



Sources of data: Global Entrepreneurship Monitor; Office of National Statistics; European Cluster Observatory; European Innovation Scoreboard; EuroStat.



TEA % in UK NUTS 2 Regions



This work is based on data provided through EDINA UKBORDERS with the support of the ESRCand JISC and uses boundary material which is copyright of the Crown.

Figure 3.9 TEA rates of NUTS 2 regions in the UK, pooled 2002-2008 (source Levie and Hart, GEM UK Report 2008)





Figure 3.8 TEA estimates and 95% confidence intervals for NUTS 2 regions of the UK for pooled 2002-2008 (source Levie, Hart, and Anyadike-Danes, 2009)



### Model for Study





# **Descriptive Statistics**

#### **Entrepreneurial GEM variables of interest:**

. summarize TEA02030405060708 TEAUKNuts2 suskill0208rebal knowent0208rebal fe > arfail0208rebal age gender1 UKoccup02030405060708

Max	Mi n	Std. Dev.	Mean	0bs	Vari abl e
1	0	. 2224668	. 0522174	72313	TEA0203040~8
. 09406	. 03525	. 0098768	. 0542746	72282	TEAUKNuts2
1	0	. 4991914	. 4714692	41464	suskill020~1
1	0	. 4279023	. 2413419	41464	knowent020~1
1	0	. 4766755	. 3490498	41464	fearfail02~1
64	18	12. 23672	42. 13993	72313	age
1	0	. 4914362	. 4078381	72313	gender1
7	1	1. 675716	2. 102341	71907	UKoccup020~8

#### **Cluster related UK NUTS2 variables of interest:**

- . \* Cluster related regional variables
- . summarize clusterstarsEU PopDens2004 Employees incpercapita Unempl2005 RIS2 > 006 InnovlevelEU

Vari abl e	0bs	Mean	Std. Dev.	Min	Max
clustersta~U PopDens2004 Employees incpercapita Unempl2005	72282 72282 72282 72282 72282 72282	6.321173 625.8008 128480 16823.89 4.62921	2.848122 1377.345 123618 1847.887 1.039381	2 8 22326 15074. 49 2. 4	16 9210. 368 826093 23382. 77 7. 764856
RI S2006 I nnovl evel EU	72313 72282	. 5255251 . 4872444	. 0891288 . 4998407	. 41 0	. 72



### **Exploratory Graphs UK**

#### Ave NUTS2 TEA over cluster stars





# UK Main Model Result

# H1: A one unit increase in *cluster-stars* leads to a 1.03 1 increase in the log-odds of *TEA* (p=0).

Logistic regression Log likelihood = - <b>7542.9584</b>				Numbe LR ch Prob Pseud	rofobs = i2(113) = ≻chi2 = oR2 =	41220 3158.84 0.0000 0.1731	Nagelkerke R squared = .206
TEA0203040~8	Odds Ratio	Std. Err.	z	P≻ z	[95% Conf.	Interval]	Hosmer & Lemeshow test
suskill020~1 knowent020~1 fearfail02~1 gender1 age agesquared clustersta~U _IUKoccup0~2 _IUKoccup0~3 _IUKoccup0~4 _IUKoccup0~5 _IUKoccup0~6 _IUKoccup0~7	7.207049 2.44929 .5009508 1.585818 1.100825 .9987348 1.033407 1.597856 .4958 .2075421 .5453548 .6077912 1.029133	.501223 .1100042 .0278981 .0787082 .0163153 .0001789 .0075396 .0973046 .0973046 .0716765 .0437158 .1143966 .0983317 .1227367	28.40 19.95 -12.41 9.29 6.48 -7.07 4.50 7.70 -4.85 -7.47 -2.89 -3.08 0.24	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.004 0.002 0.810	6.288682 2.242902 .44915 1.438818 1.069308 .9983842 1.018735 1.418084 .3734655 .137345 .3615152 .4426317 .8146204	8.25953 2.674668 .5587257 1.747836 1.133271 .9990855 1.04829 1.800417 .6582071 .3136171 .8226816 .8345768 1.300133	statistic Chi- square = 8.94, p = 0.3477 Overall percentage predicted correctly = 79.7 %

#### H2: Neither the *Innovation* variable or the *Regional Innovation Score* was significant to TEA (p=0.287)



# Germany : UK

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Population	82,329,758 (July 2009 est.)	61,113,205 (July 2009 est.)
Unit of Analysis	97 Planning regions	37 NUTS2
No. of Clusters	237 (Rocha & Sternberg, 2005, p.276)	143 (European Cluster Observatory)
No. Respondents	29,633 (2001-2003)	41,220 (2002-2005)
Total Entrepreneurial Activity	4.5 ('04) 5.4 ('05) 4.2 ('06)	6.3 ('04) 6.2 ('05) 5.8 ('06)
Statistical models	Bi-variate and Multiple regression OLS Fixed Effects	Bi-variate, Multiple regression and mainly Logistic regression, but also GLLAMM and random intercept logit model
Results	Significant	Significant

# Results

#### GERMANY

#### **UNITED KINGDOM**

Clusters & Entrepreneurship Relationship in Germany: Highly Significant Clusters & Entrepreneurship Relationship in the UK: Highly Significant\*\*\*

H1: The level of entrepreneurship is lower in regions with industrial agglomerations. (t=-0.01; p<t=0.50; not significant);

H2: The level of entrepreneurship is higher in regions with clusters as compared to entrepreneurship in regions with industrial agglomerations. (t = 2.25 + r. (t = 0.012))

(t=2.25; p<t=0.013);

H3: Entrepreneurship in regions with regions with more i clusters with external networks is higher than that of than entrepreneurship in regions without clusters with external networks. UK: Neither the International Networks.

(t=2.67; p<t=0.004).

Rocha and Sternberg (2004)

H1: The level of entrepreneurship of regions with clusters is higher than that of regions with fewer or no clusters.

UK: A one unit increase in the number of *cluster-stars* leads to a 1.03 increase in the log-odds of *Total Entrepreneurial Activity* (p<t=0.001) H2: The level of entrepreneurship of regions with more innovative clusters is higher than that of regions with less innovative clusters.

UK: Neither the *Innovation* variable or the *Regional Innovation Score* were significant to *TEA* (p<t=0.287)



### **Improvements**

- Merged different datasets.
- Logistic regression.
- Multi-level modelling.
- Pooled dataset of 2002-2005; larger UK sample.
- Innovation explored.



# **Conclusion**

- A multiple regression model result differed slightly from the more defendable logistic regression model result,
- => the latter showing there is a **positive impact** of clusters on entrepreneurship.
- However, the effect of more innovativeness among clusters to entrepreneurship was not found to be significant.



# Discussion

- $\Rightarrow$  Next steps:
- Cluster types based on inter-firm and external networks.
- Small world networks.
- Large firm dominated clusters.
- Cultural theory typology (Douglas 1978, Thompson et al 1990)
- Effect on High Growth vs Low Growth TEA
- Cluster industry sectors and TEA sectors
- *Migration (churn of people)*
- Opportunity Perception
- Business Structure Database IDBR



# Discussion

• Cultural theory typology applied to organizations in clusters (Douglas 1978; Schwarz and Thompson 1990)

		Gro	pup
Grid-group cultural model		Weak bonds between people	Strong bonds between people
Many a inte di	nd varied rpersonal fferences	Fatalism	Collectivism
<i>Gna</i> Significant betwee	similarity en people	Individualism	Egalitarianism

Figure source: http://changingminds.org/explanations/culture/grid-group\_culture.htm



Entrepreneurship Related	STATA variable names	Inclusion / Exclusion in Model
(source GEM UK)		
Total Entrepreneurial Activity	TEA02030405060708	Dependent variable used in Logistic Regression (main analysis)
(nascent or new entrepreneurs)	No activity=0;	
	Yes activity=1	
TEA average for each UK NUTS 2	TEAUKNUTS2	Dependent variable used briefly to explore Multiple Regression (not
region in %		conclusive)
Innovative Total Entrepreneurial	TEAInnov0208	Dependent variable used briefly to explore H2 (not conclusive;
Activity (nascent or new	No activity=0;	extremely rare event)
entrepreneurs)	Yes activity=1	
Have skills to start a business in	suskill0208rebal	Included: significant
sample rebalanced for attitudes	No =0; Yes =1	,,,
Know an entrepreneur in sample	knowent0208rebal	Included: significant
rebalanced for attitudes	No =0; Yes =1	,,,
Fear failure if start a business in	fearfail0208rebal	Included; significant
sample rebalanced for attitudes	No =0; Yes =1	
Gender	gender1	Included; significant
	Female = 0 Male = 1	
Age: exact age at time of interview	age	Included + its squared transformation; both significant
in years		
UK occupation standardized	UKoccup02030405060708	Included; significant
-	Categorical	
Cluster Related (ECO)	STATA variable names	Inclusion / Exclusion in Model
Sum of cluster stars allocated for all	clusterstarsEU	Most important independent variable. Included and found to be
clusters in each UK NUTS 2 region.		marginally significant
No. of porcons per lem square	RonDong2004	Evaludad due to incignificance on lad to incignificance of alustanetors
(Source: Eurostat)	T OpDens2004	Excluded due to insignificance of led to insignificance of clusterstars
No. of employees in all clusters in	Employees	Excluded due to multicollinearity (see section below)
each UK NUTS 2 region.	1 2	, , , , , , , , , , , , , , , , , , ,
Unemployment rate in 2005 (%).	Unempl2005	Excluded due to insignificance or led to insignificance of clusterstars
(Source: Eurostat)		
Disposable income, by UK NUTS 2	incpercapita	Excluded due to insignificance or led to insignificance of clusterstars
region, 2004 (Euro per person)		
Innovation level	InnovlevelEU	Excluded due to insignificance or led to insignificance of clusterstars
	Medium=0 High=1	
Regional Innovation Scoreboard	RIS2006	Excluded due to insignificance or led to insignificance of clusterstars
awarded by EU in 2006		



# GLLAMM Model for H1

. xi: gllamm TEA02030405060708 suskill0208rebal knowent0208rebal fearfail0208rebal gender1 age ag > esquared clusterstarsEU i.UKoccup02030405060708, i( NUTS2C0DE) i.UKoccup0203~8 \_IUKoccup02\_1-7 (naturally coded; \_IUKoccup02\_1 omitted)

Iteration	0:	log	likelil	hood	=	-25302.672	(not	concave)
Iteration	1:	log	likelil	hood	=	-1082. 184	(not	concave)
Iteration	2:	log	likelil	hood	=	2293. 1999	(not	concave)
Iteration	3:	log	likelil	hood	=	2704. 208		
Iteration	4:	log	likelil	hood	=	2848. 3181		
Iteration	5:	log	likelil	hood	=	2915. 8185		
Iteration	6:	log	likelil	hood	=	2916. 0346	(not	concave)
Iteration	7:	log	likelil	hood	=	2916. 0346	(not	concave)
Iteration	8:	log	likelil	hood	=	2916. 0346	(not	concave)
Iteration	9:	log	likelil	hood	=	2916. 0346	(not	concave)
Iteration	10:	loğ	likelil	hood	=	2916. 0346		

number of level 1 units = 41220number of level 2 units = 37

Condition Number = 14866538

gllamm model

log likelihood = **2916.0346** 

TEA0203040~8	Coef.	Std. Err.	Z	P> z	[95% Conf.	Interval]
suskill020-1 knowent020-1 fearfail02-1 gender1 age agesquared clustersta-U _IUKoccup0-2 _IUKoccup0-3 _IUKoccup0-4 _IUKoccup0-5 _IUKoccup0-6 _IUKoccup0-7 cons	. 0753823 . 0640944 0305968 . 0234625 . 0043003 0000562 . 0018356 . 020939 0169406 0238635 018833 0166137 . 00047 . 0395976	. 0023694 . 0026819 . 0023693 . 0024754 . 0006895 8. 31e-06 . 0003892 . 0032079 . 0045783 . 0050191 . 0072946 . 0062317 . 0055859 3. 593449	31. 81 23. 90 -12. 91 9. 48 6. 24 -6. 77 4. 72 6. 53 -3. 70 -4. 75 -2. 58 -2. 67 0. 08 0. 01	0. 000 0. 010 0. 008 0. 933 0. 991	. 0707382 . 0588379 0352405 . 0186109 . 0029489 0000725 . 0010729 . 0146516 0259139 0337006 0331301 038275 0104781 -7. 003434	. 0800263 . 0693509 - 0259531 . 0283142 . 0056517 - 0000399 . 0025984 . 0272264 - 0079673 - 0140263 - 0140263 - 0045359 - 0043999 . 0114182 7. 082629

Variance at level 1

.05073528 (.0003534)

Variances and covariances of random effects

\*\*\*level 2 (NUTS2CODE)

var(1): .0461535 (2.8641963)



# Rare Events Logit for H1

#### . \* Now compare with relogit

. xi: relogit TEA02030405060708 suskill0208rebal knowent0208rebal fearfail020 > 8rebal gender1 age clusterstarsEU i.UKoccup02030405060708 i.UKoccup0203~8 \_IUKoccup02\_1-7 (naturally coded; \_IUKoccup02\_1 omitted) (31093 missing values generated)

#### Corrected logit estimates

Number of obs = 41220

TEA0203040~8	Coef.	Robust Std. Err.	z	P> z	[95% Conf.	Interval]
suskill020~l knowent020~l fearfail02~l gender1 age clustersta~U _IUKoccup0~2 _IUKoccup0~3 _IUKoccup0~4 _IUKoccup0~5 _IUKoccup0~6 _IUKoccup0~7 _Cons	1.994199 .9010131 6742792 .4329401 0075696 .0332857 .4380884 6815125 -1.823995 8388614 5097746 0005299 -4.433084	.0692864 .0450074 .055282 .0506312 .0019341 .0074775 .0619154 .1440542 .2072714 .2073594 .1599252 .1171986 .1202775	$\begin{array}{r} 28.78\\ 20.02\\ -12.20\\ 8.55\\ -3.91\\ 4.45\\ 7.08\\ -4.73\\ -8.80\\ -4.05\\ -3.19\\ -0.00\\ -36.86\end{array}$	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.001 0.996 0.000	1.858401 .8128002 78263 .3337048 0113604 .01863 .3167365 9638537 -2.230239 -1.245278 8232223 230235 -4.668823	2.129998 .989226 5659285 .5321755 0037789 .0479413 .5594403 3991714 -1.41775 4324445 .1963269 .2291752 -4.197344



# Random Intercept Model H1

Random-effects Group variable	s logistic reg e: NUTS2CODE	Number Number	of obs      = of groups   =	41220 37		
Random effects	s u_i ~ <b>Gauss</b> i	Obs per	group: min = avg = max =	165 1114. 1 6034		
Log likelihood	d = -7541.694	Wald ch Prob > (	i 2( <b>13</b> ) = chi 2 =	2068.58 0.0000		
TEA0203040~8	OR	Std. Err.	Z	P> z	[95% Conf.	Interval]
suski     020~  knowent020~  fearfai   02~  gender1 age agesquared cl ustersta~U _  UKoccup0~2 _  UKoccup0~3 _  UKoccup0~4 _  UKoccup0~5 _  UKoccup0~6 _  UKoccup0~7	7. 178688 2. 446407 . 5015835 1. 590458 1. 101084 . 9987301 1. 034629 1. 599048 . 4953712 . 2079362 . 5436513 . 6083998 1. 029368	. 4996218 . 1099799 . 0279631 . 0790399 . 0163391 . 0001791 . 0096526 . 0974637 . 0716466 . 0438049 . 114084 . 0984742 . 122938	28. 32 19. 90 -12. 38 9. 34 6. 49 -7. 09 3. 65 7. 70 -4. 86 -7. 46 -2. 90 -3. 07 0. 24	0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.004 0.002 0.808	6. 2633 2. 240074 . 449665 1. 442848 1. 069521 . 9983792 1. 015882 1. 418991 . 3730952 . 1375978 . 3603278 . 443012 . 8145381	8. 227861 2. 671746 . 5594965 1. 753169 1. 133578 . 9990812 1. 053722 1. 801951 . 6577212 . 3142307 . 8202441 . 835531 1. 300859
/I nsi g2u	-4. 709306	. 8618542			-6. 398509	-3. 020103
sigma_u rho	. 0949264 . 0027315	. 0409064 . 0023478			. 0407926 . 0005056	. 2208986 . 0146155

Likelihood-ratio test of rho=0: chibar2(01) = 2.53 Prob >= chibar2 = 0.056



# **Multiple Regression**

. xi: sw regress TEAUKNuts2 PopDens2004 suskill0208rebal knowent0208rebal fe
> arfail0208rebal incpercapita Ünempl2005 clusterstarsEU RIS2006 InnovlevelEU g
> ender1 age i.UKoccup02030405060708, pr(.06)
i.UKoccupO2O3~8 _IUKoccupO2_1-7 (naturally coded; _IUKoccupO2_1 omitted)
begin with full model
p = <b>0.8992</b> >= 0.0600
p = <b>0.8351</b> >= 0.0600
p = <b>0.5026</b> ≻= 0.0600 removing _ <b>IUKoccupO2_6</b>
p = <b>0.5038</b> >= 0.0600 removing _ <b>IUKoccupO2_3</b>
p = <b>0.3910</b> ≻= 0.0600 removing <b>_IUKoccupO2_4</b>
p = <b>0.3835</b> >= 0.0600 removing <b>fearfail0208rebal</b>
p = <b>0.2879</b> ≻= 0.0600 removing _ <b>IUKoccupO2_7</b>

_	Source	55	df	MS	Number of obs = <b>41220</b> F(10, 41209) <b>=10174.53</b>
	Model Residual	2.90328149 1.17589036	10 <b>41209</b>	.290328149 .000028535	Prob > F = 0.0000 R-squared = 0.7117 Pdi P-squared = 0.7117
-	Total	4.07917184	41219	.000098963	Root MSE = $.00534$

TEAUKNuts2	Coef.	Std. Err.	t	P≻ t	<b>[95%</b> Conf.	. Interval]
PopDens 2004	4.78e-06	3.71e-08	129.06	0.000	4.71e-06	4.86e-06
suskill020~1	.0002776	.0000552	5.03	0.000	.0001695	.0003858
knowent020~1	.0002346	.0000636	3.69	0.000	.00011	.0003592
age	7.56e-06	2.17e-06	3.49	0.000	3.31e-06	.0000118
incpercapita	2.11e-06	3.12e-08	67.61	0.000	2.05e-06	2.17e-06
Unempl2005	0048197	.000039	-123.58	0.000	0048962	0047433
clustersta~U	0006657	.0000141	-47.33	0.000	0006933	0006382
RIS 2006	.0062349	.0007031	8.87	0.000	.0048568	.0076131
InnovlevelEU	.0006604	.0001072	6.16	0.000	.0004502	.0008705
genderl	0001188	.0000547	-2.17	0.030	000226	0000117
cons	.0382587	.0004411	86.73	0.000	.0373941	.0391233



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