Does Management Matter?

15.034 Econometrics for Managers
Final Project

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INTRODUCTION

Does Management Matter?

How does the **management** of a hospital affect **patient outcomes**?

Does Management Matter?

How does the **management** of a hospital affect **patient outcomes**?

D Y

Does Management Matter?

How does the **management** of a hospital affect **patient outcomes**?

D **Y**

Modeling as econometricians:

- Y = patient outcomes = heart attack mortality rates
- D = management = management z-score
- X = ?

DATA

World Management Survey: Hospital Data

3
years

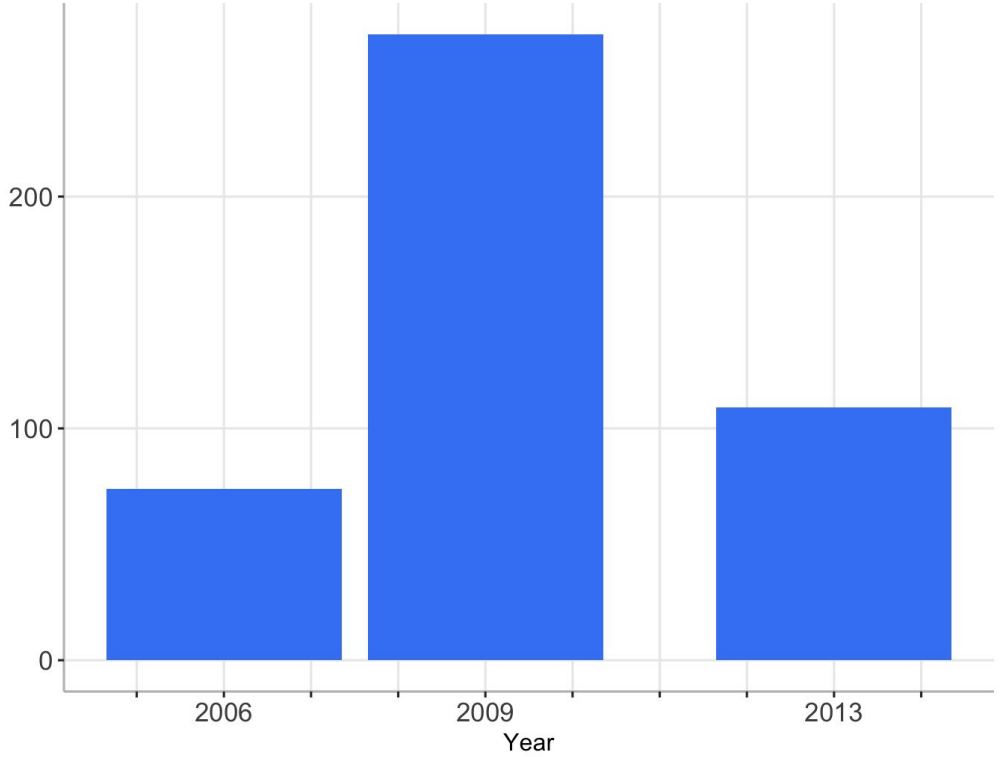
5
countries

453
hospitals

World Management Survey: Hospital Data

3

years



World Management Survey: Hospital Data

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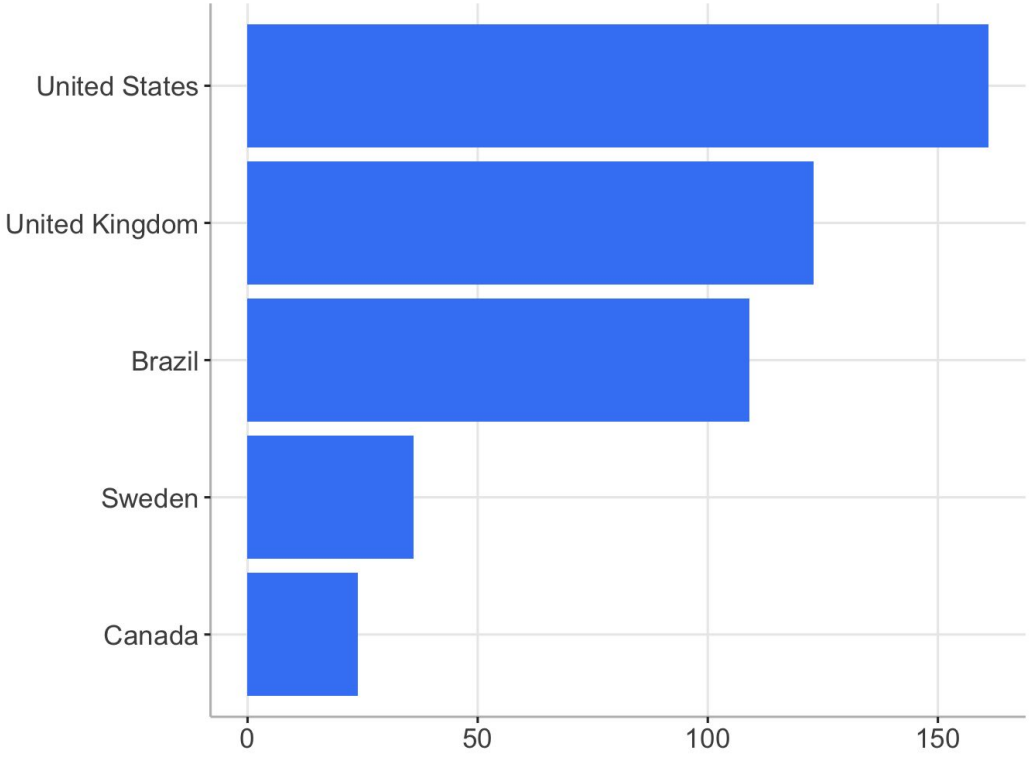

What Data Do We Have?

HOSPITAL
hospital ID
zami_rate
beds
for profit?
not for profit?
competitors

GEOGRAPHY
elevation
dist. to ocean/river
precipitation
temperature
country
region

M-B SCHOOL
M-B school ID
dist. to M-B school
time to M-B school
age of M-B school
QS ranking
offers PhD

MANAGEMENT
management
zmanagement
lmba
mba

OTHER
year (yy06, yy09)
survey reliability
analyst

What Are Our Y's and D's?

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Does management affect patient outcomes?

Y = patient outcomes = **zami_rate**
D = management = **zmanagement**

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Other management variables are too related to treatment **zmanagement** and risk overcontrolling. **Don't include.**

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Other hospital variables like number of beds and for-profit status help predict outcome **zami_rate** and will not overcontrol treatment **zmanagement**. **Include**.

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Studies show that higher temperatures can increase the rate of heart attacks, which impacts **zami_rate**. **Include.**

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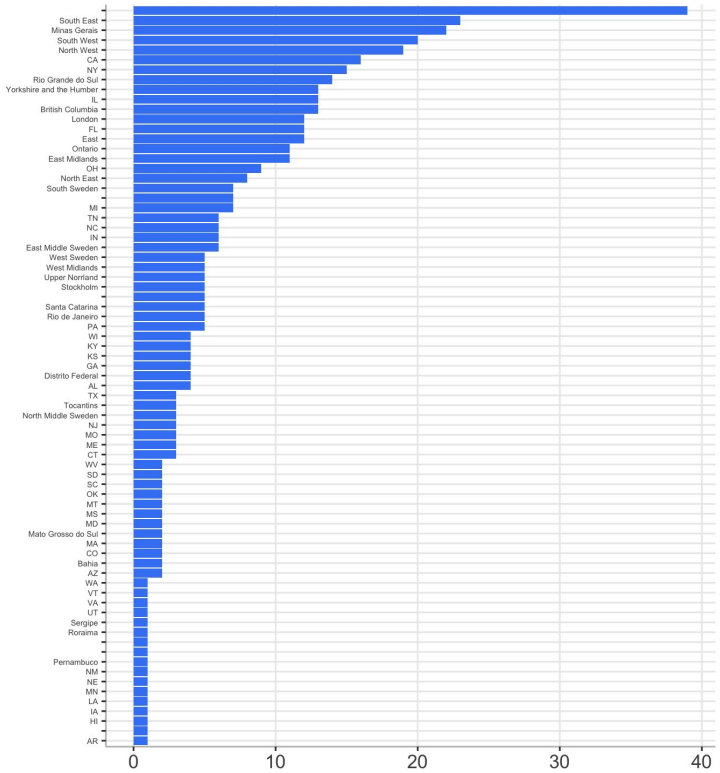
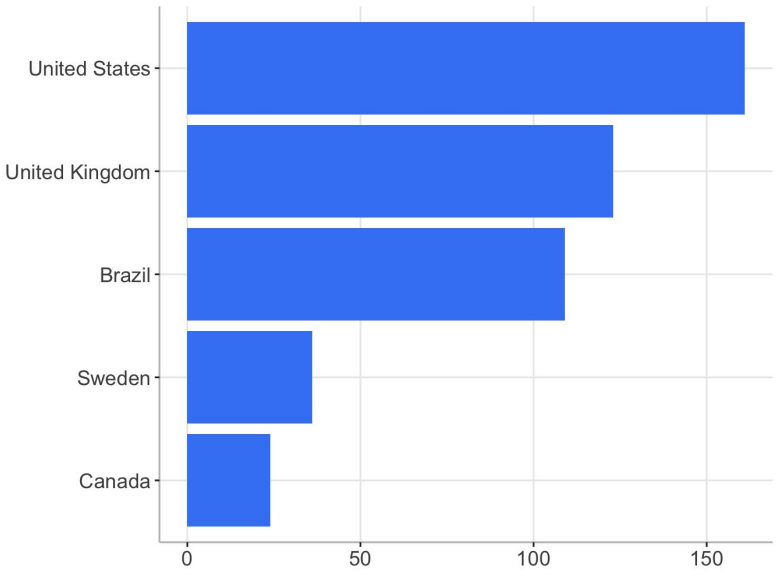
Country and region are both good possibilities for a fixed effect model, as our 5 countries may differ in many aspects that is endogenous.

What Are Our X's? Country vs Region

Regions



Countries



Some regions have too few observations. Let's use country.

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Region adds too much noise. Let's use country.

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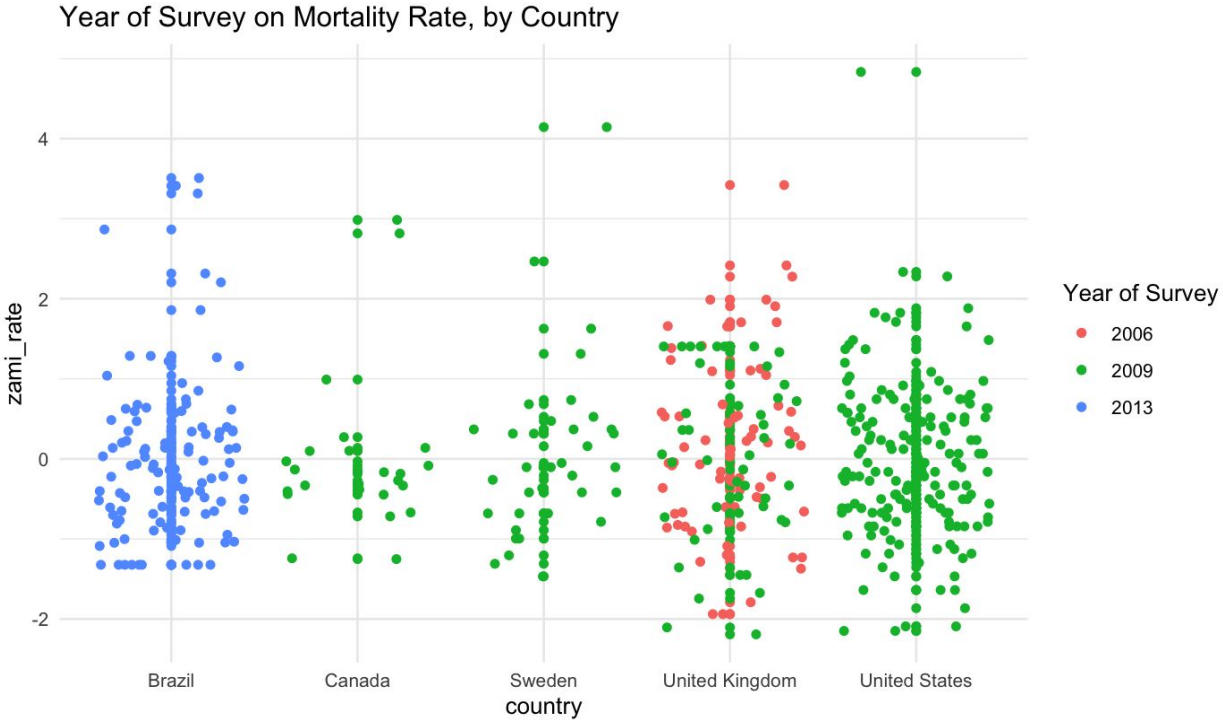
Might year be a good fixed effect to include?

What Are Our X's? Year?

Year and country are highly correlated; most countries are surveyed in only one year.

- 2006: UK
- 2009: Canada, Sweden, UK, US
- 2013: Brazil



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Year and country are too related. **Don't include.**

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The M-B school variables may act as good instruments.

- ↓ time/distance to M-B → ↑ share of graduates
- ↑ age of M-B → ↑ pronounced management practices

Distance is related to time, and ranking/PhD is related to age.

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Survey reliability (and the missingness of survey reliability) may speak to a hospital's overall quality, including **zmanagement** and **zami_rate**. **Include.**

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We will not be doing fixed effects per hospital / M-B school / analyst; it will be difficult to find within-variation for any.
Don't include.

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zami_rate
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GEOGRAPHY
~~elevation~~
~~dist. to ocean/river~~
~~precipitation~~
temperature^
country
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M-B SCHOOL
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Note we'll be using the log of some variables (*) to reduce standard errors, and we'll be including the missing indicator of some variables (^) as a complementary control when available.

MODELING

FIXED-EFFECT MODELING

Fixed-Effects Model

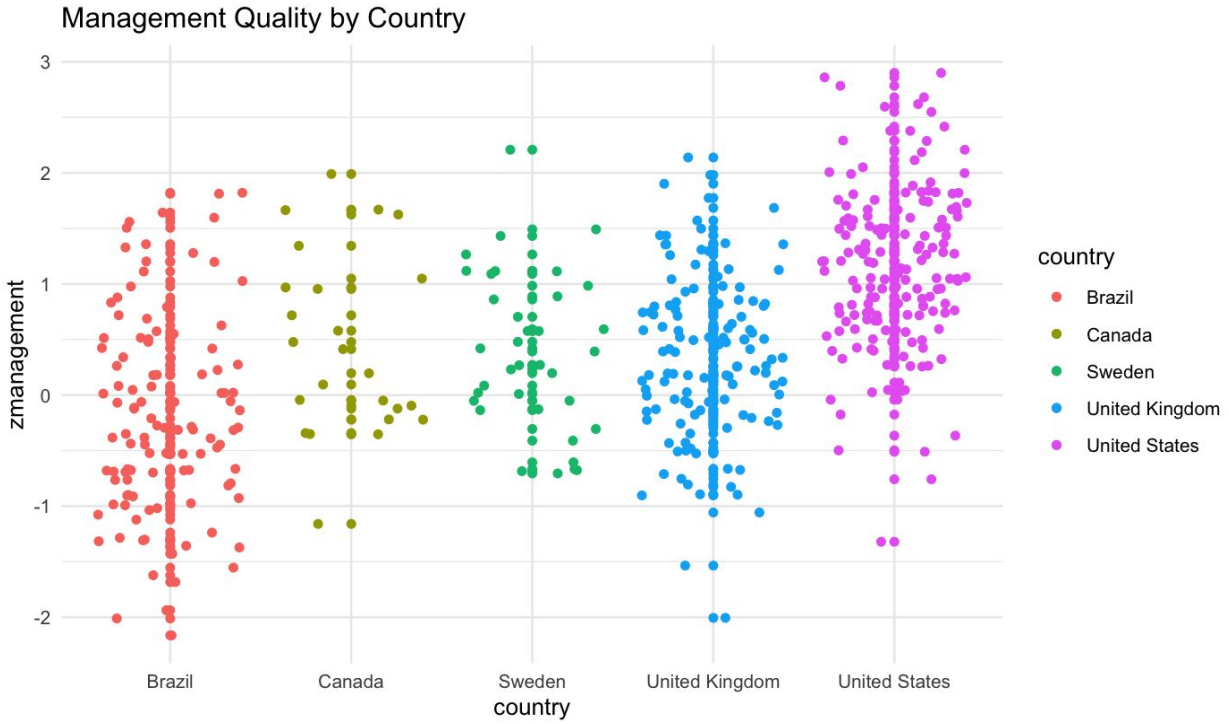
Recall: Fixed-effect models include D, X, and “categorical fixed effect” variables. This reduces variation per country that may be endogenous.

Here:

- Y = zami_rate
- D = zmanagement
- X = hospital controls, temperature, survey reliability
- FE = country (dummy variables)

Fixed-Effects Model: Why Country?

Management practices vary between countries.



Fixed-Effects Model: Why Country?

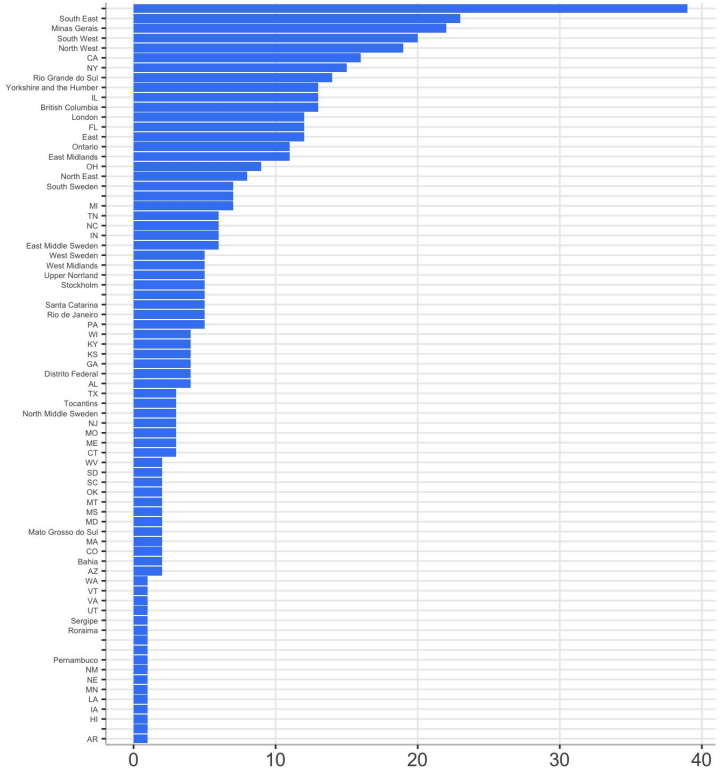
Management practices vary between countries.

(Statistically significantly.)

Country	Coefficient	Standard Error	P-Value
Intercept [Brazil]	-0.186	0.0743	0.0125
Canada	0.636	0.1750	0.0003
Sweden	0.575	0.1492	0.0001
United Kingdom	0.529	0.1021	3.3e-7
United States	1.33	0.0963	<2e-16

Fixed-Effects Model: Why Not Region?

Regions



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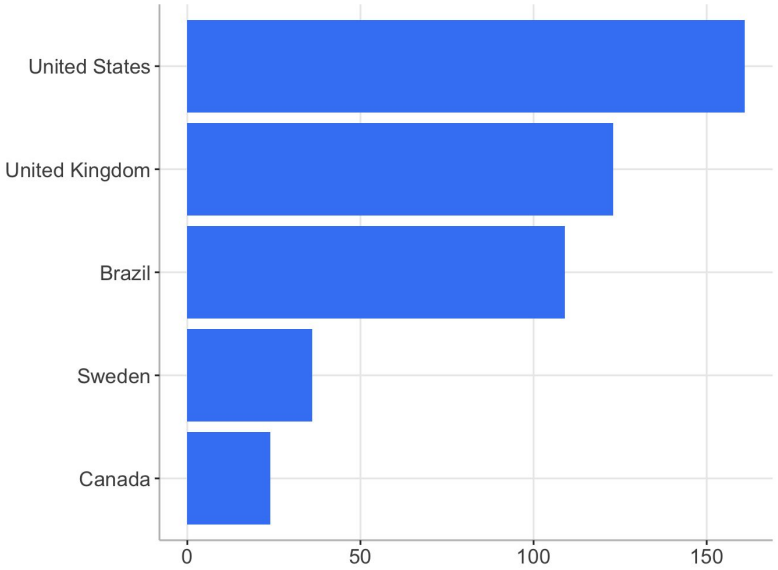
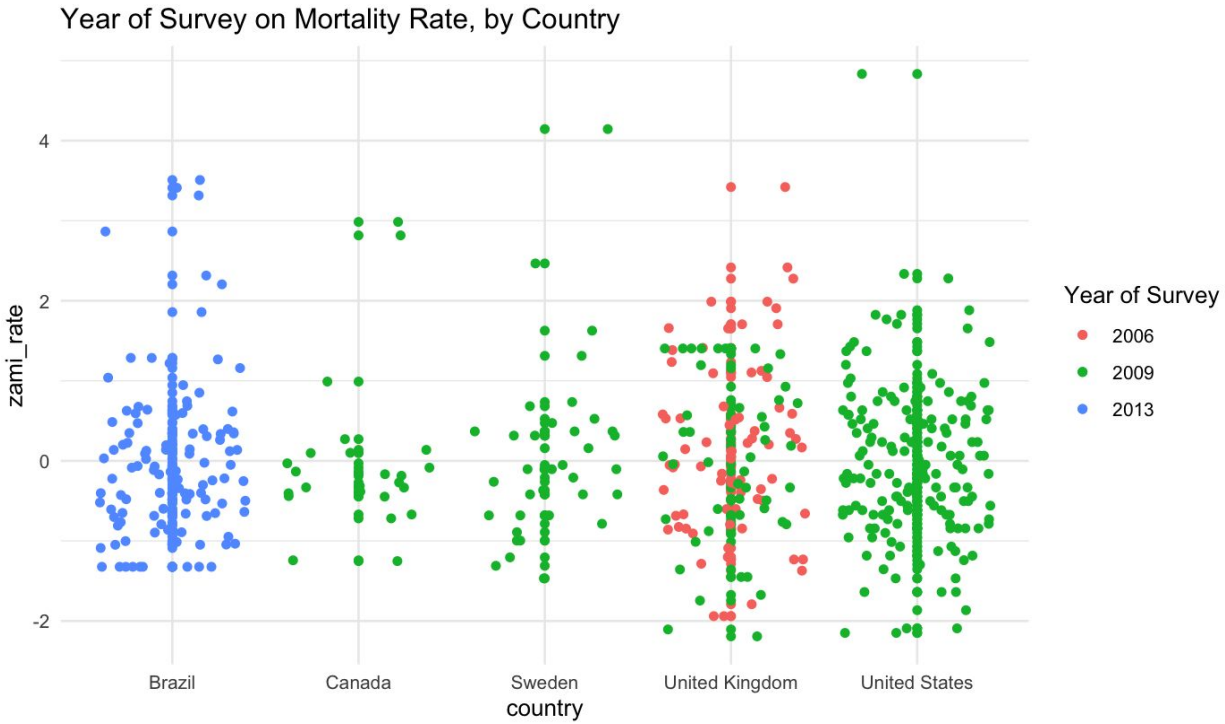


Recall: Region buckets are **too small**. Using region **increases standard error** and **decreases significance**.

Fixed-Effects Model: Why Not Year?



Recall:

Each country is already exclusively surveyed within one year (except UK).

Including year fixed effects **increases standard errors** and **decreases significance**.

Fixed-Effects Model

$$Y_{ic} = \beta_0 + \beta_1 D_{ic} + \beta_2 X_{ic} + \delta_c + \epsilon_{ic}$$

Y = zami_rate

D = zmanagement

X = hospital controls, temperature^, survey reliability^

δ = country fixed effects

Estimate via `plm(Y ~ D + X, model="within", index="country")`

Fixed-Effects Model

Variable	Coefficient	Standard Error	P-Value
zmanagement	-0.1824	0.06488	0.00516
hos_lbed	0.0087	0.00978	0.37461
hos_fprofit	-0.0351	0.21729	0.87201
hos_nfprofit	-0.2665	0.13385	0.04711
hos_numcompetitors	-0.1994	0.08638	0.16756
survey_reliability	0.0039	0.02651	0.88452
survey_reliability_miss	0.1929	2.85211	0.94610
grid_temp_new	0.0095	0.01496	0.52632
grid_temp_new_miss	0.6965	1.62950	0.66927

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Increasing management practices by 1 standard deviation **decreases heart attack mortality** by 0.1824 standard deviations.

Management matters!

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Our controls also have coefficients matching our original hypotheses.

INSTRUMENTAL VARIABLE MODELING

Instrumental Variable Model

What if zmanagement is endogenous?

- **Survey data** may lead to...
  - ↳ Selected sample bias (How were hospitals chosen?)
  - ↳ Measurement error of management scores (How was management measured?)

- There is a risk of **OVB**. For example, more affluent areas may...
  - ↳ Be inhabited by people who take care of themselves better
  - ↳ Have richer hospitals that can afford better management

Instrumental Variable estimation may alleviate some endogeneity concerns.

Instrumental Variable Model: Instruments

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Earlier, we agreed that M-B variables may be instruments.

- ↓ time/distance to M-B → ↑ share of graduates
- ↑ age of M-B → ↑ pronounced management practices

Distance is related to time, and ranking/PhD is related to age.

Instrumental Variable Model: Instruments

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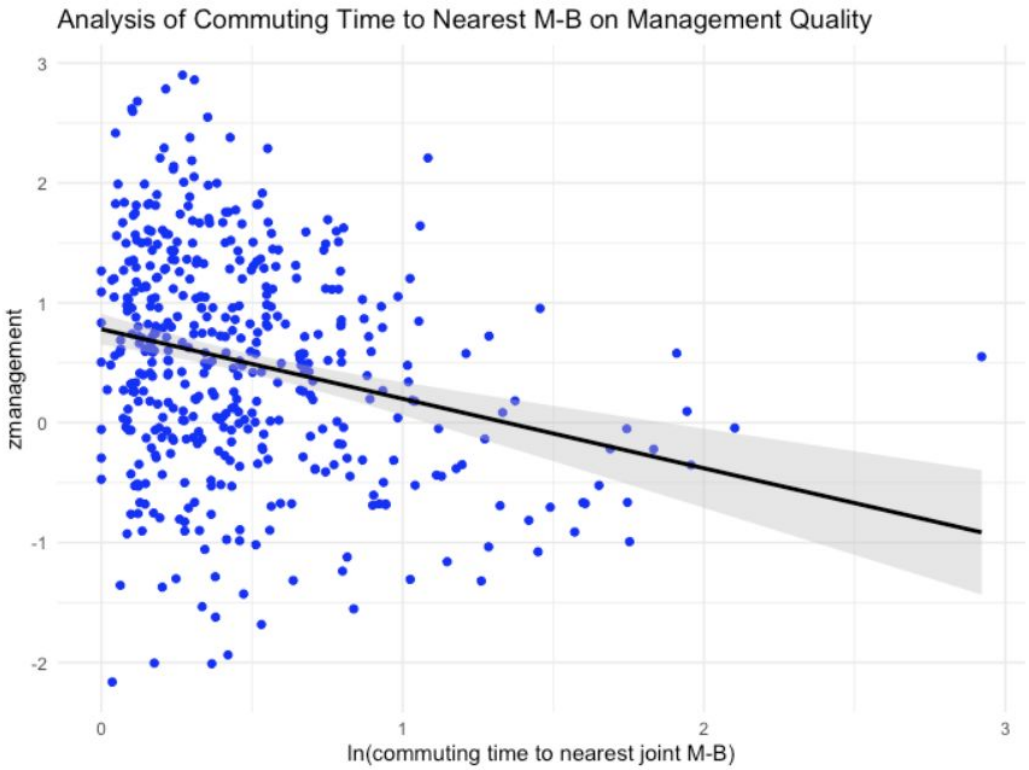
Instrumental Variable Model: Time to M-B

`logcom_ttime` = ln(commuting time to nearest combined Medical-Business school)

Hospitals **closer to M-B schools** will have **more graduates** from that school working there.

↑ **zmanagement**
Unrelated to **zami_rate**

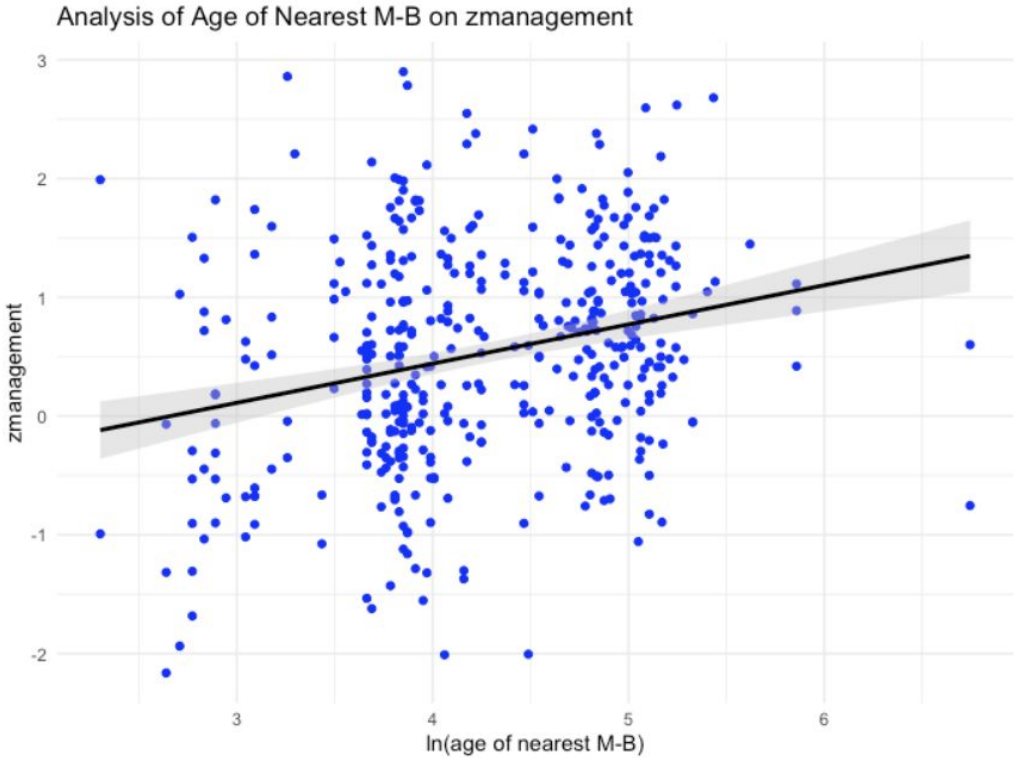


Instrumental Variable Model: Age of M-B

`com_lage` =
ln(age of nearest combined Medical-Business school)

Older M-B schools will have had **more time to bring expertise** into the community.

↑ **zmanagement**
Unrelated to **zami_rate**



Instrumental Variable Model: First Stage

$$D = \gamma_0 + \gamma_1 Z + \gamma_2 X + \omega$$

D = zmanagement

Z = time to M-B school, age of M-B school^

X = hospital controls, temperature^, survey reliability^, country

Estimate via `lm(D ~ Z + X)`

Instrumental Variable Model: First Stage

Variable	Coefficient	Standard Error	P-Value
logcom_ttime	-0.313476	0.099266	0.00170
com_lage	-0.007723	0.059524	0.89683
com_lage_miss	-0.825983	6.122994	0.89275

Note: Controls are included in model, but not in table for brevity.

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The coefficients of our instruments are consistent with our hypotheses!

Note: Controls are included in model, but not in table for brevity.

Instrumental Variable Model: Second Stage

$$Y = \beta_0 + \beta_1 \hat{D} + \beta_2 X + \epsilon$$

Y = zami_rate

D = predicted zmanagement from instruments

X = hospital controls, temperature^, survey reliability^, country

Estimate via `ivreg(Y ~ D + X | Z + X)`

Instrumental Variable Model: Second Stage

Variable	Coefficient	Standard Error	P-Value
zmanagement	-1.043021	0.513398	0.0428
Canada	0.885774	0.635189	0.1639
Sweden	0.873678	0.609245	0.1523
United Kingdom	0.946296	0.561131	0.0924
United States	1.524804	0.783257	0.0522
hos_lbed	0.005460	0.011728	0.6418
hos_fprofit	0.265066	0.312200	0.3963
hos_nfprofit	-0.075137	0.194510	0.6995
hos_numcompetitors	-0.017080	0.118724	0.8857
survey_reliability	0.104658	0.067228	0.1202
survey_reliability_miss	10.998751	7.212318	0.1280
grid_temp_new	0.007524	0.017750	0.6719
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Increasing management practices by 1 standard deviation **decreases heart attack mortality** by 1.04 standard deviations.

Management still matters!

CONCLUSION

Remaining Concerns

Endogeneity

- Survey data
  - ↳ Sample selection bias
  - ↳ Measurement error
- OVB from unobserved characteristics
  - ↳ Capabilities
  - ↳ Patients

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Significance

- Instrumental Variable model has an F-statistic p-value of 0.4013
  - ↳ May not be able to draw firm conclusions from this model

Main Findings

Fixed Effects

Increasing zmanagement by 1 **decreases** zami_rate by **0.1824**.

Instrumental Variables

Increasing zmanagement by 1 **decreases** zami_rate by **1.0456**.

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Instrumental Variables

Increasing zmanagement by 1 **decreases** zami_rate by **1.0456**.

Robust results by controlling for relevant factors on hospital and geography.

Potential mechanism:

Better Management → **Better Organization & Knowledge Sharing** → **More Prompt Responses in Life-Saving Scenarios**

MANAGEMENT DOES MATTER!

APPENDIX

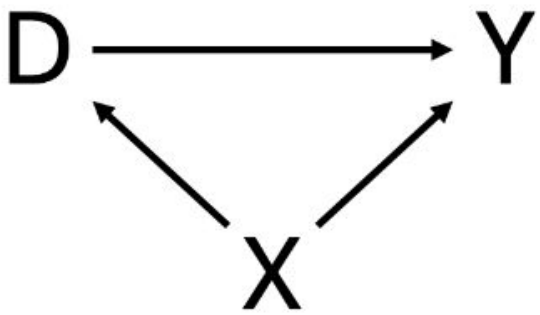

Figure 1: *A causal relationship where the control, X, influences the variable of interest, D, and the outcome of interest, Y. Here, it* ***is*** *appropriate to control for X*

Figure 1: *Showing that management quality differs across countries, see Appendix C: Table X for more verbose results with a simple linear regression*

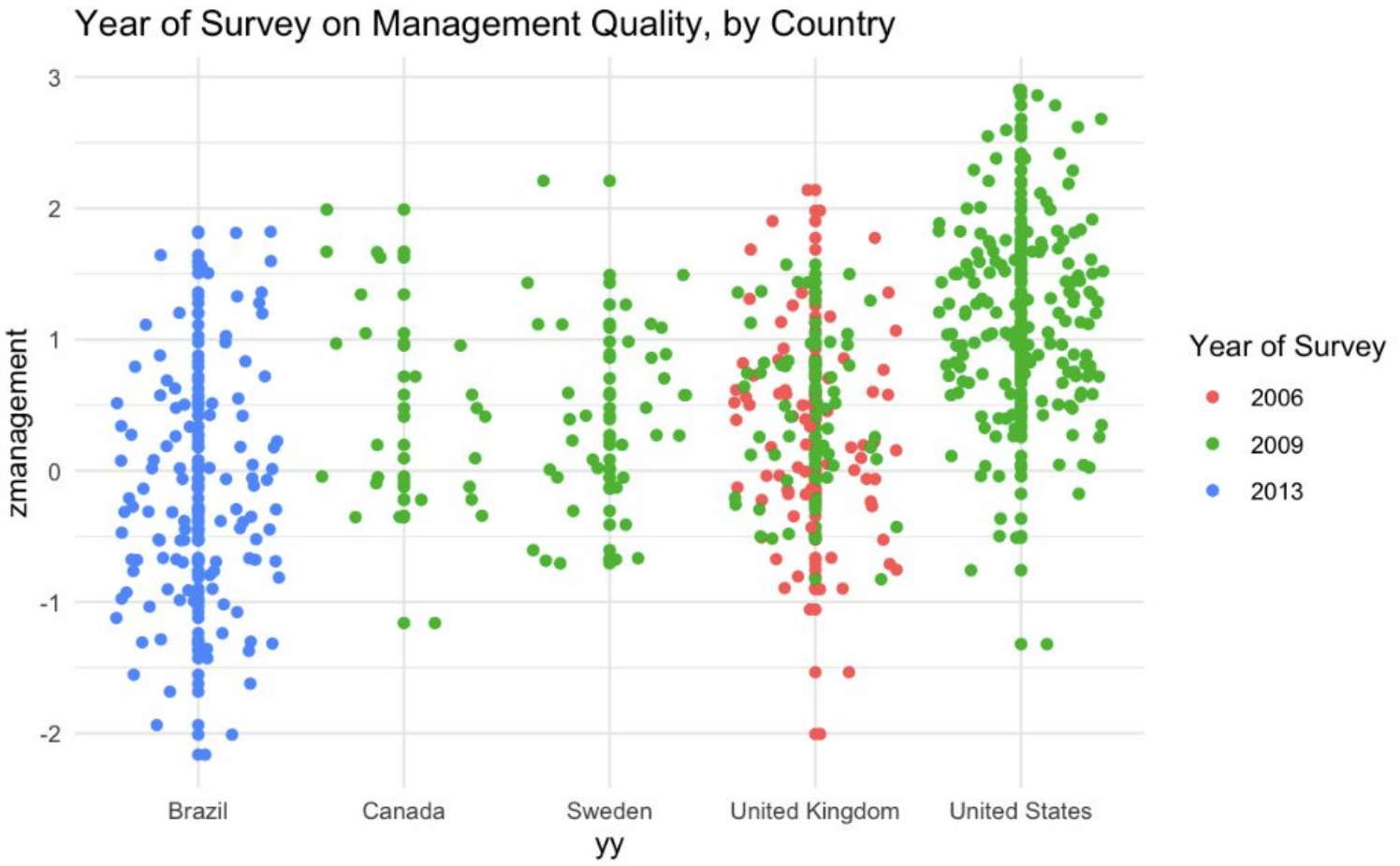

Figure 2: *Showing that management differs across countries and has limited change overtime*

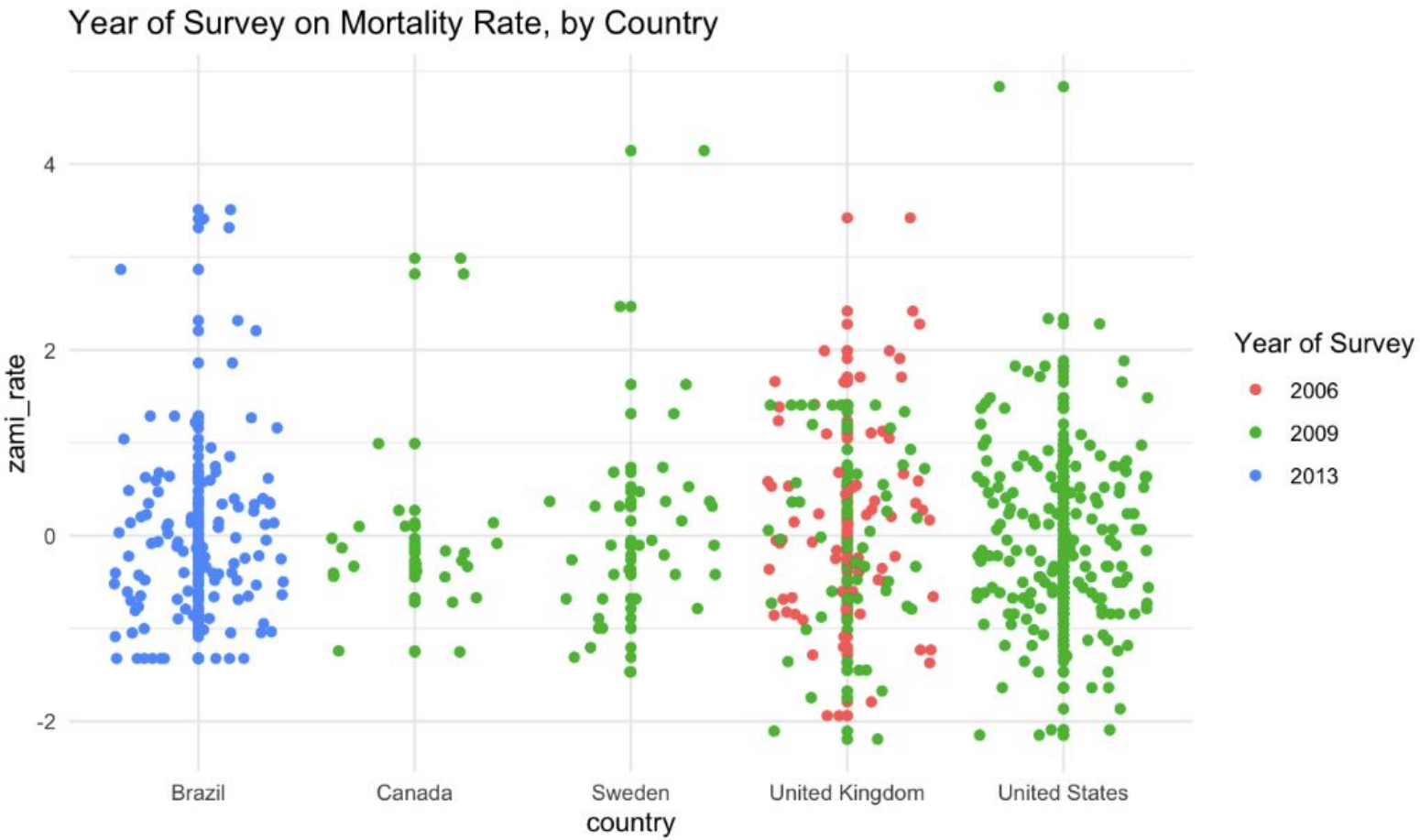

Figure 3: *Showing the year that each country was surveyed*

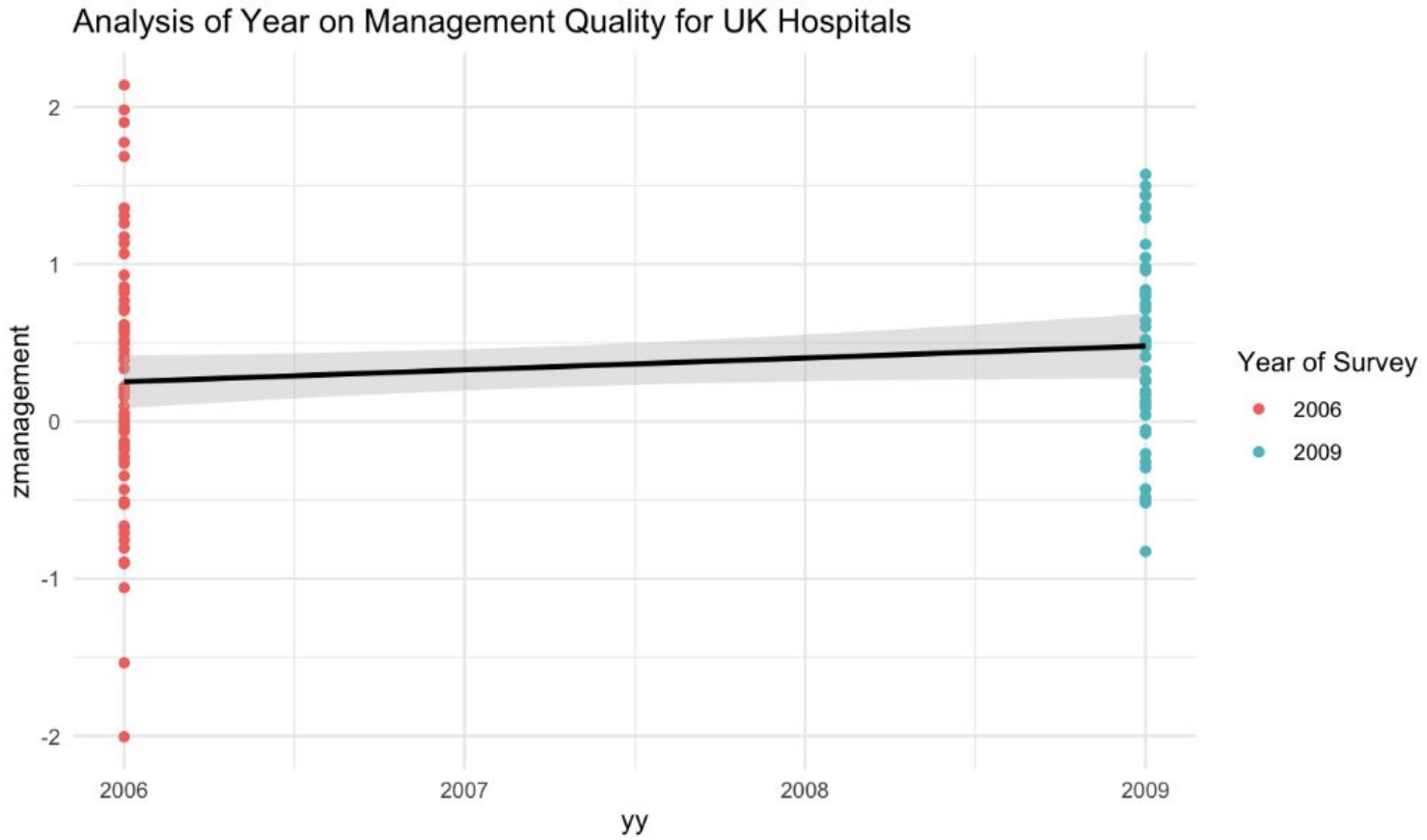

Figure 4: *Illustrating that no significant relationship exists between "yy" and "zmanagement" for UK Hospitals when comparing survey results from 2006 to 2009*

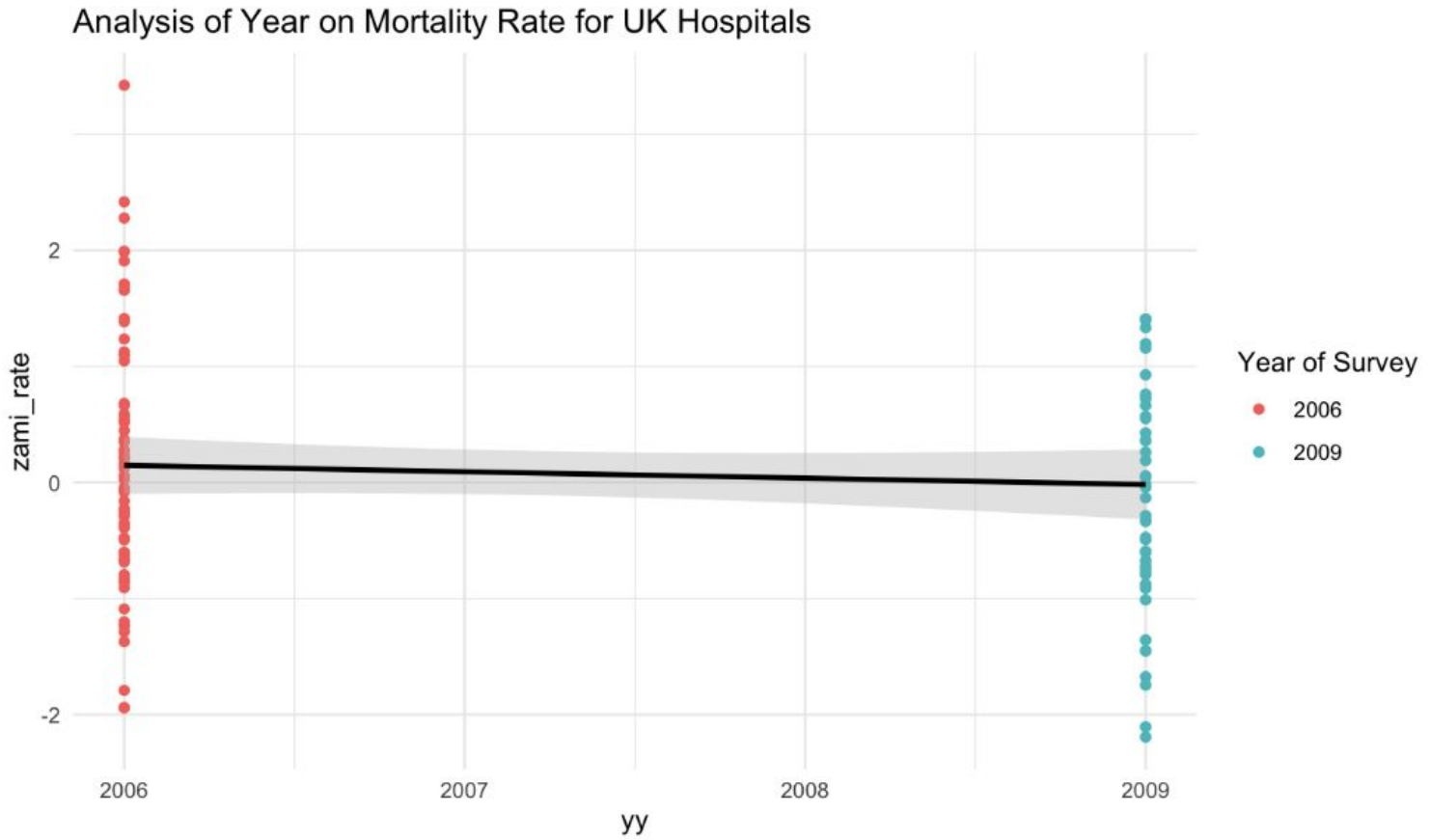

Figure 5: *Illustrating that no significant relationship exists between "yy" and "zami_rate" for UK Hospitals when comparing survey results from 2006 to 2009*

Figure 6: *Showing that the log of the commuting time to the nearest joint Medical and Business school is potentially related to management scores.*

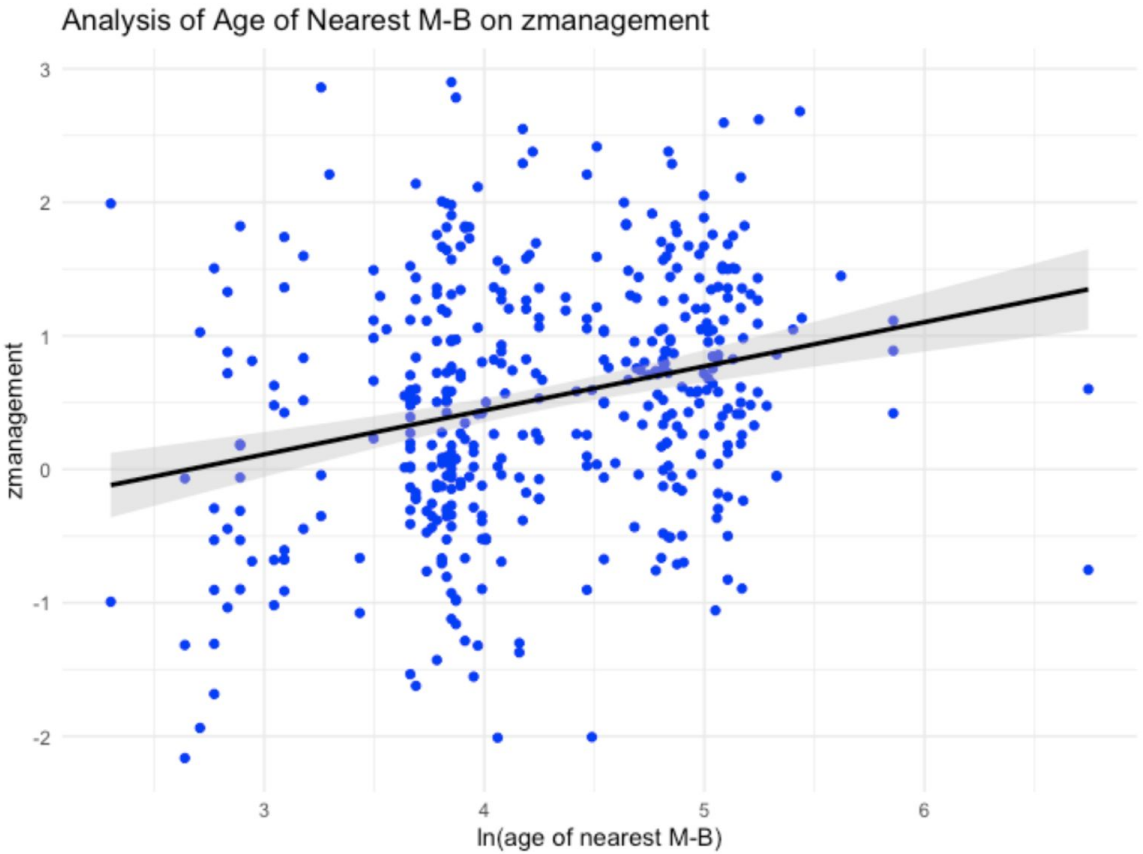

Figure 7: *Showing that the log of the age of the nearest joint Medical and Business school is potentially related to management scores.*

Country	Coefficient	Standard Error	P-Value
Intercept [Brazil]	-0.186	0.0743	0.0125
Canada	0.636	0.1750	0.0003
Sweden	0.575	0.1492	0.0001
United Kingdom	0.529	0.1021	3.3e-7
United States	1.33	0.0963	<2e-16

Table 1: *Coefficients when predicting management quality as a function of country lm(zmanagement ~ country), see Appendix B: Figure 1 for related visualization*

Variable	Coefficient	Standard Error	P-Value
zmanagement	-0.1824	0.06488	0.00516
hos_lbed	0.0087	0.00978	0.37461
hos_fprofit	-0.0351	0.21729	0.87201
hos_nfprofit	-0.2665	0.13385	0.04711
hos_numcompetitors	-0.1994	0.08638	0.16756
survey_reliability	0.0039	0.02651	0.88452
survey_reliability_miss	0.1929	2.85211	0.94610
grid_temp_new	0.0095	0.01496	0.52632
grid_temp_new_miss	0.6965	1.62950	0.66927

Table 2: *Summary statistics of final fixed-effects model in R*

plm(zami_rate ~ zmanagement + hos_lbed + hos_fprofit + hos_nfprofit + hos_numcompetitors + survey_reliability + survey_reliability_miss + grid_temp_new + grid_temp_new_miss, model="within", index="country")

Variable	Coefficient	Standard Error	P-Value
logcom_ttime	-0.313476	0.099266	0.00170
com_lage	-0.007723	0.059524	0.89683
com_lage_miss	-0.825983	6.122994	0.89275

Table 3: *Coefficients for stage 1 of the instrumental variables model. Controls are included in the model, but not shown in the table for brevity.*

stage_1_lm <- lm(zmanagement ~ logcom_ttime + com_lage + com_lage_miss + as.factor(country) + hos_lbed + hos_fprofit + hos_nfprofit + hos_numcompetitors + survey_reliability + survey_reliability_miss + grid_temp_new + grid_temp_new_miss)

Variable	Coefficient	Standard Error	P-Value
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Table 4: *Summary statistics of the final instrumental variables model in R*

reg_iv <- ivreg(zami_rate ~ zmanagement + as.factor(country) + hos_lbed + hos_fprofit + hos_nfprofit + hos_numcompetitors + survey_reliability + survey_reliability_miss + grid_temp_new + grid_temp_new_miss

| logcom_ttime + com_lage + com_lage_miss + as.factor(country) + hos_lbed + hos_fprofit + hos_nfprofit + hos_numcompetitors + survey_reliability + survey_reliability_miss + grid_temp_new + grid_temp_new_miss,

data=data)