Agglomeration: A New Tool for TII Project Appraisal

TII National Roads Conference, Sept 2018

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Agglomeration Benefits: What, Where, and Why!

TII National Roads Conference, Sept 2018

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Introduction

Introduction:

- Commissioned by TII

- Team Effort:
  - Dan Graham, Imperial College London
  - Edgar Morgenroth, ESRI/Dublin City University
  - AECOM

- Purpose:
  - Evaluation of transport appraisal projects

- Next Steps
  - Provided to DTTAS
  - Need to adopt official parametres
  - Develop PAG Unit

Evidence on the link between Productivity
and Agglomeration for Ireland: Estimated
Parameters for Wider Economic Benefit
Calculations (DRAFT)

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What is Agglomeration? – Part I

Why do we live in towns and cities?

- Jobs

- Healthcare

- Living standards

- Education

- Social reasons

What happens when towns and cities grow?

- Labour market pooling

- Knowledge spillovers occur

- Businesses become more specialised

- Supply chains become shorter and more resilient

- Productivity and incomes increase

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What is Agglomeration? - Part II

Can we produce agglomerative benefits with better transport?

Will improved transportation links increase productivity?

- If yes, what types of transport will improve productivity:
    - **Road,**
    - **Rail,**
    - **Marine, and**
    - **Air**

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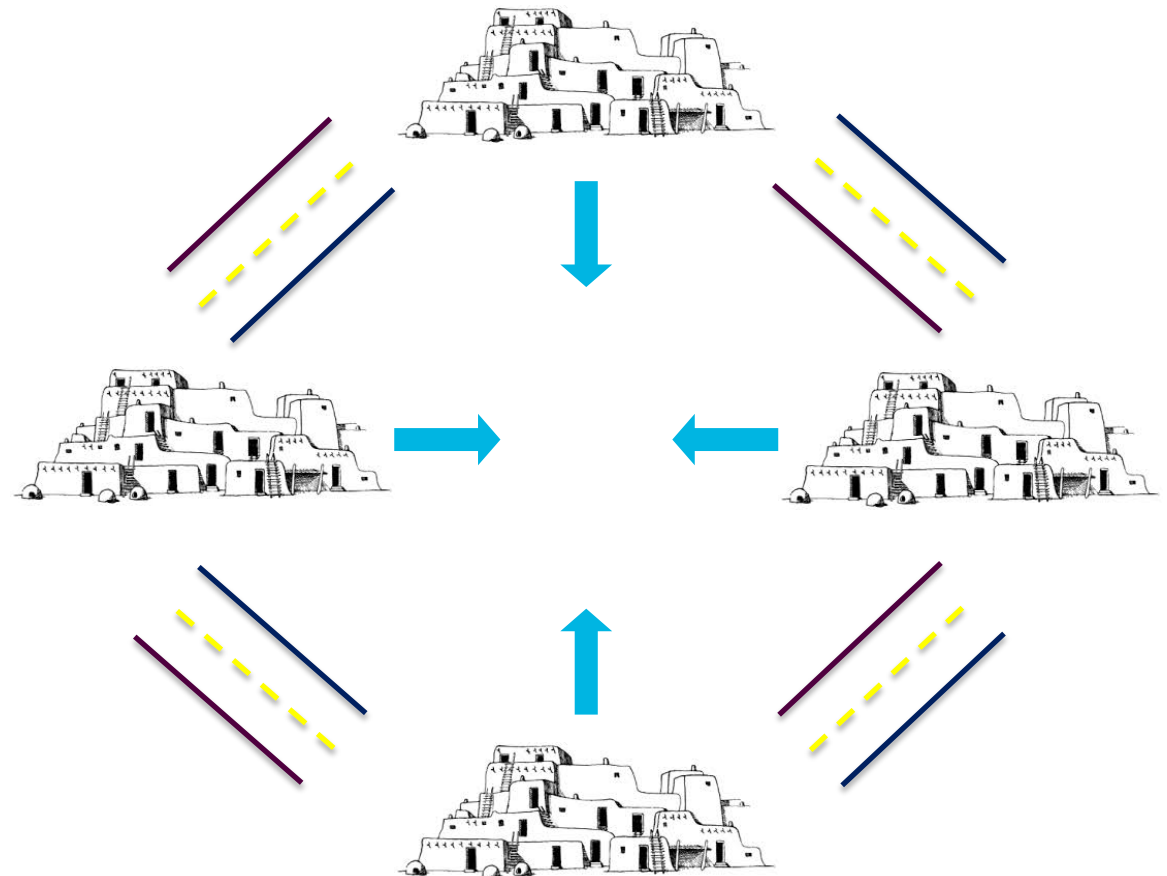
Where does Agglomeration Occur?: Identifying Agglomeration - Part I

Measuring Effective Density as the sum of:
- **Employment per Electoral District**, over
- **Distance** from the centre of respective **Electoral District to job**, to the power of
- Agglomeration change

$$\frac{1}{n} \sum_{j=1}^{n} \frac{E_j}{d_{ij}^{\alpha}},$$

Measuring the productivity of firms in Ireland:
- Company Registration Office Data: FAME Database
- Geocoded Company Locations
- Contains information on:
    - **Turnover**
    - **Employees**
    - **Fixed Assets**
- Examined sectors likely to benefit from agglomeration
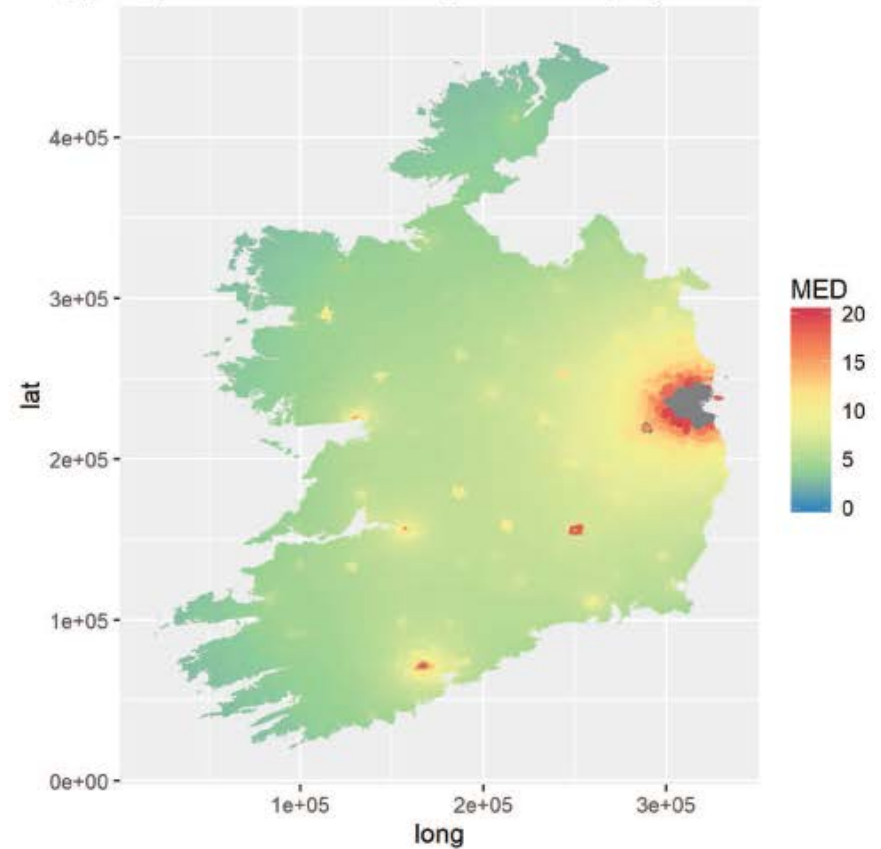- Economic techniques use to investigate the relationship between density and productivity

$$y_{it} = g(\rho_{it}, Z_{it}) f(x_{it})$$

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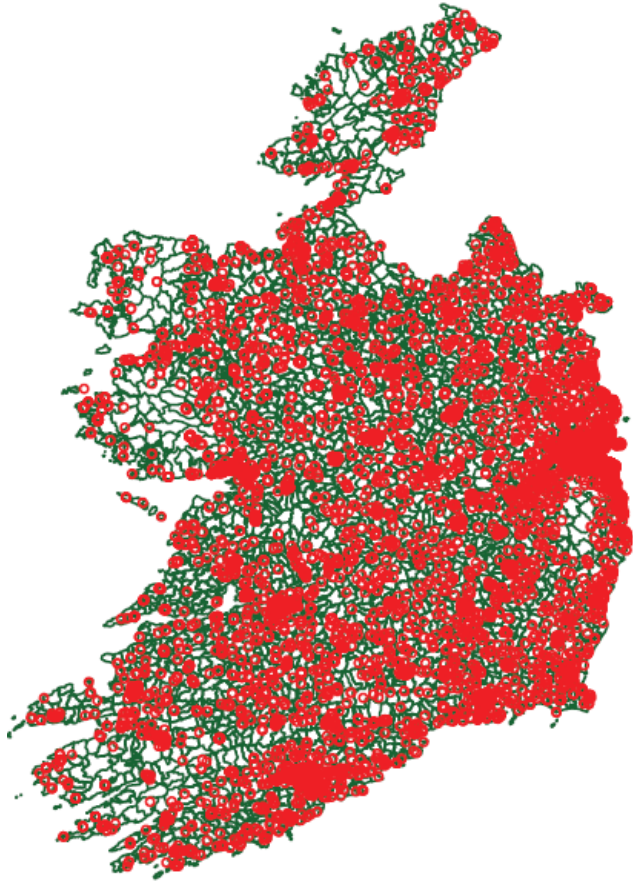# Where does Agglomeration Occur?: Identifying Agglomeration – Part II

(a) map of MED values: employment 2016
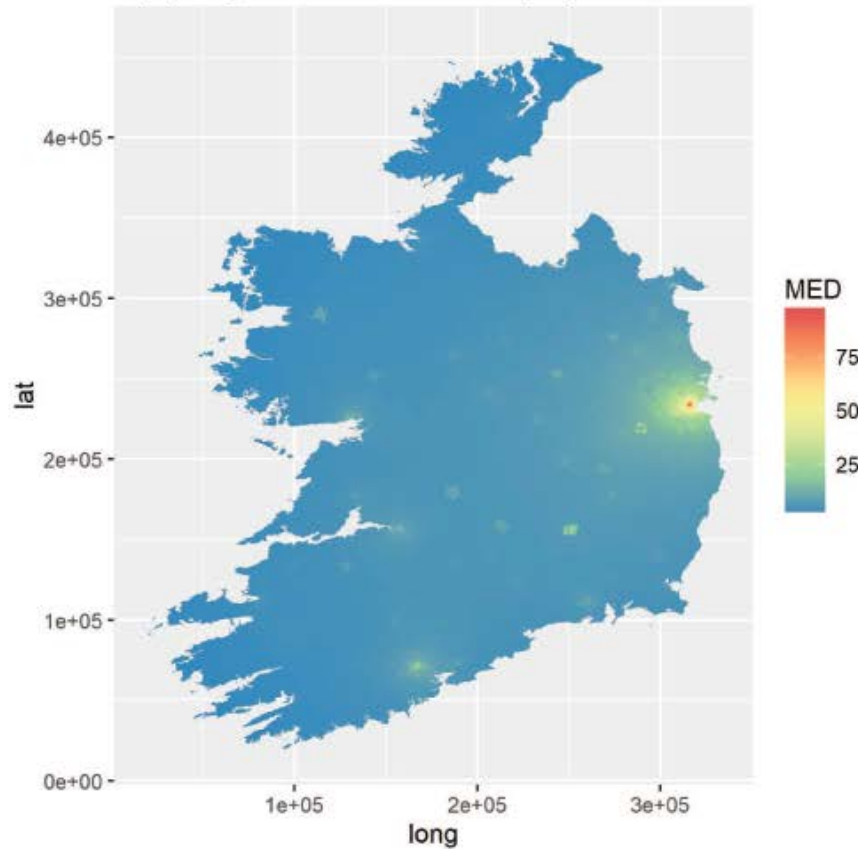
(b) map of MED values Range 0-20: employment 2016

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Where does Agglomeration Occur?: Identifying Agglomeration - Part III

	Sector	Code	SIC Divisions
1	Manufacturing	MAN	10-33
2	Construction	CON	41-43
3	Wholesale & Distribution	WAD	45-47
4	Transport	TRA	49-56
5	Information & Communication Technology	ICT	58-63
6	Financial & Business services	FIN	64-74

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Where does Agglomeration Occur?: Identifying Agglomeration - Part IV

	sic code	*decay parameter*	*elasticity*
Manufacturing	10-33	1.25	0.015 (0.000)
Construction	41-43	1.00	0.065 (0.023)
Wholesale & Retail	45-47	-	-
Transport	49-56	1.25	0.092 (0.022)
Inf. & Comm. Tech.	58-63	-	-
Fin. & Bus. services	64-74	1.50	0.058 (0.010)

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Where does Agglomeration Occur?: Identifying Agglomeration Part V

- 47 Similar studies
- Average value for elasticity was 0.047
- Tightly bunched
- Our results consistent with these

mean = 0.047   s.d. = 0.049   n = 47

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Why do we need to measure Agglomeration Benefits? – Part I

Costs

Maintenance and Operating Costs

Construction Costs

Benefits

Emissions Reductions
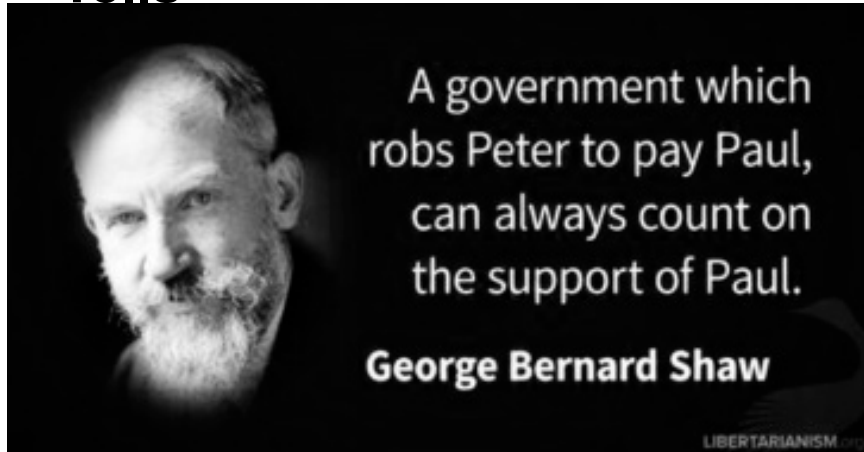
Time Savings

Safety Improvements
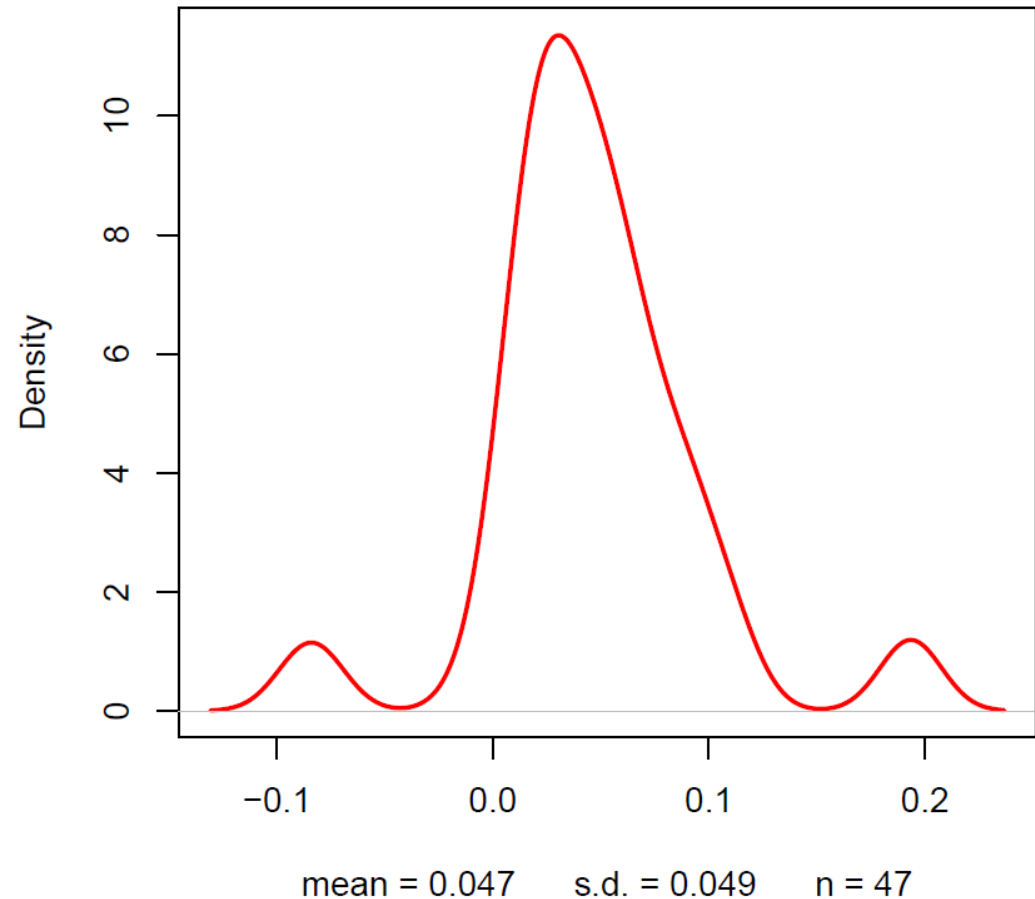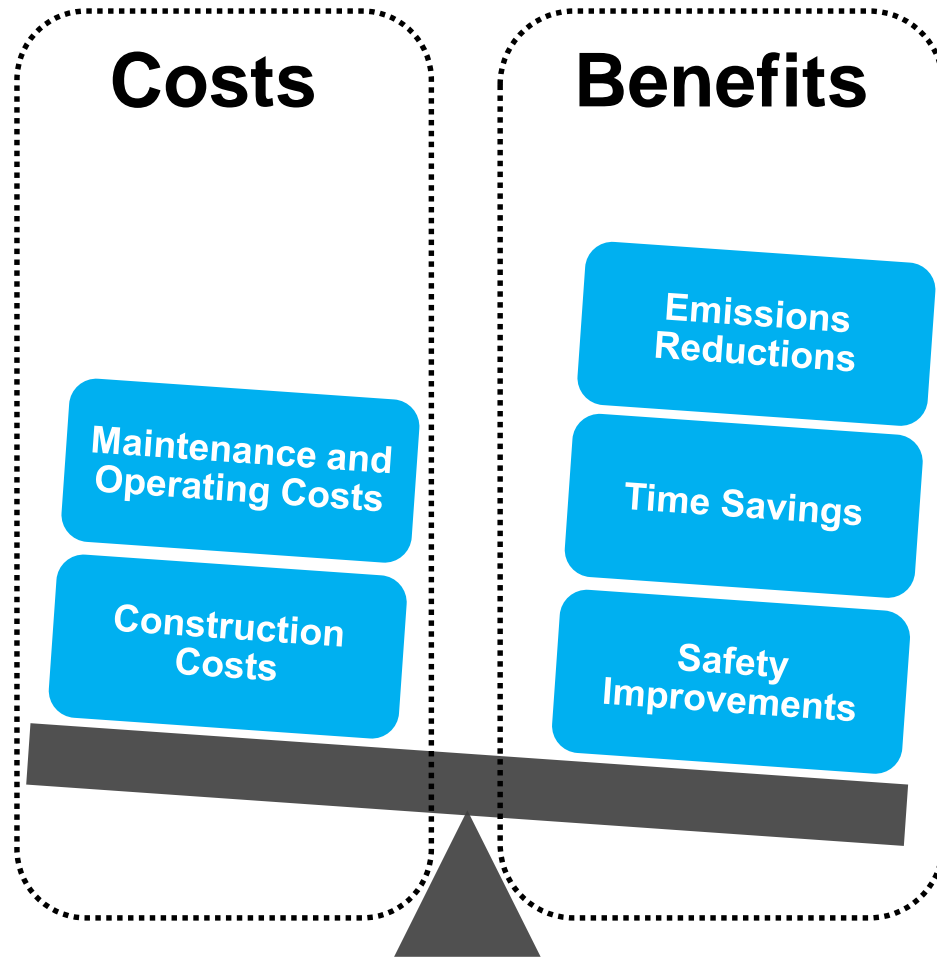
Why?
- **Externalities:**
  - Some costs are not borne by the user directly, but impact society e.g. Pollution

- **Public Good:**
  - Goods provided to benefit society without profit

- **Cost-Benefit Appraisal:**
  - Is the solution effective?
  - Is the solution efficient?

- **Need a comprehensive measure of benefits for decision making**

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Why do we need to measure Agglomeration Benefits? – Part II

These are **not** benefits for CBA, unlike Agglomeration

Tolls

A government which robs Peter to pay Paul, can always count on the support of Paul.

George Bernard Shaw

Extra activity due to a new road:
- Transport is a **means to an end**
- **Zero-Sum**/Displacement
- **But,** changing patterns may support spatial policy

Employment from construction

- What is the **opportunity cost** of construction?
  - Is the money **additional**, or reallocated?
  - What else could the money have been spent on?
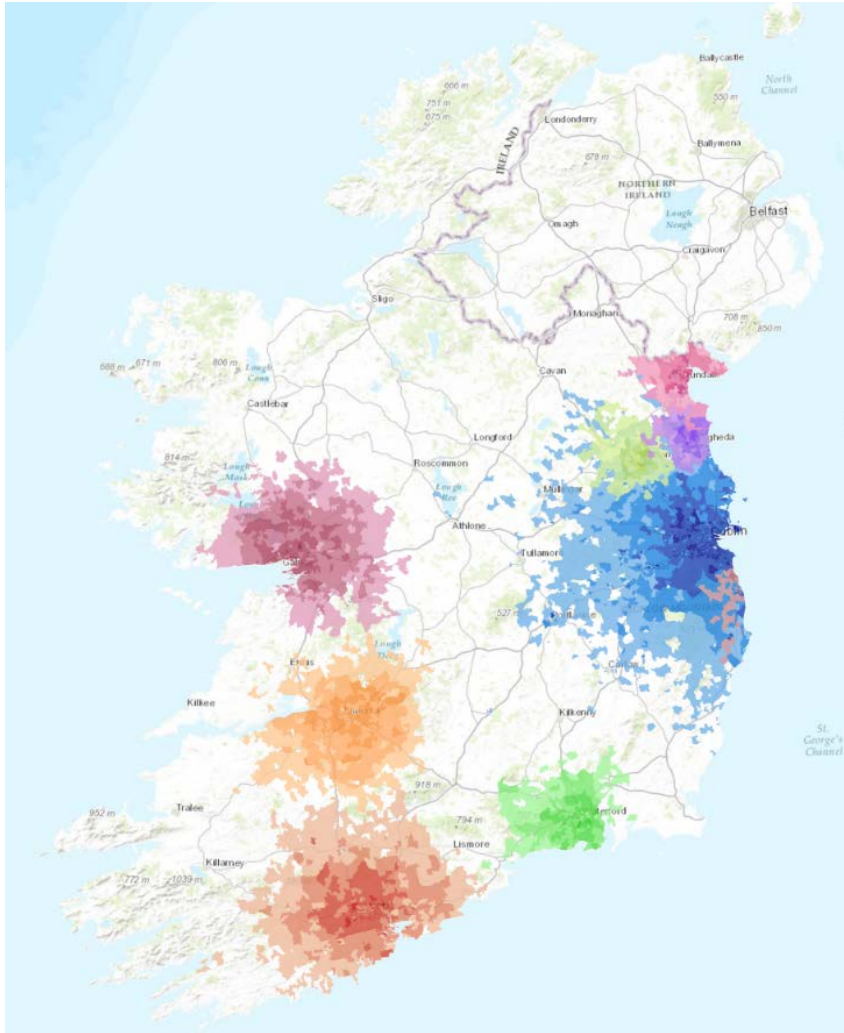 - How many homes?
  - How many hospital beds?

Increase the value of land or existing property

- Access improvements increase the value of land

- What happens to land values elsewhere?

- Double counts the other benefits

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Agglomeration Benefits: How and When are they Calculated!

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How are Benefits Calculated? – Inputs

To calculate agglomeration benefits we need:

- **Jobs by Sector** (SIC Code/NACE Code):
    - **Manufacturing**(10-33/C)
    - **Construction** (41-43/F)
    - **Transportation** (49-56/H&I)
    - **Financial and Business Services** (64-74/K,L & M)

- Productivity Estimates in **Gross Value Added by Sector** (NACE Code)
    - **Manufacturing**(C)
    - **Construction** (F)
    - **Transportation** (H & I)
    - **Financial and Business Services** (K,L & M)

- **Average Generalised Cost of Travel Estimates** between Electoral Districts

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How are Benefits Calculated? – Effective Density

To calculate Effective Density:

- Effective Density Equation, by mode:

$$d_i^{S,k,f} = \sum_j \frac{E_j^{S,f}}{(g_{i,j}^{S,f}) a^k}$$

- Where:
  - $E_i^{S,f}$ is **Total jobs (E)** for all sectors in **Electoral Division (j)** in the **Option (s)** for each **forecast year (f)**, over

  - $g_{i,j}^{S,f}$ the **Average Generalised Cost of Travel (g)** between the centre point of one **Electoral District (j)** to another **Electoral District (i)** for the **Option (s)** for each **forecast year (f)** to the power of **distance decay parameter (a)** for each **sector (k)**

	sic code	decay parameter	elasticity
Manufacturing	10-33	1.25	0.015 (0.000)
Construction	41-43	1.00	0.065 (0.023)
Wholesale & Retail	45-47	-	-
Transport	49-56	1.25	0.092 (0.022)
Inf. & Comm. Tech.	58-63	-	-
Fin. & Bus. services	64-74	1.50	0.058 (0.010)

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How are Benefits Calculated? – Benefits

To calculate Effective Density:

- Effective Density Equation, by mode:

$$WEI^f = \left[\left(\frac{d_i^{DS,k,f}}{d_i^{DM,k,f}} \right)^{p^k} - 1 \right] GVAW_i^{DM,k,f} E_i^{DM,k,f}$$

	sic code	decay parameter	elasticity
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- Where:

  - $\left[\left(\frac{d_i^{DS,k,f}}{d_i^{DM,k,f}} \right)^{p^k} - 1 \right]$ is the effective density in the 'Do Something' over the 'Do Minimum/Do Nothing' to the power of the elasticity of productivity for the sector minus 1 – to identify estimated productivity increases.

  - $GVAW_i^{DM,k,f}$ is the measure of productivity per worker per sector per forecast year in the 'Do Minimum'

  - $E_i^{DM,k,f}$ is the total employment per sector per forecast year in the 'Do Minimum/Do Nothing'

  - Falls within 10%-30% of traditional benefist as estimated by TUBA

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How are Benefits Calculated? – Problems

Some problems include:

- **Productivity Estimates**: unreliable due to issues in national statistics. Limited regional data:
    - **Manufacturing GVA overstated**
    - Equity Values

- **Job Growth:** natural increases in job numbers:
    - Need long-term assumptions
    - Growth by sector or aggregated growth

- Weakness in the evidence base between changes in generalised travel costs and agglomeration impacts:
    - Causality

Industry Type	
Industry Type	**GVA €per Employee (2016, December Seasonally Adjusted)**
Manufacturing	€79,000*
Construction	€52,342
Transport	€27,618
Financial and Business Services	€56,985
*Estimated from the Department of Business Annual Business Survey of Economic Impact, 2016	

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How are Benefits Calculated? – Software

Calculations:
- Currently processed using Python script (not fixed).
  - **Pros:** Processes large amount of data quickly, plus flexible
  - **Cons:** User knowledge of Python may be limited, licensing obstacles

- Intention to deliver user friendly interface similar to **COBALT**

- Requires input files for:
  - **Average Generalised Cost of Travel Estimates** by Electoral District;
  - **Jobs Data** by Electoral District;
  - **3 modelled years** (opening year, scheme design year and scheme horizon year)

- Processes handled internally:
  - **Job Growth:** New assumptions required
  - **Productivity Growth:** CAF assumptions
  - **Interpolation**: Estimating intermediate years
  - **Discounting**: Taking into account time preferences

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Thank You