Historical Analysis of Survey Data and Survey Results: The Incredible Possibilities Afforded by Longitudinal Multilevel Analysis Using Time at a Higher Level

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Presented at the 6th ESRA Conference, July 13-17, Reykjavik, Iceland

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Outline

• The idea, the problem and the solution
• Example 1: Combining survey results: 2-level models: Evolution of support for sovereignty
  • Impact of methods, question wording and events
• Example 2: Combining survey results: 2-level model: Evolution of voting intention for Obama and Romney in 2012
  • Impact of methods
• Example 3: Combining survey data files: 3-level model
  • Evolution of trust in Canada
    • Impact of object of trust, sexe&age, question wording and time.
• Conclusion & future path
The idea, the problem & the solution

• We have access to huge quantities of data on similar topics from different sources.
• We would like to be able to use the full potential of all these data
  • To trace change over time of different attitudes and behaviors
  • To assess whether change over time is the same in different regions & contexts or for different age groups, etc.
• But we are hindered by the fact that
  • Measures of similar concepts are not always the same
  • The surveys that we use may have different methodological features that have to be taken into account.

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Combining survey results using multilevel modeling: two levels

♦ At level 2: change over time and its predictors, i.e. events and time itself.

Level 2

- Time 1
- Time 2
- Time 3
- . . .
- Time n

Level 1

♦ At level 1: variation between polls and its predictors, i.e., methods, sample size, question wording, etc.
Example 1: Change in support for sovereignty in Quebec (Yale & Durand, 2011)

- Close to 700 polls between 1976 and 2008, 7 periods, 3 under study

- Poll results differ at level 1 in:
  - Question wording, i.e. whether the question pertains to an opinion or to voting intention
  - Constitutional option, i.e. whether the question refers to sovereignty with an association/partnership with the rest of Canada, to sovereignty per se, to independence or to separation
  - Proportion of undecideds and sample size

- The research questions are:
  - Does support differ according to the question asked --voting intention or attitude, constitutional option?
  - What is the likely change in average support for sovereignty and which events, if any, influence change?
  - Is change similar for different constitutional options?
Example 1: Change in support for sovereignty in Quebec (Yale & Durand, 2011)

At level 1:
- Question wording (constitutional option):
  - Separation
  - Independence
  - Sovereignty
  - Sovereignty-association or sovereignty-partnership
- Type of question: voter intent vs favorability, mandate
- Proportion of undecideds
- Sample size

At level 2:
- Time, time squared, time cubic;
- Elections;
- Events: Accords --Meech Lake, Charlottetown --and sponsorship scandal.
At level 1

Effects related to polls and questions (Yale & Durand, 2011)

Table 1 – Summary of Average Effects Linked to Measure

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>39.84***</td>
<td>60.71***</td>
<td>48.98***</td>
</tr>
<tr>
<td></td>
<td>(1.51)</td>
<td>(1.05)</td>
<td>(1.57)</td>
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<tr>
<td>Voterint</td>
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<td>-3.18***</td>
<td>-4.04**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.76)</td>
<td>(1.35)</td>
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<tr>
<td>Sovereignty</td>
<td>—</td>
<td>-7.63***</td>
<td>-6.75***</td>
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<tr>
<td></td>
<td></td>
<td>(1.09)</td>
<td>(0.87)</td>
</tr>
<tr>
<td>Independence</td>
<td>—</td>
<td>-13.46***</td>
<td>-8.95***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.90)</td>
<td>(1.31)</td>
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<tr>
<td>Separation</td>
<td>—</td>
<td>-16.84***</td>
<td>-11.38***</td>
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<tr>
<td></td>
<td></td>
<td>(1.08)</td>
<td>(1.52)</td>
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<tr>
<td>Mandate</td>
<td>14.01***</td>
<td>—</td>
<td>—</td>
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<tr>
<td></td>
<td>(0.85)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extreme</td>
<td>-20.27***</td>
<td>—</td>
<td>—</td>
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<tr>
<td></td>
<td>(1.67)</td>
<td></td>
<td></td>
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<tr>
<td>Size</td>
<td>n.s.</td>
<td>n.s.</td>
<td>n.s.</td>
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<td>Non-disclosers</td>
<td>n.s.</td>
<td>n.s.</td>
<td>0.21*</td>
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<td>(0.0941)</td>
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Variance component

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<tr>
<td>R</td>
<td>20.04</td>
<td>24.99</td>
<td>19.93</td>
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<tr>
<td>(%)</td>
<td>66</td>
<td>49</td>
<td>61</td>
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<tr>
<td>Interception</td>
<td>10.10***</td>
<td>25.68***</td>
<td>12.53***</td>
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<tr>
<td>(%)</td>
<td>34</td>
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<td>39</td>
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<td>Deviation</td>
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<tr>
<td>DL</td>
<td>21</td>
<td>58</td>
<td>121</td>
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Compared to attitudes re: Sovereignty-association.

Voter intent: -3 pts to -4 pts
Sovereignty: -7 pts to -8 pts
Independence: -9 pts to -14 pts
Separation: -12 pts to -17 pts
Mandate: + 14 pts
Extreme: -20 pts

+ item NR → + support

49%-66% of variance btw polls, the rest, between time units

* P< 0.05
** P<0.01
*** P<0.001

n.s. not significant. The variable was tested in one previous model and removed from the model.

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<table>
<thead>
<tr>
<th></th>
<th>Sovereignty - partnership</th>
<th>Sovereignty</th>
<th>Independence</th>
<th>Separation</th>
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<tbody>
<tr>
<td>1989–1995</td>
<td>45.07***</td>
<td>45.07</td>
<td>29.55***</td>
<td>37.74</td>
</tr>
<tr>
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<td>45.07***</td>
<td>45.07</td>
<td>29.55***</td>
<td>37.74</td>
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<tr>
<td>month</td>
<td>1.79***</td>
<td>1.79</td>
<td>2.18*</td>
<td>0.73***</td>
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<tr>
<td>meech1</td>
<td>-2.30***</td>
<td>-2.51***</td>
<td>-2.79**</td>
<td>-1.10***</td>
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<tr>
<td>charlot1</td>
<td>0.48***</td>
<td>0.48</td>
<td>0.48</td>
<td>0.48</td>
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<table>
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<tbody>
<tr>
<td>intercept</td>
<td>55.30***</td>
<td>50.92***</td>
<td>47.10***</td>
<td>55.30</td>
</tr>
<tr>
<td>month</td>
<td>-0.31***</td>
<td>-0.31</td>
<td>-0.31</td>
<td>-0.87***</td>
</tr>
<tr>
<td>month^2</td>
<td>0.002***</td>
<td>0.002</td>
<td>0.002</td>
<td>0.007***</td>
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<tr>
<td>sponsorship</td>
<td>4.76**</td>
<td>4.76</td>
<td>4.76</td>
<td>-9.46***</td>
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<tr>
<td>gomery1</td>
<td>-0.55***</td>
<td>-0.55</td>
<td>-0.55</td>
<td>-0.55***</td>
</tr>
</tbody>
</table>

* P< 0.05  
** P<0.01  
*** P<0.001

### At level 2

Effects related to time and events (Yale & Durand, 2011)

Support for various options...

**1989-1995**
- ↑ with time
- ↓ after Meech failure
- ↑ after Charlottetown failure

**1995-2008**
- U shaped with time
- ↑ after spons. Scandal
- except for separation
- ↓ after Gomery report
Combined model 1989-1995
Evolution according to constitutional option - voter intent
(Yale & Durand, 2011)

Figure 1. Evolution of support for sovereignty - 1989 - 1995
Combined model 1995-2008
Evolution according to constitutional option -voter intent
(Yale & Durand, 2011)
Example 2: Change in voting intentions for Obama and Romney, U.S. 2012

The question:
- What is the likely change in voting intentions for the 2012 US presidential election?
- Is this change the same whatever the survey mode of administration?
- What is the impact of using a likely voter model?
Example 2: Change in voting intentions for Obama and Romney, U.S. 2012

- At the poll level (Level 1):
  - Dependent variable:
    - Estimate of voting intention for Obama or Romney
  - Independent variables:
    - Mode of administration (not significant)
    - Number of days poll is in the field
    - Sample size
    - Proportion of non-disclosers
    - Use of a likely voter model

- At the time level (Level 2): Defining time: week (vs day)
  - Time, time squared, time cubic, power 4, power 5

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Equations...Final model

**LEVEL 1 MODEL** (bold: group-mean centering; bold italic: grand-mean centering)

\[ \text{OBAMA} = \beta_0 + \beta_1(\text{UNDEC2}) + \beta_2(\text{NBJOURS}) + \beta_3(\text{LIKELY_V}) + \beta_4(\text{SAMPLESQ}) + r \]

**LEVEL 2 MODEL** (bold italic: grand-mean centering)

\[ \beta_0 = \gamma_{00} + \gamma_{01}(\text{TEMPS}) + \gamma_{02}(\text{TEMPS2}) + \gamma_{03}(\text{TEMPS3}) + \gamma_{04}(\text{TEMPS4}) + \epsilon_0 \]

\[ \beta_1 = \gamma_{10} \]

\[ \beta_2 = \gamma_{20} \]

\[ \beta_3 = \gamma_{30} + \gamma_{31}(\text{TEMPS}) + \gamma_{32}(\text{TEMPS2}) \]

\[ \beta_4 = \gamma_{40} \]

- At level 1: support for Obama is influenced by
  - The proportion of undecideds in the poll, the number of days the poll was in the field, the use of a Likely voter model and the sample size \((1/\sqrt{n})\)

- At level 2,
  - The intercept is influenced by time (linear, quadratic, cubic and power 4).
  - The influence of the likely voter model varies with time linear and quadratic.

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Voting intentions for Obama

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>Coefficient</th>
<th>Std error</th>
<th>T-ratio</th>
<th>d.f.</th>
<th>P-Value</th>
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<td>Intercept1: B0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept2</td>
<td>G00</td>
<td>50.9356</td>
<td>0.7750</td>
<td>65.7220</td>
<td>39</td>
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<tr>
<td>Time</td>
<td>G01</td>
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<td>0.0214</td>
<td>2.8690</td>
<td>39</td>
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<tr>
<td>Time2</td>
<td>G02</td>
<td>-0.0110</td>
<td>0.0025</td>
<td>-4.4370</td>
<td>39</td>
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<tr>
<td>Time3</td>
<td>G03</td>
<td>-0.0001</td>
<td>0.0001</td>
<td>-1.4560</td>
<td>39</td>
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<tr>
<td>Time4</td>
<td>G04</td>
<td>0.0000</td>
<td>0.0000</td>
<td>5.2930</td>
<td>39</td>
</tr>
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<td>Prop. Undecided: B1</td>
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<td></td>
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<tr>
<td>Intercept2</td>
<td>G10</td>
<td>-0.5028</td>
<td>0.0280</td>
<td>-17.9280</td>
<td>381</td>
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<tr>
<td>Nb Days in field: B2</td>
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<tr>
<td>Intercept2</td>
<td>G20</td>
<td>-0.1516</td>
<td>0.0390</td>
<td>-3.8900</td>
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<td>Likely Voter Model: B3</td>
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<td>Intercept2</td>
<td>G30</td>
<td>1.3170</td>
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<td>G31</td>
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<td>0.0060</td>
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<tr>
<td>Sample Size: B4</td>
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</tr>
<tr>
<td>Intercept2</td>
<td>G40</td>
<td>-89.6405</td>
<td>14.5841</td>
<td>-6.1460</td>
<td>381</td>
</tr>
</tbody>
</table>

Note: Events could have been added but there was no cue that some important events had influenced voting intentions substantially.

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Change in voting intention from January 2012 to Election Day

- Likely Voter Model: 59% of the polls.
- Registered voters or adults: 41%
- All the other variables have been put at the mean -- number of days (4.22), sample size (1268), proportion of non-disclosers (7.77).
Final results: variance explained

Prediction of voting intention for Obama

<table>
<thead>
<tr>
<th></th>
<th>Model 0</th>
<th>Model Niv1</th>
<th>Full model</th>
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<tbody>
<tr>
<td>Var. Niv. 2: weeks</td>
<td>.52</td>
<td>.52</td>
<td>.19</td>
</tr>
<tr>
<td>Var. Niv. 1: polls</td>
<td>4.19</td>
<td>1.82</td>
<td>1.76</td>
</tr>
<tr>
<td>Prop. var btw weeks</td>
<td>11.0%</td>
<td>22.2%</td>
<td>9.7%</td>
</tr>
<tr>
<td>Prop var. explained btw polls</td>
<td>-</td>
<td>56.6%</td>
<td>58.0%</td>
</tr>
<tr>
<td>Prop. var. explained btw weeks</td>
<td>-</td>
<td>-</td>
<td>63.5%</td>
</tr>
</tbody>
</table>

- At the beginning, 11% of the variance is between weeks, 89% between polls.
- Variables at level one -- number of days in the field, sample size, proport. of undecideds and use of a likely voter model -- explain 57% of the variance between polls.
- Evolution with time -- including the effect of the varying impact of the likely voter model -- explains 63.5% of the variance over time.
Example 3: Combining data files i.e., individual records

- **At Level 3:** poll characteristics (incl. Question wording) and change over time and its predictors

  - Level 3
    - Poll 1
    - Poll 2
    - Poll 3
    - ... Poll n

  - Level 2
    - Ind 1, Ind 2, ..., Ind n
    - Ind 1, Ind 2, ..., Ind n
    - Ind 1, Ind 2, ..., Ind n

  - Level 1
    - Meas. 1
    - Meas. 2
    - Meas. 1
    - Meas. n

- **At level 2:** Individuals and their characteristics (age, sex, education, region)

- **At level 1:** Trust and its objects and characteristics (police, religion, unions, ...)

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Example 3: Evolution of trust towards institutions in Canada

- 59 surveys with questions pertaining to trust in institutions from 1974 to 2012. Final model: 56.
- n=161,261 respondents. Final model: 134,802 with 606,540 measures.
- Measures vary according to:
  - The object of trust: religion, schools, unions, media, etc.
  - Whether the object is the institution itself or the people, i.e. religion or preasts, schools or teachers, unions or union leaders, media or journalists, etc.
  - The wording and the number of response categories (at the survey level).
- Each data base has to be put on a common basis, including socio-demographics: looking for the smallest common denominator.

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• Data from all the surveys are combined into one file for each level.

• **At level 1, the measurement level:**
  - In each file, variable names changed to common names:
    - AnswerTrustReligion, objectTrustReligion (institutions or people),...
    - AnswerTrustSchools, objectTrustSchools (institutions or people),...
  - Then, restructure the file so that there are as many lines per respondent as the number of Trust questions asked.
    - Ident1, Line1: index (religion), AnswerTrust, objectTrust, GreatTrust,
    - Ident1, Line2: index (Schools), AnswerTrust, objectTrust, GreatTrust,
    - Ident1, Line3: index (Media), AnswerTrust, objectTrust, GreatTrust, etc.

• **At level 2:** For each respondent, age, sex, region, education, income, language, etc.

• **At level 3:** For each file, time of survey (month/year), wording of trust questions,...
Equations: Basic 3-level model

- **At level 1:** Trust at the question level (ref: religion)
  - \text{GreatTrust} = \psi_0 + \psi_1(\text{Army}) + \psi_2(\text{Finance}) + \ldots + \psi_n(\text{ObjectN}) + \varepsilon

- **At level 2:** Trust at the individual level
  - \psi_0 = \pi_{00} + \pi_{01}(\text{Man}) + \pi_{02}(\text{Young}) + \pi_{03}(\text{Old}) + e_0
  - \psi_1 = \pi_{10}
  - \psi_2 = \pi_{20}, \ldots
  - \psi_n = \pi_{n0}

- **At level 3:** Trust at the survey level
  - \pi_{00} = \beta_{000} + \beta_{001}(\text{Time}) + \beta_{002}(\text{Wording}) + \beta_{000}(\text{NbChoices}) + r_{00}
  - \pi_{01} = \beta_{010}
  - \pi_{02} = \beta_{020}
  - \pi_{03} = \beta_{030}
  - \pi_{10} = \beta_{100}
  - \pi_{20} = \beta_{200}, \ldots

*Trust may evolve differently with time according to the object of confidence.*
### Results: Trust in Canada 1974-2012

<table>
<thead>
<tr>
<th>Measure level ref: Religion)</th>
<th>Model 0</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
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</thead>
<tbody>
<tr>
<td>Army</td>
<td>0.4941</td>
<td>0.4942</td>
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<tr>
<td>Financial inst.</td>
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<tr>
<td>Private. Enterpr.</td>
<td>-0.0371 ns</td>
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<tr>
<td>Justice</td>
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<td>Union</td>
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<td>-0.1267</td>
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**respondent level**

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<th>Model 2</th>
<th>Model 3</th>
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<td>Man</td>
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<tr>
<td>Young (18-29)</td>
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<td>Old (60+)</td>
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**Survey level**

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**Variance**

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<th>Model 2</th>
<th>Model 3</th>
<th>exp. var</th>
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<td>0.1538</td>
<td>0.1533</td>
<td>0.1538</td>
<td>58.1%</td>
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<td>Respond. Level</td>
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<td>0.0210</td>
<td>0.0220</td>
<td>0.0208</td>
<td>1.9%</td>
</tr>
<tr>
<td>Survey level</td>
<td>0.1566</td>
<td>0.0071</td>
<td>0.0069</td>
<td>0.0060</td>
<td>40.1%</td>
</tr>
</tbody>
</table>
Hypothesized evolution of trust in some institutions

Valois, Durand & Goyder, 2012

General trends in confidence:
Religion, unions, the media and the army

©Valois, Durand & Goyder, 2012

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Limits

- When combining results or data, we need to have enough information at all levels, for example,
  - Variation between question wording (example 1) has to be spread on all time periods.
    - We had to perform analyses separately for the different periods in order to take this into account.
  - Use of likely voter model (example 2) has to be spread also throughout the period.

- When combining data files,
  - We cannot take into account all the subtilities of question wording
  - It may be difficult to find a common denominator for response categories.
    - Use mean, put on a 7 point scale, use proportion of high trust or of low trust as dependent variables, etc.
  - It may be very difficult to find a common denominator for variables like age, income, etc.
There are incredible possibilities to combine data in order to get to the “big picture”.

Multilevel longitudinal analysis with time at the higher level allows for a thorough use of the data already collected in order to better understand different phenomena and their evolution over time and in different contexts.

Next steps:
- Refine the model.
- Combine data files on other topics, for other countries.