Understanding local police spending

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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)
Key fact 1

- Total police spending per capita varies across the country:

Police spending per capita (£, 2015-16 prices):
- 215 - 300
- 205 - 215
- 195 - 205
- 185 - 195
- 175 - 185

- Cumbria: £238
- Cleveland: £270
- Merseyside: £282
- Humberside: £225
- Lincolnshire: £177
- Dyfed-Powys: £212
- South Wales: £230
- Kent: £198
- Sussex: £190
- Devon and Cornwall: £199
There is also considerable variation in precept levels across the country:
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)
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" (?)
Outline

- Introduction
- Background and institutional detail
- Theoretical model
- Empirical estimation and data
- Results
- Summary
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
Allocation of grant revenues

- Home Office grant component allocated on the basis of 'relative needs'
  - \[ HO_{\text{grant}} = (\text{population} \ast \text{need factors} \ast \text{area cost}) \ast \text{policegrant rate} \]
  - ‘Police grant rate’ \( \sim 50\% \) (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)

\[ DCLG_{\text{grant}} = (\text{needs}) \ast (1 - \text{policegrant rate}) - (\text{assumedcounciltax} \ast \text{taxbase}) \]

- 2006-07 onwards: Four block model (4BM)
  - *Formula is complicated! But essentially still depends on needs, resource equalisation and damping (smoothing % changes)*
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
    *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.*
Distribution of precept level over time

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Distribution of change in precept level over time

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• 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
Theoretical model

Production of public safety

\[ H_F = h \left( \frac{Z_F}{P_{Z_F}}, d_F \right) \]

- \( Z_F \) is per capita police spending
- \( P_{Z_F} \) 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
Theoretical model

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)
- \( \delta_F \) allows for the possibility of persistent deviations from the published needs-based formula
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
  \[ Y_i = C_i + \pi_i(Z_F P_{ZF} - G_F) \]

- Individuals therefore face the maximisation problem:
  \[
  \max_{Z_F} U(H_F, C_i) \quad \text{s.t.} \quad Y_i = C_i + \pi_i(Z_F P_{ZF} - G_F) \\
  H_F = h(Z_F, d_F) \\
  G_F = g(\bar{d}_F, t_{bF}, \delta_F)
  \]

- Implies individuals’ demand for police services
  \[ Z_i^* = f(Y_i, P_{ZF}, \pi_i, d_F, g(\bar{d}_F, t_{bF}, \delta_F)) \]
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 \( T_F \)?
• Conduct reduced form estimation of linear relationship:

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

(Note: equivalent to estimating \( Spending_F = \alpha + \ldots + (\beta_3 + 1) G_F + \ldots + \varepsilon \) 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?
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
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)
## Descriptive statistics

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>mean</th>
<th>sd</th>
<th>min</th>
<th>p25</th>
<th>p50</th>
<th>p75</th>
<th>max</th>
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<tr>
<td>G (general) £pc</td>
<td>139.9</td>
<td>29.39</td>
<td>93.20</td>
<td>119.3</td>
<td>129.3</td>
<td>158.6</td>
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<td>G (special) £pc</td>
<td>15.47</td>
<td>8.916</td>
<td>0</td>
<td>9.331</td>
<td>14.85</td>
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<td>Precept £pc</td>
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<td>15.65</td>
<td>21.77</td>
<td>39.52</td>
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<td>$Y_i$ £000s</td>
<td>16.93</td>
<td>2.280</td>
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<td>15.23</td>
<td>16.31</td>
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<td>$\pi_i$</td>
<td>1.209</td>
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<td>1.150</td>
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<td>1.026</td>
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<td>% LA seats Labour</td>
<td>29.34</td>
<td>17.81</td>
<td>0.871</td>
<td>14.44</td>
<td>25.36</td>
<td>42.91</td>
<td>76.96</td>
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<td>% LA seats Conservative</td>
<td>38.01</td>
<td>18.08</td>
<td>0.402</td>
<td>25.93</td>
<td>41.00</td>
<td>51.87</td>
<td>72.14</td>
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<td>% pop. aged 65+</td>
<td>17.00</td>
<td>1.919</td>
<td>13.21</td>
<td>15.79</td>
<td>16.70</td>
<td>18.04</td>
<td>22.34</td>
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<td>Wales</td>
<td>0.0976</td>
<td>0.297</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>Net internal immig.</td>
<td>0.199</td>
<td>0.331</td>
<td>-0.685</td>
<td>-0.0441</td>
<td>0.210</td>
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<td>Num. billing authorities</td>
<td>8.237</td>
<td>3.509</td>
<td>2</td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>17</td>
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<td>Election turnout rate</td>
<td>34.80</td>
<td>4.077</td>
<td>22.92</td>
<td>31.93</td>
<td>34.92</td>
<td>37.70</td>
<td>45.82</td>
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<td>Workforce exit rate</td>
<td>5.535</td>
<td>1.299</td>
<td>1.805</td>
<td>4.651</td>
<td>5.349</td>
<td>6.265</td>
<td>12.73</td>
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<td>Support staff ratio</td>
<td>0.524</td>
<td>0.0910</td>
<td>0.128</td>
<td>0.458</td>
<td>0.523</td>
<td>0.583</td>
<td>0.865</td>
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<td>Mean(G) of neighbours</td>
<td>145.0</td>
<td>17.91</td>
<td>115.1</td>
<td>130.6</td>
<td>139.6</td>
<td>157.1</td>
<td>192.0</td>
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<td>% pop. BME</td>
<td>5.853</td>
<td>5.049</td>
<td>0.699</td>
<td>2.654</td>
<td>4.301</td>
<td>6.900</td>
<td>28.89</td>
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<td>Population density</td>
<td>418.7</td>
<td>404.4</td>
<td>34</td>
<td>211.9</td>
<td>271.9</td>
<td>478.4</td>
<td>2,300</td>
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<td>Log(bar density)</td>
<td>-1.005</td>
<td>0.736</td>
<td>-2.625</td>
<td>-1.517</td>
<td>-0.985</td>
<td>-0.658</td>
<td>0.870</td>
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<td>% pop. NSSEC 6,7,8</td>
<td>25.16</td>
<td>3.430</td>
<td>15.15</td>
<td>23.06</td>
<td>26.01</td>
<td>27.59</td>
<td>30.69</td>
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<tr>
<td>% households renting</td>
<td>26.50</td>
<td>3.677</td>
<td>20.45</td>
<td>24.08</td>
<td>25.21</td>
<td>27.78</td>
<td>38.00</td>
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<td>% households student occupied</td>
<td>0.338</td>
<td>0.208</td>
<td>0.0235</td>
<td>0.215</td>
<td>0.297</td>
<td>0.402</td>
<td>0.919</td>
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<td>% households overcrowded</td>
<td>4.956</td>
<td>1.062</td>
<td>3.369</td>
<td>4.022</td>
<td>4.965</td>
<td>5.499</td>
<td>7.364</td>
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<td>% households terraced</td>
<td>25.26</td>
<td>5.858</td>
<td>15.16</td>
<td>20.85</td>
<td>24.88</td>
<td>29.52</td>
<td>38.88</td>
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<td>lag.IS</td>
<td>8.061</td>
<td>2.299</td>
<td>3.602</td>
<td>6.460</td>
<td>7.413</td>
<td>9.676</td>
<td>15.46</td>
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<td>lag.unemp</td>
<td>1.498</td>
<td>0.629</td>
<td>0.439</td>
<td>1.039</td>
<td>1.343</td>
<td>1.778</td>
<td>4.142</td>
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<td>Km of motorways</td>
<td>75.14</td>
<td>58.76</td>
<td>0</td>
<td>29.20</td>
<td>68.20</td>
<td>108.3</td>
<td>231.2</td>
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<td>Km of urban roads</td>
<td>344.3</td>
<td>162.5</td>
<td>90.70</td>
<td>226.2</td>
<td>308</td>
<td>473.8</td>
<td>752.7</td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>HO grant pc</th>
<th></th>
<th></th>
<th>LG grant pc</th>
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<tr>
<td></td>
<td>( \beta )</td>
<td>se</td>
<td>( \beta )</td>
<td>se</td>
<td></td>
</tr>
<tr>
<td>Taxbase pc</td>
<td>29.158</td>
<td>22.089</td>
<td>-91.107***</td>
<td>19.255</td>
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<td>% hh renting</td>
<td>1.392***</td>
<td>0.154</td>
<td>1.489***</td>
<td>0.134</td>
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<tr>
<td>% hh overcrowded</td>
<td>4.708***</td>
<td>1.135</td>
<td>-1.983**</td>
<td>0.990</td>
<td></td>
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<tr>
<td>% pop students</td>
<td>-0.900</td>
<td>1.810</td>
<td>0.816</td>
<td>1.578</td>
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<tr>
<td>% hh terraced</td>
<td>0.357***</td>
<td>0.090</td>
<td>0.585***</td>
<td>0.078</td>
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<td>% pop lone parents</td>
<td>3.176***</td>
<td>0.913</td>
<td>-0.375</td>
<td>0.796</td>
<td></td>
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<td>% pop nssec678</td>
<td>0.418*</td>
<td>0.249</td>
<td>-0.296</td>
<td>0.217</td>
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<td>lag % pop on IS-type benefits</td>
<td>1.870***</td>
<td>0.643</td>
<td>3.196***</td>
<td>0.560</td>
<td></td>
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<tr>
<td>lag % pop unemployed</td>
<td>-4.003**</td>
<td>1.711</td>
<td>-3.599**</td>
<td>1.491</td>
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<td>lag % JSA youngmale</td>
<td>-88.408***</td>
<td>23.551</td>
<td>24.079</td>
<td>20.529</td>
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<td>lag % JSA LT</td>
<td>33.449**</td>
<td>13.172</td>
<td>39.642***</td>
<td>11.482</td>
<td></td>
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<tr>
<td>Population density</td>
<td>0.006***</td>
<td>0.002</td>
<td>0.003**</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Paid staff in 1995</td>
<td>-0.001***</td>
<td>0.001</td>
<td>-0.000</td>
<td>0.000</td>
<td></td>
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<tr>
<td>Km motorways</td>
<td>0.040***</td>
<td>0.009</td>
<td>0.033***</td>
<td>0.008</td>
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<td>Km urbanroads</td>
<td>0.006</td>
<td>0.004</td>
<td>-0.003</td>
<td>0.004</td>
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<tr>
<td>Constant</td>
<td>-4.896</td>
<td>12.964</td>
<td>23.226**</td>
<td>11.300</td>
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<td>Observations</td>
<td>451</td>
<td></td>
<td>451</td>
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<tr>
<td>R-squared</td>
<td>0.805</td>
<td></td>
<td>0.908</td>
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*** p<0.01, ** p<0.05, * p<0.1
Explaining precept revenues \( P_F = \alpha + t + \beta_1 Y_{m,F} + \beta_2 \pi_{m,F} + \gamma' G_F + \varphi d_F + \varepsilon \):
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
Explaining precept revenues \( P_F = \alpha + t + \beta_1 Y_{m,F} + \beta_2 \pi_{m,F} + \gamma' G_F + \varphi d_F + \varepsilon \):

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(3)+Efficiency</th>
<th>(4)+NF needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Y_i ) £000s</td>
<td>2.785</td>
<td>2.307</td>
</tr>
<tr>
<td>( \pi_i )</td>
<td>-28.940</td>
<td>-27.622</td>
</tr>
<tr>
<td>G (general) £pc</td>
<td>-0.137</td>
<td>-0.123</td>
</tr>
<tr>
<td>G (special) £pc</td>
<td>0.346</td>
<td>0.338</td>
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<tr>
<td>Pay index</td>
<td>3.667</td>
<td>3.380</td>
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<td>Area cost adj.</td>
<td>-74.465</td>
<td>-44.093</td>
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<td>% LA seats Labour</td>
<td>-0.123</td>
<td>-0.173</td>
</tr>
<tr>
<td>% LA seats Conservative</td>
<td>0.041</td>
<td>0.136</td>
</tr>
<tr>
<td>% pop. aged 65+</td>
<td>1.104</td>
<td>0.785</td>
</tr>
<tr>
<td>Wales</td>
<td>13.159</td>
<td>15.244</td>
</tr>
<tr>
<td>Net internal immig.</td>
<td>-9.566</td>
<td>-9.390</td>
</tr>
<tr>
<td>Num. billing authorities</td>
<td>-0.678</td>
<td>-0.736</td>
</tr>
<tr>
<td>Election turnout rate</td>
<td>0.406</td>
<td>0.371</td>
</tr>
<tr>
<td>Workforce exit rate</td>
<td>-1.141</td>
<td>-0.957</td>
</tr>
<tr>
<td>Support staff ratio</td>
<td>22.738</td>
<td>16.642</td>
</tr>
<tr>
<td>Mean(G) of neighbours</td>
<td>0.103</td>
<td>0.168</td>
</tr>
<tr>
<td>% pop. BME</td>
<td>-0.284</td>
<td>0.054</td>
</tr>
<tr>
<td>Constant</td>
<td>-276.888</td>
<td>-280.150</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.79</td>
<td>0.80</td>
</tr>
<tr>
<td>F</td>
<td>44.39</td>
<td>40.51</td>
</tr>
</tbody>
</table>

\* \( p < 0.1 \); \** \( p < 0.05 \); \*** \( p < 0.01 \)
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.
Summary so far

- 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?
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!
Extra results - change in precept

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

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td>-0.741***</td>
<td>-0.830***</td>
<td>-0.545***</td>
<td>-0.476***</td>
</tr>
<tr>
<td>(Y_i ) (\pounds 000s)</td>
<td>0.056</td>
<td>0.089</td>
<td>-0.100</td>
<td>0.056</td>
</tr>
<tr>
<td>(\pi_i)</td>
<td>-1.926*</td>
<td>-1.505</td>
<td>-1.009</td>
<td>-1.103</td>
</tr>
<tr>
<td>% staff that officers</td>
<td>0.001</td>
<td>0.011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical retirement rate</td>
<td>-0.261</td>
<td></td>
<td>-0.233</td>
<td></td>
</tr>
<tr>
<td>Num. billing authorities</td>
<td>-0.046</td>
<td></td>
<td>0.037</td>
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</tr>
<tr>
<td>% LA seats Labour</td>
<td>-0.042**</td>
<td></td>
<td>-0.031</td>
<td></td>
</tr>
<tr>
<td>% LA seats Conservative</td>
<td>-0.012</td>
<td>-0.066**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wales</td>
<td>0.260</td>
<td></td>
<td>-0.035</td>
<td></td>
</tr>
<tr>
<td>% pop 65+</td>
<td>-0.096</td>
<td></td>
<td>0.411</td>
<td></td>
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<tr>
<td>Transfer rate</td>
<td>-0.360</td>
<td></td>
<td>-0.312</td>
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<tr>
<td>% pop black minority ethnic</td>
<td>-0.061</td>
<td>-0.144</td>
<td>0.041</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>10.643***</td>
<td>13.685**</td>
<td>11.019</td>
<td>2.384</td>
</tr>
</tbody>
</table>

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

Crawford, Disney and Simpson (IFS) Understanding local police spending PEUK September 2016