

FLS 6441 - Methods III: Explanation and Causation

Week 5 - Natural Experiments

Jonathan Phillips

April 2019

Classification of Research Designs

	Independence of Treatment Assignment?	Researcher Controls Treatment Assignment?
Controlled Ex- periments	✓	✓
Natural Experi- ments	✓	
Observational Studies		

Classification of Research Designs

		Independence of Treatment Assignment	Researcher Controls Treatment Assignment?
Controlled Experiments	Field Experiments	✓	✓
	Survey and Lab Experiments	✓	✓
Natural Experiments	Natural Experiments	✓	
	Instrumental Variables	✓	
	Discontinuities	✓	
Observational Studies	Difference-in-Differences		
	Controlling for Confounding		
	Matching		
	Comparative Cases and Process Tracing		

Section 1

Natural Experiments

Natural Experiments

Advantages:

- ▶ We don't need to run our own experiment! (Too expensive, unethical or politically impossible)

Natural Experiments

Advantages:

- ▶ We don't need to run our own experiment! (Too expensive, unethical or politically impossible)
- ▶ Still have independence of potential outcomes from treatment

Natural Experiments

Advantages:

- ▶ We don't need to run our own experiment! (Too expensive, unethical or politically impossible)
- ▶ Still have independence of potential outcomes from treatment
- ▶ Treatment may be more 'realistic' than in a controlled experiment

Natural Experiments

Advantages:

- ▶ We don't need to run our own experiment! (Too expensive, unethical or politically impossible)
- ▶ Still have independence of potential outcomes from treatment
- ▶ Treatment may be more 'realistic' than in a controlled experiment

Disadvantages:

- ▶ We can never be sure randomization really worked

Natural Experiments

Advantages:

- ▶ We don't need to run our own experiment! (Too expensive, unethical or politically impossible)
- ▶ Still have independence of potential outcomes from treatment
- ▶ Treatment may be more 'realistic' than in a controlled experiment

Disadvantages:

- ▶ We can never be sure randomization really worked
- ▶ We don't get to choose the treatments we want to evaluate, just 'discover' them

Natural Experiments

Advantages:

- ▶ We don't need to run our own experiment! (Too expensive, unethical or politically impossible)
- ▶ Still have independence of potential outcomes from treatment
- ▶ Treatment may be more 'realistic' than in a controlled experiment

Disadvantages:

- ▶ We can never be sure randomization really worked
- ▶ We don't get to choose the treatments we want to evaluate, just 'discover' them
- ▶ We don't get to choose the population and sample

Verifying Randomization

- If it's an important treatment, *someone* had an incentive to try and alter it

Verifying Randomization

- ▶ If it's an important treatment, *someone* had an incentive to try and alter it
- ▶ The burden of proof is on us: How can we increase confidence that assignment was (as-if) random?

Verifying Randomization

- ▶ If it's an important treatment, *someone* had an incentive to try and alter it
- ▶ The burden of proof is on us: How can we increase confidence that assignment was (as-if) random?
- ▶ Two strategies:

Verifying Randomization

- ▶ If it's an important treatment, *someone* had an incentive to try and alter it
- ▶ The burden of proof is on us: How can we increase confidence that assignment was (as-if) random?
- ▶ Two strategies:
 1. Check balance on lots of variables
 - ▶ Especially variables that are potential omitted variables

Verifying Randomization

- ▶ If it's an important treatment, *someone* had an incentive to try and alter it
- ▶ The burden of proof is on us: How can we increase confidence that assignment was (as-if) random?
- ▶ Two strategies:
 1. Check balance on lots of variables
 - ▶ Especially variables that are potential omitted variables
 2. **Causal Process Observations**

Verifying Randomization

- ▶ If it's an important treatment, *someone* had an incentive to try and alter it
- ▶ The burden of proof is on us: How can we increase confidence that assignment was (as-if) random?
- ▶ Two strategies:
 1. Check balance on lots of variables
 - ▶ Especially variables that are potential omitted variables
 2. **Causal Process Observations**
 - ▶ Documents/code/video evidence

Verifying Randomization

- ▶ If it's an important treatment, *someone* had an incentive to try and alter it
- ▶ The burden of proof is on us: How can we increase confidence that assignment was (as-if) random?
- ▶ Two strategies:
 1. Check balance on lots of variables
 - ▶ Especially variables that are potential omitted variables
 2. **Causal Process Observations**
 - ▶ Documents/code/video evidence
 - ▶ Interviews with eyewitnesses

Verifying Randomization

- ▶ If it's an important treatment, *someone* had an incentive to try and alter it
- ▶ The burden of proof is on us: How can we increase confidence that assignment was (as-if) random?
- ▶ Two strategies:
 1. Check balance on lots of variables
 - ▶ Especially variables that are potential omitted variables
 2. **Causal Process Observations**
 - ▶ Documents/code/video evidence
 - ▶ Interviews with eyewitnesses
 - ▶ Verifying treatment assignment matches documents

Verifying Randomization

- ▶ If it's an important treatment, *someone* had an incentive to try and alter it
- ▶ The burden of proof is on us: How can we increase confidence that assignment was (as-if) random?
- ▶ Two strategies:
 1. Check balance on lots of variables
 - ▶ Especially variables that are potential omitted variables
 2. **Causal Process Observations**
 - ▶ Documents/code/video evidence
 - ▶ Interviews with eyewitnesses
 - ▶ Verifying treatment assignment matches documents
 - ▶ Identify risks of reverse causation, omitted variables, (Self-)selection

Verifying Randomization

- ▶ How does Snow argue that households' assignment to water company is as-if random?

The Problem of Not Controlling Treatment Assignment

- ▶ “Random assignment of the intervention is not sufficient to provide an unbiased estimate of the causal effect.” (Sekhon and Titunik 2012)

The Problem of Not Controlling Treatment Assignment

- ▶ “Random assignment of the intervention is not sufficient to provide an unbiased estimate of the causal effect.” (Sekhon and Titunik 2012)
- ▶ Treatment and control groups are defined *after* randomization - it's our responsibility to make sure:

The Problem of Not Controlling Treatment Assignment

- ▶ “Random assignment of the intervention is not sufficient to provide an unbiased estimate of the causal effect.” (Sekhon and Titunik 2012)
- ▶ Treatment and control groups are defined *after* randomization - it's our responsibility to make sure:
 1. **These two groups actually are comparable** (POs are independent of treatment)

The Problem of Not Controlling Treatment Assignment

- ▶ “Random assignment of the intervention is not sufficient to provide an unbiased estimate of the causal effect.” (Sekhon and Titunik 2012)
- ▶ Treatment and control groups are defined *after* randomization - it's our responsibility to make sure:
 1. **These two groups actually are comparable** (POs are independent of treatment)
 - ▶ We can only compare those units *that were part of the original randomization*

The Problem of Not Controlling Treatment Assignment

- ▶ “Random assignment of the intervention is not sufficient to provide an unbiased estimate of the causal effect.” (Sekhon and Titunik 2012)
- ▶ Treatment and control groups are defined *after* randomization - it's our responsibility to make sure:
 1. **These two groups actually are comparable** (POs are independent of treatment)
 - ▶ We can only compare those units *that were part of the original randomization*
 2. **That the treatment is the factor we actually want to study**

The Problem of Not Controlling Treatment Assignment

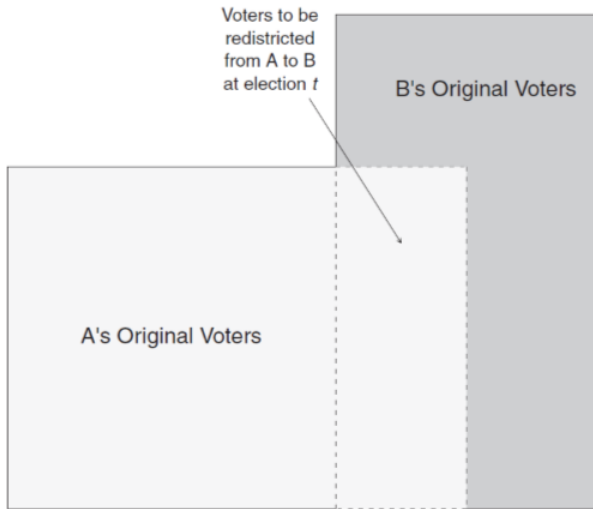
- ▶ “Random assignment of the intervention is not sufficient to provide an unbiased estimate of the causal effect.” (Sekhon and Titunik 2012)
- ▶ Treatment and control groups are defined *after* randomization - it's our responsibility to make sure:
 1. **These two groups actually are comparable** (POs are independent of treatment)
 - ▶ We can only compare those units *that were part of the original randomization*
 2. **That the treatment is the factor we actually want to study**
 - ▶ We have to 'interpret' the treatment

The Problem of Not Controlling Treatment Assignment

- ▶ “Random assignment of the intervention is not sufficient to provide an unbiased estimate of the causal effect.” (Sekhon and Titunik 2012)
- ▶ Treatment and control groups are defined *after* randomization - it's our responsibility to make sure:
 1. **These two groups actually are comparable** (POs are independent of treatment)
 - ▶ We can only compare those units *that were part of the original randomization*
 2. **That the treatment is the factor we actually want to study**
 - ▶ We have to 'interpret' the treatment
 - ▶ Sometimes treatments are 'bundles'

The Problem of Not Controlling Treatment Assignment

- ▶ “Random assignment of the intervention is not sufficient to provide an unbiased estimate of the causal effect.” (Sekhon and Titunik 2012)
- ▶ Treatment and control groups are defined *after* randomization - it's our responsibility to make sure:
 1. **These two groups actually are comparable** (POs are independent of treatment)
 - ▶ We can only compare those units *that were part of the original randomization*
 2. **That the treatment is the factor we actually want to study**
 - ▶ We have to 'interpret' the treatment
 - ▶ Sometimes treatments are 'bundles'
 - ▶ Sometimes treatments are 'repeated', creating interactions or changing expectations



The Problem of Not Controlling Treatment Assignment

	A's Original Voters	Switched Voters	B's Original Voters
2000 election context		Same	Same
Duration of exposure to incumbent in district B		4 years	12 years
1996 and prior election context	Same	Same	

The Problem of Not Controlling Treatment Assignment

	A's Original Voters vs. Switched Voters	B's Original Voters vs. Switched Voters
Potential Outcomes Independent of Treatment Assignment?	Yes	No
What is 'Treatment'?	Different election context, different candidates	Difference in duration of exposure to incumbent

Section 2

Randomized Natural Experiments

Ferraz and Finan (2008)

- Do voters punish corrupt politicians?

Ferraz and Finan (2008)

- ▶ Do voters punish corrupt politicians?
- ▶ Corruption is hard to manipulate (ethically)

Ferraz and Finan (2008)

- ▶ Do voters punish corrupt politicians?
- ▶ Corruption is hard to manipulate (ethically)
- ▶ We can also look at voters' *information* about corruption

Ferraz and Finan (2008)

- ▶ **Population:** Brazilian municipalities with population less than 450,000
- ▶ **Sample:** 373 Municipalities with audits either side of 2004 elections and first-term mayors
- ▶ **Treatment:** CGU Audit before election
- ▶ **Control:** CGU Audit after election
- ▶ **Treatment Assignment Mechanism:** Randomized (Caixa)
- ▶ **Outcome:** Vote Share for the Incumbent in 2004 election

Ferraz and Finan (2008)

- How do we know audits were random?

Ferraz and Finan (2008)

- ▶ How do we know audits were random?
- ▶ What about the content of reports? Isn't there more pressure just before an election?

Ferraz and Finan (2008)

- ▶ How do we know audits were random?
- ▶ What about the content of reports? Isn't there more pressure just before an election?
 - ▶ Quantitative evidence?

Ferraz and Finan (2008)

- ▶ How do we know audits were random?
- ▶ What about the content of reports? Isn't there more pressure just before an election?
 - ▶ Quantitative evidence?
 - ▶ Balance tests

Ferraz and Finan (2008)

- ▶ How do we know audits were random?
- ▶ What about the content of reports? Isn't there more pressure just before an election?
 - ▶ Quantitative evidence?
 - ▶ Balance tests
 - ▶ Fixed effects to the state (auditing team)

Ferraz and Finan (2008)

- ▶ How do we know audits were random?
- ▶ What about the content of reports? Isn't there more pressure just before an election?
 - ▶ Quantitative evidence?
 - ▶ Balance tests
 - ▶ Fixed effects to the state (auditing team)
 - ▶ Amount of corruption = $\alpha + \beta \text{Party in Government}$

Ferraz and Finan (2008)

- ▶ How do we know audits were random?
- ▶ What about the content of reports? Isn't there more pressure just before an election?
 - ▶ Quantitative evidence?
 - ▶ Balance tests
 - ▶ Fixed effects to the state (auditing team)
 - ▶ Amount of corruption = $\alpha + \beta \text{Party in Government}$
 - ▶ Amount of corruption = $\alpha + \beta \text{Vote Share Margin}$

Ferraz and Finan (2008)

- ▶ How do we know audits were random?
- ▶ What about the content of reports? Isn't there more pressure just before an election?
 - ▶ Quantitative evidence?
 - ▶ Balance tests
 - ▶ Fixed effects to the state (auditing team)
 - ▶ Amount of corruption = $\alpha + \beta \text{Party in Government}$
 - ▶ Amount of corruption = $\alpha + \beta \text{Vote Share Margin}$
 - ▶ Qualitative evidence?

Ferraz and Finan (2008)

- ▶ How do we know audits were random?
- ▶ What about the content of reports? Isn't there more pressure just before an election?
 - ▶ Quantitative evidence?
 - ▶ Balance tests
 - ▶ Fixed effects to the state (auditing team)
 - ▶ Amount of corruption = $\alpha + \beta \text{Party in Government}$
 - ▶ Amount of corruption = $\alpha + \beta \text{Vote Share Margin}$
 - ▶ Qualitative evidence?
 - ▶ Hiring, salary and work conditions of auditors

Ferraz and Finan (2008)

- ▶ How do we know audits were random?
- ▶ What about the content of reports? Isn't there more pressure just before an election?
 - ▶ Quantitative evidence?
 - ▶ Balance tests
 - ▶ Fixed effects to the state (auditing team)
 - ▶ Amount of corruption = $\alpha + \beta \text{Party in Government}$
 - ▶ Amount of corruption = $\alpha + \beta \text{Vote Share Margin}$
 - ▶ Qualitative evidence?
 - ▶ Hiring, salary and work conditions of auditors
 - ▶ Interviews with auditors

Ferraz and Finan (2008)

- ▶ How do we know audits were random?
- ▶ What about the content of reports? Isn't there more pressure just before an election?
 - ▶ Quantitative evidence?
 - ▶ Balance tests
 - ▶ Fixed effects to the state (auditing team)
 - ▶ Amount of corruption = $\alpha + \beta \text{Party in Government}$
 - ▶ Amount of corruption = $\alpha + \beta \text{Vote Share Margin}$
 - ▶ Qualitative evidence?
 - ▶ Hiring, salary and work conditions of auditors
 - ▶ Interviews with auditors
- ▶ What about the timing of publication?

Ferraz and Finan (2008)

- ▶ How do we know audits were random?
- ▶ What about the content of reports? Isn't there more pressure just before an election?
 - ▶ Quantitative evidence?
 - ▶ Balance tests
 - ▶ Fixed effects to the state (auditing team)
 - ▶ Amount of corruption = $\alpha + \beta \text{Party in Government}$
 - ▶ Amount of corruption = $\alpha + \beta \text{Vote Share Margin}$
 - ▶ Qualitative evidence?
 - ▶ Hiring, salary and work conditions of auditors
 - ▶ Interviews with auditors
- ▶ What about the timing of publication?
 - ▶ PMDB imbalance?

Ferraz and Finan (2008)

► Methodology

$$\text{► } VS_{ms} = \alpha + \beta \text{Audited Early}_{ms} + X_{ms} + FE_s + \epsilon_{ms}$$

Ferraz and Finan (2008)

► Methodology

- $VS_{ms} = \alpha + \beta \text{Audited Early}_{ms} + X_{ms} + FE_s + \epsilon_{ms}$
- Result: No Effect

Ferraz and Finan (2008)

- The importance of a theoretical model:

Ferraz and Finan (2008)

- ▶ The importance of a theoretical model:
- ▶ Treatment is the release of audit information, but the *theory* they seek to test is when voters *learn something about candidates*

Ferraz and Finan (2008)

- ▶ The importance of a theoretical model:
- ▶ Treatment is the release of audit information, but the *theory* they seek to test is when voters *learn something about candidates*
- ▶ The *content* of the audit report information varies

Ferraz and Finan (2008)

- ▶ The importance of a theoretical model:
- ▶ Treatment is the release of audit information, but the *theory* they seek to test is when voters *learn something about candidates*
- ▶ The *content* of the audit report information varies
- ▶ We need treatment and control groups reflecting this

Ferraz and Finan (2008)

- ▶ The importance of a theoretical model:
- ▶ Treatment is the release of audit information, but the *theory* they seek to test is when voters *learn something about candidates*
- ▶ The *content* of the audit report information varies
- ▶ We need treatment and control groups reflecting this
- ▶ Ideally, we would also incorporate voters' *priors* about how corrupt candidates are vary, but they don't have data on that

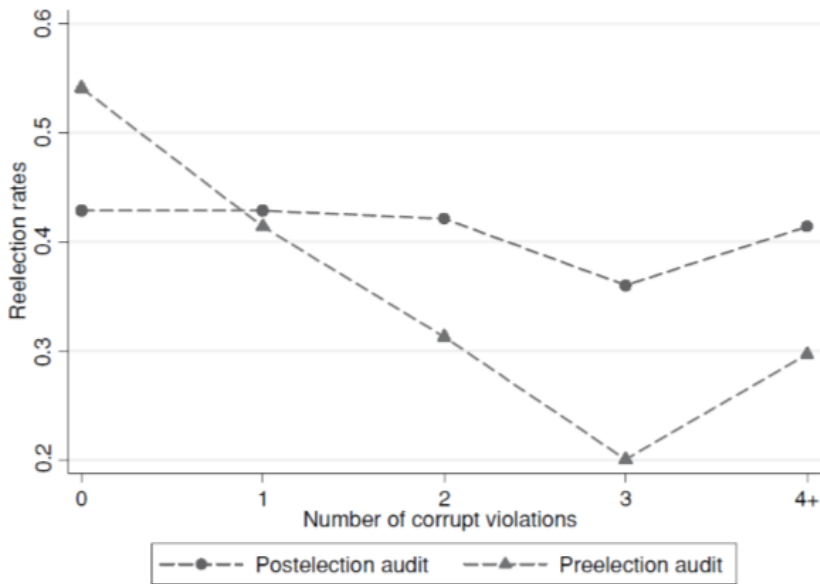
Ferraz and Finan (2008)

- ▶ Methodology
 - ▶ So expected vote share change is *conditional on the content of the audit report*

Ferraz and Finan (2008)

► Methodology

- So expected vote share change is *conditional on the content of the audit report*
- $VS_{ms} = \alpha + \beta_1 \text{Audited Early}_{ms} + \beta_2 \text{Corruption}_{ms} + \beta_3 \text{Audited Early}_{ms} * \text{Corruption}_{ms} + X_{ms} + FE_s + \epsilon_{ms}$



Ferraz and Finan (2008)

- Have we interpreted treatment correctly?

Ferraz and Finan (2008)

- ▶ Have we interpreted treatment correctly?
- ▶ Audits may also have changed competition within the elite

Ferraz and Finan (2008)

- ▶ Have we interpreted treatment correctly?
- ▶ Audits may also have changed competition within the elite
- ▶ Or campaign strategies - maybe parties ran 'cleaner' candidates before they knew the outcome of the audit report

Section 3

Non-Randomized Natural Experiments

Non-Randomized Natural Experiments

- How can we achieve causal inference without randomization?

Non-Randomized Natural Experiments

- ▶ How can we achieve causal inference without randomization?
- ▶ Our necessary condition is always "The Treatment Assignment Mechanism is independent of potential outcomes"

Non-Randomized Natural Experiments

- ▶ How can we achieve causal inference without randomization?
- ▶ Our necessary condition is always "The Treatment Assignment Mechanism is independent of potential outcomes"
- ▶ Can we find real-world treatment assignments that ignored potential outcomes?

Non-Randomized Natural Experiments

- ▶ How can we achieve causal inference without randomization?
- ▶ Our necessary condition is always "The Treatment Assignment Mechanism is independent of potential outcomes"
- ▶ Can we find real-world treatment assignments that ignored potential outcomes?
 - ▶ "As good as random", "As-if random"

Non-Randomized Natural Experiments

- There are good reasons to be skeptical: Humans are *strategic* and anticipate potential outcomes

Non-Randomized Natural Experiments

- ▶ There are good reasons to be skeptical: Humans are *strategic* and anticipate potential outcomes
- ▶ But sometimes they are trying to alter outcomes *different to the potential outcomes we care about*

Non-Randomized Natural Experiments

- ▶ There are good reasons to be skeptical: Humans are *strategic* and anticipate potential outcomes
- ▶ But sometimes they are trying to alter outcomes *different to the potential outcomes we care about*
 - ▶ If these outcomes are not correlated with (/orthogonal to/'independent of') our own potential outcomes, we might be okay

Non-Randomized Natural Experiments

- ▶ There are good reasons to be skeptical: Humans are *strategic* and anticipate potential outcomes
- ▶ But sometimes they are trying to alter outcomes *different to the potential outcomes we care about*
 - ▶ If these outcomes are not correlated with (/orthogonal to/'independent of') our own potential outcomes, we might be okay
 - ▶ But we cannot test this

Non-Randomized Natural Experiments

- ▶ There are good reasons to be skeptical: Humans are *strategic* and anticipate potential outcomes
- ▶ But sometimes they are trying to alter outcomes *different to the potential outcomes we care about*
 - ▶ If these outcomes are not correlated with (/orthogonal to/'independent of') our own potential outcomes, we might be okay
 - ▶ But we cannot test this
 - ▶ We have to rely on qualitative evidence of the treatment assignment mechanism

Posner (2004)

- **Hypothesis:** Cultural differences become political cleavages when the cultural groups are large portions of the population

Posner (2004)

- ▶ **Hypothesis:** Cultural differences become political cleavages when the cultural groups are large portions of the population
- ▶ **Treatment:** Smaller country (relative to size of ethnic group)

Posner (2004)

- ▶ **Hypothesis:** Cultural differences become political cleavages when the cultural groups are large portions of the population
- ▶ **Treatment:** Smaller country (relative to size of ethnic group)
- ▶ **Control:** Larger country

Posner (2004)

- ▶ **Hypothesis:** Cultural differences become political cleavages when the cultural groups are large portions of the population
- ▶ **Treatment:** Smaller country (relative to size of ethnic group)
- ▶ **Control:** Larger country
- ▶ **Potential Outcomes:** Degree of political conflict between ethnic groups in larger/smaller countries

Posner (2004)

- ▶ **Hypothesis:** Cultural differences become political cleavages when the cultural groups are large portions of the population
- ▶ **Treatment:** Smaller country (relative to size of ethnic group)
- ▶ **Control:** Larger country
- ▶ **Potential Outcomes:** Degree of political conflict between ethnic groups in larger/smaller countries
- ▶ **Treatment Assignment Mechanism:** African borders that cross ethnic group boundaries

Posner (2004)

- ▶ African colonial borders assigned people to be 'Zambian' or 'Malawian'.

Posner (2004)

- ▶ African colonial borders assigned people to be 'Zambian' or 'Malawian'.
- ▶ Straight lines drawn with a ruler in Berlin

Posner (2004)

- ▶ African colonial borders assigned people to be 'Zambian' or 'Malawian'.
- ▶ Straight lines drawn with a ruler in Berlin
- ▶ Little knowledge of local geography or populations

Posner (2004)

- ▶ African colonial borders assigned people to be 'Zambian' or 'Malawian'.
- ▶ Straight lines drawn with a ruler in Berlin
- ▶ Little knowledge of local geography or populations
- ▶ Zambia-Malawi border defined by geography: by the watershed of the hills

Posner (2004)

- ▶ African colonial borders assigned people to be 'Zambian' or 'Malawian'.
- ▶ Straight lines drawn with a ruler in Berlin
- ▶ Little knowledge of local geography or populations
- ▶ Zambia-Malawi border defined by geography: by the watershed of the hills
- ▶ Splitting the Chewa and Tumbuka groups

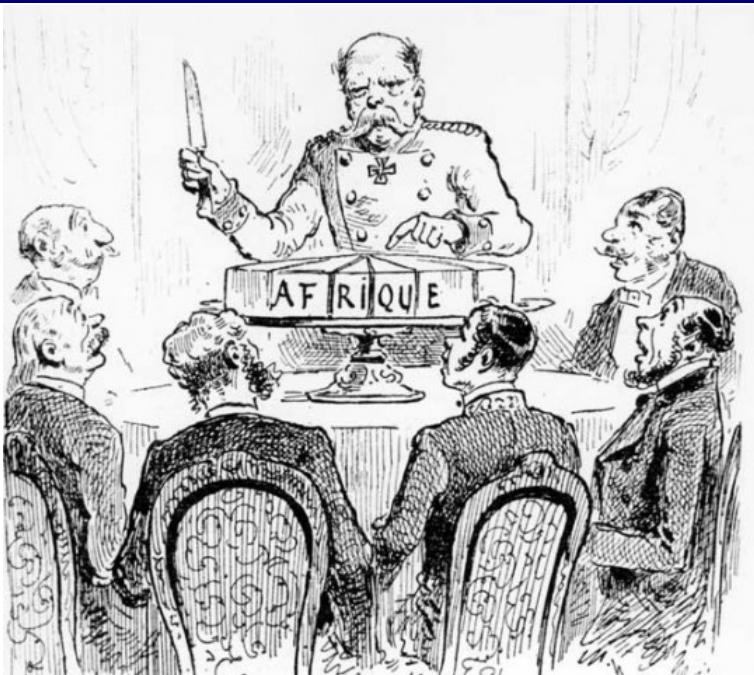


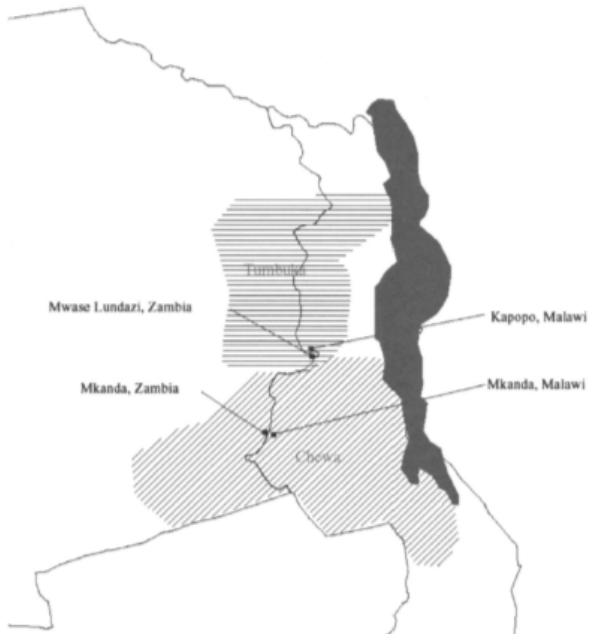
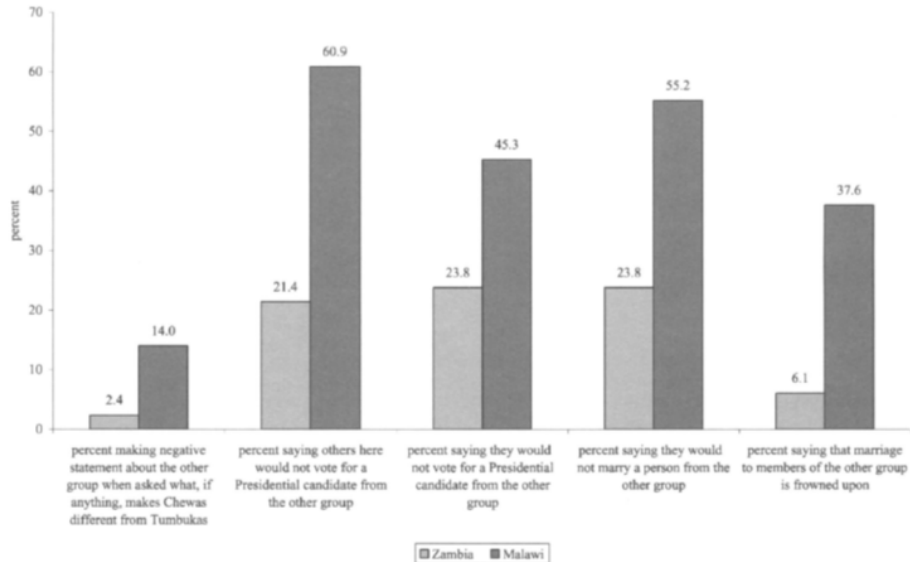
FIGURE 1. Research Sites

FIGURE 2. Chewa—Tumbuka Relations in Zambia and Malawi Compared



Posner (2004)

- What is treatment here?

Posner (2004)

- What is treatment here? Being in Zambia/Malawi

Posner (2004)

- ▶ What is treatment here? Being in Zambia/Malawi
- ▶ What is Posner interested in?

Posner (2004)

- ▶ What is treatment here? Being in Zambia/Malawi
- ▶ What is Posner interested in? Large ethnic groups relative to country size

Posner (2004)

- ▶ What is treatment here? Being in Zambia/Malawi
- ▶ What is Posner interested in? Large ethnic groups relative to country size
- ▶ But lots of things are different about Zambia!

Posner (2004)

- ▶ What is treatment here? Being in Zambia/Malawi
- ▶ What is Posner interested in? Large ethnic groups relative to country size
- ▶ But lots of things are different about Zambia!
- ▶ Eg. Zambia is *much* richer than Malawi due to copper revenues - maybe politics doesn't need to be as conflictual