Understanding local police spending

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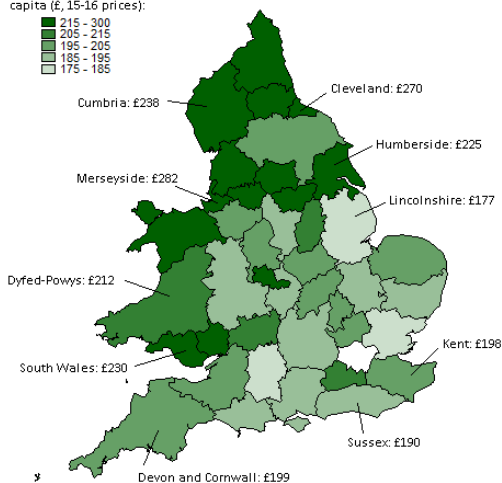Public Economics (PEUK) Conference, Pembroke College, Oxford, Sept 8th 2016

Institutional context

- There are 43 territorial police forces in England and Wales

  - Each with its own budget and responsibility for financing its services

- Forces obtain income from three main sources:

  1. General grants from central government departments (HO, DCLG)
  2. Specific grants
  3. An addition to local council tax - the police 'precept'

- General grant funding allocated between forces according to funding formula

  - Home Office (HO) based on relative needs
  - Dept of Communities & Local Government (DCLG) based on relative needs and local taxable capacity

- The precept level is set locally

  - To fund the difference between desired spending and grant income
  - Desired spending decided by Police Authorities (pre-2012), by PCCs (post-2012)

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- Total police spending per capita varies across the country:

Police spending per capita (£, 15-16 prices):
- 215 – 300
- 205 – 215
- 195 – 205
- 185 – 195
- 175 – 185

Cumbria: £238

Cleveland: £270

Humberside: £225

Merseyside: £282

Lincolnshire: £177

Dyfed-Powys: £212

Kent: £198

South Wales: £230

Sussex: £190

Devon and Cornwall: £199

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Key fact II

- There is also considerable variation in precept levels across the country:

Police precept per band D property (£, 15-16 prices):

- 210 – 240
- 180 – 210
- 150 – 180
- 120 – 150
- 90 – 120

Northumbria: £91

Cleveland: £204

Cumbria: £211

North Yorkshire: £222

Merseyside: £159

Humberside: £181

North Wales: £219

Lincolnshire: £195

Dyfed-Powys: £197

South Wales: £167

Kent: £151

Sussex: £150

Devon and Cornwall: £170

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This paper
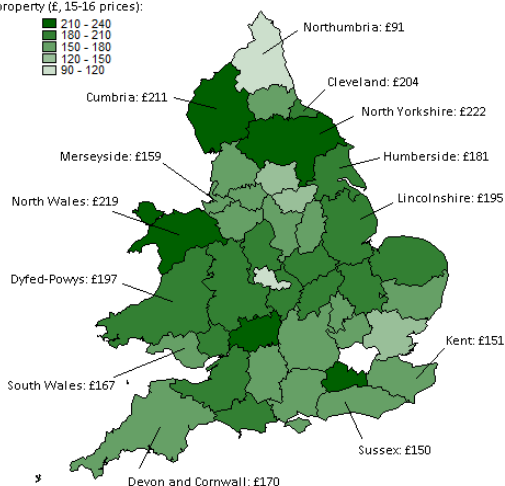
- **Aim is to explain the variation in precept levels (and/or spending levels) across forces and time**
- Potential explanations:
    1. Differences in needs?
    2. Differences in grants (conditional on needs)?
    3. Differences in local demand for police spending (e.g. due to income differences, different taxable capacity, different preferences)?
    4. Other political economy or efficiency reasons?
    5. Different explanations have different policy implications

- Academic context
    1. Demand for local public spending (e.g. Preston and Ridge, 1995)
    2. The 'fiscal federalism' issue (e.g. Musgrave, 1959; Oates 1999)
    3. (But police forces in UK centrally funded from 1850s until precept introduced in 1995-96)

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Policy context

Recent reforms to police funding arrangements:

1. Elected Police and Crime Commissioners (PCCs) replaced police authorities in 2012 to increase local accountability
2. Funding formulae suspended in 2012-13
   - Since 2013-14 police forces have been given the same % cuts to their grants
   - Implies a greater spending power reduction for those who are relatively more reliant on grants (as opposed to precept revenues)
3. Home Office had planned to reform the grant allocation formula in 2015.
4. Spending Review 2015 announced "greater flexibility [for PCCs] in their local funding decisions by rewarding those areas which have historically kept council tax low" (?)

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- Background and institutional detail
- Theoretical model
- Empirical estimation and data
- Results
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Composition of police revenues over time
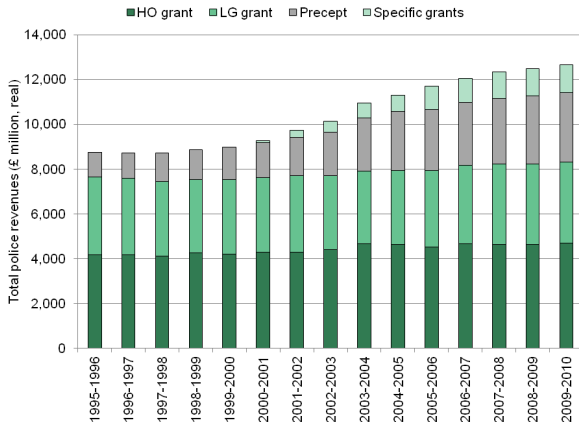
- 1995-96: Precept = 13% of revenues
- 1995-96 to 2009-10: Grants grew 25%, Precept grew 181%
- 2009-10: Precept = 25% of revenues

- Home Office grant component allocated on the basis of 'relative needs'
  - *HOgrant = (population * need factors * area cost) * policegrantrate*
  - 'Police grant rate' ~50% (declined slightly over time)
  - Need factors: % renters, % LT unemployed, population density, etc

- DLCG grant component allocated on the basis of 'relative needs' and resource equalisation
  - 1995-96 to 2002-03: Standard Spending Assessment (SSA)
  - 2003-04 to 2005-06: Formula Funding Share (FFS)

 $DCLGgrant = (needs) * (1 - policegrantrate) - (assumedcounciltax * taxbase)$

  - 2006-07 onwards: Four block model (4BM)
    Formula is complicated! But essentially still depends on needs, resource equalisation and damping (smoothing % changes)

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Precept revenues

- Police force budget (and therefore precept revenue/rate) set by Police Authorities until 2012, Police and Crime Commissioners since 2012

  - PA was a body with 17 members: 9 from LA, 8 independent (3+ magistrates)

- Some constraints imposed by central government

  - 1995-6 to 1998-99: Universal Capping
    Authorities told in advance what precept increase they would be allowed (and most just set at that level?)
  - 1999-00 to 2010-11: Selective Capping
    Authorities told that excessive increases would be capped. No force warned until 2004-05.
  - 2011-12 onwards: Freeze grants
    Various grant incentives from central government to freeze council tax rates.

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Distribution of precept level over time

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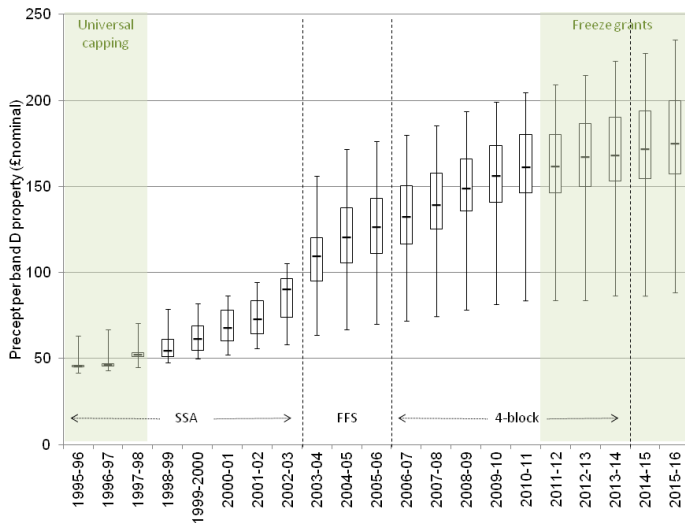
Distribution of change in precept level over time
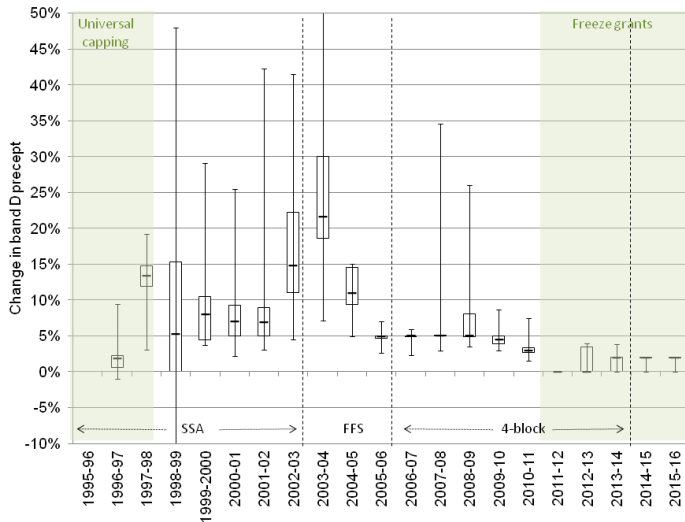
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Theoretical model

- Set out a simple theoretical model to illustrate:
  - the factors that one would expect to play a role in determining local police funding
  - the channels through which these factors would be expected to operate

- Components of the model:
  - Production function of public safety
  - Grant allocation formulae
  - Individual demand for public safety
  - Public choice mechanism

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Production of public safety

$$H_F = h(Z_F/Pz_F, d_F)$$

- Z_F is per capita police spending
- Pz_F is the price of police services
- d_F is local 'need' for policing - i.e. local characteristics that affect the level of public safety achieved from a given police service level

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Grant allocation

$$G_F = g(\bar{d}_F, tb_F, \delta_F)$$

- $\bar{d}_F$ are indicators of local 'need' that appear in the grant allocation formula (imperfect overlap with d_F?)
- tb_F is the taxbase (i.e. local revenue raising capacity)
- δ_F allows for the possibility of persistent deviations from the published needs-based formula

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Theoretical model

Individuals' demand

- Individuals derive utility from public safety and other consumption

$$U_i = u(H_i, C_i)$$

  - Assume all individuals in an area enjoy the same safety $H_i = H_F$

- Individuals' income must cover their private consumption and their contribution to the funding of police services

$$Y_i = C_i + \pi_i(Z_F P z_F - G_F)$$

- Individuals therefore face the maximisation problem:

$$\max_{Z_F} U(H_F, C_i) \text{ s.t. } Y_i = C_i + \pi_i(P z_F Z_F - G_F)$$

$$H_F = h(Z_F, d_F)$$

$$G_F = g(\bar{d}_F, tb_F, \delta_F)$$

- Implies individuals' demand for police services

$$Z_i^* = f(Y_i, P z_F, \pi_i, d_F, g(\bar{d}_F, tb_F, \delta_F))$$

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Theoretical model

Public choice mechanism

- To get from individual preferences to public choice over public spending we need to consider (Borcherding and Deacon, 1972):

    1. Mechanism for aggregating individual preferences
    2. Preferences of the police authority
    3. Costs to the police authority

- Assume that police authority sets spending with reference to the optimal demand of the median voter $Z_{m,F}^*$

- Also allow for ideology of the police authority I_F and the efficiency of the police authority E_F to matter

- Then local demand for police services per capita given by:

$$Z_F = f(Z_{m,F}^*, I_F, E_F)$$

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Empirical estimation

- Theoretical model suggests individual demand for police services:

$$Z_i^* = f(Y_i, Pz_F, \pi_i, d_F, g(\bar{d}_F, tb_F, \delta_F))$$

  or for precept:

$$T_i^* = f(Y_i, Pz_F, \pi_i, d_F, g(\bar{d}_F, tb_F, \delta_F))Pz_F - G_F$$

- Empirical estimation requires functional form assumptions...

- We could choose functional forms for $u(H_F, C_i)$, $h(Z_F, d_F)$, and $g(\bar{d}_F, tb_F, \delta_F)$ and solve for the demand function?
    - G_F is plausibly linear in known arguments
    - Assume form for $U()$ and $H()$ and estimate simultaneously?
        - Yields estimates of price/income elasticities of demand for public safety
        - But does it actually help us explain variation in T_F?

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Empirical estimation

- Conduct reduced form estimation of linear relationship:

$$Precept_F = \alpha + \beta_0 t + \beta_1 Y_m + \beta_2 \pi_m + \beta_3 G_F + \gamma' d_F + \lambda' I_F + \theta' E_F + \varepsilon$$

(Note: equivalent to estimating $Spending_F = \alpha + ... + (\beta_3 + 1)G_F + ... + \varepsilon$ since precept = spending - grant)

- – Reduced form so cannot interpret structural parameters of utility function or production function
- + Can examine which factors are correlated with local revenue raising
- + Can infer mechanisms though excludability assumptions?

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Data

- Focus on the period 2000-01 to 2010-11 (inclusive) when 'free' choice on changes to precept levels
- Use 41 forces (exclude London forces) so 451 observations
- Data drawn from many different sources (often aggregated from LA level)
  - Revenue (precept/grant) from CIPFA
  - 'Median income' from (currently) ASHE
  - Taxable capacity from CIPFA/VOA
  - 'Needs' from Census, APS/LFS, ABS, DWP, DfT
  - 'Ideology' from www.electionscentre.co.uk

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Other included variables

- "Preference" factors

    - % LA seats held by Labour
    - % LA seats held by Conservatives
    - Wales indicator
    - % population aged 65+
    - Net internal immigration

- Efficiency indicators

    - Number of billing authorities
    - Election turnout rate
    - % staff who are uniformed staff (PO and PCSO)
    - Workforce exit rate

- Needs not included in the grant allocation formula

    - Mean formula grant of neighbouring authority
    - % population black and ethnic minorities (in 2001)

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Descriptive statistics

VARIABLES	mean	sd	min	p25	p50	p75	max
G (general) £pc	139.9	29.39	93.20	119.3	129.3	158.6	239.7
G (special) £pc	15.47	8.916	0	9.331	14.85	20.42	61.69
Precept £pc	51.50	15.65	21.77	39.52	51.30	61.53	96.12
Y_j £000s	16.93	2.280	13.01	15.23	16.31	18.30	26.06
π_j	1.209	0.0692	1.016	1.150	1.217	1.259	1.342
Pay index	102.5	0.830	100	102.5	102.8	102.9	103.0
Area cost adj.	1.020	0.0350	1	1	1	1.026	1.159
% LA seats Labour	29.34	17.81	0.871	14.44	25.36	42.91	76.96
% LA seats Conservative	38.01	18.08	0.402	25.93	41.00	51.87	72.14
% pop. aged 65+	17.00	1.919	13.21	15.79	16.70	18.04	22.34
Wales	0.0976	0.297	0	0	0	0	1
Net internal immig.	0.199	0.331	-0.685	-0.0441	0.210	0.405	1.372
Num. billing authorities	8.237	3.509	2	5	7	10	17
Election turnout rate	34.80	4.077	22.92	31.93	34.92	37.70	45.82
Workforce exit rate	5.535	1.299	1.805	4.651	5.349	6.265	12.73
Support staff ratio	0.524	0.0910	0.128	0.458	0.523	0.583	0.865
Mean(G) of neighbours	145.0	17.91	115.1	130.6	139.6	157.1	192.0
% pop. BME	5.853	5.049	0.699	2.654	4.301	6.900	28.89
Population density	418.7	404.4	34	211.9	271.9	478.4	2,300
Log(bar density)	-1.005	0.736	-2.625	-1.517	-0.985	-0.658	0.870
% pop. NSSEC 6,7,8	25.16	3.430	15.15	23.06	26.01	27.59	30.69
% households renting	26.50	3.677	20.45	24.08	25.21	27.78	38.00
% households student occupied	0.338	0.208	0.0235	0.215	0.297	0.402	0.919
% households overcrowded	4.956	1.062	3.369	4.022	4.965	5.499	7.364
% households terraced	25.26	5.858	15.16	20.85	24.88	29.52	38.88
% lone parent households	6.105	1.189	4.002	5.117	5.798	6.952	9.669
lag_IS	8.061	2.299	3.602	6.460	7.413	9.676	15.46
lag_unemp	1.498	0.629	0.439	1.039	1.343	1.778	4.142
Km of motorways	75.14	58.76	0	29.20	68.20	108.3	231.2
Km of urban roads	344.3	162.5	90.70	226.2	308	473.8	752.7

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Outline

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Explaining grant revenues ($G = \alpha + \beta' \bar{d}_F + \varepsilon$)

VARIABLES	HO grant pc		LG grant pc	
	β	se	β	se
Taxbase pc	29.158	22.089	-91.107***	19.255
% hh renting	1.392***	0.154	1.489***	0.134
% hh overcrowded	4.708***	1.135	-1.983**	0.990
% pop students	-0.900	1.810	0.816	1.578
% hh terraced	0.357***	0.090	0.585***	0.078
% pop lone parents	3.176***	0.913	-0.375	0.796
% pop nssec678	0.418*	0.249	-0.296	0.217
lag % pop on IS-type benefits	1.870***	0.643	3.196***	0.560
lag % pop unemployed	-4.003**	1.711	-3.599**	1.491
lag % JSA youngmale	-88.408***	23.551	24.079	20.529
lag % JSA LT	33.449**	13.172	39.642***	11.482
Population density	0.006***	0.002	0.003**	0.001
Paid staff in 1995	-0.001***	0.001	-0.000	0.000
Km motorways	0.040***	0.009	0.033***	0.008
Km urbanroads	0.006	0.004	-0.003	0.004
Constant	-4.896	12.964	23.226**	11.300
Observations	451		451	
R-squared	0.805		0.908	

*** p<0.01, ** p<0.05, * p<0.1

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Explaining precept revenues ($P_F = \alpha + t + \beta_1 Y_{m,F} + \beta_2 \pi_{m,F} + \gamma' G_F + \varphi d_F + \varepsilon$):

VARIABLES	(1)Demand		(2)+Preferences	
	β	se	β	se
Y_i £000s	2.369	1.002**	3.182	0.805***
π_i	-40.704	18.816**	-42.377	16.488**
G (general) £pc	-0.211	0.044***	-0.146	0.053***
G (special) £pc	0.658	0.107***	0.383	0.066***
Pay index	4.211	0.681***	4.458	0.544***
Area cost adj.	-73.891	54.993	-121.519	47.494**
% LA seats Labour			-0.135	0.076*
% LA seats Conservative			0.072	0.098
% pop. aged 65+			0.760	0.840
Wales			16.793	2.878***
Net internal immig.			-10.534	3.264***
Constant	-276.181	80.674***	-280.773	76.207***
R^2	0.65		0.75	
F	61.09		58.62	

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

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Results - precept

- Reasonable proportion of variation in spending explained by demand factors
  - Income positively associated with precept revenues (consistent with public safety being a normal good).
  - At the mean this implies an average private income elasticity of around 0.25 (but with our linear specification this doesn't imply constant income elasticity of demand.)
  - Higher tax price of policing associated with a lower precept
  - Overall grants are negatively associated with precept (80p increase in spend for a £1 increase in grant) - suggests crowd out of private spending

- Preference factors explain another 10% of the variation
  - No significant association of spending with included political and age-related preference factors
  - Spending per capita significantly higher in Wales - could be institutional or preference differences
  - One standard deviation higher net immigration rate associated with £3pc. lower precept revenues

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Results - precept

Explaining precept revenues ($P_F = \alpha + t + \beta_1 Y_{m,F} + \beta_2 \pi_{m,F} + \gamma' G_F + \varphi d_F + \varepsilon$):

VARIABLES	(3)+Efficiency		(4)+NF needs	
	β	se	β	se
Y_i £000s	2.785	0.742***	2.307	0.636***
π_i	-28.940	16.510*	-27.622	14.447*
G (general) £pc	-0.137	0.050***	-0.123	0.049**
G (special) £pc	0.346	0.068***	0.338	0.070***
Pay index	3.667	0.536***	3.380	0.589***
Area cost adj.	-74.465	47.239	-44.093	40.062
% LA seats Labour	-0.123	0.075	-0.173	0.075**
% LA seats Conservative	0.041	0.091	0.136	0.092
% pop. aged 65+	1.104	0.700	0.785	0.710
Wales	13.159	3.240***	15.244	3.651***
Net internal immig.	-9.566	2.820***	-9.390	2.914***
Num. billing authorities	-0.678	0.239***	-0.736	0.250***
Election turnout rate	0.406	0.155**	0.371	0.168**
Workforce exit rate	-1.141	0.390***	-0.957	0.365**
Support staff ratio	22.738	17.527	16.642	18.110
Mean(G) of neighbours			0.103	0.054*
% pop. BME			-0.284	0.260
Constant	-276.888	72.946***	-280.150	73.638***
R^2	0.79		0.80	
F	44.39		40.51	

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

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Results - precept

- None of our efficiency factors are related in the direction implied by inefficiency or lack of accountability
- Difficult to identify the impact of need on police spending
    - Formula grant of neighbouring police forces (potentially capturing spill-overs) has weak positive correlation with precept
    - Proportion of local population BME insignificant.
    - Limited available measures of 'need' not included in the grant allocation formula.

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- Preferences (income and tax price) and grants explain a large proportion of the variation in precept revenues per capita across forces

  - Income is positively associated with precept revenues
  - Tax price is negatively associated
  - Grants are negatively associated (crowd out private spending) but less than 1:1

- Found little evidence so far of much role for efficiency of local police force, political factors or needs not captured by the funding formula.

  - Though including these variables does explain some additional variation in precept revenues across forces
  - Could be that our measures of these factors could be improved?

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Next steps

- Can/should we do any better than linear reduced form analysis?

- Are there any better indicators of efficiency/politics/needs that we could explore?

    - Needs

        - Divorce rates (proxy for domestic abuse)?
        - Internet prevalence (proxy for cyber crime)?
        - Mental health needs? (Differential) cutbacks in social services increase demands on police time?

    - Political factors?
    - Efficiency?

- Any other thoughts are welcome!

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$$\Delta P_F = \alpha + t + \beta_1 Y_{m,F} + \beta_2 \pi_{m,F} + \gamma' \Delta G_F + \varphi \bar{d}_F + \delta E_F + \lambda I_F + \vartheta d_F + \varepsilon :$$

VARIABLES	(1)	(2)	(3)	(4)
t	-0.741***	-0.830***	-0.545***	-0.476***
Y_i (£000s)	0.056	0.089	-0.100	0.056
π_i	-1.926*	-1.505	-1.009	-1.103
% staff that officers		0.001		0.011
Medical retirement rate		-0.261		-0.233
Num. billing authorities		-0.046		0.037
% LA seats Labour		-0.042**		-0.031
% LA seats Conservative		-0.012		-0.066**
Wales		0.260		-0.035
% pop 65+		-0.096		0.411
Transfer rate		-0.360		-0.312
% pop black minority ethnic		-0.061	-0.144	0.041
Constant	10.643***	13.685**	11.019	2.384
Observations	369	369	369	369
R-squared	0.268	0.286	0.297	0.311
Needs	NO	NO	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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