Re-Evaluating the Effect of Jesuit Missions on Present-Day Human Capital

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Topics in Macroeconometrics · Project Presentation

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Recap

Using BMA to Evaluate the Model Setup

Spatial Scope

Spatial Methods

What Lies Ahead

What was this about again?

In his paper, Valencia Caicedo (2019) finds **persistent effects on present-day human capital** in localities where **Jesuits had established a mission** 300 years earlier.

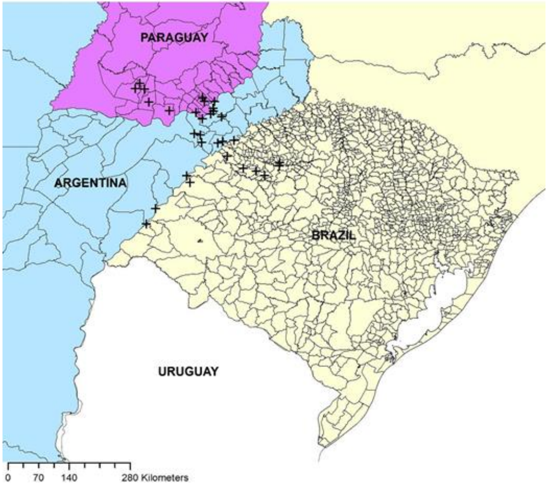

Figure I from Valencia Caicedo (2019)

(A Third of) Table II from Valencia Caicedo (2019)

	Illiteracy	
	(1)	**(2)**
Mission distance	0.0105***	0.0112**
	(0.004)	(0.005)
	{0.004}	{0.005}
Geo controls	No	Yes
State fixed effects	Yes	Yes
Observations	547	548
Within R^2	0.037	0.068
R^2	0.042	0.073

Note: Robust standard errors in parentheses and Conley standard errors in curly brackets.

*** $p < 0.01$, ** $p < 0.05$.

What Do I Want to Investigate?

Variables

- The **mission distance** coefficient is not consistently positive.
- FVC conducts some robustness checks, but other small changes sometimes lead to the effect changing or vanishing.

Space (geographic, not model)

- Distance is accounted for **linearly**.
- The mission distance coefficient **becomes insignificant** when changing that.
- It might also make sense to consider, e.g., spatial autocorrelation.

Varying the Distance Measure: Original Model

	Illiteracy			
	(1)	(2)	(3)	(4)
distmiss	0.011**			
	(0.005)			
distmiss_log		0.078		
		(0.289)		
distmiss_exp			−3.293	
			(2.082)	
distmiss_gauss				−1.631
				(1.246)
Geo Controls	Yes	Yes	Yes	Yes
Observations	548	548	548	548
R^2	0.073	0.063	0.067	0.066
Adjusted R^2	0.049	0.038	0.043	0.041
Residual Std. Error (df = 533)	3.912	3.934	3.924	3.927
Note:				*p<0.1; **p<0.05; ***p<0.01

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How to Deal with Distance

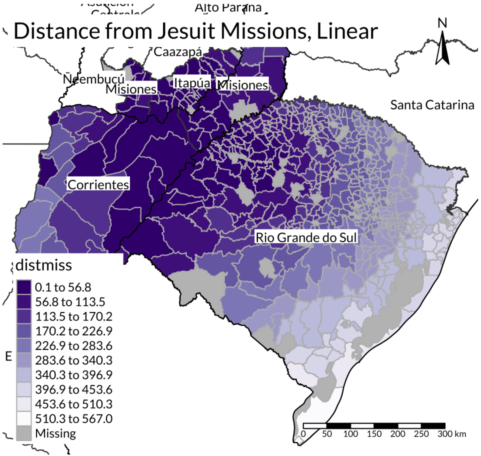
Distance Measures

- **Linear distance**, just as in the original paper
- **Exponential distance**, with $\lambda = \frac{1}{200}$
- **Logarithmic distance**
- **Gaussian distance**, with $\exp\left(-\frac{d^2}{2 \cdot 100^2}\right)$

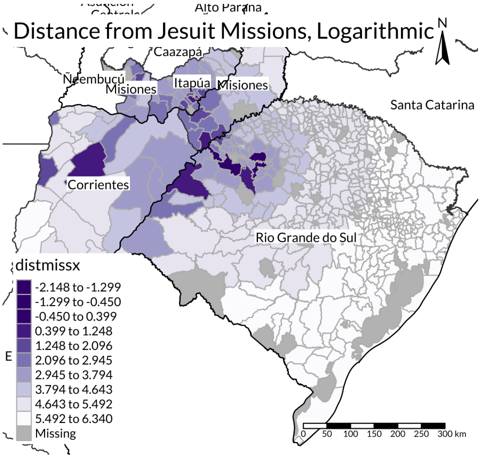
Fixed Inclusion?

- **Naively averaging** over all possible models in the model space yields a **low PIP** for *any* distance measure.
- I **fix the distance measure** and average over that model subspace. Even a non-robust determinant may be causally related to the outcome.

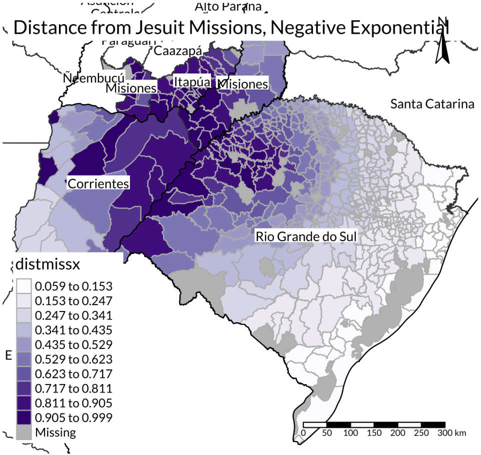
Linear Distance



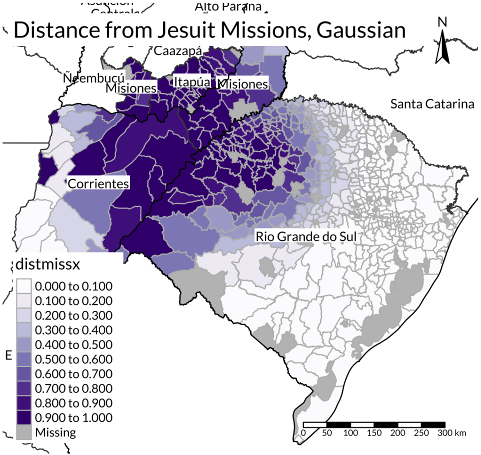
Logarithmic Distance



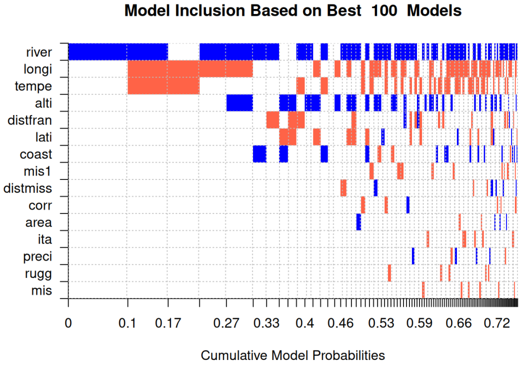
Exponential Distance

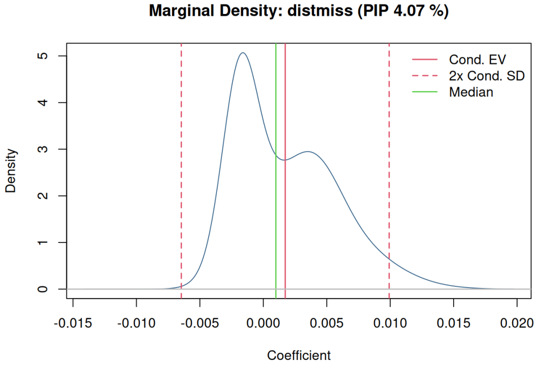


Gaussian Distance



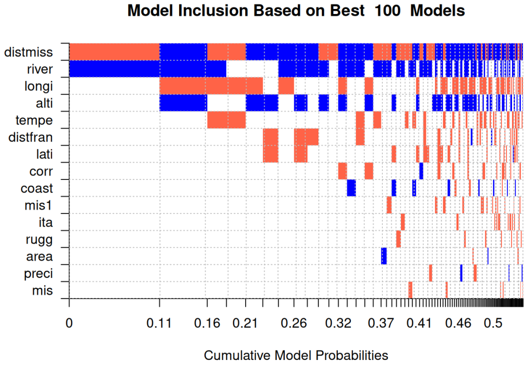
Linear Distance

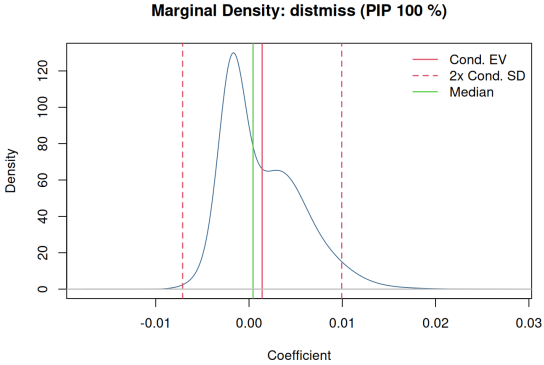




show all tables and figures

Linear Distance, Fixed Inclusion





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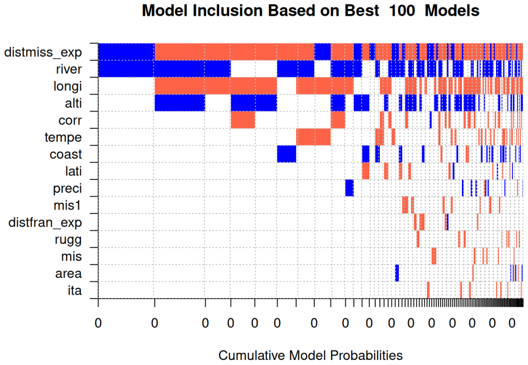
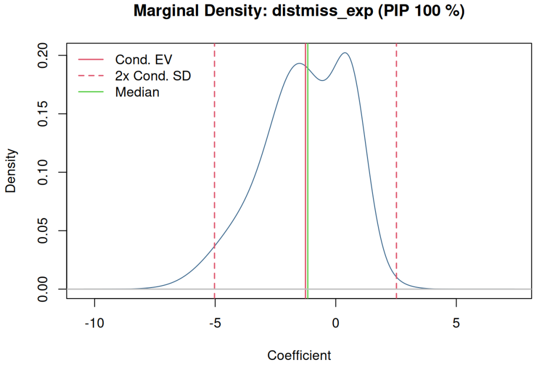
Exponential Distance, Fixed Inclusion





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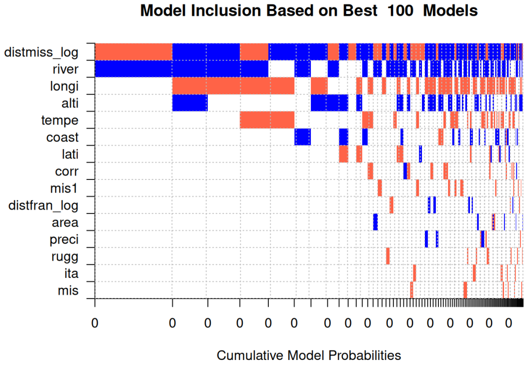
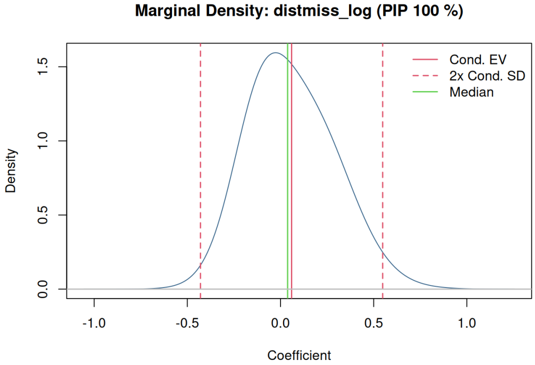
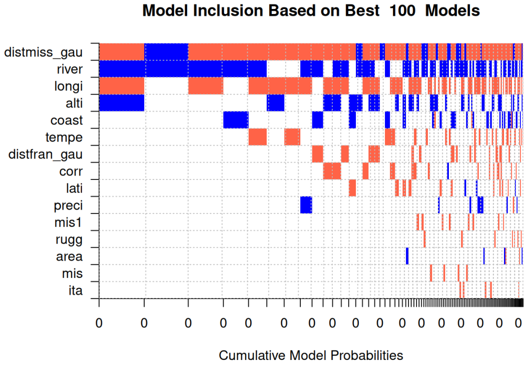
Logarithmic Distance, Fixed Inclusion

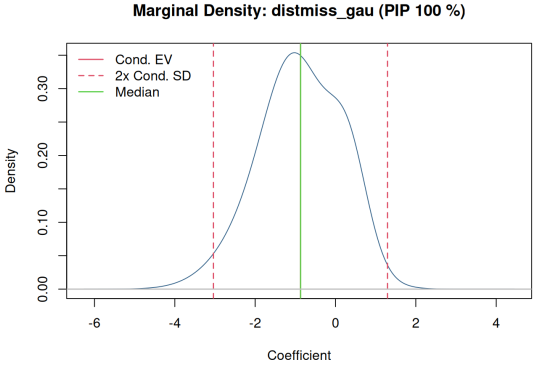




show all tables and figures

Gaussian Distance, Fixed Inclusion





show all tables and figures

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What Lies Ahead

Back to the Original Map

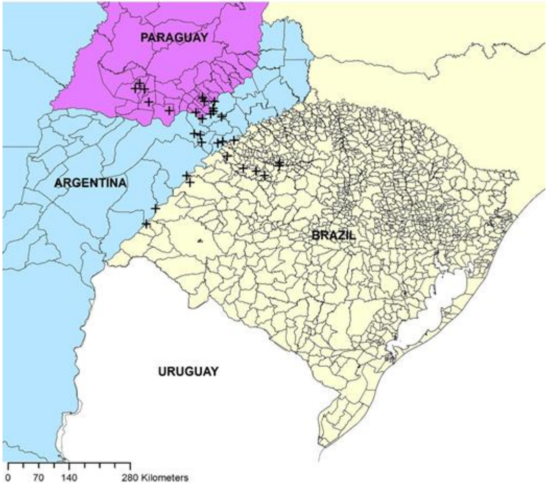
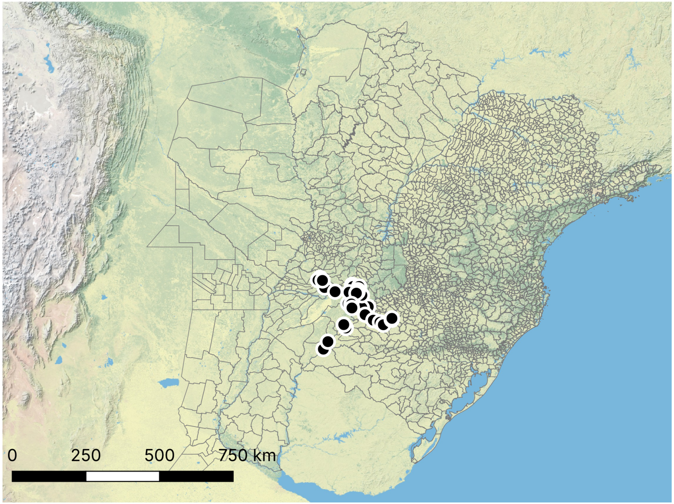


Figure I from Valencia Caicedo (2019)

The original dataset contains a **spatially unbalanced** selection of localities.

Especially linear distance may be **overly sensitive** to observations far away from the missionary region.

Let's Extend the Sample



Spatially extended sample

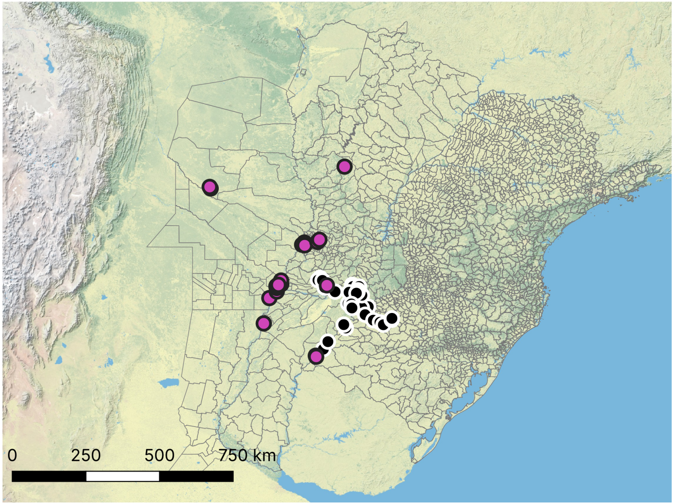
Therefore, I **collected data** for surrounding states in Brazil and Argentina as well as the entirety of Paraguay.

(Uruguay might also be interesting.)

Data Sources

- **Geographic characteristics** are taken from GADM (2023)
  - Area, longitude, latitude, distance calculation
- **Climate data** is from Fick and Hijmans (2017)
  - Temperature, precipitation
- **Elevation** is taken from Farr et al. (2007)
- **Ruggedness** is taken from Amatulli et al. (2020)
- **River streams** are taken from Allen and Pavelsky (2018)

Other Things that Happened Around that Area



Black: Jesuit Missions; Pink: Battles

Missions are somewhat **clustered**, and municipalities farther away have similar distances to the closest mission.

Mapping **battles of the Paraguay War** (1864–1870) yields some overlap with the missionary area.

Regression Results with Extended Data Set

(Dep.: illiteracy)	**Mission Distance**	**Both Variables**	**Battle Distance**
distmiss	0.0029**	0.0100***	
	(0.0011)	(0.0015)	
distbattle		-1.510***	-0.5942***
		(0.1980)	(0.1401)
Observations	2,202	2,202	2,202
R^2	0.33385	0.35119	0.33646
Adjusted R^2	0.32215	0.33949	0.32481

Heteroskedasticity-robust standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1* show full table

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Ways to Treat Space

- **Space** occurs in the models from the paper in various instances: **coordinates** as explanatories, linear **distances**, and Conley **standard errors** as a robustness check.
- It may make sense to more **explicitly** account for a **spatial network**.
- The following models are estimated with an order-one queen **contiguity matrix** and otherwise unchanged from the original. They serve only as an illustration.
- Next steps are revising the **specification** and varying the **matrices** (e.g. distance decay matrix).

SLX Results

(Dep.: illiteracy)	SLX No Controls	SLX Geo Controls
distmiss	-0.004	0.003
	(0.007)	(0.009)
lag.distmiss	0.005***	0.005**
	(0.002)	(0.002)
Observations	556	556
R^2	0.080	0.168
Adjusted R^2	0.054	0.122
Residual Std. Error	3.913 (df = 540)	3.770 (df = 526)
F Statistic	3.120*** (df = 15; 540)	3.662*** (df = 29; 526)
Note:		*p<0.1; **p<0.05; ***p<0.01

SDM Results

(Dep.: illiteracy)	**SDM No Controls**
distmiss	-0.007
	(0.005)
lag.distmiss	0.002**
	(0.001)
Observations	556
Log Likelihood	-1,395.697
σ^2	7.805
Akaike Inf. Crit.	2,827.395
Wald Test	2,150.868*** (df = 1)
LR Test	287.349*** (df = 1)

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Still to Do

- To average over different distance measures, it would be beneficial to be able to **restrict** the model space to models with **only one distance measure**.
- It may make sense to impose a **prior on the decay parameter**(s) instead of fixing them.
- **SDM** and the **SLX** models require a more careful implementation.
- It would be nice to be able to **add variables**, but suitable variables (e.g. initial population density) are hard to find.

References (1)

Allen, G. H., & Pavelsky, T. M. (2018). Global River Widths from Landsat (GRWL) Database. https://doi.org/10.5281/ZENODO.1297434

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Farr, T. G., Rosen, P. A., Caro, E., Crippen, R., Duren, R., Hensley, S., Kobrick, M., Paller, M., Rodriguez, E., Roth, L., Seal, D., Shaffer, S., Shimada, J., Umland, J., Werner, M., Oskin, M., Burbank, D., & Alsdorf, D. (2007).The Shuttle Radar Topography Mission. *Reviews of Geophysics*, *45*(2). https://doi.org/10.1029/2005rg000183

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