The causal effects of an industrial policy

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Bruegel, 6th December 2012

MOTIVATION

- Industrial policies pervasive both in developed and developing economies and involve large sums of tax payers money
- Current revival of industrial strategies to support growth: e.g. subsidies to auto & banks; loan guarantees; export & FDI support; special enterprise zones, etc.
- **Lots of theories** (negative & positive)
  - Infant industries; agglomeration; increasing returns
  - Poor government information; Political economy
- **Lots of case studies** (negative & positive)
  - European "National Champions"
  - Asian Tigers: Taiwan, South Korea, Singapore, **China**

MOTIVATION: DO INDUSTRIAL SUBSIDIES WORK?

- Economists generally pessimistic

- Rodrik (2007): The pessimistic view of industrial subsidies does not have firm empirical basis since governments typically targets "losers" naive empirical techniques may underestimate any true positive effects

- Econometric evaluations of causal impact of industrial policies rare
  - Difficulty in accessing administrative panel data
  - Identification

- Evaluation increasingly important due to budget constraints

RELATED LITERATURES

- **Place-based policies**
  - US Empowerment Zones (Busso et al, 2010; Neumark & Kolko, 2010)
  - Tennessee Valley Authority (Kline and Moretti, 2012)
  - Tax-based (Holmes, 1998; Albouy, 2009)
  - French Enterprise Zones (Gobillon et al, 2010; Mayer et al, 2011)
  - Regional policy in EU (Wren and Taylor, 1999; Bronzini & De Blasio, 2008, Cerqua and Pellegrini, 2012)

- **RSA & similar UK regional policies**
  - National Audit Office (2003) "Industrial Survey" methods
  - Devereux et al (2007). Multinationals, no quasi-experiment
  - Other UK regional schemes (Gibbons et al, 2011; Eino & Overman, 2011)

- **Industrial Subsidies**

- **Innovation Policies**

SUMMARY: WHAT DO WE DO?

- Estimate causal effects of major business support program in UK **Regional Selective Assistance (RSA)** on jobs, investment; productivity, entry/exit & unemployment
  - Selected firms are given investment subsidies in disadvantaged geographical areas (mainly manufacturing)
  - Main UK firm subsidy scheme:
- Rich panel data for non-treated and treated plants & firms
  - administrative data on population of all RSA recipients matched to population of plants (2.2m observations over 350k plants)
- **Quasi-experiment:** EU-wide definition of a "disadvantaged area" determined by EU State Aid rules & revised every at regular intervals.
  - In sample period 1986-2004 there were two changes in eligibility and maximum subsidy in 1993 & 2000

SUMMARY: WHAT DO WE FIND?

- **Overall program effects (ATT):**
  - Increases investment & employment on intensive and extensive (i.e. more net entry of plants) margins.
  - A 10 percentage point investment subsidy in area generates ~6.6% higher employment
  - Reduces unemployment, little displacement from other areas
  - OLS has large downward bias
- Zero effect for large firms – suggestive of "gaming"
- No effect on Total Factor Productivity & recipients mainly low productivity
  - **Cost per job around $6,500, so relatively cheap**
- Doesn't mean industrial policy good, but a necessary condition

Institutional Setting

Modelling

Data

Results

REGIONAL SELECTIVE ASSISTANCE: RSA

- Provides investment grants to firms in “eligible” areas. The grants cover between 10% to 35% of capital expenditure.

- Firms apply with business plan, accounts & reasons for needing grant. Government Agency (currently Dept of Business, Innovation & Skills, BIS) decides whether to fund.

FORMAL RSA ELIGIBILITY CRITERIA

- **LOCATION:** the project must take place in an Assisted Area
  <u>This is fundamental to eligibility under the RSA scheme</u>
- **ADDITIONALITY**: Meant to show that without RSA investment project would not have occurred
- **JOBS:** Meant to create/ safeguard employment - not be simply offset by job losses elsewhere
  - Additionality & jobs criteria hard to enforce because counterfactual not known to government agency (especially for large firms)

GEOGRAPHICAL VARIATION OF SUPPORT

Location determines eligibility & size of grants.

- Different types of Assisted Areas:
  - **Development Area**/ **Tier 1**: grant can cover max 20% to 35% net grant equivalent (NGE) of investment project costs
  - **Intermediate Area** /**Tier 2**: grants can cover max 10% to 30% NGE of investment project costs

- In our sample period major map changes in 1993 & 2000: Map of assisted areas changed because of EU-wide rules.

CHANGES IN AREA ELIGIBILITY

- RSA is a form of State Aid to industry that could distort competition between EU Member States
- Treaties of Rome & Amsterdam: State aid illegal except under restrictive conditions. Allow assistance in “deprived areas” defined by a common formula:
  - Eligibility rules common to whole EU decided every 7 years
  - Maximum threshold of support (NGE) in Assisted Area
- Changes in area’s eligibility depend on:
  - Changes in eligibility criteria (& weights given to them)
  - Changes in EU wide values; e.g. one criteria is area’s GDP/capita relative to EU average GDP/capita . When Poland & other A8 countries joined EU, EU GDP/capita fell so some UK areas exogenously lost eligibility
  - Changes in area’s characteristics (potentially endogenous)

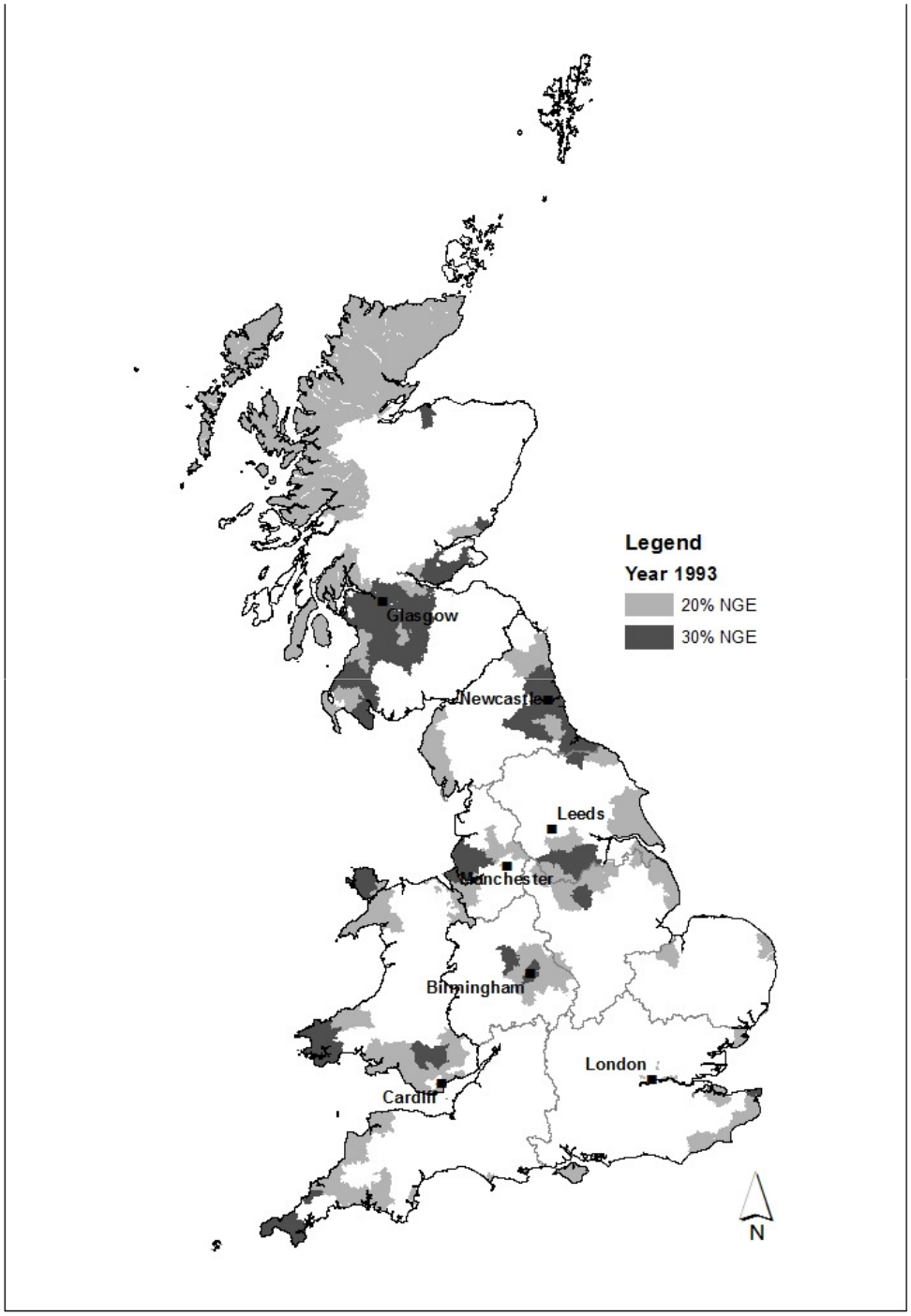
EXAMPLES OF CRITERIA ON AREA ELIGIBILITY

The 1993 rules

- Peripherality
- Population Density
- GDP per capita relative to EU average
- Relative unemployment (level and long-term)
- Activity Rates
- Occupational Structure
- New business growth

The 2000 rules

- Peripherality
- Population Density
- GDP per capita relative to EU average
- Relative unemployment (level and long-term)
- Activity Rate
- Manufacturing share of employment


Legend
Year 1993
20% NGE
30% NGE
Glasgow
Newcastle
Leeds
Manchester
Birmingham
London
Cardiff
N

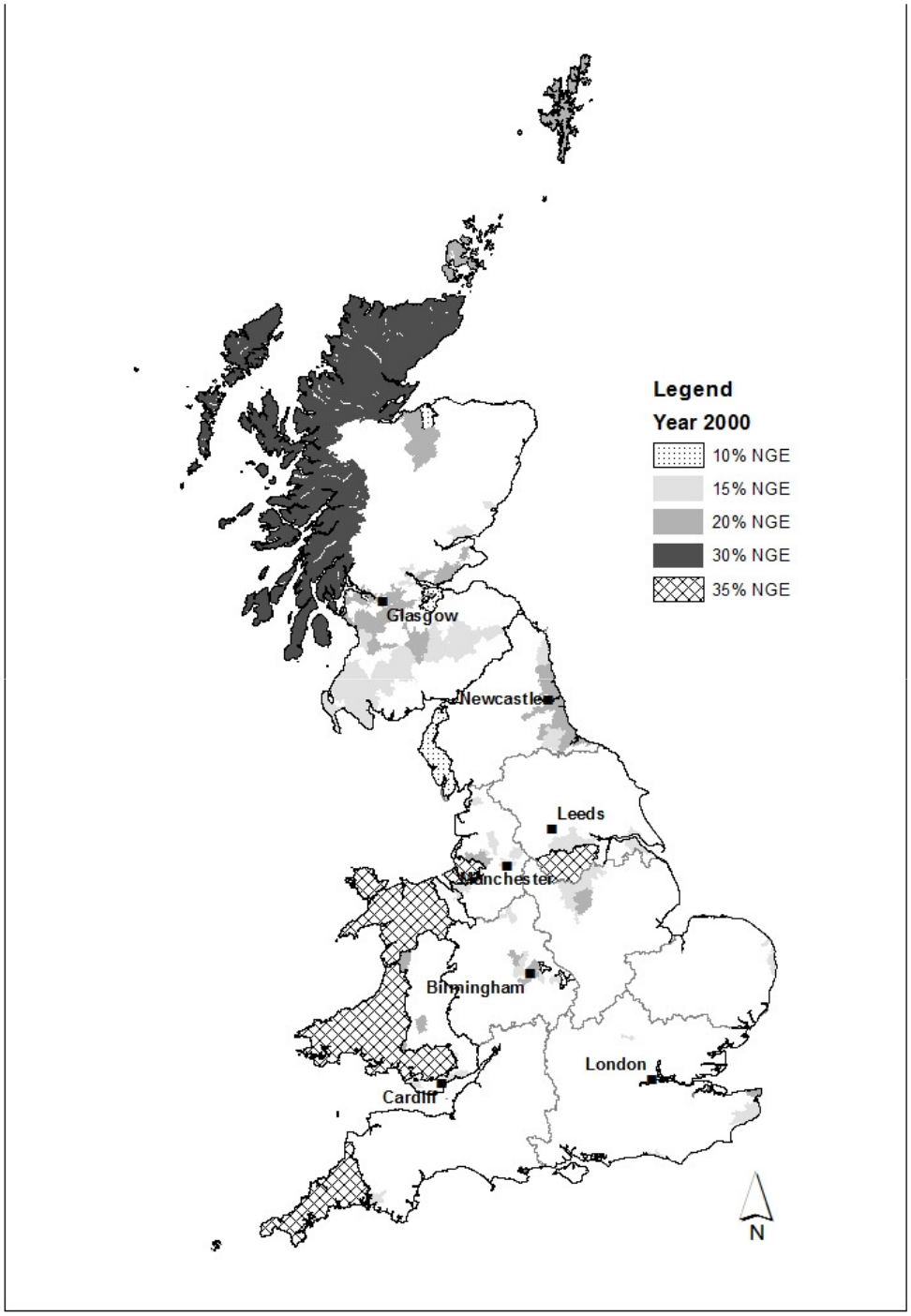

Legend
Year 2000
10% NGE
15% NGE
20% NGE
30% NGE
35% NGE
Glasgow
Newcastle
Leeds
Manchester
Birmingham
London
Cardiff
N

TABLE A1: IDENTIFICATION

Unit of Observation	Year	Total Number of Units	Units which changed their eligibility to RSA	Increase in eligibility	Decrease in eligibility
Areas (wards)	1993	10,737	1,893	1,034	859
	2000	10,737	4,048	1,424	2,624
Plants	1993	146,420	23,225	14,369	8,856
	2000	163,796	50,920	14,967	35,953
Firms	1993	125,444	19,866	12,505	7,361
	2000	148,598	45,692	13,520	32,172

Institutional Setting

Modelling

- Theory
- **Econometrics**

Data

Results

PLANT LEVEL ANALYSIS

$$y_{it} = \alpha RSA_{it} + \beta AGE_{it} + \eta_i + \tau_t + v_{it}$$

- *y* are outcomes like ln(employment) for **plant** *i*
- RSA switches on when a firm receives any investment subsidy
- Since program funds firms/areas in trouble we expect E($RSA_{it} v_{it}$) <0 so estimate of program effect (α) downwards biased
- Instrument for *RSA* is maximum investment subsidy (*NGE*). Changes driven by EU rules & so exogenous to plant characteristics and local/national political economy sources of endogeneity
- Also estimate equation at **firm** level:
  - Across plant, within firm substitution
  - Data on investment and productivity only firm level
- Also estimate at **area** level (entry/exit, unemployment, substitution)

Institutional Setting

Modelling

Data

Results

DATA

SAMIS database: since 1972 information on RSA applicants; name; address (postcode); how much they receive and when.

IDBR: list of all UK plants & firms with names, address, industry, ownership; **employment**, entry and exit dates.

ARD: Government survey of a stratified sample of businesses with info on employment, investment, output, materials, etc. Info recorded at **firm** level (same as **plant** for 80% of the time)

EU official documents to gather information on eligibility rules and maps

We use matched data from these sources for the manufacturing sector for the period 1986 to 2004

TABLE 1: DESCRIPTIVE STATISTICS

PARTICIPATING FIRMS TEND TO BE LARGER AND LESS PRODUCTIVE THAN NON-PARTICIPANTS

Variable		mean		Sd	median	Obs.
Plant Employment	non treated	22.25		118.92	2	3,193,504
	Treated before	79.39	***	241.45	6	136,488
Firm Employment	non treated	253		737	111	145,389
	Treated before	417	***	957	171	8,209
Real Value added per worker	non treated	31.05		162.51	24.27	136,524
	Treated before	26.32	**	23.51	22.38	7247
Total Factor Productivity	non treated	0.02		0.33	0.01	134,755
	Treated before	-0.03	***	0.29	-0.03	7,925

Institutional Setting

Modelling

Data

Results

RESULTS

- **Plants**
  - Employment (by firm size)
- **Firms**
  - Employment, investment, Productivity, Wages
- **Area**
  - Employment, # firms, substitution, Unemployment
- **Robustness/extensions**

TABLE 2; Dependent variable: ln(Plant employment), Plant Fixed Effects

	OLS	Red. Form	First Stage	IV
A. ALL Plants; 2,258,571 obs; 353,626 plant Fixed Effects				
RSA (Participant)	0.108***			0.358***
	(0.008)			(0.135)
NGE (investment subsidy)		0.086***	0.240***	
		(0.033)	(0.018)	

TABLE 2- cont; Dependent variable: ln(Plant employment)

	OLS	Red. Form	First Stage	IV
A. ALL Plants; 2,258,571 obs; 353,626 plant Fixed Effects				
RSA (Participant)	0.108***			0.358***
	(0.008)			(0.135)
NGE (investment subsidy)		0.086***	0.240***	
		(0.033)	(0.018)	
B. Plants in SMALL Firms (under 150 employees); 2,151,881 obs; 339,767 plant Fixed Effects				
RSA (Participant)	0.117***			0.484***
	(0.008)			(0.140)
NGE (investment subsidy)		0.115***	0.237***	
		(0.034)	(0.018)	

TABLE 2- cont; Dependent variable: ln(Plant employment)

	OLS	Red. Form	First Stage	IV
A. All Plants; 2,258,571 obs; 353,626 plant Fixed Effects				
RSA (Participant)	0.108***			0.358***
	(0.008)			(0.135)
NGE (investment subsidy)		0.086***	0.240***	
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B. Plants in SMALL Firms (under 150 employees); 2,151,881 obs; 339,767 plant Fixed Effects				
RSA (Participant)	0.117***			0.484***
	(0.008)			(0.140)
NGE (investment subsidy)		0.115***	0.237***	
		(0.034)	(0.018)	
C. Plants in LARGE Firms (over 150 employees); 106,690 obs; 13,859 plant Fixed Effects				
RSA (Participant)	0.130***			-0.157
	(0.024)			(0.563)
NGE (investment subsidy)		-0.042	0.268***	
		(0.150)	(0.062)	

TABLE 3: ALTERNATIVE SIZE THRESHOLDS

- Table 3 - Shows that the same pattern occurs for alternative size cut-offs (100 or 50 workers) or using continuous size measure
- Table 4 – Shows that the same pattern occurs when we aggregate to firm level (i.e. No within-firm shifting)
- **Bottom line: Large firms do not increase employment following RSA receipt!**

TABLE 5: FIRM INVESTMENT REGRESSIONS (ARD SAMPLE)

Method	**OLS**	**Red. Form**	**First Stage**	**IV**
Dependent variable	**Ln(INV)**	**Ln(INV)**	**RSA**	**Ln(INV)**
A. All Firms (129,584 obs)				
RSA (Participant)	0.227***			0.621
	(0.030)			(0.426)
NGE (investment subsidy)		0.290	0.462***	
		(0.198)	(0.060)	
B. Small Firms (87,765 obs)				
RSA (Participant)	0.222***			0.973*
	(0.040)			(0.501)
NGE (investment subsidy)		0.500*	0.514***	
		(0.259)	(0.066)	
C. Large Firms (41,819 obs)				
RSA (Participant)	0.233***			-0.148
	(0.045)			(0.761)
NGE (investment subsidy)		-0.050	0.361***	
		(0.274)	(0.105)	

TABLE 5: FIRM PRODUCTIVITY REGRESSIONS (ARD SAMPLE)

Method	**OLS**	**Red. Form**	**First Stage**	**IV**
Dependent variable	**Ln(PROD)**	**Ln(PROD)**	**RSA**	**Ln(PROD)**
A. All Firms (129,584 obs)				
RSA (Participant)	0.000			0.009
	(0.004)			(0.057)
NGE (investment subsidy)		0.004	0.434***	
		(0.024)	(0.059)	
B. Small Firms (87,765 obs)				
RSA (Participant)	0.004			0.026
	(0.005)			(0.067)
NGE (investment subsidy)		0.012	0.474***	
		(0.031)	(0.070)	
C. Large Firms (41,819 obs)				
RSA (Participant)	-0.008			-0.090
	(0.007)			(0.109)
NGE (investment subsidy)		-0.030	0.352***	
		(0.038)	(0.095)	

TABLE 6: AREA LEVEL ANALYSIS: POSITIVE EFFECT ON NET ENTRY, NO EVIDENCE OF DISPLACEMENT

Dependent Variable	**ln(Employ-ment)**	**ln(#Plants)**	**ln(Employ-ment)**	**ln(#Plants)**
Level of aggregation	**Wards**	**Wards**	**TTWA**	**TTWA**
Years	**1986-2004**	**1986-2004**	**1986-2004**	**1986-2004**
NGE (invest subsidy)	0.287**	0.171***	0.355***	0.248***
	(0.118)	(0.049)	(0.133)	(0.083)
Observations	177,794	177,794	6,001	6,001
#Fixed effects/Clusters	10,737	10,737	322	322

MAGNITUDES (1986-2004)

- Estimate the implied aggregate increase in jobs every year using reduced form coefficients and Investment subsidy (NGE)
  - A NGE of 10% creates 2.9% more jobs
- Average of 111,000 extra jobs per year
- Average £190m pa RSA spend + 10% admin costs for government + 7% admin costs for firms (NAO, 2003) implies
  - nominal £2,063 per job
  - Add 30% deadweight cost of taxation & this is **£4,000 ($6,300)** per job in 2010 prices

TABLE 6 –CONT.: AREA LEVEL ANALYSIS – UNEMPLOYMENT & SERVICE EMPLOYMENT

Dependent Variable	ln(Employ-ment)	ln(Unemploy-ment)	ln(Service Employment)
Level of aggregation	**Wards**	**Wards**	**Wards**
Years	**1996-2004**	**1996-2004**	**1996-2004**
NGE (invest subsidy)	0.210*	-0.700***	0.090
	(0.109)	(0.044)	(0.061)
Observations	73,896	73,284	73,829
#Fixed effects & clusters	10,737	10,716	10,737

MAGNITUDES (1996-2004) – CONT.

- These jobs don't seem to be displacement within UK
  - Same methodology as above implies a reduction in unemployment of 77,648 p.a.
  - Investment subsidy (NGE) effect on employment bit smaller over same time period = 88,193 p.a.
  - So most of increase in jobs comes from lower unemployment rather than migration, etc.
- A positive assessment - Higher cost than some welfare reforms, but lower cost than most government programs

CONCLUSIONS

- Evaluate a major industrial policy (RSA) using "quasi-experiment" of EU driven changes in eligibility for UK areas
- **Results:**
  - **positive effect** on jobs, investment and net entry (all badly underestimated by OLS compared to IV)
  - Growth of employment mainly from fall in unemployment.
  - **No evidence** of large displacement effects from other areas.
  - **No effect on larger firms**. Probably gaming the system (also could be financial constraints). Implication is that policy should be targeted to SMEs
- **No effect on Total Factor Productivity** & possibly negative aggregate effect because recipients tend to be large & low productivity
- **Cost per job of ~$6300** seems good value for money, especially since this seems to come from falls in unemployment

What happens when support is unexpectedly withdrawn: the "experiment"

- (Joint work with Mehtap Beyza Polat)
- We use an unexpected exogenous loss in eligibility for support to examine what happens when support is withdrawn or lost
  - After a 2 years consultation period the UK government proposed a first "map for support" to the European Commission:
    - first proposal submitted to the Commission by letter of 15 July 1999 (SG(99) A/9846) was withdrawn by letter of 10 April 2000 and proposed a new version of the map on 8 August 2000 base on 194 Job Opportunity Zones (65 were supported)
- We use both local unemployment data and business register data

PROBLEM WITH IV? CHANGING AREA CHARACTERISTICS?

- Changes in area's values of GDP, unemployment, etc. These could be endogenous, but:
  - Would bias treatment effects probably downwards (areas with worse trends more likely to get treated)
  - The eligibility decision based on historical data. For the 2000 change only data in 1998 and before was used. In 1993 only data in 1988 and before was used
- We show robustness to fixed effects*time trends
- Construct an alternative IV based solely on the rule changes and ignore any changes in (lagged) area characteristics

Extra Slides

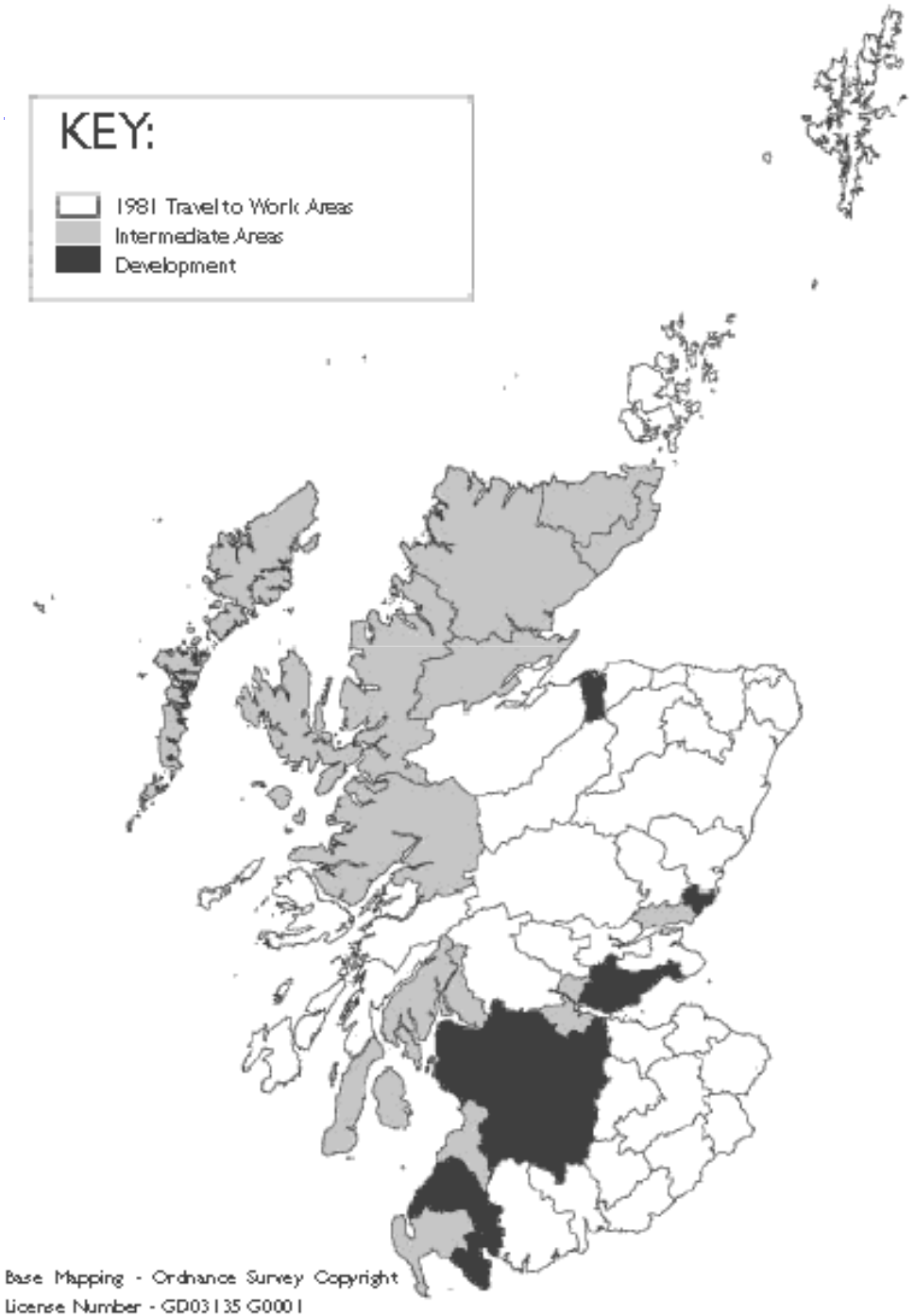
NEXT STEPS

- Longer run evaluation of the place-based policy (cf Kline and Moretti, 2012 on TVA)

- Why such a larger effect on small firms than large firms
  - Gaming
  - Financial constraints
  - Selection
  - Interaction with other parts of policy system

- Welfare & productivity

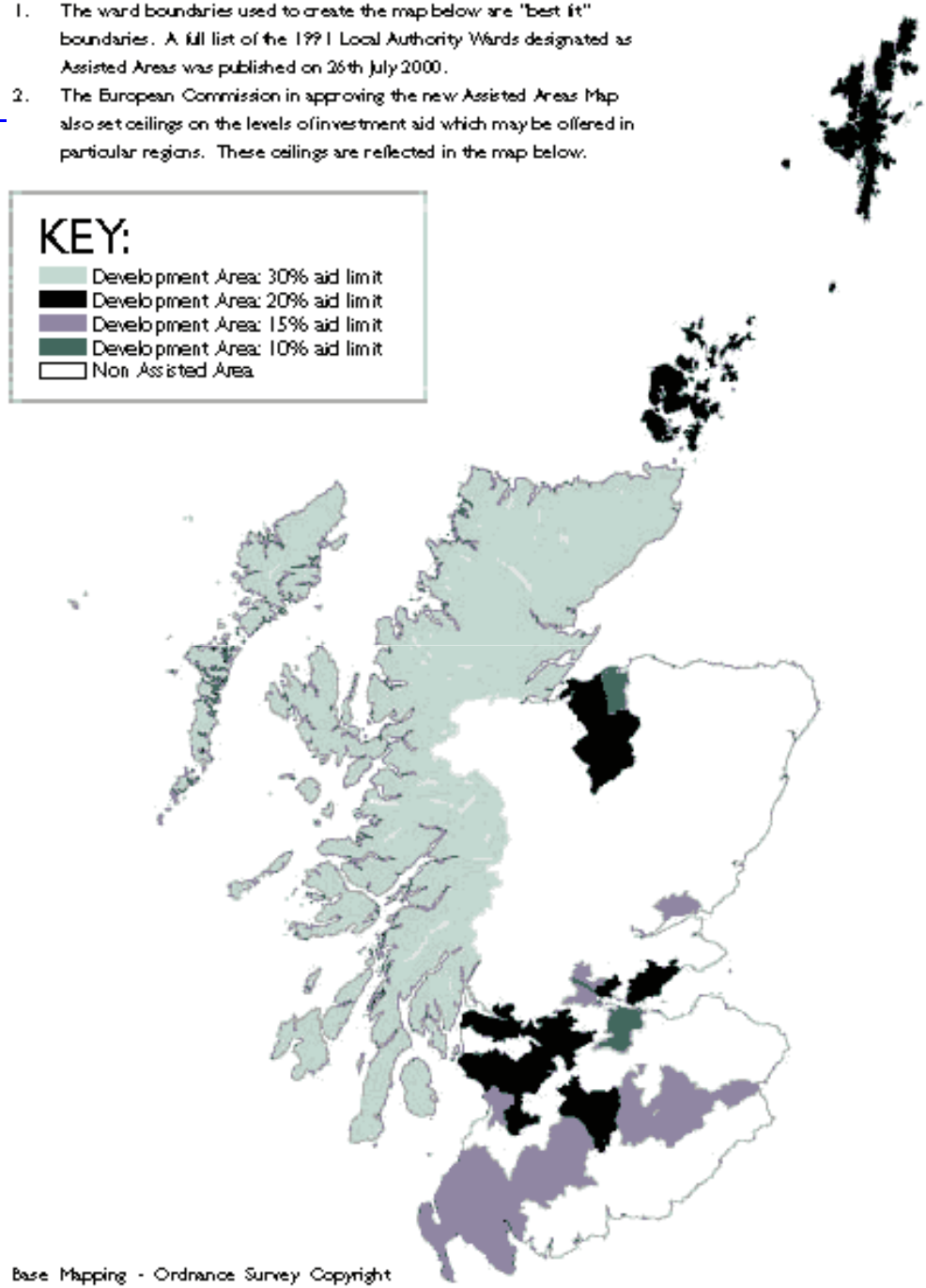
- Heterogeneity across industries and areas



Base Mapping - Ordnance Survey Copyright
License Number - GD03135 G0001

Notes:

1. The ward boundaries used to create the map below are "best fit" boundaries. A full list of the 1991 Local Authority Wards designated as Assisted Areas was published on 26th July 2000.
2. The European Commission in approving the new Assisted Areas Map also set ceilings on the levels of investment aid which may be offered in particular regions. These ceilings are reflected in the map below.



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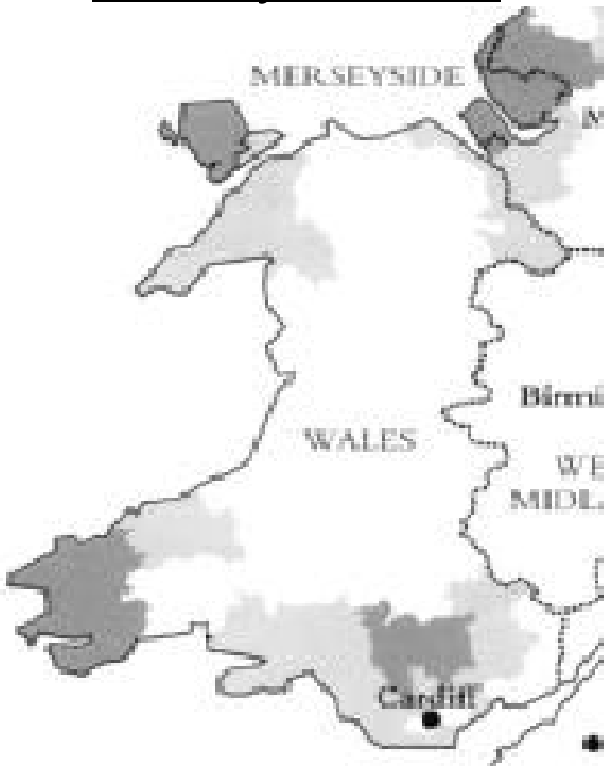
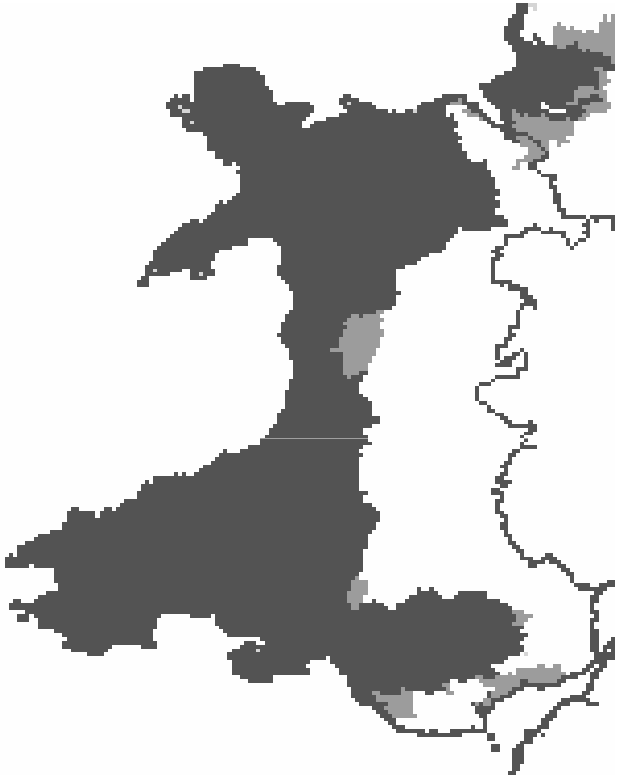
Assisted Areas Maps

prior to August 1st 1993

August 1st 1993 to January 1st 2000



after January 1st 2000



INTERMEDIATE AREA (20% NGE)

DEVELOPMENT AREA (30% NGE)

Article 87(3)(a) Tier 1

Article 87(3)(c) Tier 2

Tier 1=35% NGE; Tier 2=20% NGE

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The eligibility map changes

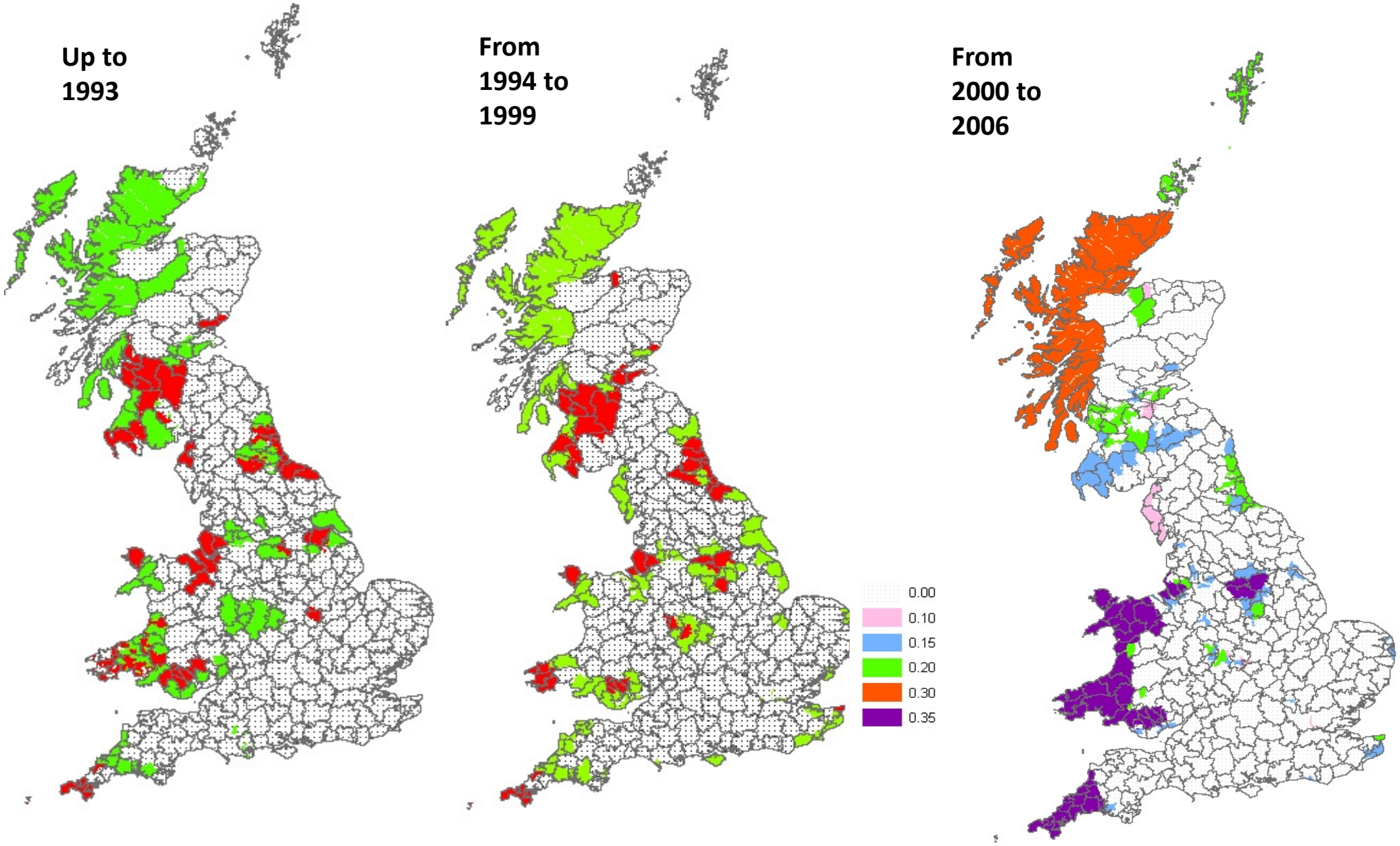

TABLE A2, A3: AREA CHARACTERISTICS, SELECTED YEARS

	NGE (Maximum Investment Subsidy)	% of all GB Wards that are in eligible areas	% manufacturing jobs in eligible areas	RSA spend (£m)	% Of all RSA applicants matched
1986	0.248	0.296	0.37	103.3	0.63
1995	0.241	0.320	0.38	221.7	0.80
2003	0.237	0.263	0.37	197.3	0.88
1986-04	***0.243***	***0.295***	***0.39***	***191.0***	***0.77***

TABLE 2: PLANT EMPLOYMENT REGRESSIONS

Method	OLS	Reduced Form	First Stage	IV
Dependent Variable:	**Ln(employment)**		**RSA**	**Ln(employ)**
Not including Plant Fixed effects (2,258,571 obs)				
RSA (Participant)	1.212***			3.016***
	(0.026)			(0.144)
NGE (investment subsidy)		1.088***	0.361***	
		(0.062)	(0.009)	
Including 353,626 Plant Fixed effects				
RSA (Participant)	0.108***			0.358***
	(0.008)			(0.135)
NGE (investment subsidy)		0.086***	0.240***	
		(0.033)	(0.018)	

Notes: Standard Errors clustered by 10,675 wards. All columns include a full set of time dummies and plant age.

TABLE 2: PLANT EMPLOYMENT REGRESSIONS

	(5)	(6)	(7)	(8)
	OLS	**Reduced Form**	**First Stage**	**IV**
Dependent Variable:	**Ln(employment)**		**RSA**	**Ln(employ)**
A. ALL Plants (2,258,571 obs; 353,626 plant Fixed Effects)				
RSA (Participant)	0.108***			0.358***
	(0.008)			(0.135)
NGE (investment subsidy)		0.086***	0.240***	
		(0.033)	(0.018)	

Notes: Standard Errors clustered by 10,675 wards. All columns include a full set of time dummies, age and plant fixed effects.

• Col (8) ATT implies RSA increases employment by 35.8 log points 43%, e.g. from median of 6 workers (in treatment group before receiving RSA) to 8.6 workers

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TABLE 3: ALTERNATIVE SIZE THRESHOLDS

Method	OLS	Reduced Form	First Stage	IV
A. Plants in firms with less than 100 employees (2,117,695 observations over 10,677 clusters (Wards))				
RSA (Participant)	0.121***			0.472***
	(0.009)			(0.145)
NGE (investment subsidy)		0.110***	0.233***	
		(0.034)	(0.018)	
B. Plants in firms with more than 100 employees (140,876 observations over 4,995 clusters (Wards))				
RSA (Participant)	0.127***			0.150
	(0.020)			(0.403)
NGE (investment subsidy)		0.050	0.315***	
		(0.128)	(0.058)	
C. Plants in firms with less than 50 employees (2,039,908 observations over 10,665 clusters (Wards))				
RSA (Participant)	0.129***			0.557***
	(0.009)			(0.149)
NGE (investment subsidy)		0.127***	0.229***	
		(0.034)	(0.018)	
D. Plants in firms with more than 50 employees (218,663 observations over 5,877clusters (Wards))				
RSA (Participant)	0.129***			0.090
	(0.016)			(0.298)
NGE (investment subsidy)		0.030	0.316***	
		(0.094)	(0.047)	

TABLE 4: FIRM-LEVEL EMPLOYMENT REGRESSIONS

Method	OLS	Reduced Form	First Stage	IV	OLS	Reduced Form	First Stage	IV
Sample	**Population of all firms (IDBR)**				**ARD Sub-Sample of IDBR**			
B. Firms with less than 150 employees								
RSA	0.133***			0.553***	0.156***			0.277*
	(0.008)			(0.150)	(0.015)			(0.165)
NGE		0.132***	0.238***			0.142*	0.515***	
		(0.036)	(0.018)			(0.085)	(0.067)	
Observations	2,131,047	2,131,047	2,131,047	2,131,047	87,748	87,748	87,748	87,748
C. Firms with 150 employees or more								
RSA	0.236***			-0.490	0.149***			-0.070
	(0.022)			(0.540)	(0.016)			(0.383)
NGE		-0.170	0.357***			-0.020	0.361***	
		(0.179)	(0.087)			(0.137)	(0.105)	
Observations	63,637	63,637	63,637	63,637	41,819	41,819	41,819	41,819

TABLE 3: ALTERNATIVE SIZE THRESHOLDS - CONT

E. Linear interactions with continuous size (2,258,571 observations over 10,675 clusters (Wards))

Method	OLS	Reduced Form	1st Stage: RSA	1st Stage: RSA*Size	IV
RSA (Participant)	0.167***				0.931***
	(0.009)				(0.168)
RSA * Size	0.002				-0.553*
	(0.005)				(0.132)
NGE (investment subsidy)		0.148***	0.229***	0.124***	
		(0.032)	(0.017)	(0.018)	
NGE*Size		-0.083***	-0.051***	0.245***	
		(0.025)	(0.009)	(0.033)	

TABLE 7: ROBUSTNESS (FIRM REDUCED FORM)

A. Baseline	All	Small Firms	Large Firms
NGE	0.098***	0.132***	-0.170
	(0.035)	(0.036)	(0.179)
B. Instruments only based on rule changes			
NGE	0.149***	0.152***	-0.113
	(0.056)	(0.056)	(0.319)
C. Common support sample (Propensity Score matching)			
NGE	0.292**	0.282**	0.090
	(0.121)	(0.143)	(0.177)
D. Controlling for EU Structural Funds			
NGE	0.111***	0.146***	-0.140
	(0.036)	(0.037)	(0.179)
EU Structural Funds	-0.010	-0.010	-0.040*
	(0.006)	(0.006)	(0.021)
E. Interactions with sectoral capital intensity			
NGE	0.051	0.045	-0.060
	(0.041)	(0.042)	(0.199)
NGE X Sectoral Capital Intensity	0.110*	0.204***	-0.210
	(0.059)	(0.058)	(0.291)