

DEMOGRAPHIC WINTER IS COMING...



Mancinelli, Marchesin, Sisti, Venanzi

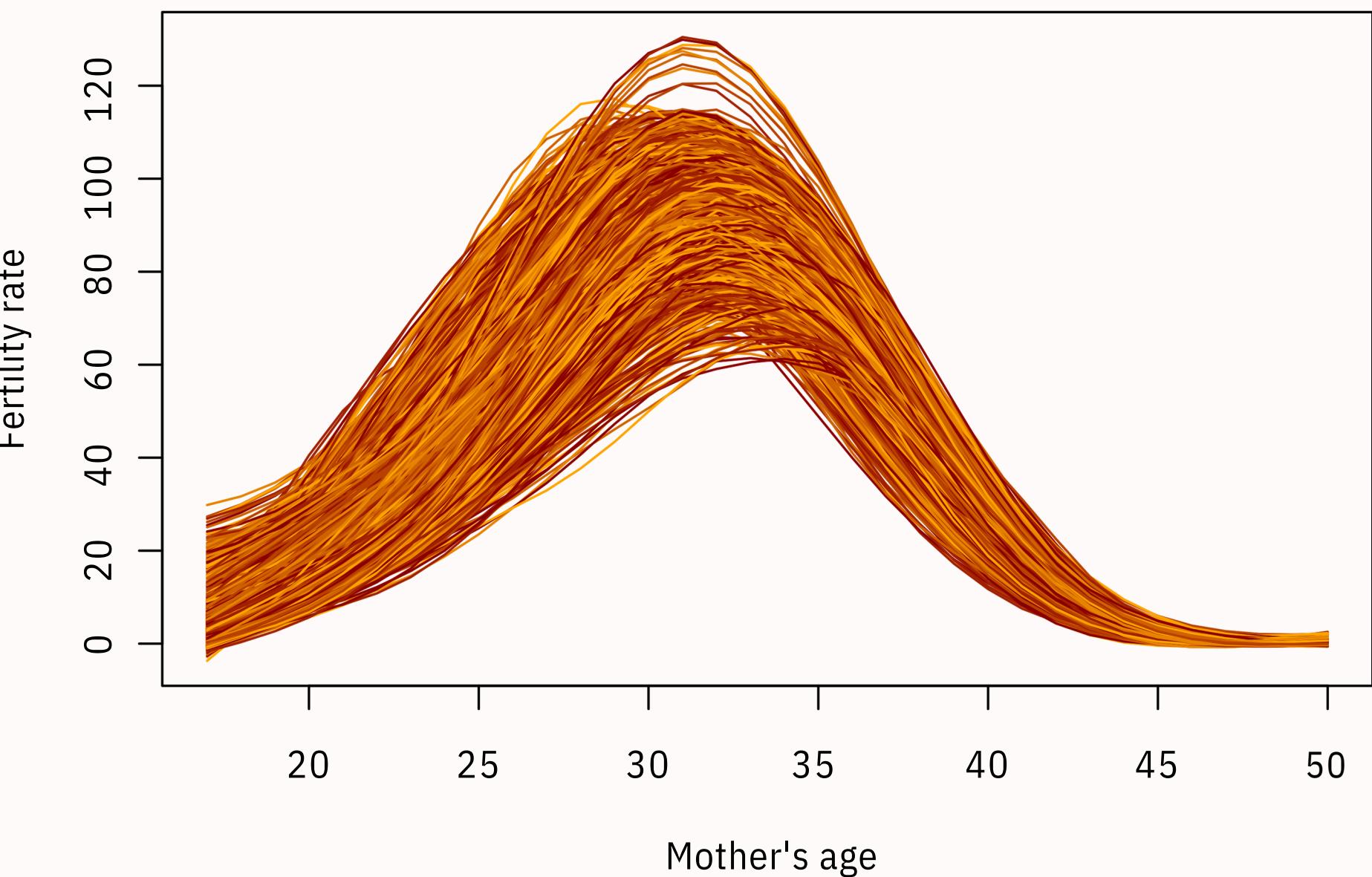
RESEARCH QUESTIONS

How can we ensure a **stable birth rate** despite the trend towards **delayed fertility**?

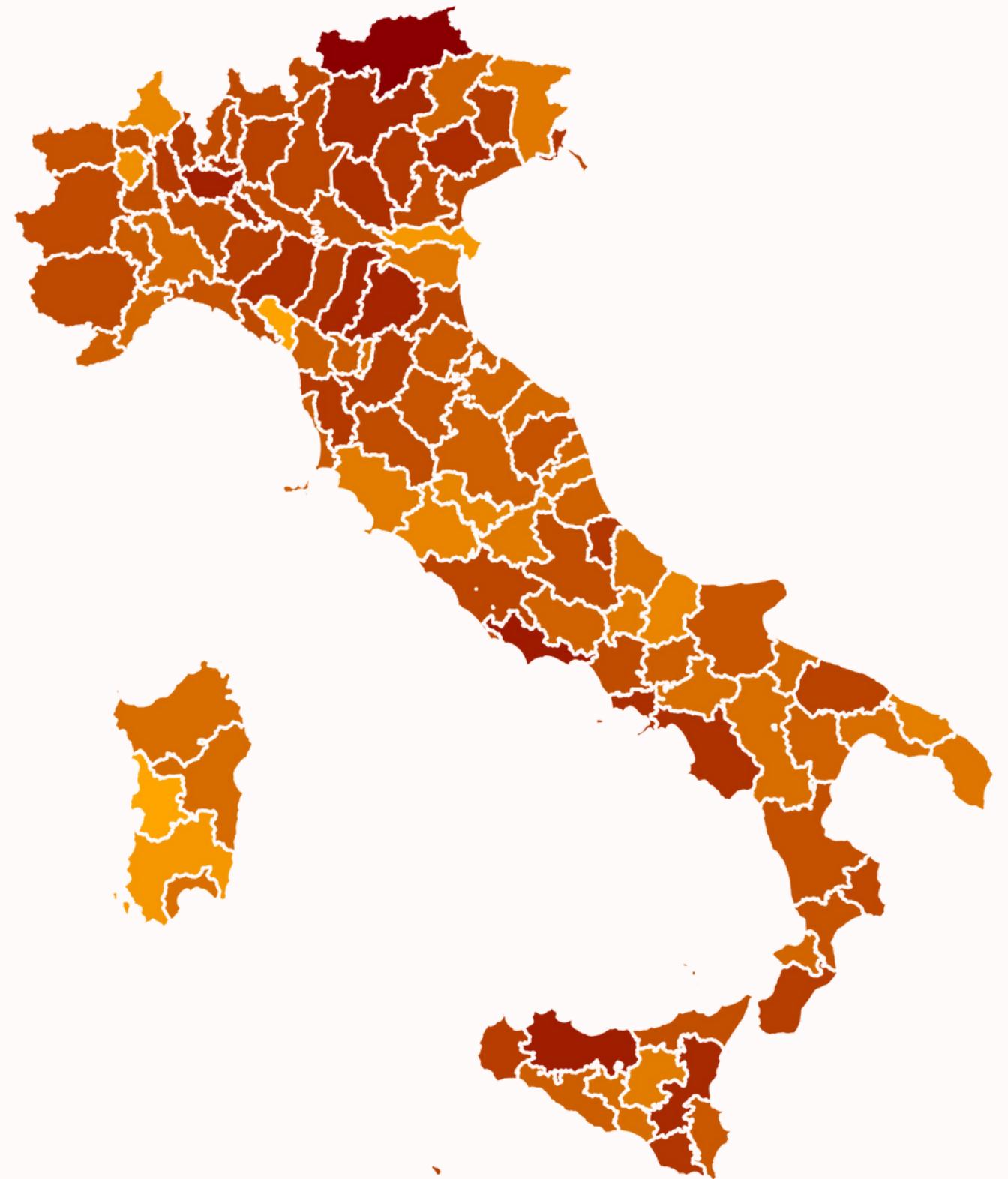
What **effective measures** can be taken to ensure that this problem does not affect the number of newborns?

THE DATA

- ISTAT dataset
- 2002-2021
- Italian Provinces
- Women's ages from 17 to 50
- Fertility rates



MEI OF NOWADAYS CURVES



MEI for provinces

0.19 0.8

The darker the province is coloured, the higher is the curve

MATHEMATICAL FRAMEWORK

FDA approach: $f_{ij} : \mathbb{R} \rightarrow \mathbb{R}$

Noisy measurements:

$$n_{ijk} = f_{ij}(k) + \varepsilon_{ijk}$$

$$i = 2002, \dots, 2021$$

$$j = Agrigento, \dots, Viterbo$$

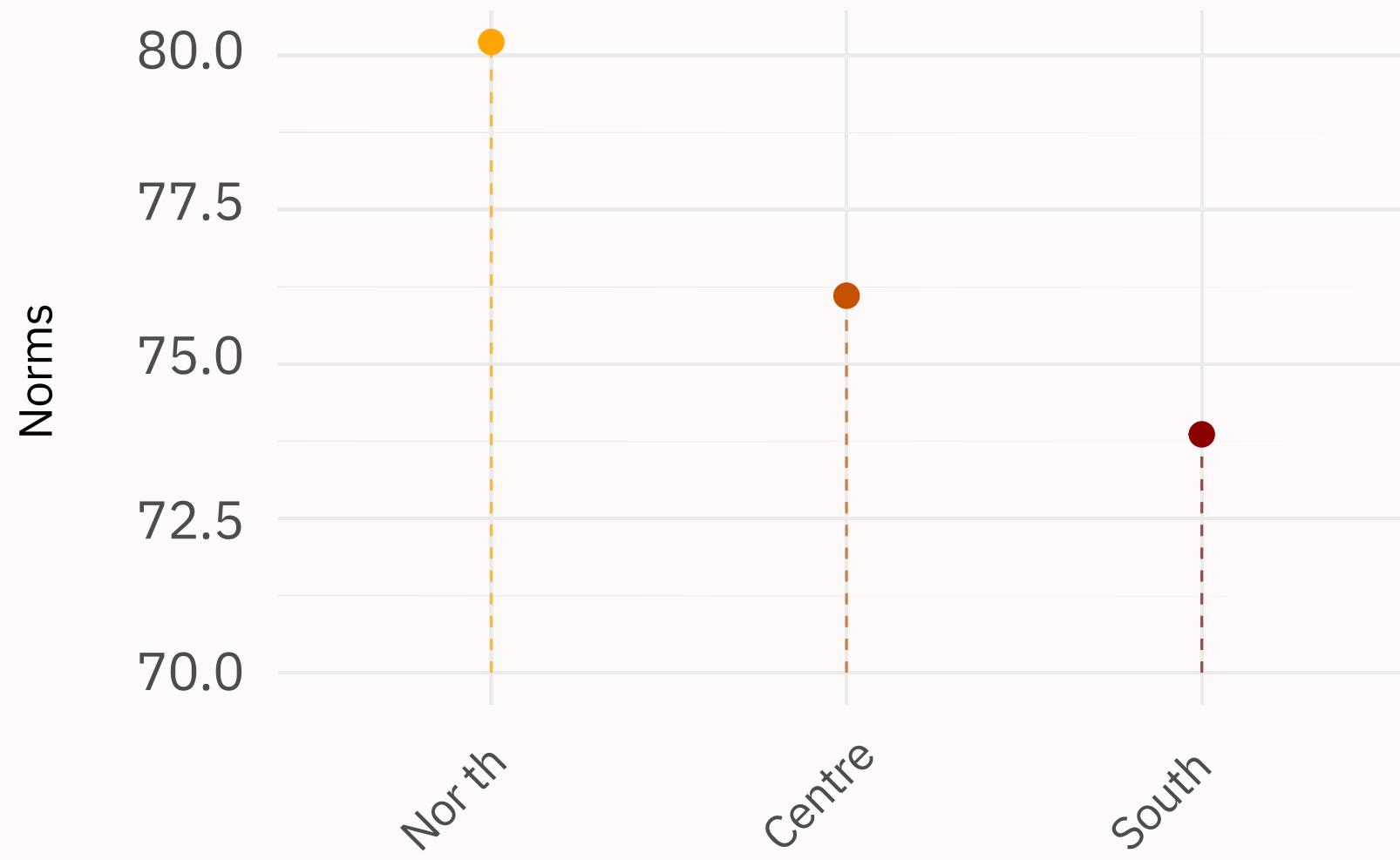
$$k = 17, \dots, 50$$

Smoothing of the curves

$$\mathcal{P}(\lambda) = \int_{17}^{50} (f_{ij}^{(')})^2$$

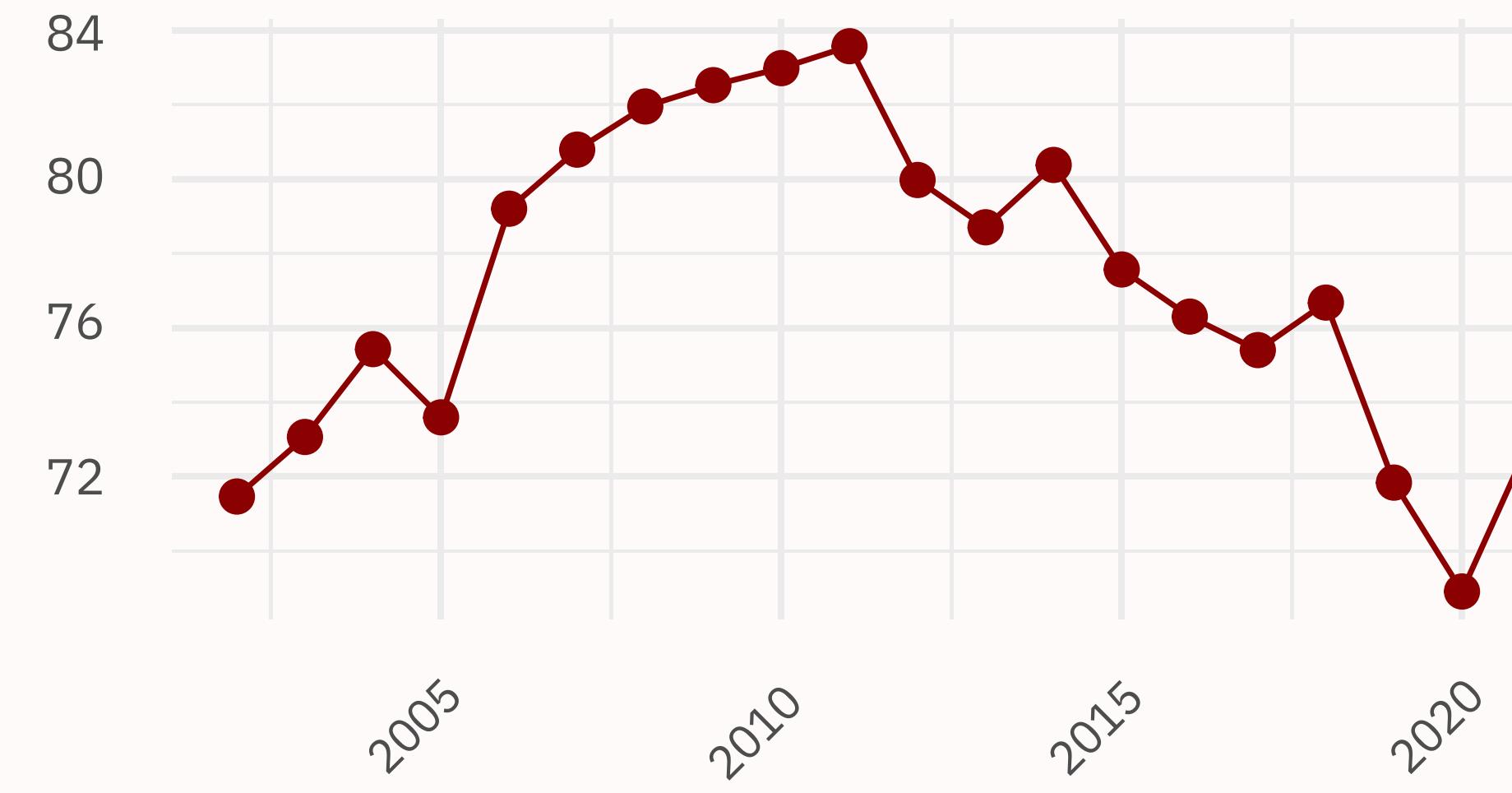
GEO-TEMPORAL DIFFERENCES

Standardized norms of medians



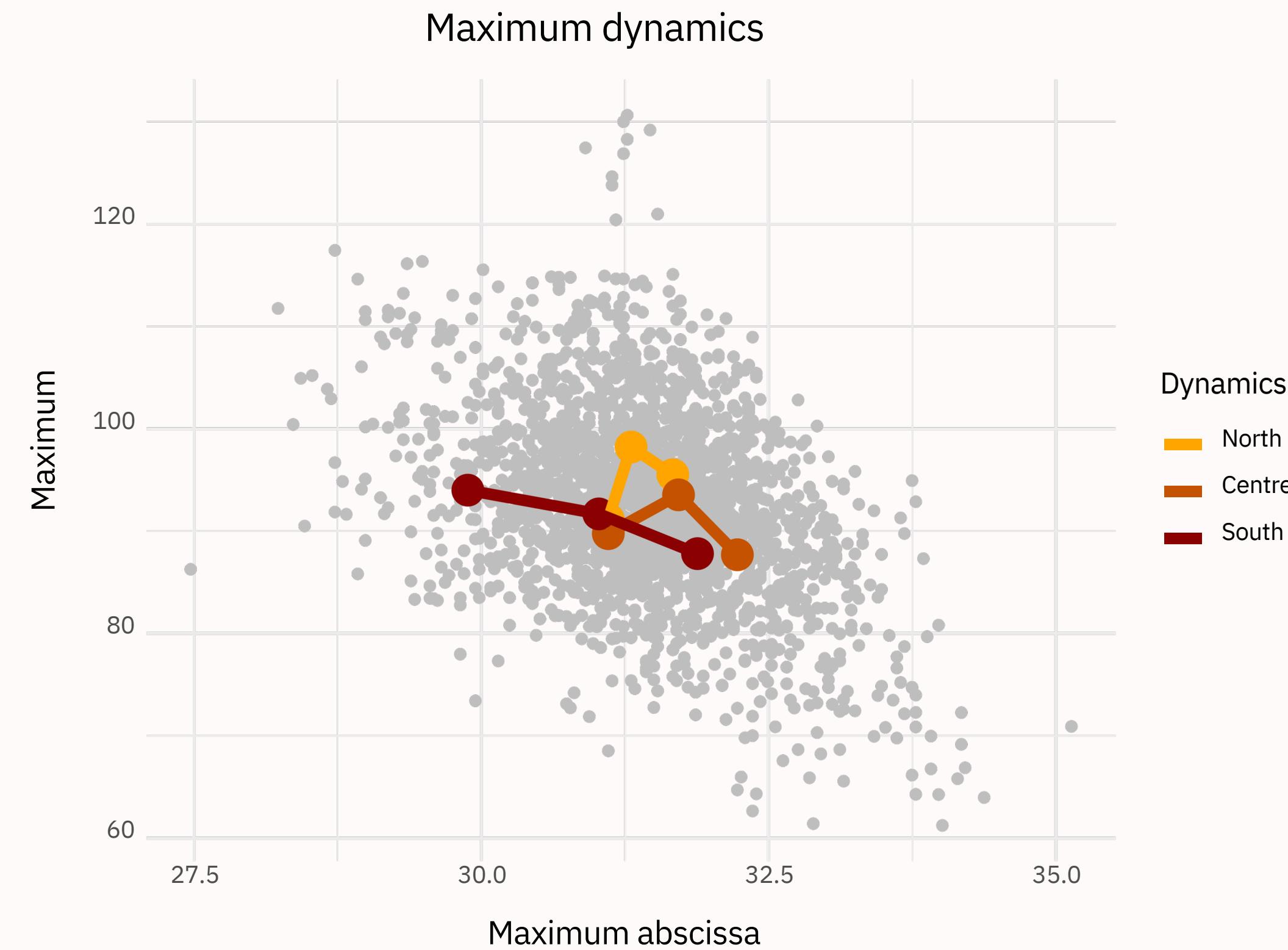
L^2 norm of the medians grouped for geographic region

Standardized norms of medians



L^2 norm of the medians grouped for year

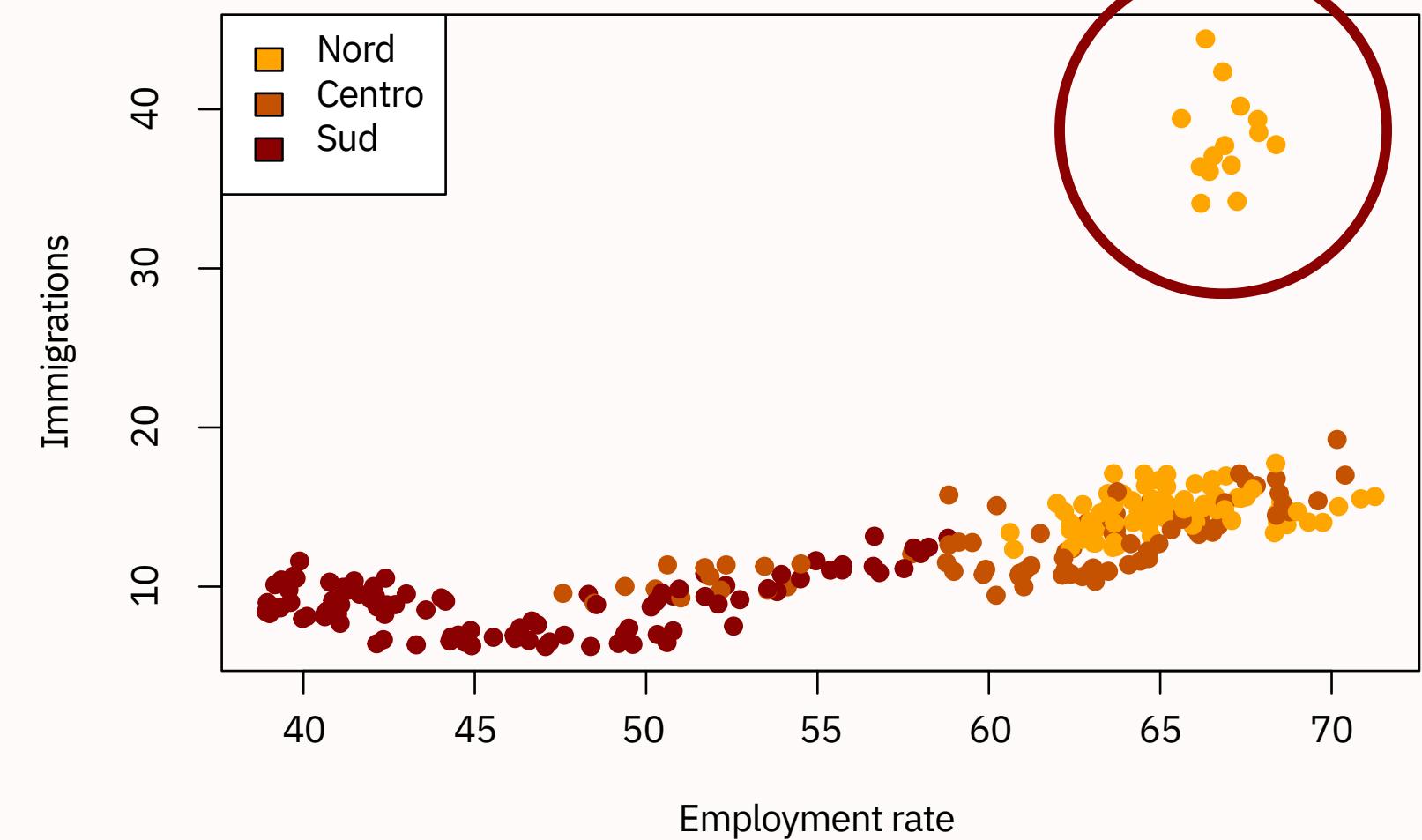
MAXIMA ANALYSIS



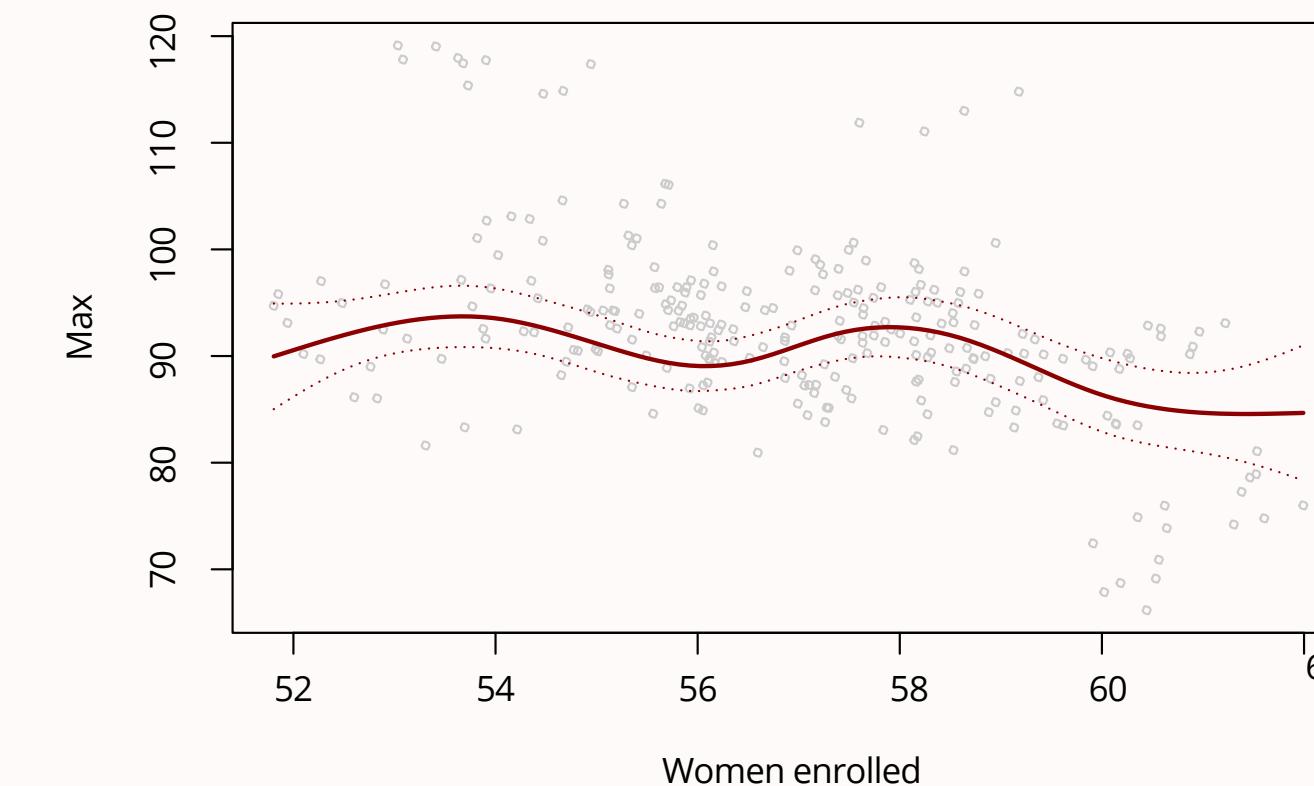
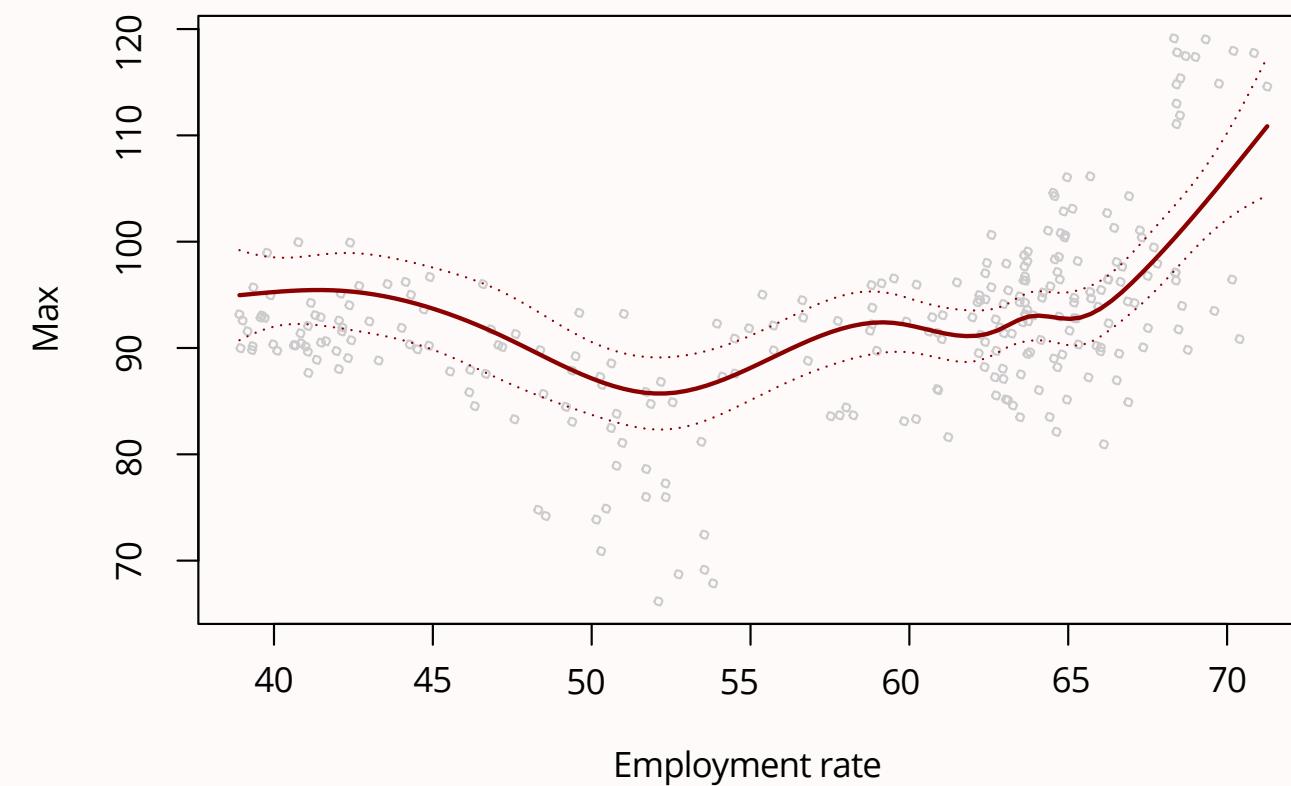
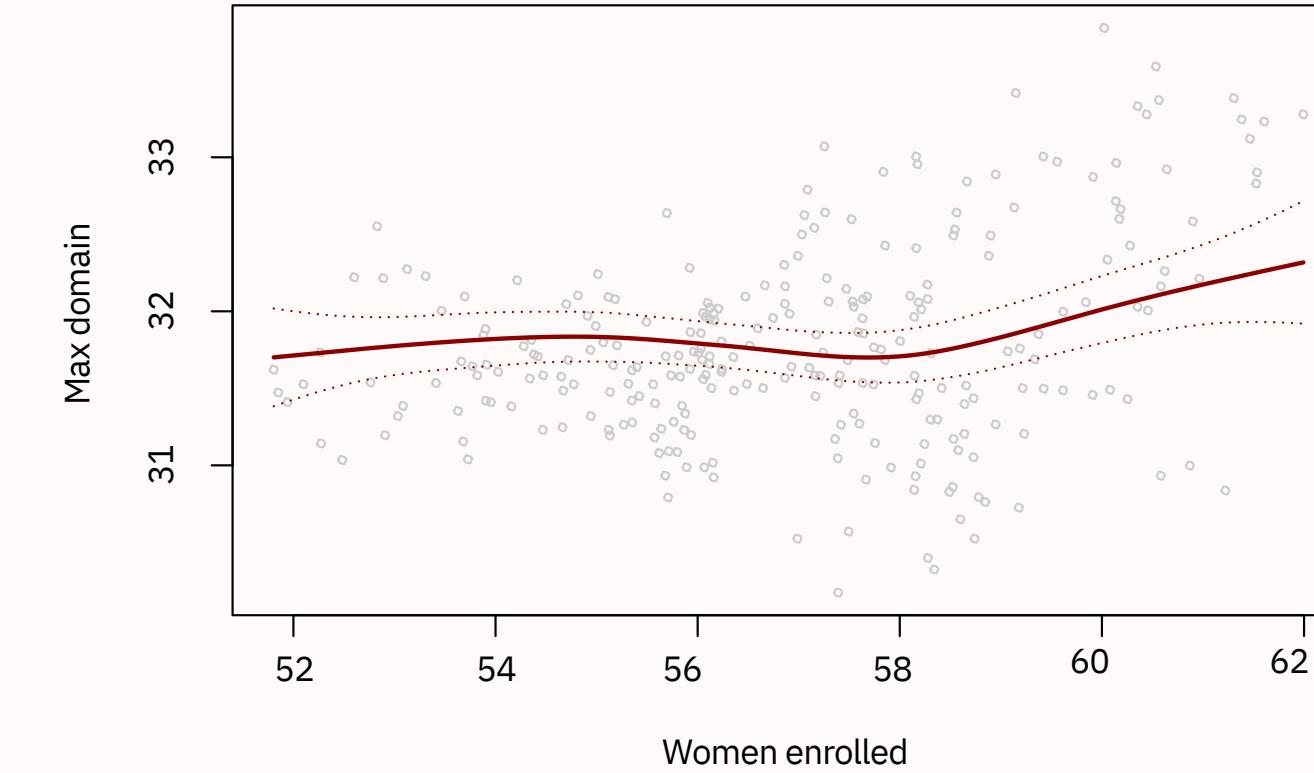
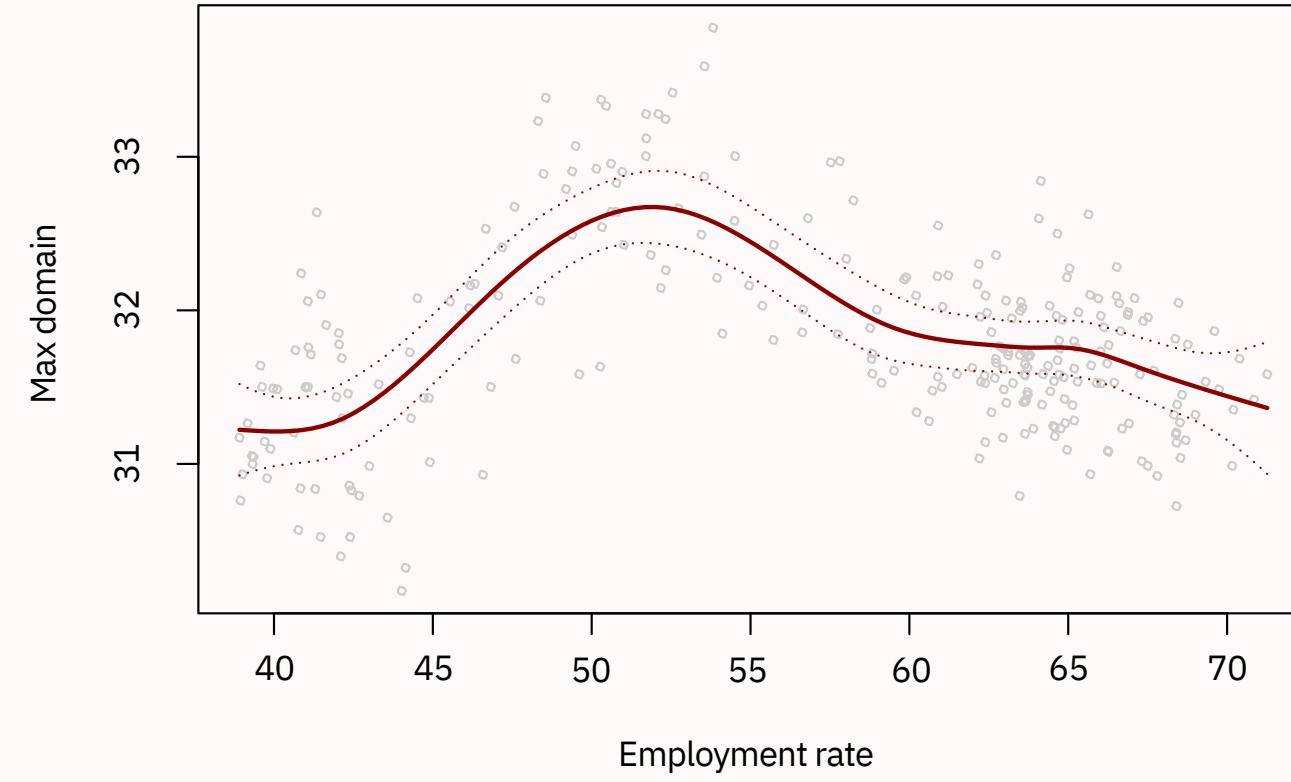
SEMIPARAMETRIC REGRESSION

$$Y = \beta_0 + \beta_1 * Immigrations + f_1(Employment.rate) + f_2(Women.enrolled) + \varepsilon$$

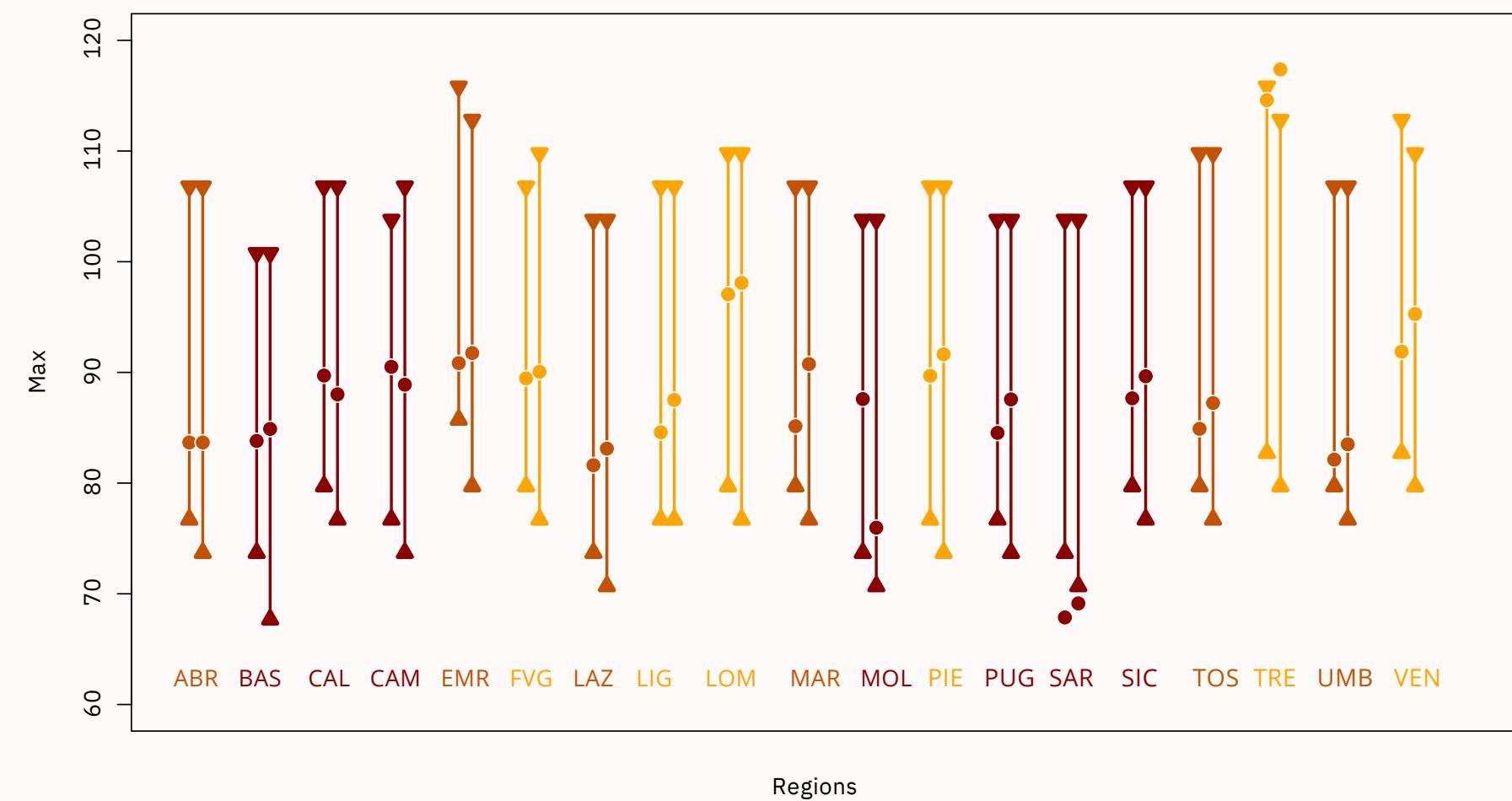
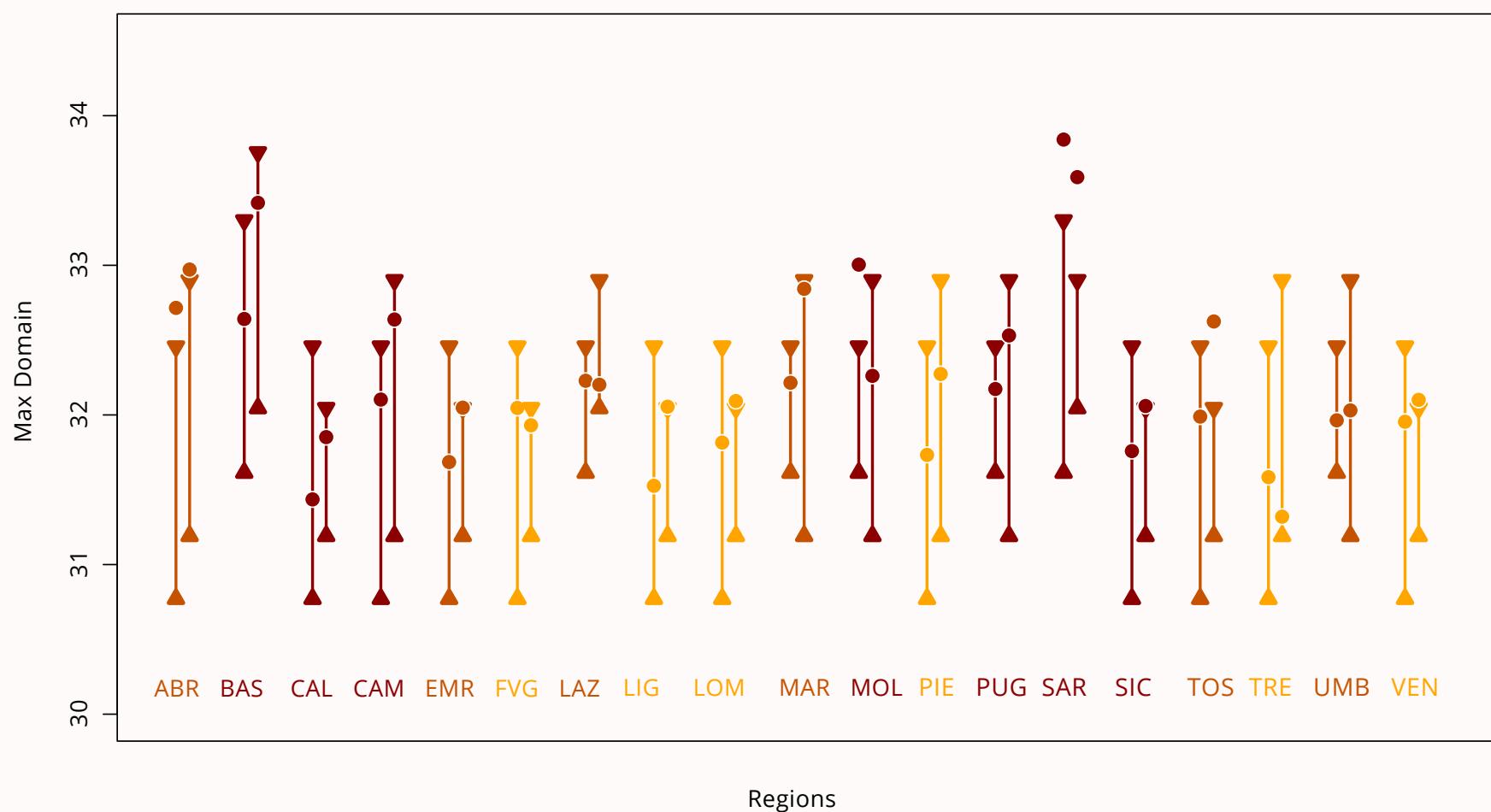
Response variable	R^2_{adj}	β_1
Women's age of fertility peak	0.556	-0.09436
Max value fertility rate	0.560	0.67910
Max value of the second derivative	0.479	-0.04389



SEMIPARAMETRIC REGRESSION



CONFORMAL PREDICTION



CONCLUSIONS

1

Delayed
fertility

2

Highly
prosperous
society

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