

# Exploring the effects of national and regional popular vote Interstate compact on a toy symmetric version of the Electoral College: An electoral engineering perspective

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# The birth of that project

Exploring the effects of MRPV and MNPV

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Three criteria  
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MRPV

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Under IAC

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- Two years ago in Lund: Olivier de Mouzon, Thibault Laurent, Dominique Lepelley and Michel Lebreton (2016). The theoretical Shapley-Shubik probability of an Election Inversion in a toy symmetric version of the US presidential Electoral System.
- In 2016, Trump won the US presidential election → criticism and alternatives proposals to the US Electoral College were discussed in the media
- Motivations: what are the effects of MRPV and MNPV (Modified Regional/National Popular Vote) interstate compact?

# US Electoral College

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- Two-tier electoral system:
  - 1 Individual voters cast votes in the first tier to choose between rival slates of “Presidential electors”. Rule: state winner-take-all.
  - 2 Winning elector slates cast blocs of electoral votes for the candidate to whom they are pledged.
- 538 electoral votes are cast; 270 are required for election.
- Main criticism: winner of the Electoral College (EC)  $\neq$  winner of the Popular Vote (PV).
- Historically, for US presidential elections, the referendum paradox appeared in roughly 7% of the elections (Neubauer, Schilling and Zeitlin, 2012).

# US presidential elections

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### ■ Year 2000: Bush vs. Gore

Candidates	National votes	Electoral College votes
Gore	48.4%	266
Bush	47.9%	271
Other	3.7%	0

### ■ Year 2016: Clinton vs. Trump

Candidates	National votes	Electoral College votes
Clinton	48%	232
Trump	45.9%	306
Other	4.1%	0

# Historical opinions

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## Gallup survey

- Support for an amendment peaked at 80% in 1968 (after Richard Nixon election).
- 60% in 2004 (George W. Bush election) and 2011.
- 49% in 2017 (Donald Trump election) say they want to amend the Constitution to allow for a popular vote.

After Trump election, many petitions and initiatives to amend the constitution in order to replace the EC by PV.

# Reform attempts

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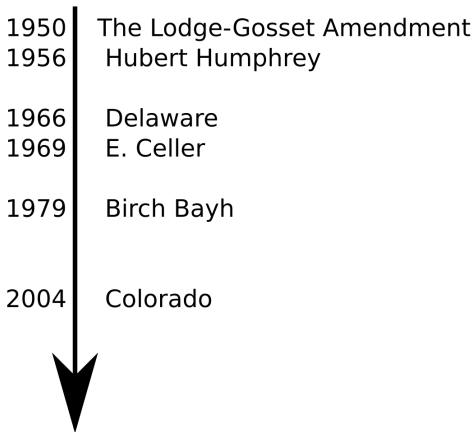
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# National Popular Vote Interstate Compact (NPVIC or NPV)

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- Interstate compact: “agreement between two or more states which requires congressional ratification” (Elliot and Ali, 1988).
- 11 states (CA, DC, HI, IL, MA, MD, NJ, NY, RI, VT, WA) with 165 electoral votes. The bill will take effect when enacted by states with 98 more electoral votes.
- The compact has the power to choose the national popular vote winner.
- Advantages and problems discussed in many papers: Bennett (2001), Koza et al. (2013), Gaines (2012), Miller (2012), De Witt and Schwartz (2016).



# Framework

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- Simplifications of the US Electoral College by a toy symmetric version.
- Aim: examining the effect of implementing the compact depending on the number of states.
- Two versions of the NPV (Brams and Kilgour, 2013): National Modified Popular Vote (NMPV) and Regional Modified Popular Vote (RMPV).
- Three criteria to measure the effect of the compact: pivotality, utility and probability of an election inversion.
- Three different probabilistic assumptions: *a priori Banzhaf/IC* model, *a priori Shapley-Shubik/IAC* model and *a priori May/IAC\**.

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# Simplifications of the US Electoral College

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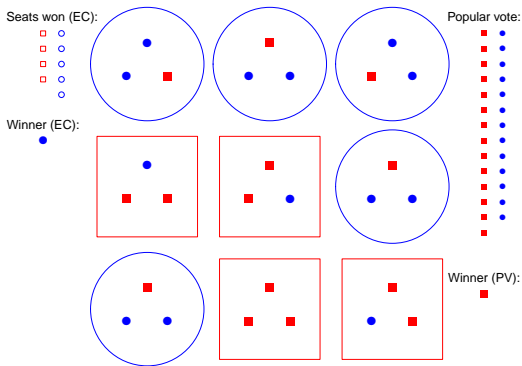
Election inversions  
Utility  
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Conclusion

- Two presidential candidates:  $D$  and  $R$ .
- Number of states:  $K$ .
- An equal and odd number of voters in each state:  $n$ .
- One pledged elector per state.
- Number of states inside the compact:  $L$ .

# Example: electoral college vs. popular vote ( $K = 9$ , $n = 3$ )

$L = 0$  (Electoral College),  $L = K$  (popular vote)



# Example: regional popular vote interstate compact ( $K = 9, n = 3$ )

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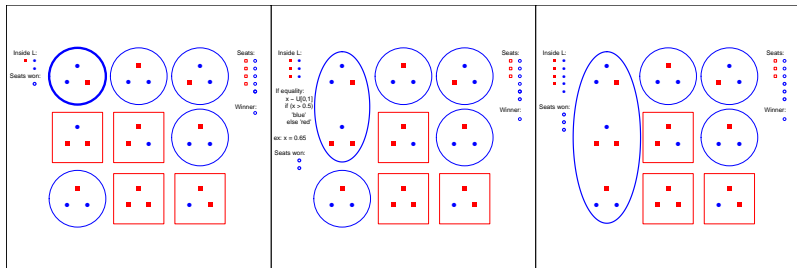
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Regional popular vote interstate compact: mega-state uses the winner-take-all rule inside the coalition. Example with  $L = 1, 2, 3$



# Example: national popular vote interstate compact ( $K = 9, n = 3$ )

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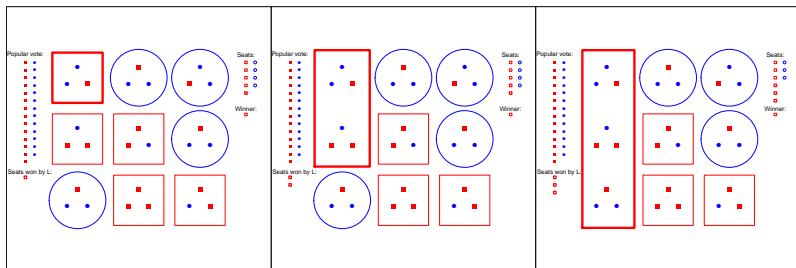
Election inversions

Utility

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Conclusion

National popular vote interstate compact: electoral votes are given in the compact to the nationwide popular winner.  
Example with  $L = 1, 2, 3$



Remark: voters outside have a double vote !

# Probability model in Social Choice literature: *IC* (Impartial Culture)

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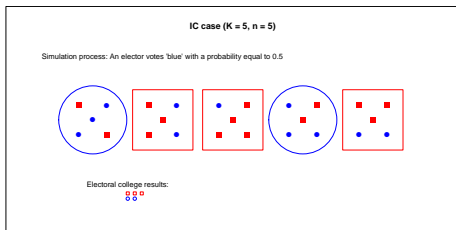
MRPV

Under *IC*  
Under *IAC*  
Under *IAC*

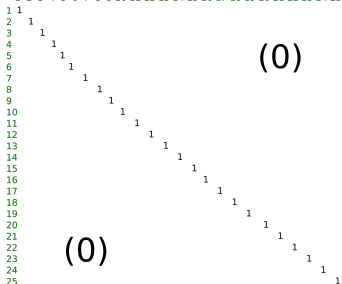
MNPV

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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25



# Probability model in Social Choice literature: *IAC* (Impartial Anonymous Culture)

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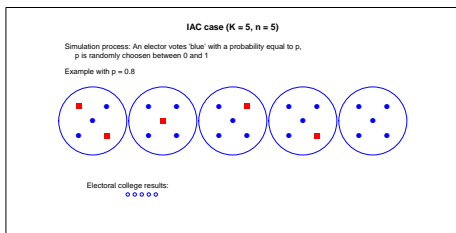
MRPV

Under *IC*  
Under *IAC*  
Under *IAC*

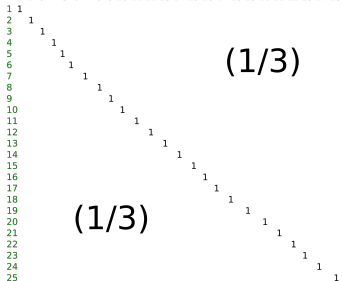
MNPV

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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25





# Probability models in Social Choice literature : IAC\* (District Based Impartial Anonymous Culture)

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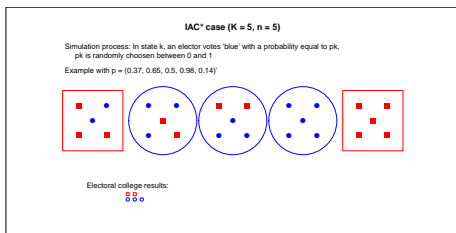
MRPV

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# Criteria 1: utility

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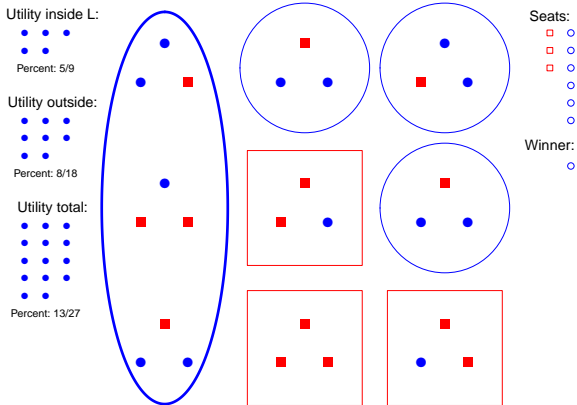
Utility

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## Utility: Who are the electors satisfied?

example with  $K = 9$  and  $L = 3$  (RPV Mechanism)



# Criteria 2: pivotality

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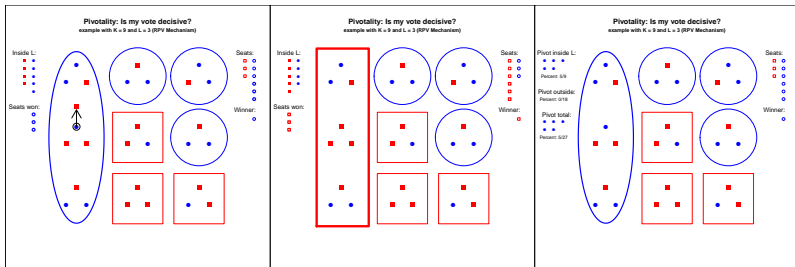
MNPV

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# Decomposition of MNPV pivotality outside (1)

Exploring the effects of MRPV and MNPV

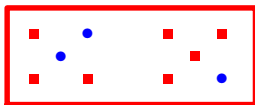
## Decomposition of piviality outside ( $K = 5, n = 5, L = 2$ , NPV Mechanism)

Case DO: Direct Only

Popular vote results:

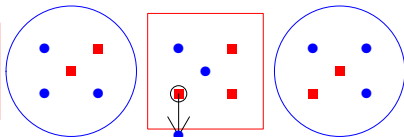


Number of seats won inside L:  $\square \square$



Electoral college results:  $\square \square \square \square \square$

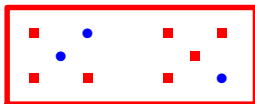
Winner:  $\square$



Popular vote results:

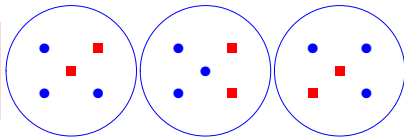


Number of seats won inside L:  $\square \square$



Electoral college results:  $\square \square \square \square \square$

Winner:  $\circ$



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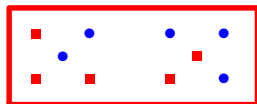
## Decomposition of pivotality outside ( $K = 5, n = 5, L = 2$ , NPV Mechanism)

Case IO: Indirect Only

Popular vote results:

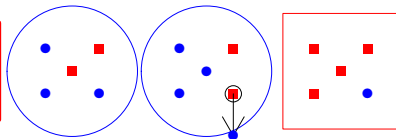


Number of seats won inside L:  $\square \square$



Electoral college results:  $\square \square \square \square \square$

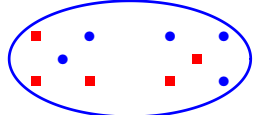
Winner:  $\square$



Popular vote results:

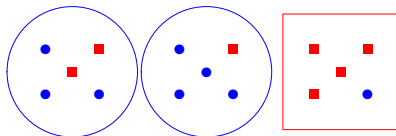


Number of seats won inside L:  $\square \square$



Electoral college results:  $\square \square \square \square \square$

Winner:  $\square$



# Decomposition of MNPV pivotality outside (3)

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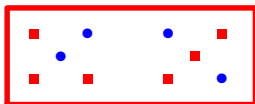
## Decomposition of pivotality outside ( $K = 5, n = 5, L = 2$ , NPV Mechanism)

Case BD: Direct and Indirect, Direct sufficient

Popular vote results:

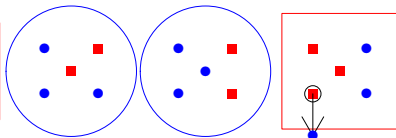


Number of seats won inside L:  $\square \square$



Electoral college results:  $\square \square \square \square \square$

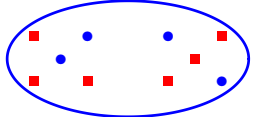
Winner:  $\square$



Popular vote results:

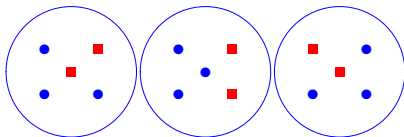


Number of seats won inside L:  $\square \square$



Electoral college results:  $\square \square \square \square \square$

Winner:  $\square$



# Decomposition of MNPV pivotality outside (4)

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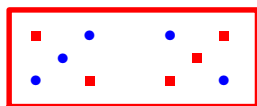
## Decomposition of pivotality outside ( $K = 5, n = 5, L = 2$ , NPV Mechanism)

Case BD: Direct and Indirect, Indirect sufficient

Popular vote results:

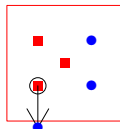
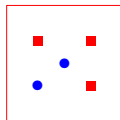
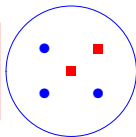


Number of seats won inside L:  $\square \square$



Electoral college results:  $\square \square \square \square \circ$

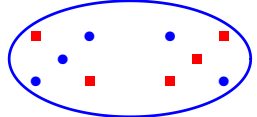
Winner:  $\square$



Popular vote results:

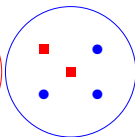
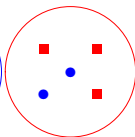
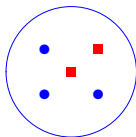


Number of seats won inside L:  $\circ \circ$



Electoral college results:  $\square \circ \circ \circ \circ$

Winner:  $\circ$



# Decomposition of MNPV pivotality outside (5)

Exploring the effects of MRPV and MNPV

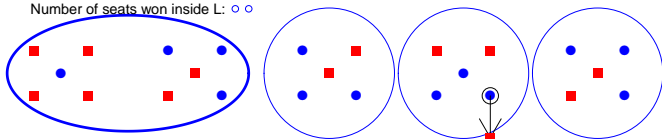
## Decomposition of pivotality outside ( $K = 5, n = 5, L = 2$ , NPV Mechanism)

Case B: Direct and Indirect, both are necessary

Popular vote results:



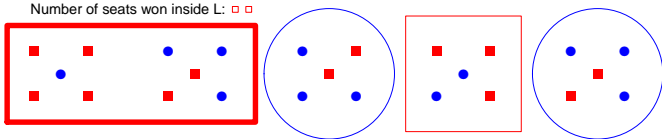
Number of seats won inside L: ○ ○



Popular vote results:



Number of seats won inside L: □ □



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# Criteria 3: election inversion

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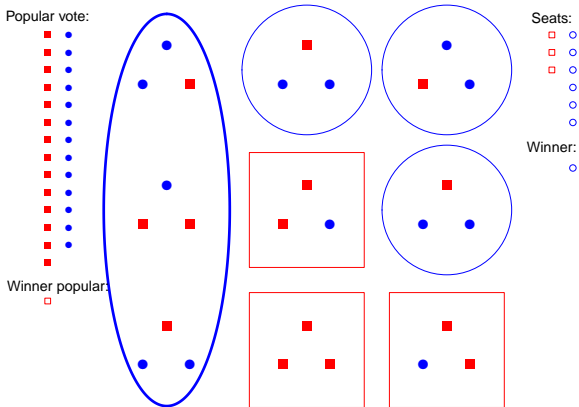
Utility

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## Election inversion: Y or N?

Example of Yes with  $K = 9$  and  $L = 3$  (Mechanism 1)



# Simulation framework

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Under  $IAC$

Under  $IAC^*$

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Conclusion

- $K = 51$
- $L = 1, \dots, K$
- $n = 1000001$
- Repeating  $10^8$  simulations of a MRPV and MNPV interstate compact under  $IC$ ,  $IAC$  and  $IAC^*$ .
- Compute the three criteria and present the average mean of the results.

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# Pivotality under IC

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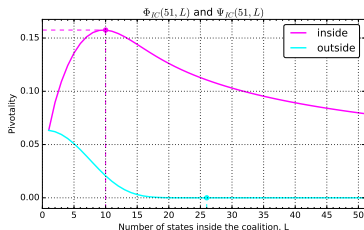
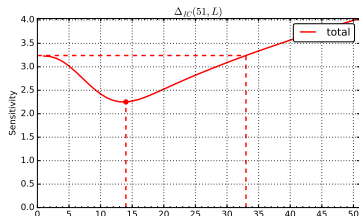
Under IC  
Under IAC  
Under IAC

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- Analytical form of the power of a citizen living inside or outside.
- Being inside is much better than being outside.
- Maximum inside obtained when  $L = 1.4\sqrt{K}$
- Sensitivity:  $L = 14$  leads to its worst performance.
- $\rightarrow$  interstate compact beneficial when about 2/3 of the states are inside.



# Utility under IC (simulations)

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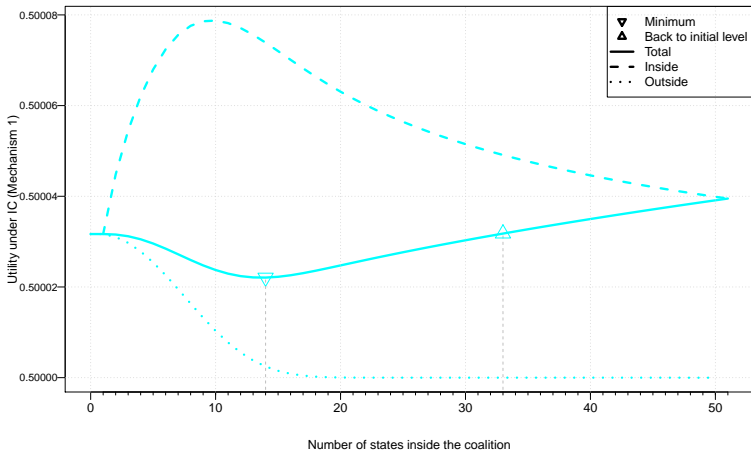
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# Election inversion under IC (simulations)

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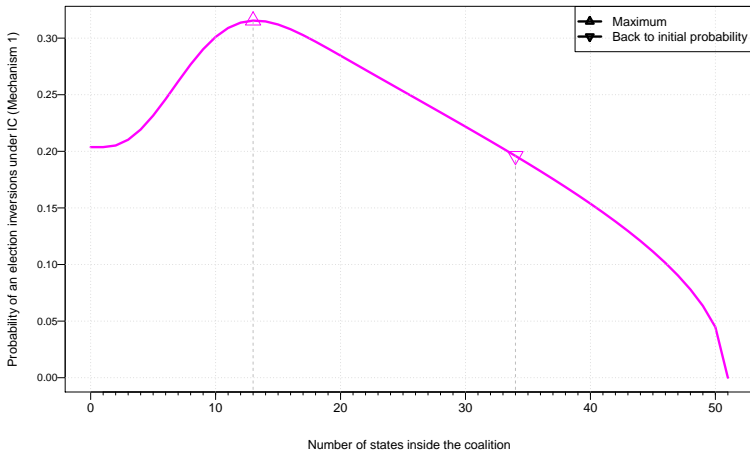
MRPV

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MNPV

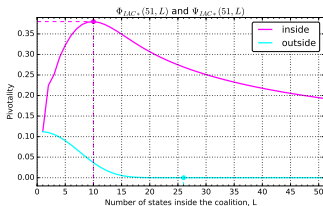
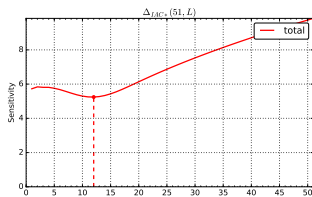
Election inversions  
Utility  
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Conclusion

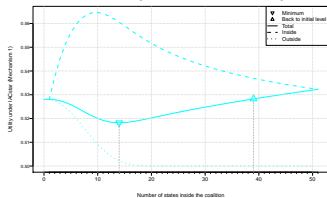


# Under $IAC_*$

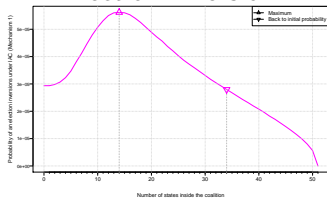
## Pivotality (Analytical result)



## Utility (simulations)



## Election inversion



→ interstate compact beneficial when about 4/5 of the states are inside.

# Pivotality under IAC (simulations only)

Exploring the effects of MRPV and MNPV

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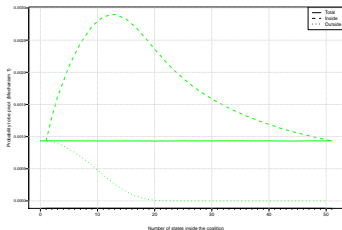
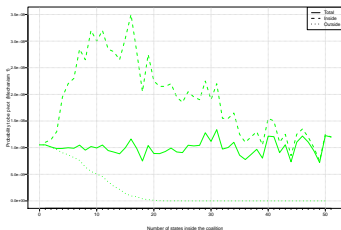
Under IC  
Under IAC  
Under IAC

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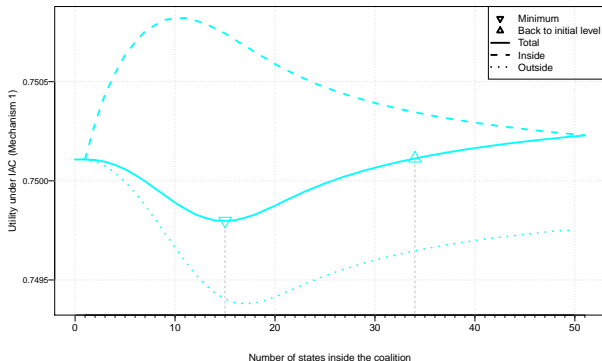
$n = 1000001$  (noisy because of the rarity of events) and  $n = 10$



- Inside better than outside.
- Sensitivity constant (property of the IAC).



# Utility under IAC (simulations)



- Utility outside: it decreases til  $L = 17$  and increases
- Total utility : minimum obtained when  $L = 15$ .
- Interstate compact beneficial when about 2/3 of the states are inside.

# Election inversion under IAC (simulations)

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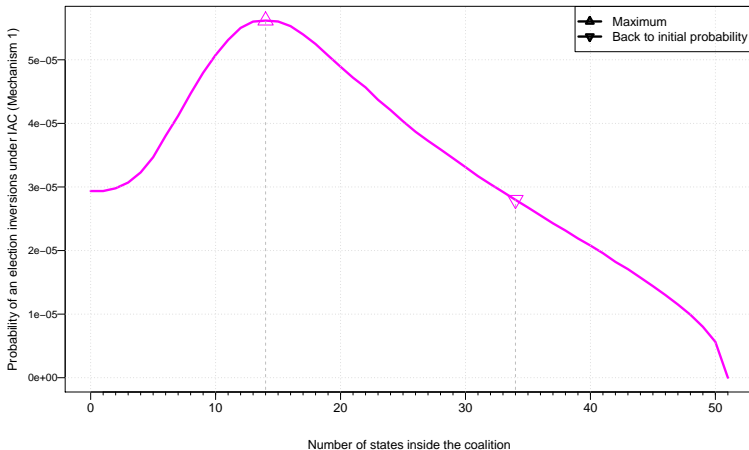
MRPV

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# Election inversions under $IC$ , $IAC_*$ , $IAC$

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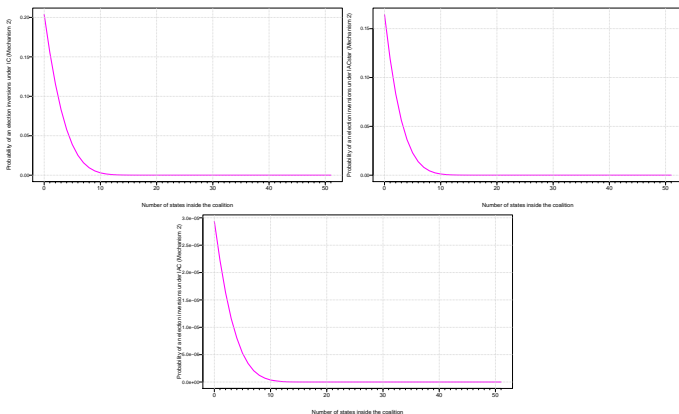
MRPV

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Under  $IAC$   
Under  $IAC$

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Probability declines rapidly to 0  $\rightarrow$  convergence to the popular vote is obtained for relatively small interstate compact.

# Utility under $IC$ , $IAC_*$ , $IAC$

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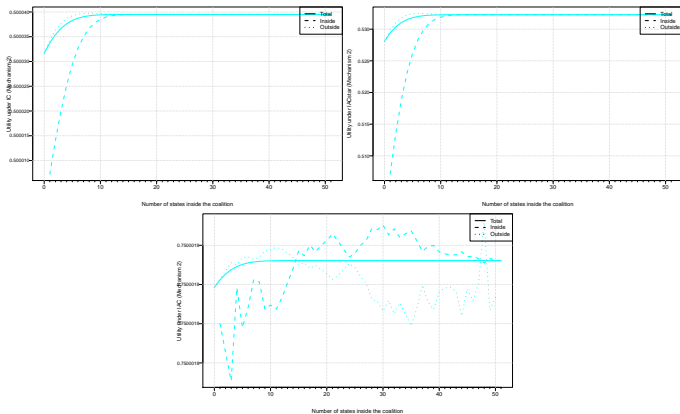
MRPV

Under  $IC$   
Under  $IAC$   
Under  $IAC$

MNPV

Election inversions  
**Utility**  
Pivotality

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- Better to be outside than inside.
- Convergence to the popular vote when  $L = 10$ .

# Pivotality under $IC$ , $IAC_*$ , $IAC$

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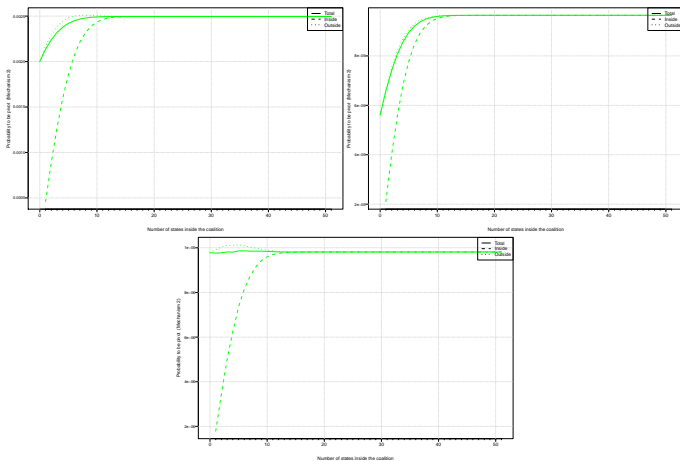
MRPV

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Under  $IAC$   
Under  $IAC$

MNPV

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Same observations than for utility.

# Decomposition of the pivotality under $IC$ , $IAC_*$ , $IAC$

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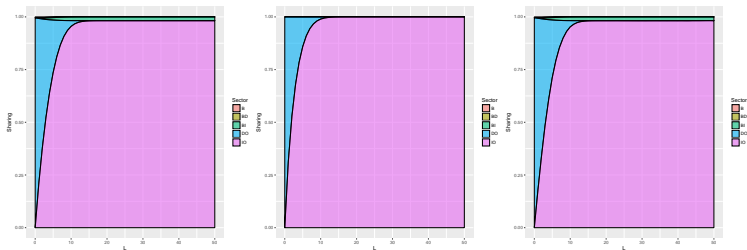
MRPV

Under  $IC$   
Under  $IAC$   
Under  $IAC$

MNPV

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- IO (indirect only) is dominant when  $L$  gets large.
- DO (direct only) declines with  $L$ .

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# Conclusion

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## 1 MRPV

- Positive effect on the interstate compact (with a maximum obtained when  $L = 1.4\sqrt{K}$  under  $IAC$  and  $IAC^*$ ).
- Strong negative effect outside the coalition.
- The compact needs to contain 64% of the states to find better properties than EC.

## 2 MNPV

- The externality imposed by the interstate compact on the other states is positive rather than being negative.
- Maximum social gain is obtained for small values of  $L$ .
- States outside the coalition have a double vote.