



# Misleading Charts

Data Visualization and Exploration

Ozan Kahramanoğulları

by Matteo Ceccarello based on material from  
How charts lie – Alberto Cairo

# Misleading charts

Collected by Matteo Ceccarello based on material from  
How charts lie – Alberto Cairo

# How Charts Lie



Getting Smarter about  
Visual Information

Alberto Cairo

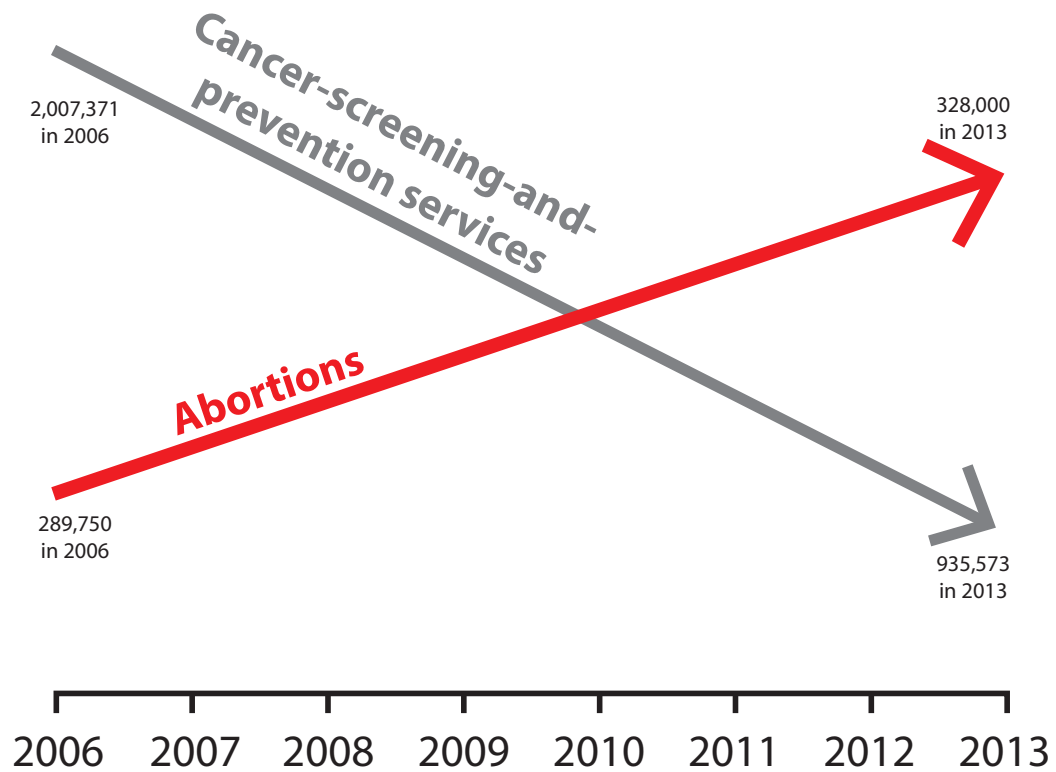


# 5 Ways to lie with charts

- Bad design choices
- Using dubious data
- Showing insufficient data
- Concealing uncertainty
- Suggesting misleading patterns

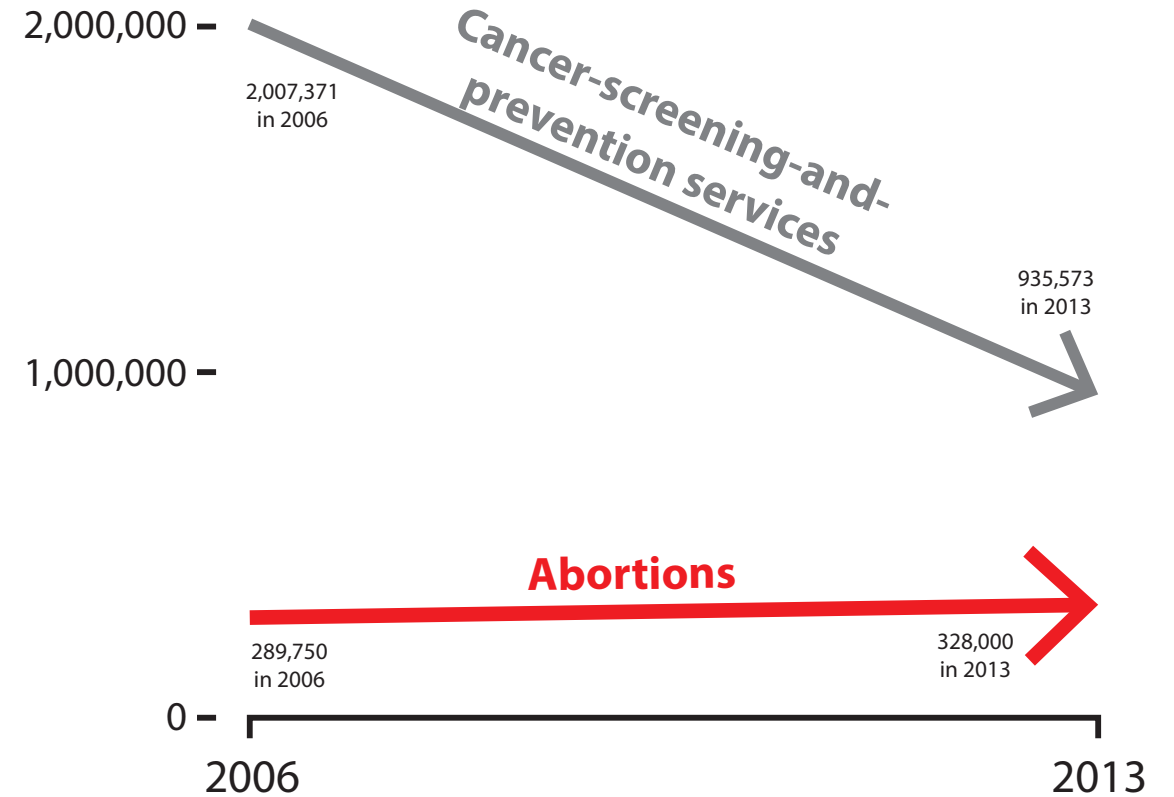
Poor design

## Planned Parenthood Federation of America: Abortions up—life-saving procedures down



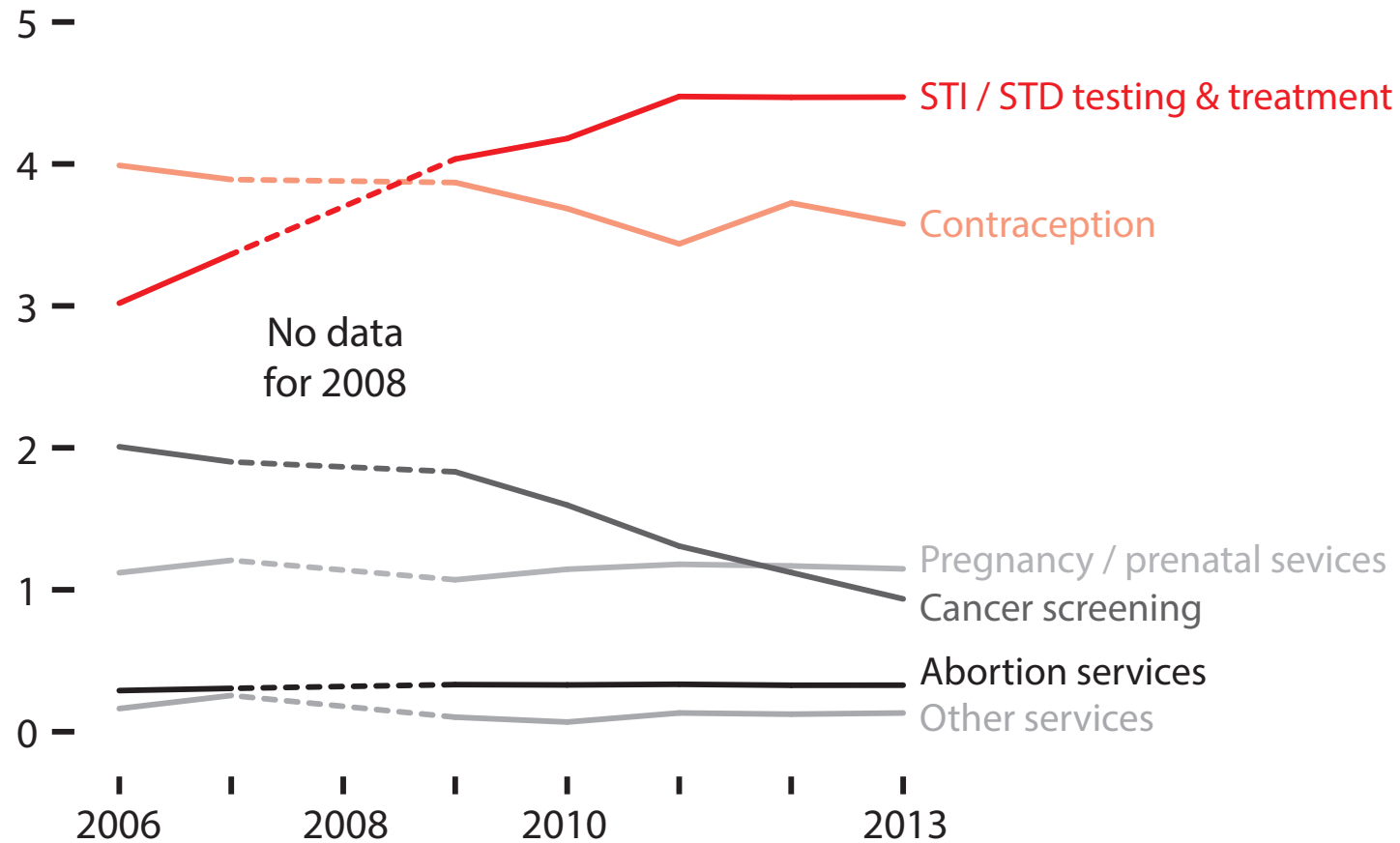
(Source: Americans United for Life)

## Planned Parenthood Federation of America



Poor design, mixing different scales

## Services provided by Planned Parenthood (millions)



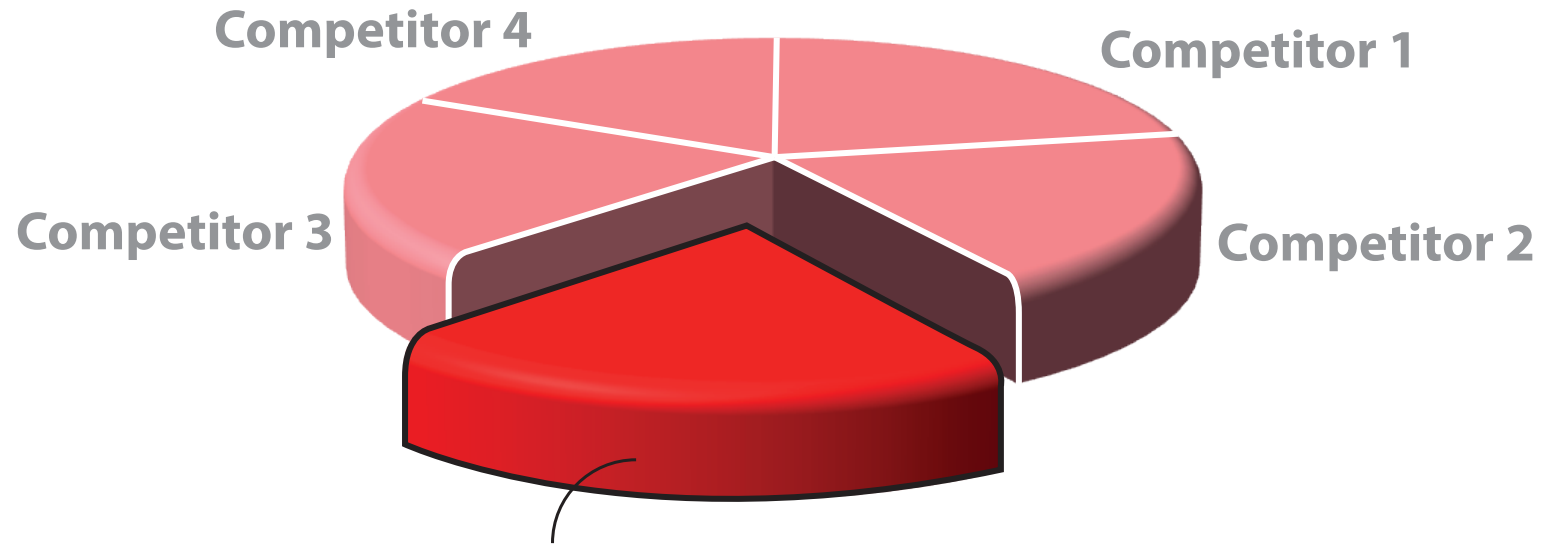
(Source: Emily Schuch and Planned Parenthood Federation of America)

Even better: provide all the context





## Share of All Companies in Our Market



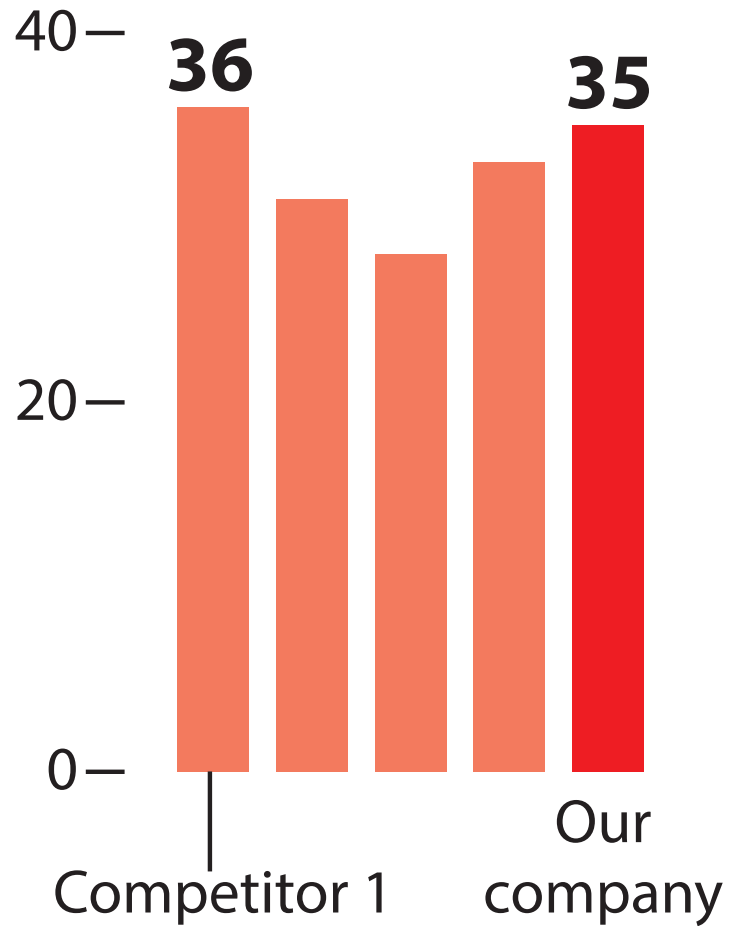
Record sales of **35** million dollars in 2018

# Our Company's Sales Have Soared!

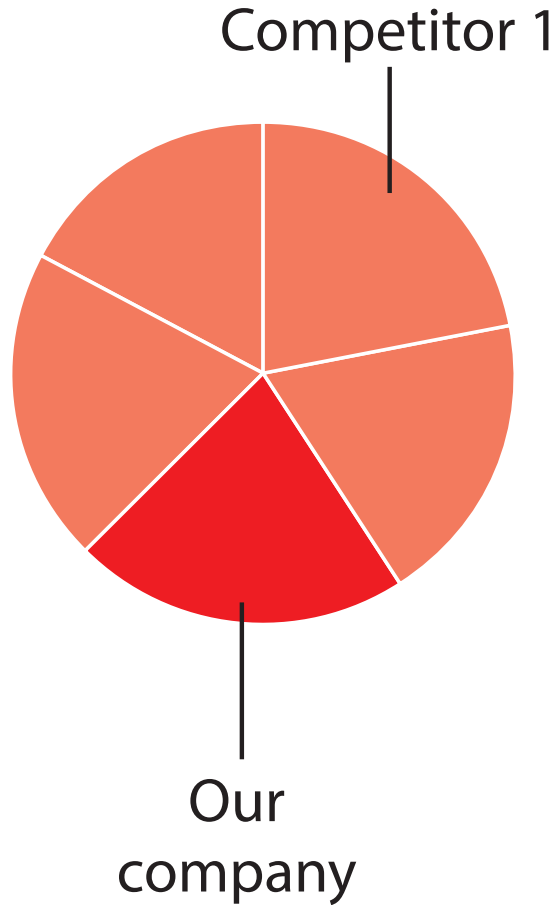


## 2018 sales

Millions of dollars

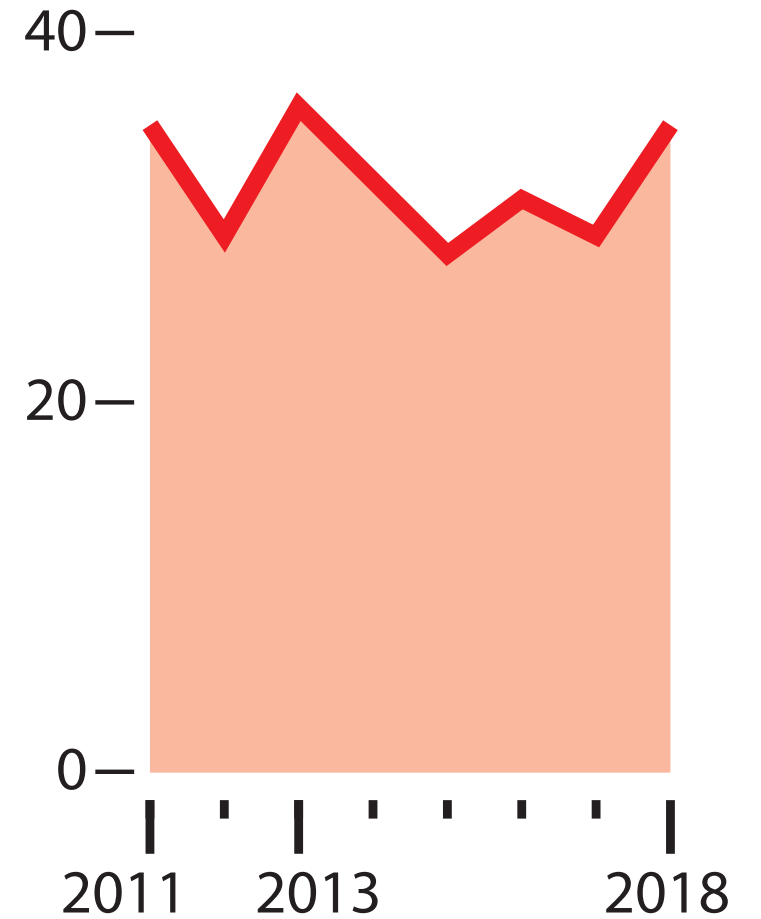


## Market share



## Sales since 2011

Millions of dollars





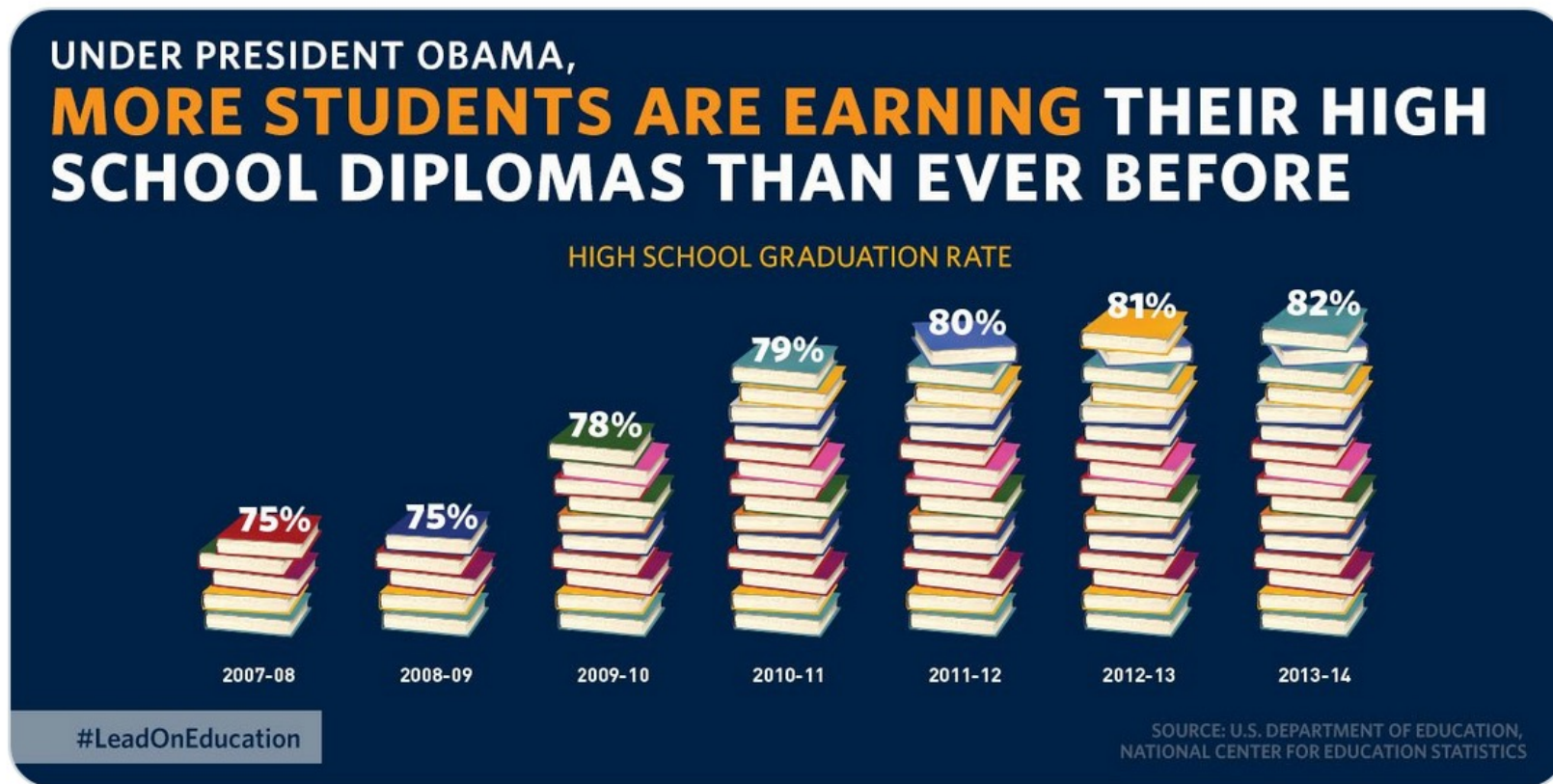
White House Archived ✓

@ObamaWhiteHouse



Good news: America's high school graduation rate has increased to an all-time high. 🎓 [wapo.st/1m40Mei](http://wapo.st/1m40Mei)

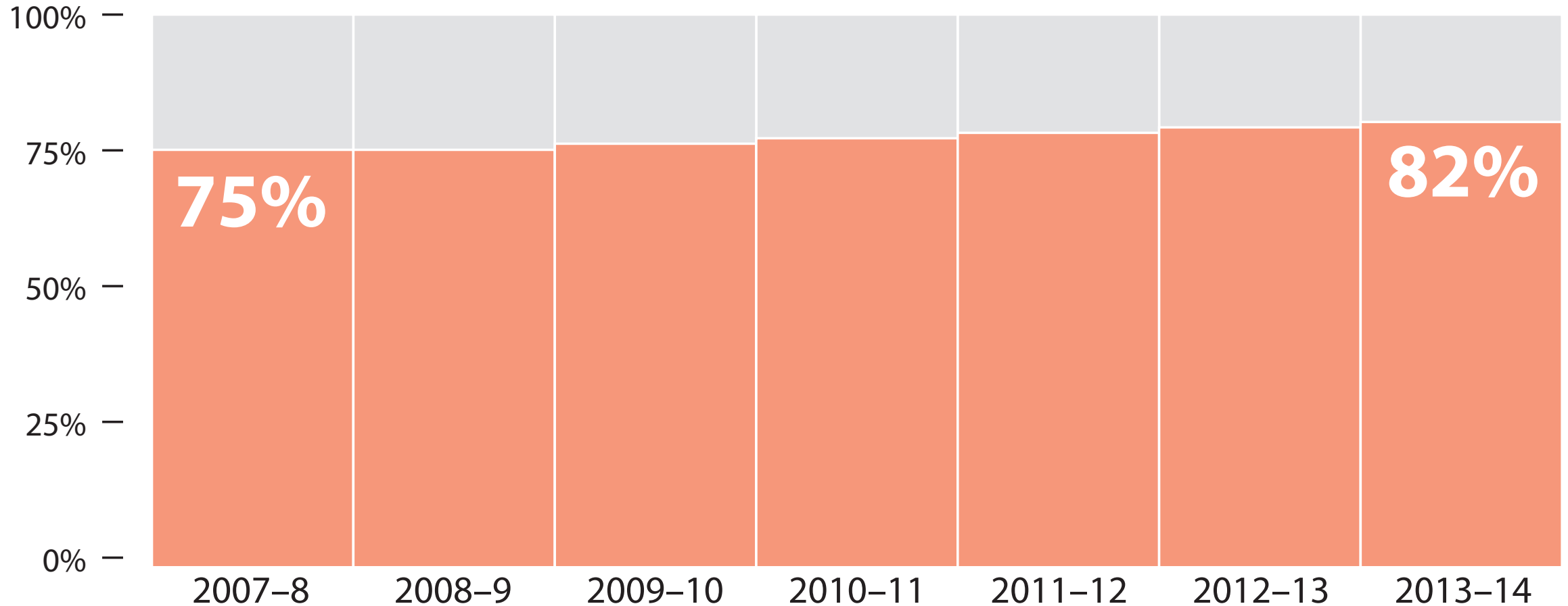
[Traduci il Tweet](#)



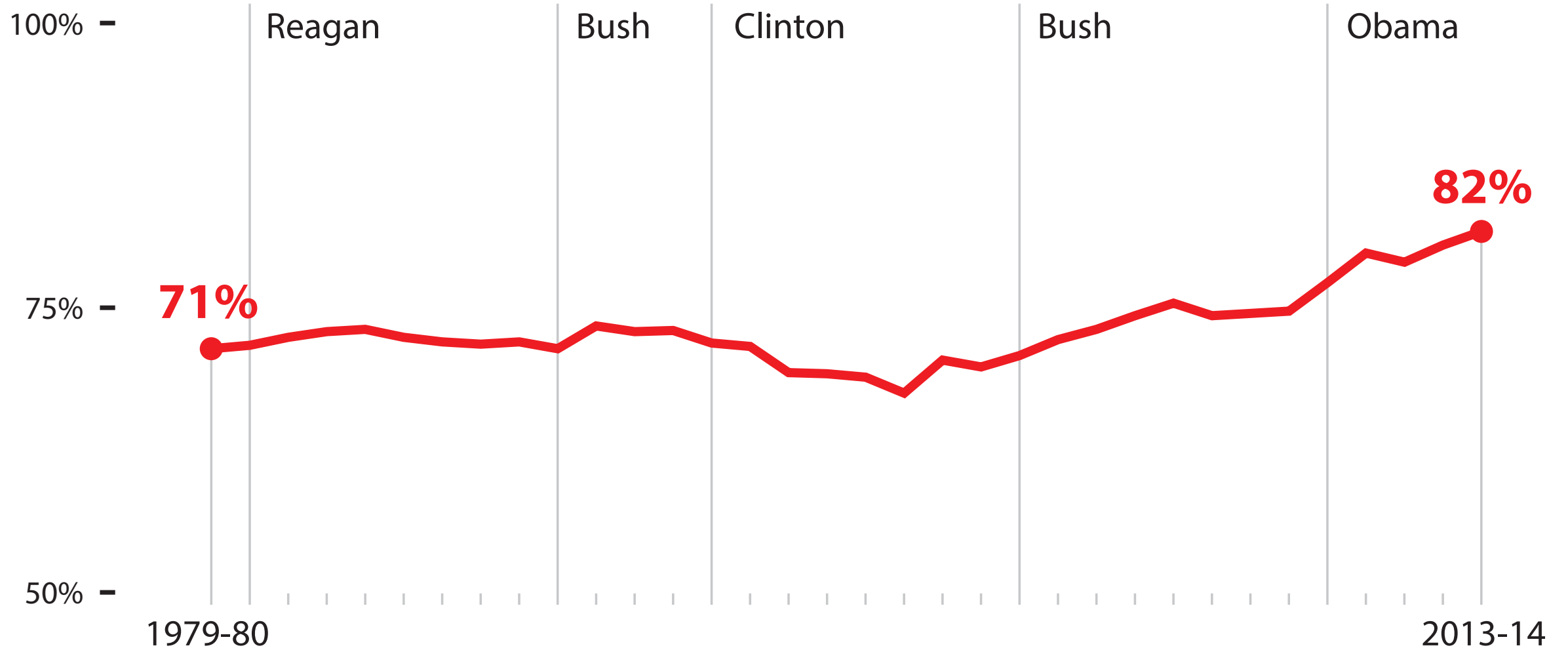
Poor design:  
non-zero baseline!

# Under President Obama, **more students are earning their high school diplomas than ever before**

High school graduation rate

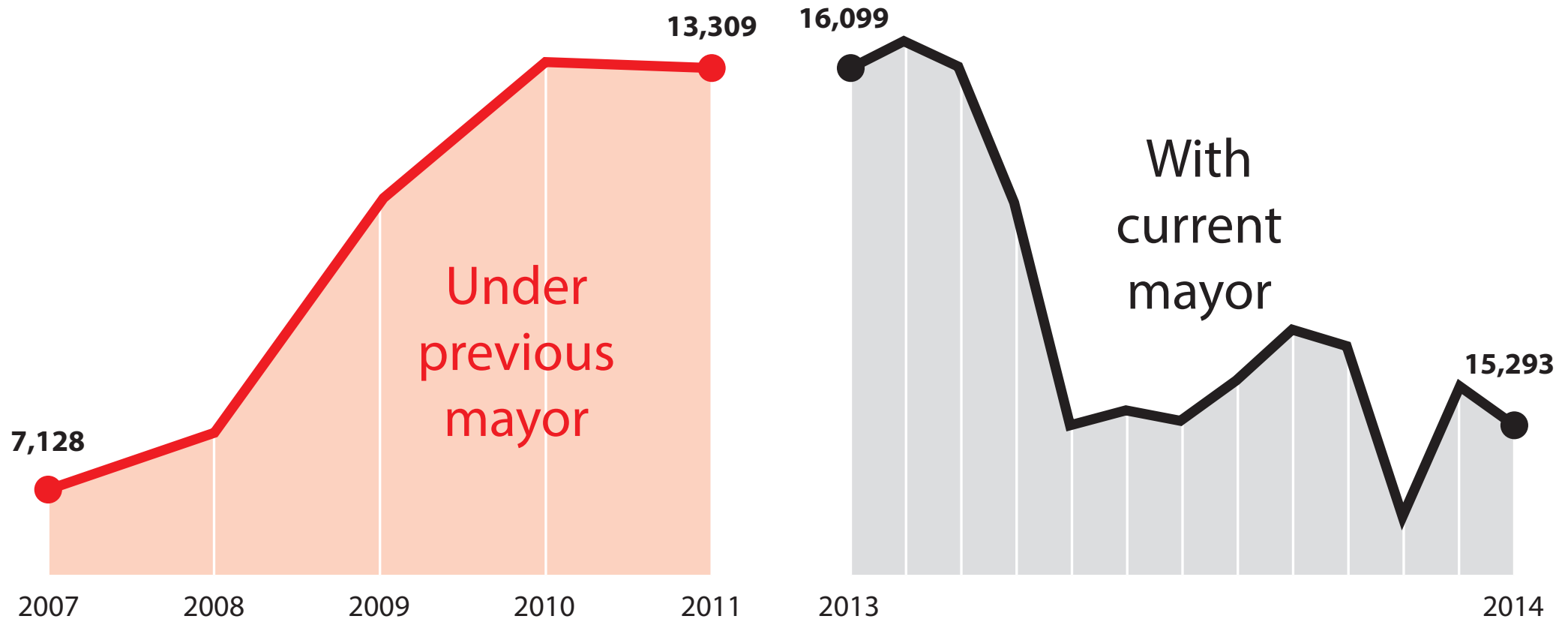


# High school graduation rates under each president



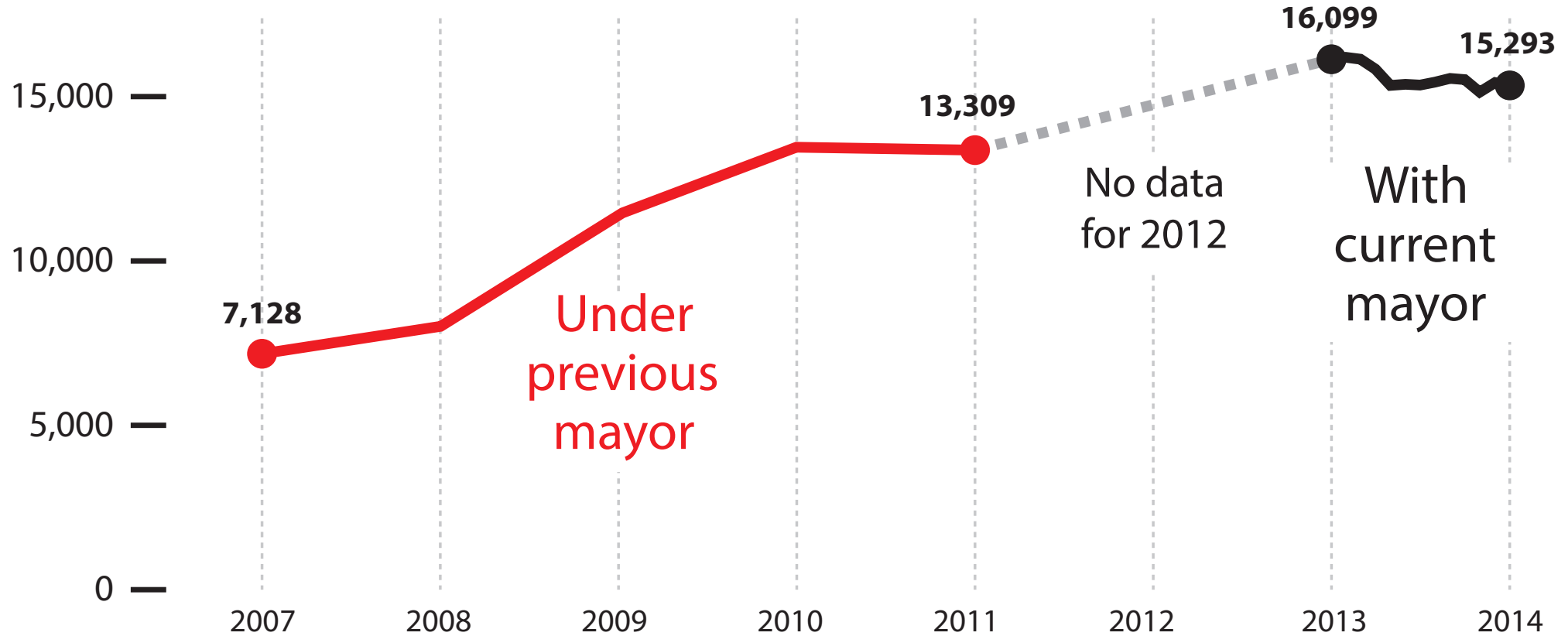
(Source: National Center for Education Statistics)

# Unemployed adults in Alcorcón



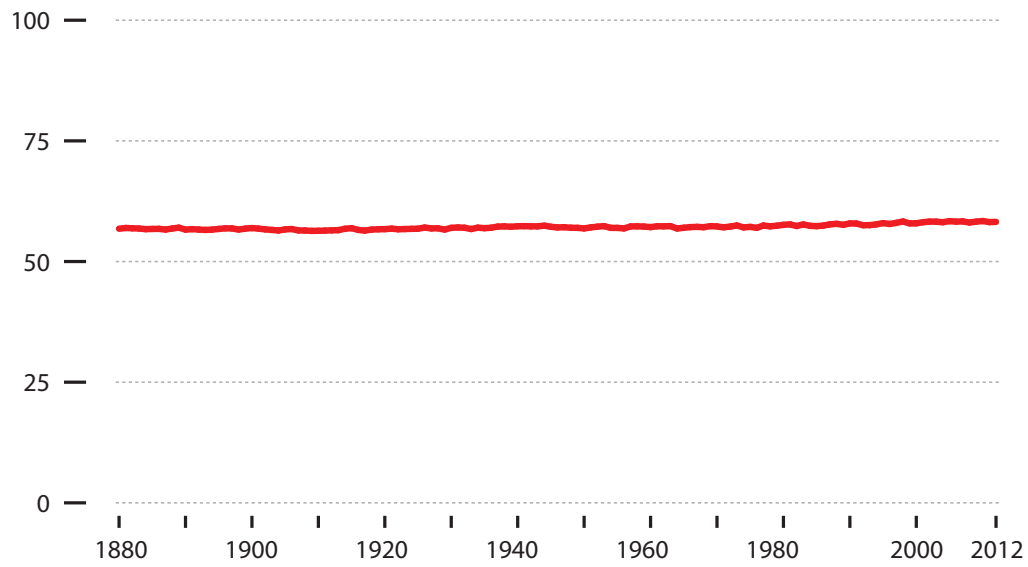
Bad design: different x and y axes

# Unemployed adults in Alcorcón

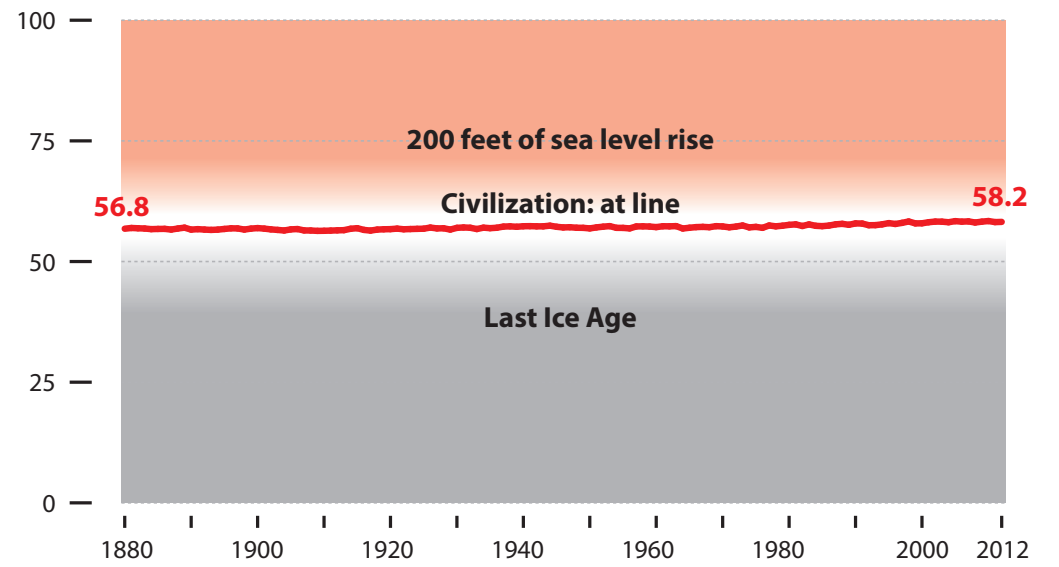




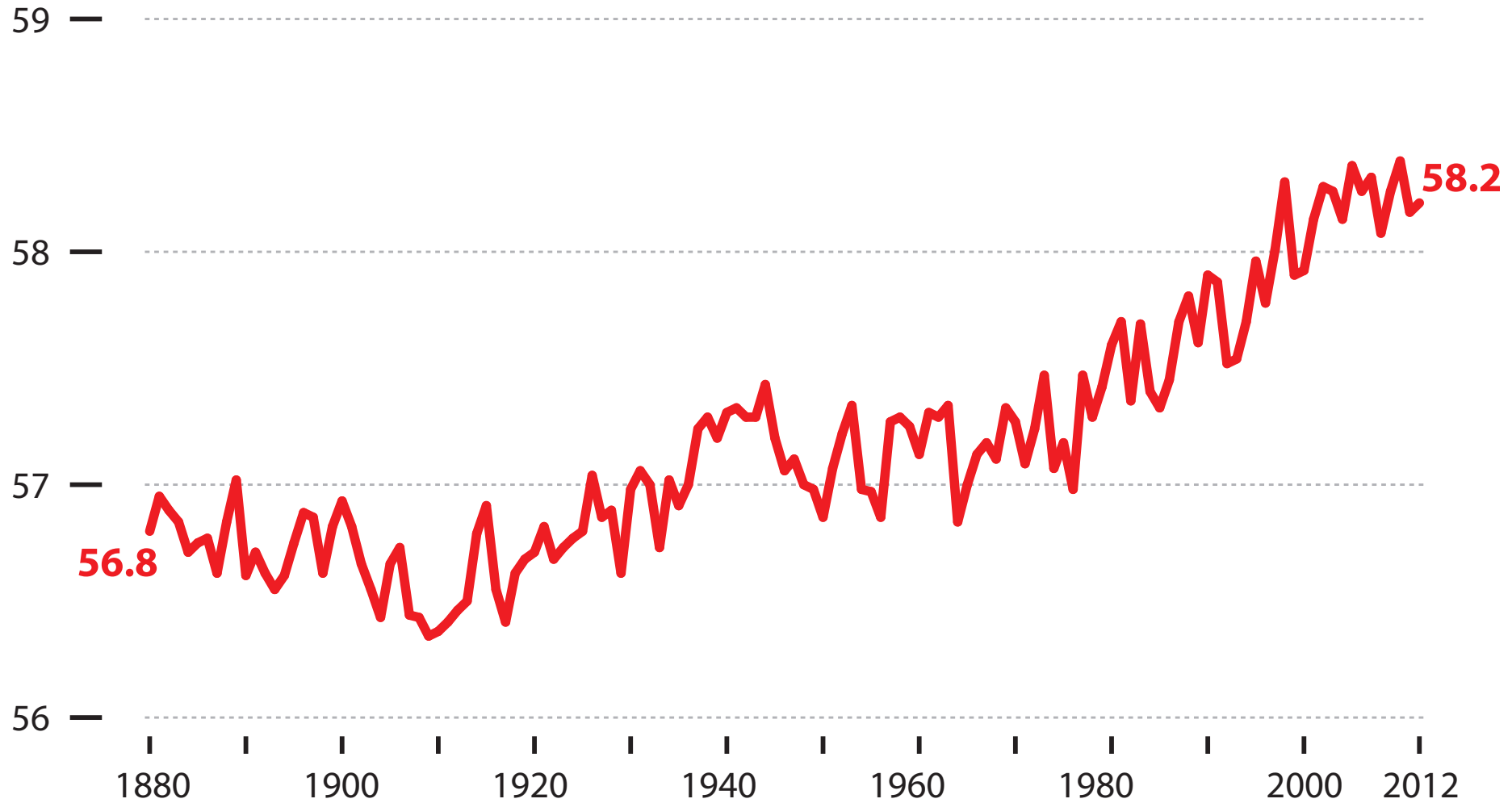
**Average annual global temperature in degrees Fahrenheit**



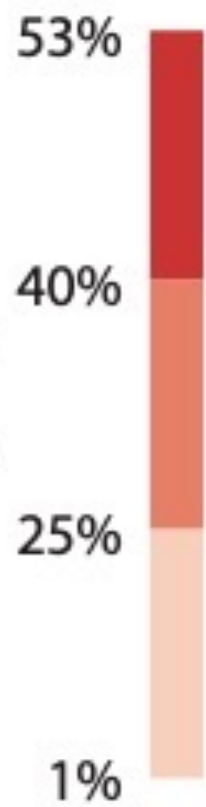
**Average annual global temperature in degrees Fahrenheit**



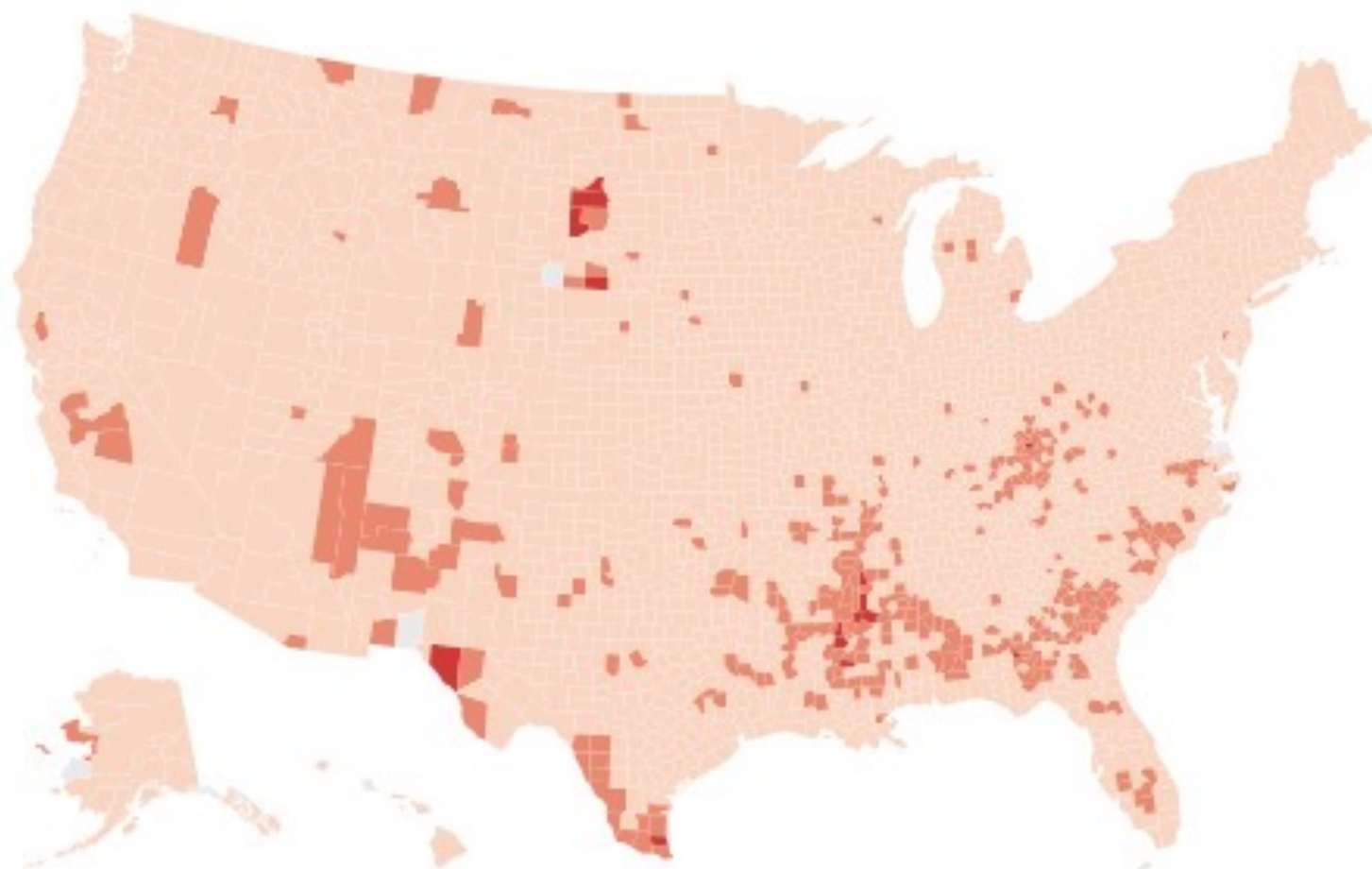
# Average annual global temperature in degrees Fahrenheit

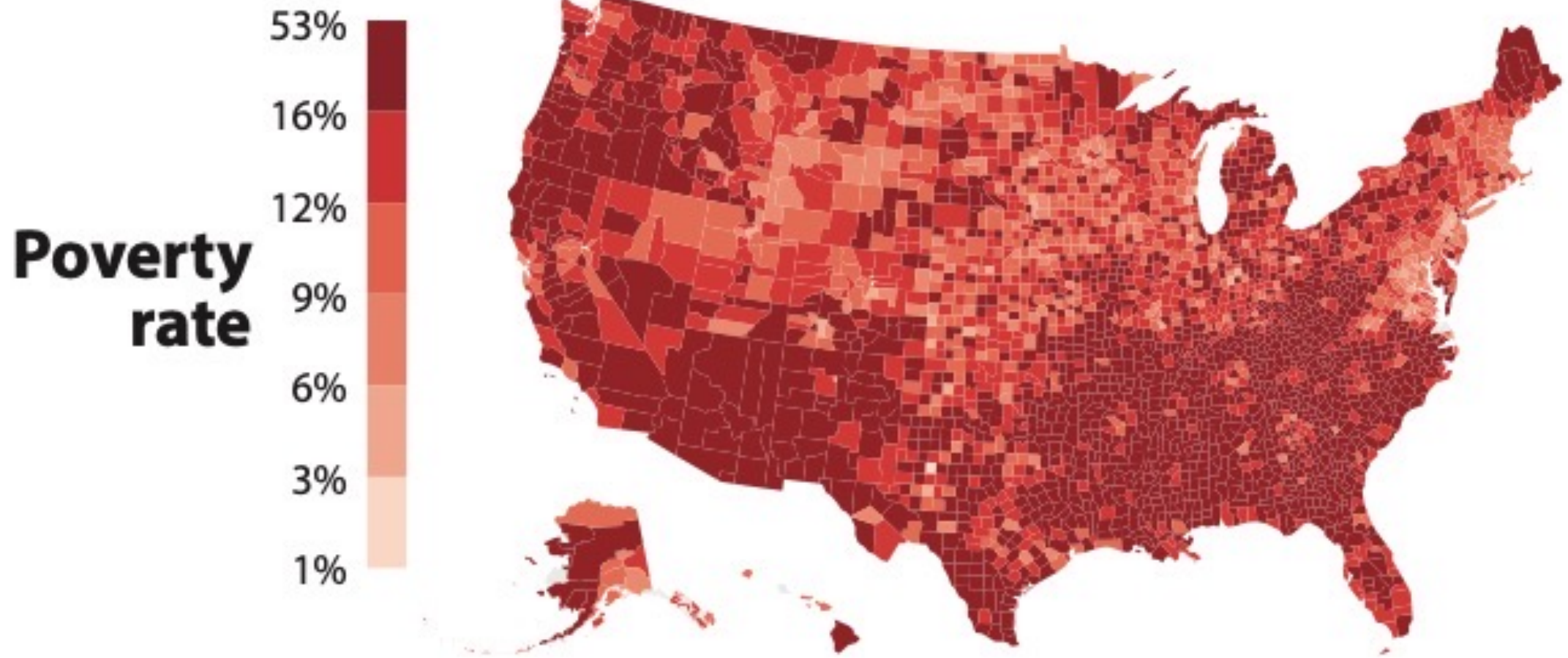


# Poverty rate



(Source: Census Bureau)

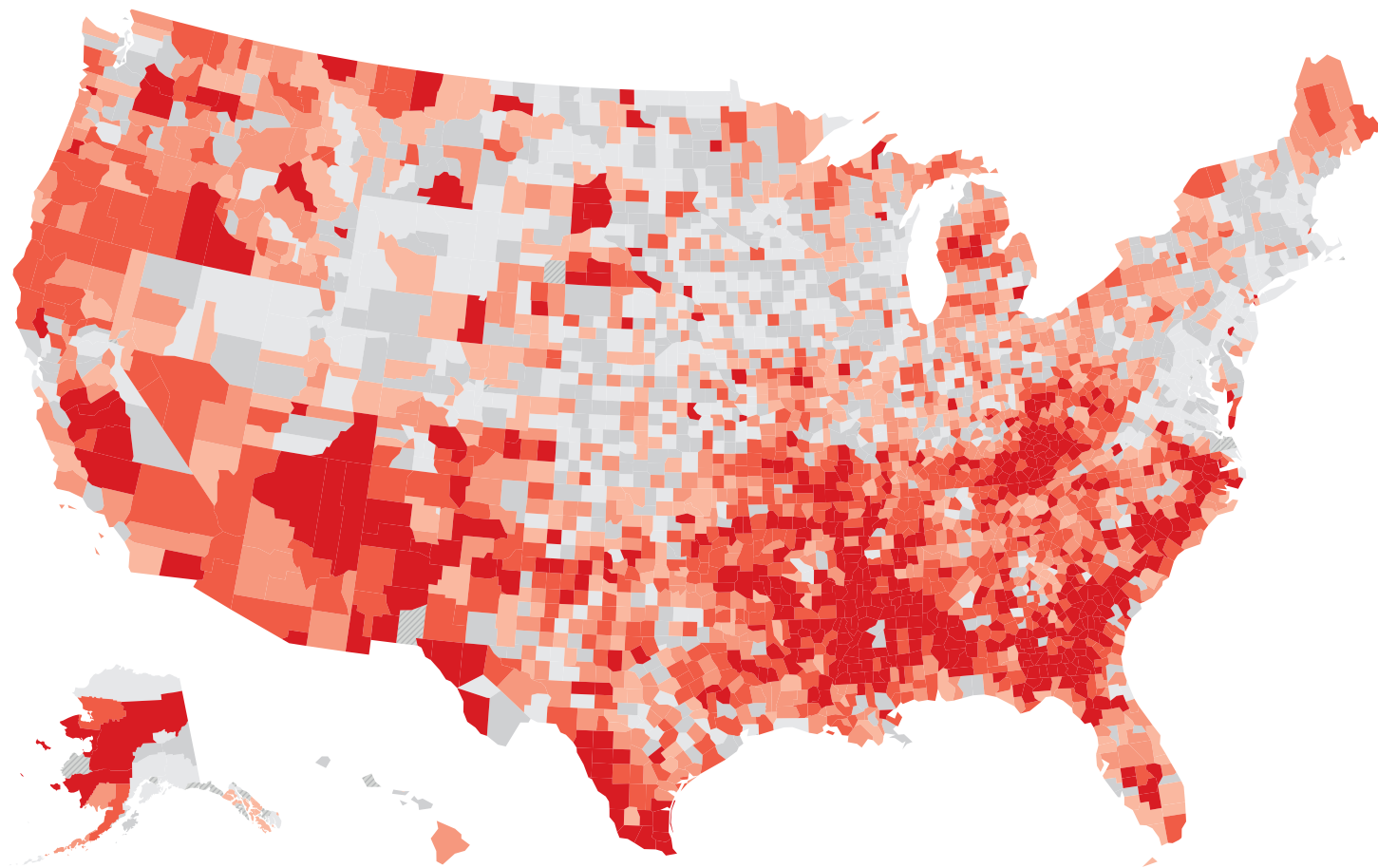
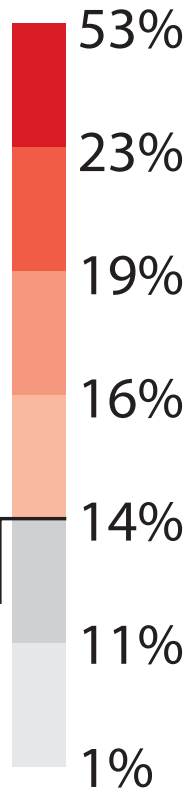




Bad design: distorted color scale with uneven bins

# Poverty rate

National average



# Watch out!

- Multiple scales for the same aesthetic
- Uneven scales (including colour)
- Misplaced baselines
- Wrong ranges

# Showing dubious data

What and how is being counted

U.S. ECONOMIC  
CONFIDENCE  
SOARS  
BY  
50%

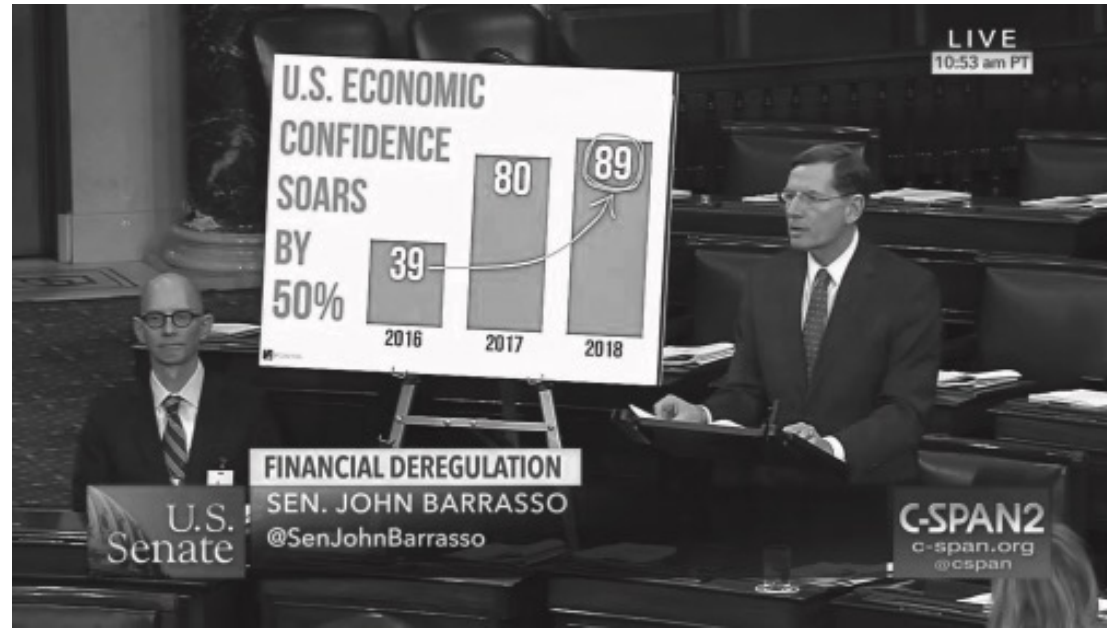


FINANCIAL DEREGULATION  
SEN. JOHN BARRASSO  
@SenJohnBarrasso

U.S.  
Senate

C-SPAN2  
c-span.org  
@cspan





Confusion between

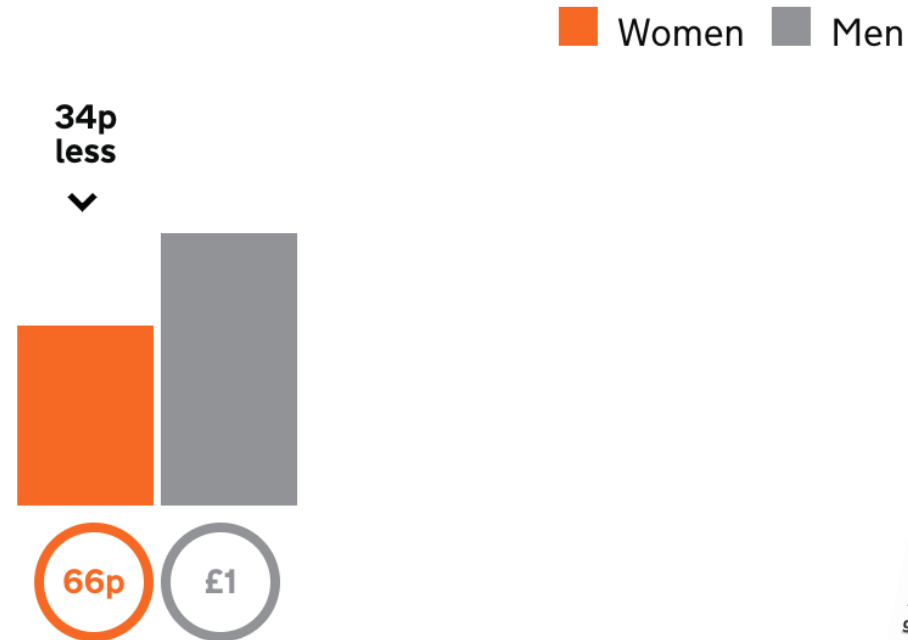
percentage change  $\left(\frac{89-39}{39} \cdot 100 = 128\%\right)$

and

percentage point change  $(89 - 39 = 50\%)$

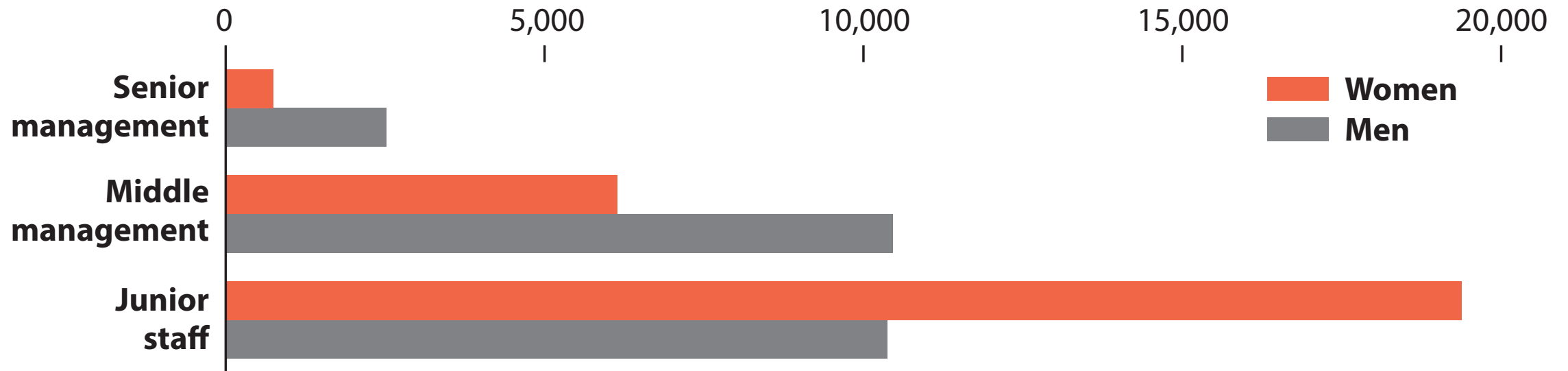
# Hourly pay gap

In this organisation, women earn 66p for every £1 that men earn when comparing median hourly pay. Their median hourly pay is 34% lower than men's.

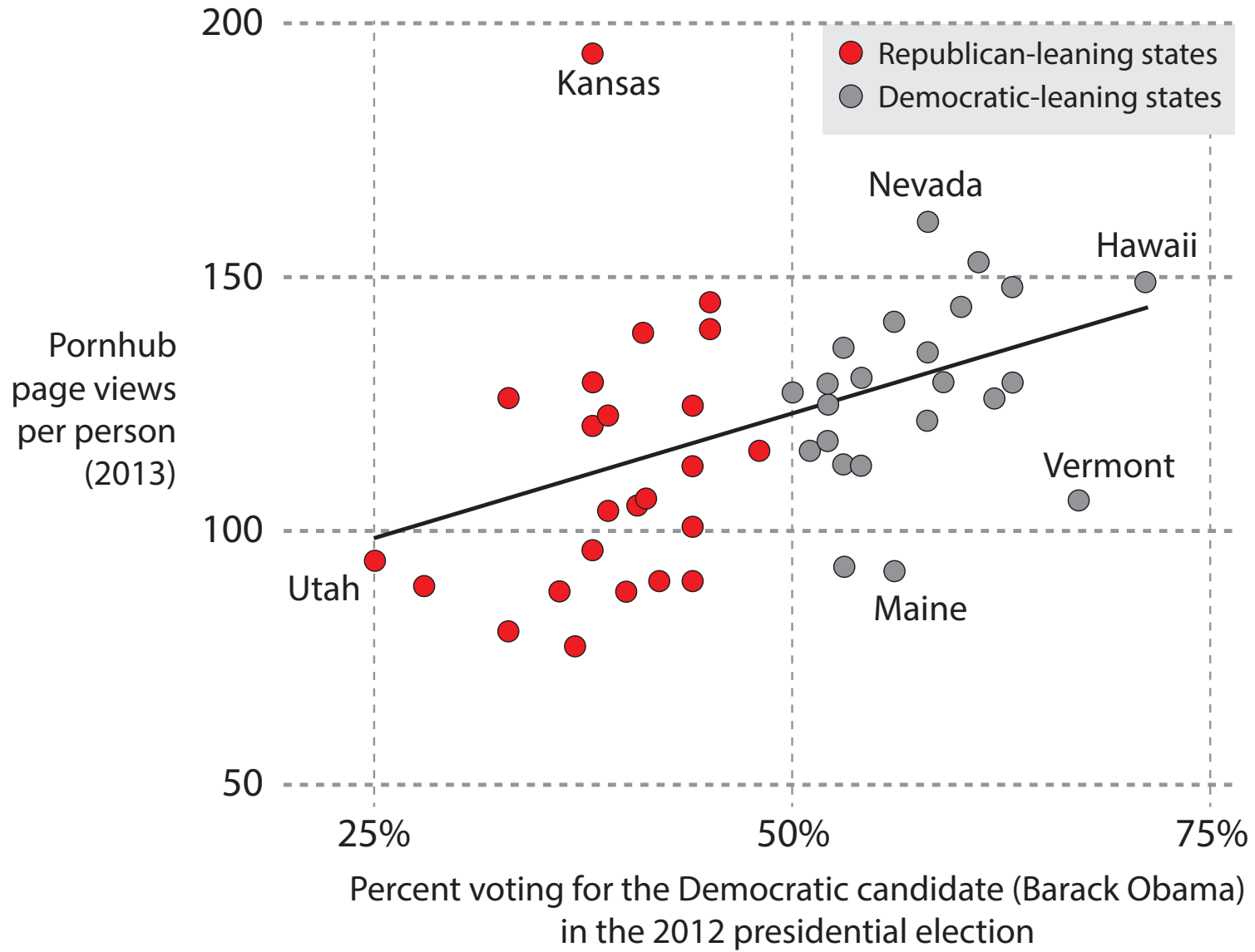


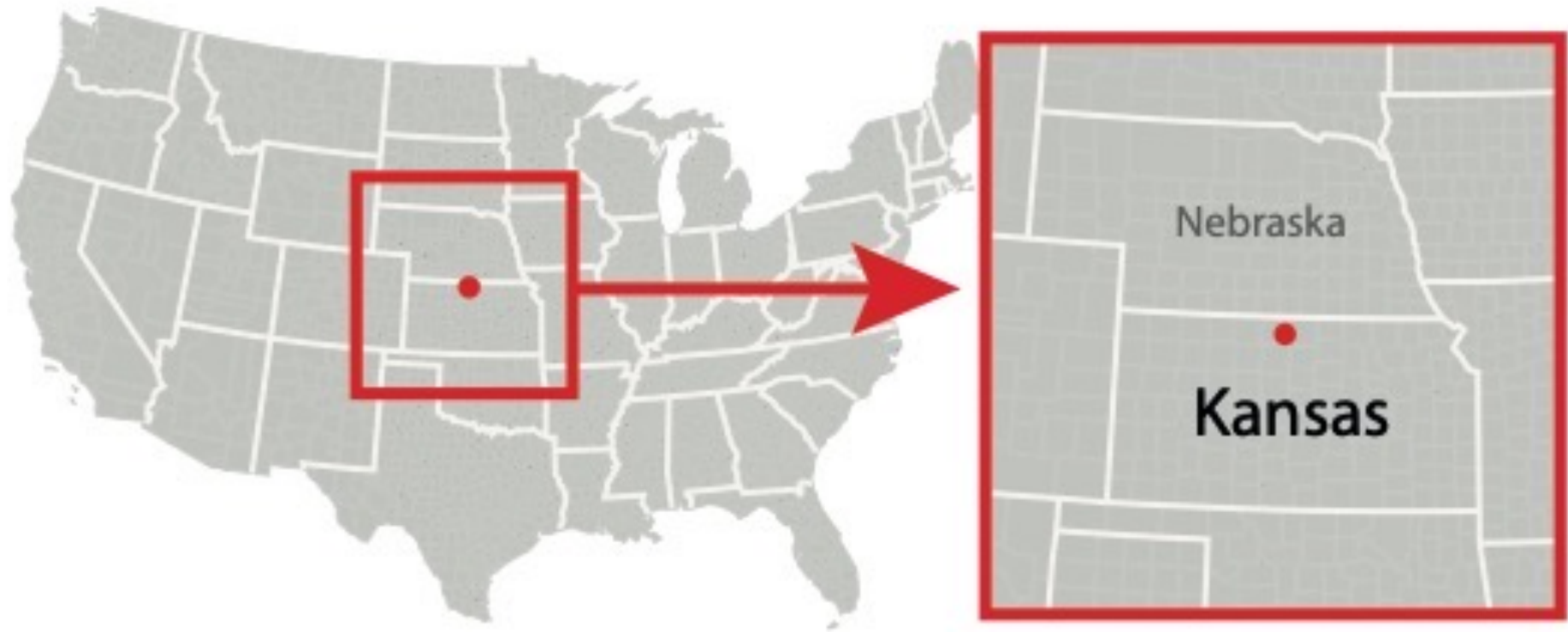
When comparing mean (average) hourly pay, women's mean hourly pay is 42.1% lower than men's.

# Barclays Bank employees in the UK



There is a gender pay-gap problem, but it's due to the fact that managerial roles are mostly occupied by men!





- Geographic center of the contiguous United States

The data collection process might distort the data!

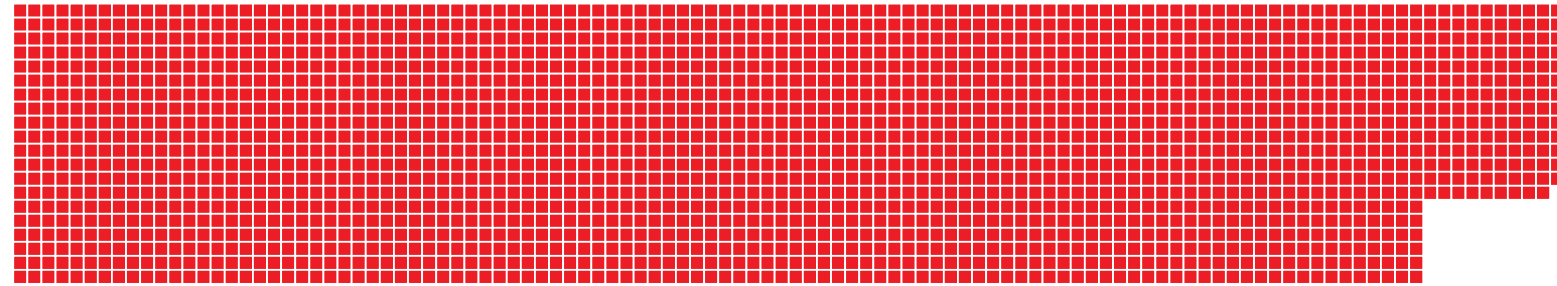
# Watch out!

- Misinterpretations of basic concepts
- Issues approached from a single point of view
- Problems in the data collection process

# Displaying insufficient data

An easy way to distort reality

Graphic after Breitbart news:

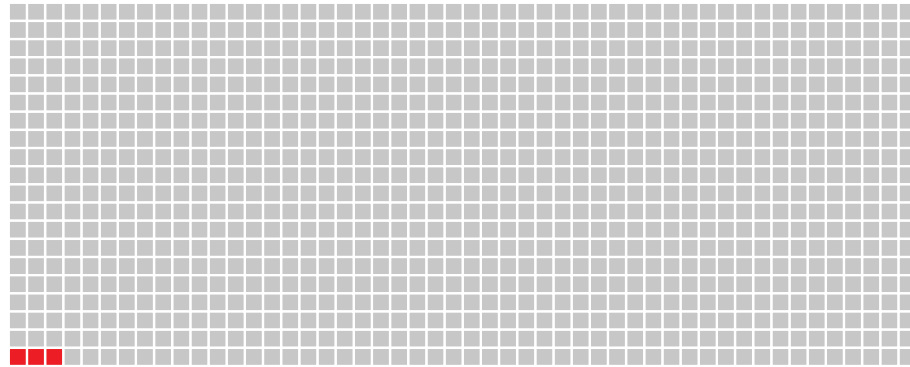


**2,139** **DACA recipients**  
convicted or accused  
of crimes against Americans

DACA stands for **Deferred Action for Childhood Arrivals**, and is meant to protect from deportation people who entered the USA illegally when they were children

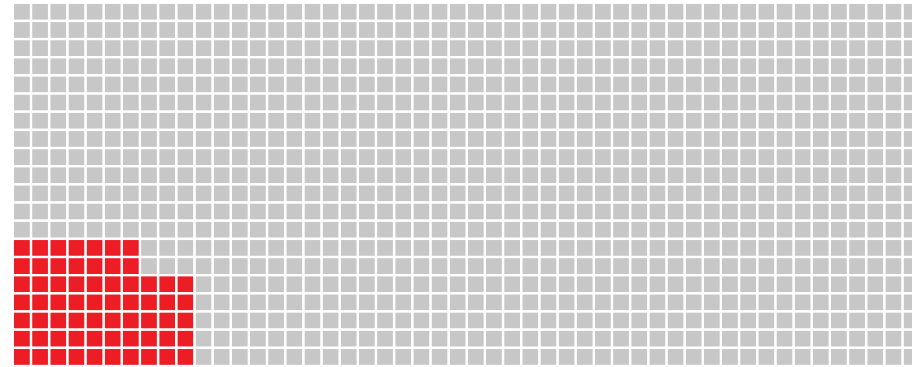


## Out of every 1,000 DACA recipients ...



**3** have had their temporary protected status revoked due to “a felony criminal conviction; a significant misdemeanor conviction; multiple misdemeanor convictions; gang affiliation; or arrest for any crime in which there is deemed to be a public safety concern.”

## Out of every 1,000 voting-age people who live in the U.S. ...



**64** were ex-felons in 2010. This doesn't include people convicted of misdemeanors.

(Source: Shannon, Sarah K.S., et. al. “The growth, scope, and spatial distribution of people with felony records in the United States, 1948 to 2010.” *Demography* 54(5)(2017): 1795-1818)



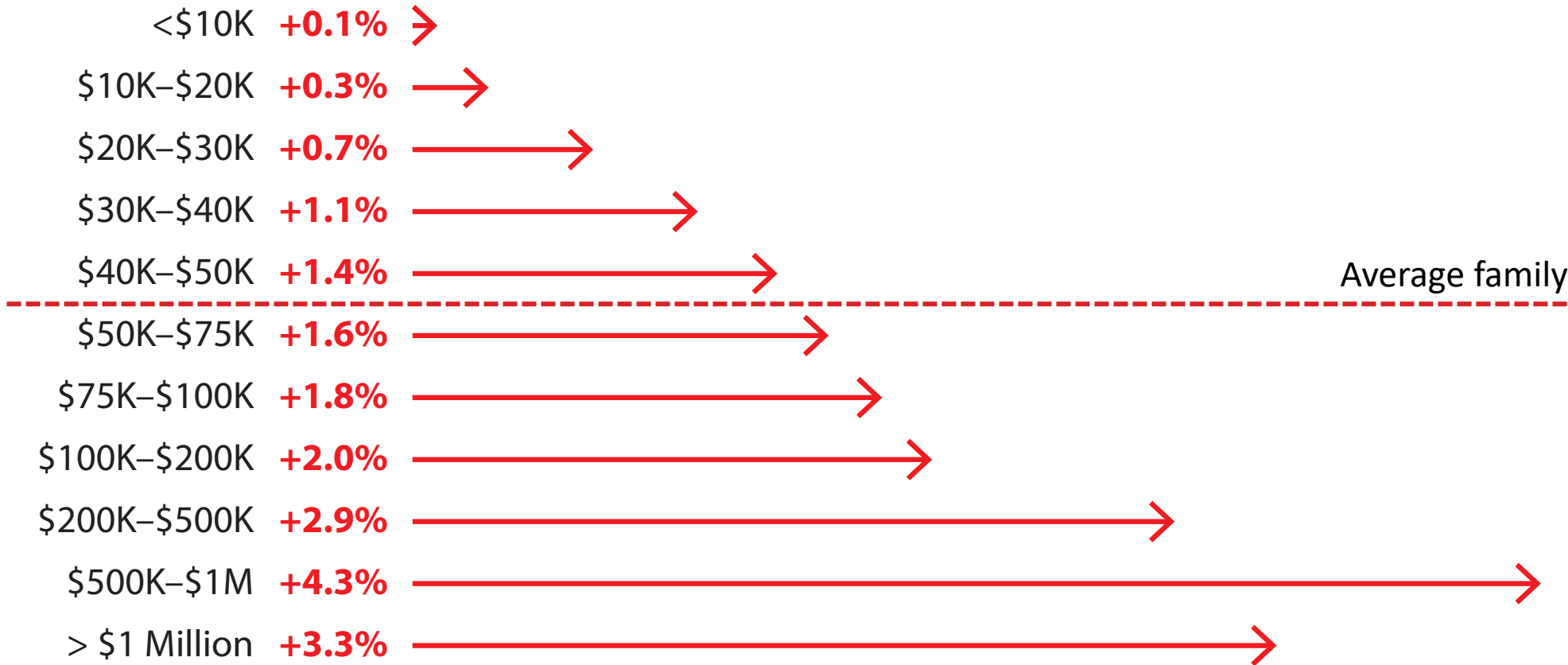
The average family will save

**\$1,182**

per year on their taxes.

Household income      Percent change in after-tax income

(Source: Tax Policy Center)



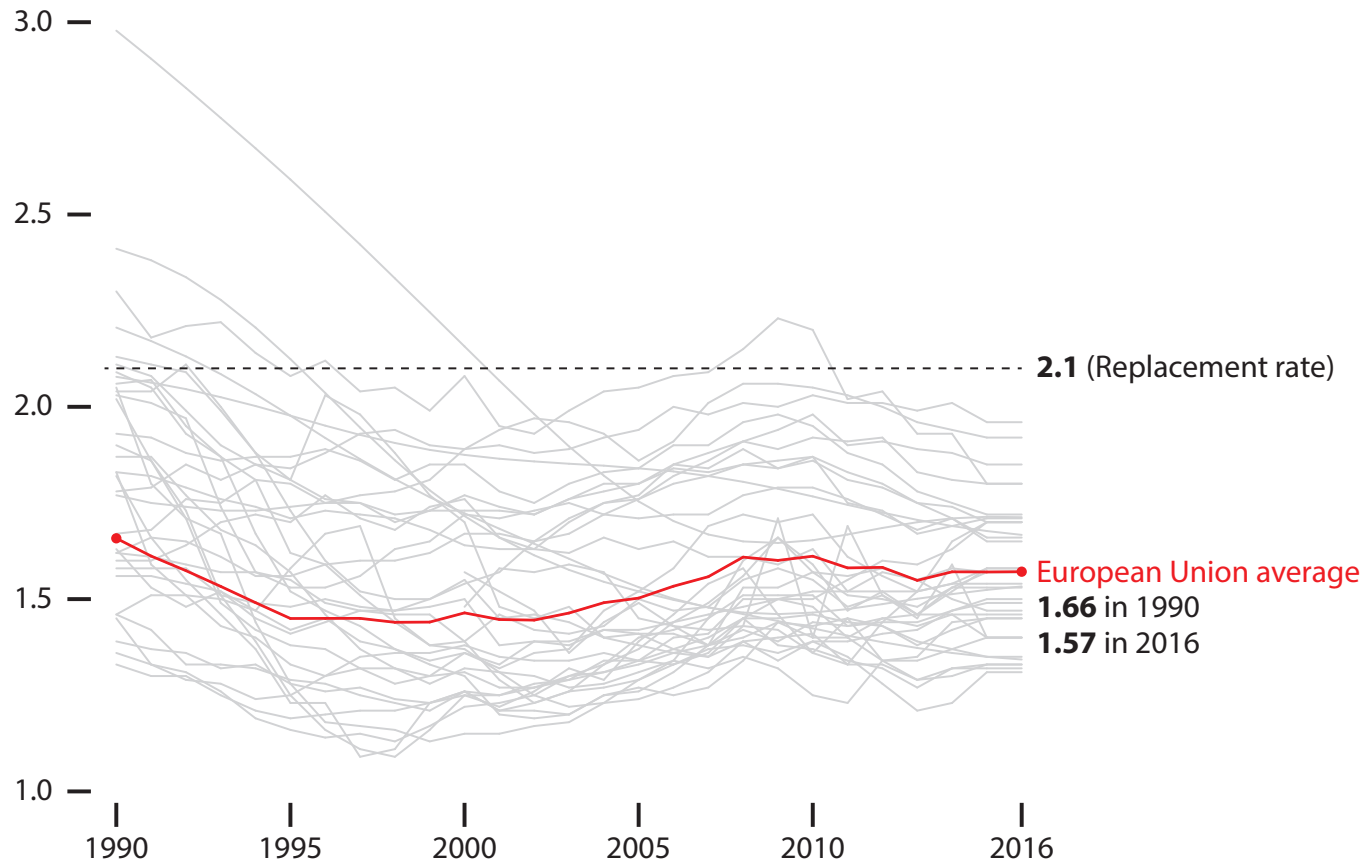


Capitalism+atheism+feminism = sterility = migration.  
EU birthrate = 1.6. Replacement = 2.1. Merkel, May,  
Macron, Gentiloni all childless.

### Fertility rate in European countries

Children per woman. Each grey line is a country.

(Source: World Bank Data)



# Fertility rate in European countries, 1990–2016

Compared to the replacement rate: 2.1 children per woman

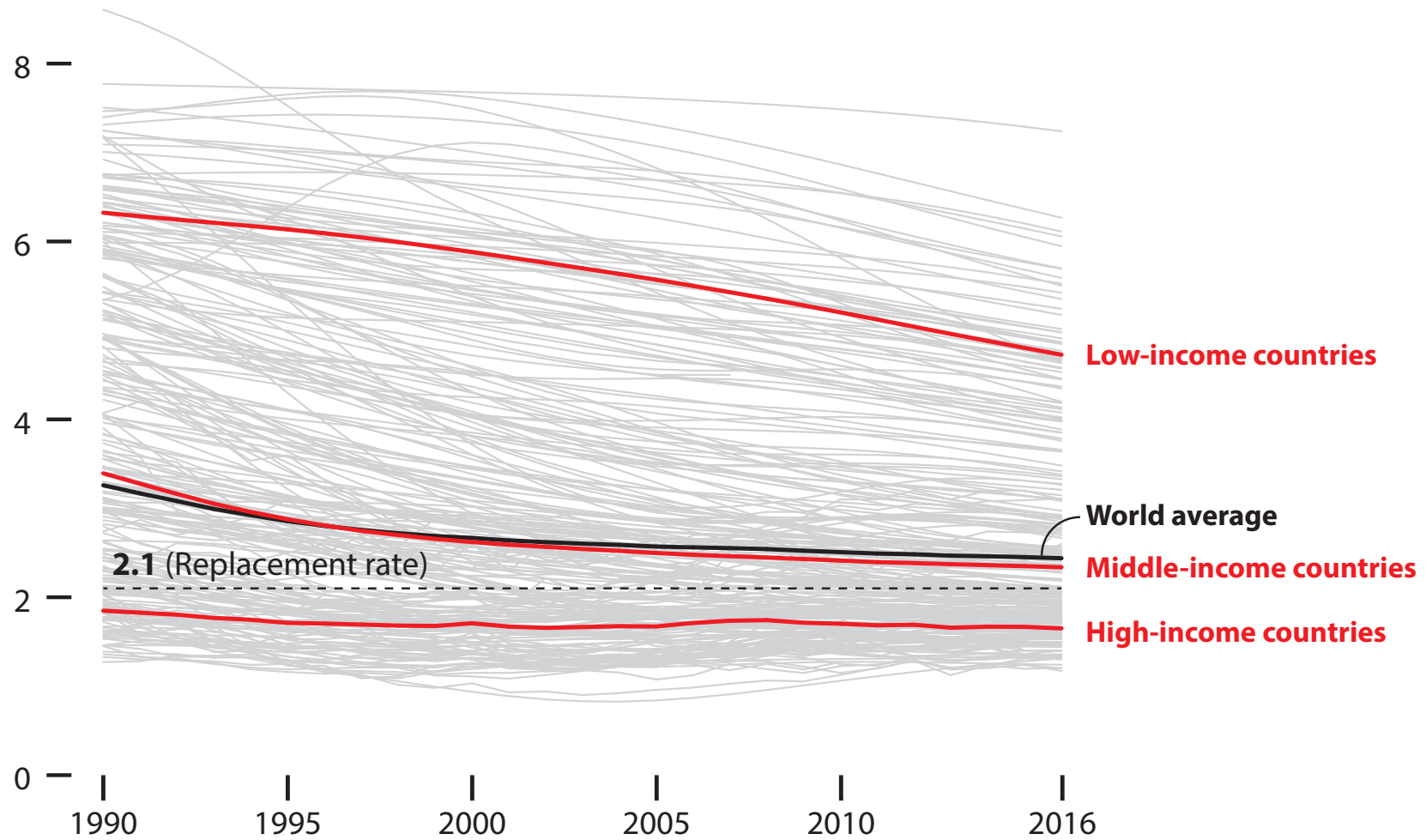
Note: not all these countries belong to the European Union



# Fertility rate

Children per woman. Each grey line is a country.

(Source: World Bank Data)



# Watch out!

- Non-normalized data
- Lack of context
- Averages only are misleading
- Too much data is just like too little data

Concealing uncertainty



**Poll:**  
Pennsylvania  
18th District  
special election

(Source: Gravis)



**Rick Saccone: +3 percent points**

**Results:**  
Pennsylvania  
18th District  
special election  
**March 13, 2018**



**Conor Lamb: +0.2 percent points**

**Poll:**  
Pennsylvania  
18th District  
special election

(Source: Gravis)

**Margin of error at the 95% level: +/-3 percent points**



## ORIENTAMENTI DI VOTO: 22 NOVEMBRE 2021

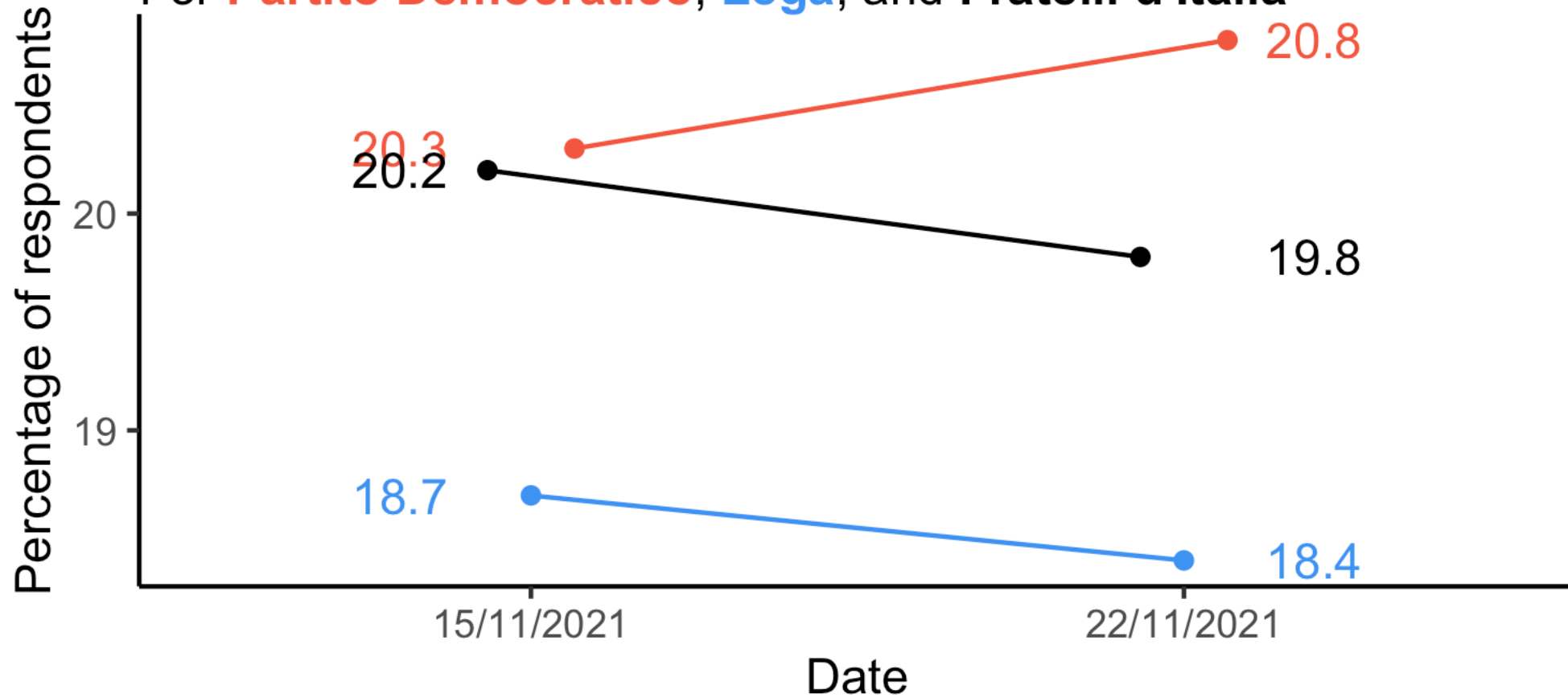
	Stima 22/11/2021	Stima 15/11/2021	Trend
<b>PARTITO DEMOCRATICO</b>	<b>20,8</b>	<b>20,3</b>	<b>+0,5</b>
<b>FRATELLI D'ITALIA</b>	<b>19,8</b>	<b>20,2</b>	<b>-0,4</b>
<b>LEGA</b>	<b>18,4</b>	<b>18,7</b>	<b>-0,3</b>
<b>MOVIMENTO 5 STELLE</b>	<b>15,7</b>	<b>16,1</b>	<b>-0,4</b>
<b>FORZA ITALIA</b>	<b>6,8</b>	<b>6,9</b>	<b>-0,1</b>
<b>AZIONE</b>	<b>4,0</b>	<b>3,9</b>	<b>+0,1</b>
<b>SINISTRA ITALIANA</b>	<b>2,5</b>	<b>2,5</b>	<b>=</b>



Valori %. Sondaggio realizzato da SWG S.p.a. per conto di La7 S.p.A.. Indagine condotta con tecnica mista CATI-CAMI-CAWI su un campione di 1.200 soggetti maggiorenni residenti in Italia (4513 non rispondenti) tra il 17 e il 22 novembre 2021. Il campione è stratificato per zona e prevede quote per età e sesso. Il margine d'errore statistico dei dati riportati è di 0,34% a un intervallo di confidenza del 95%. Il documento informativo completo del sondaggio sarà disponibile sul sito [www.sondaggiopoliticoelettorali.it](http://www.sondaggiopoliticoelettorali.it)

# Declared voting intentions

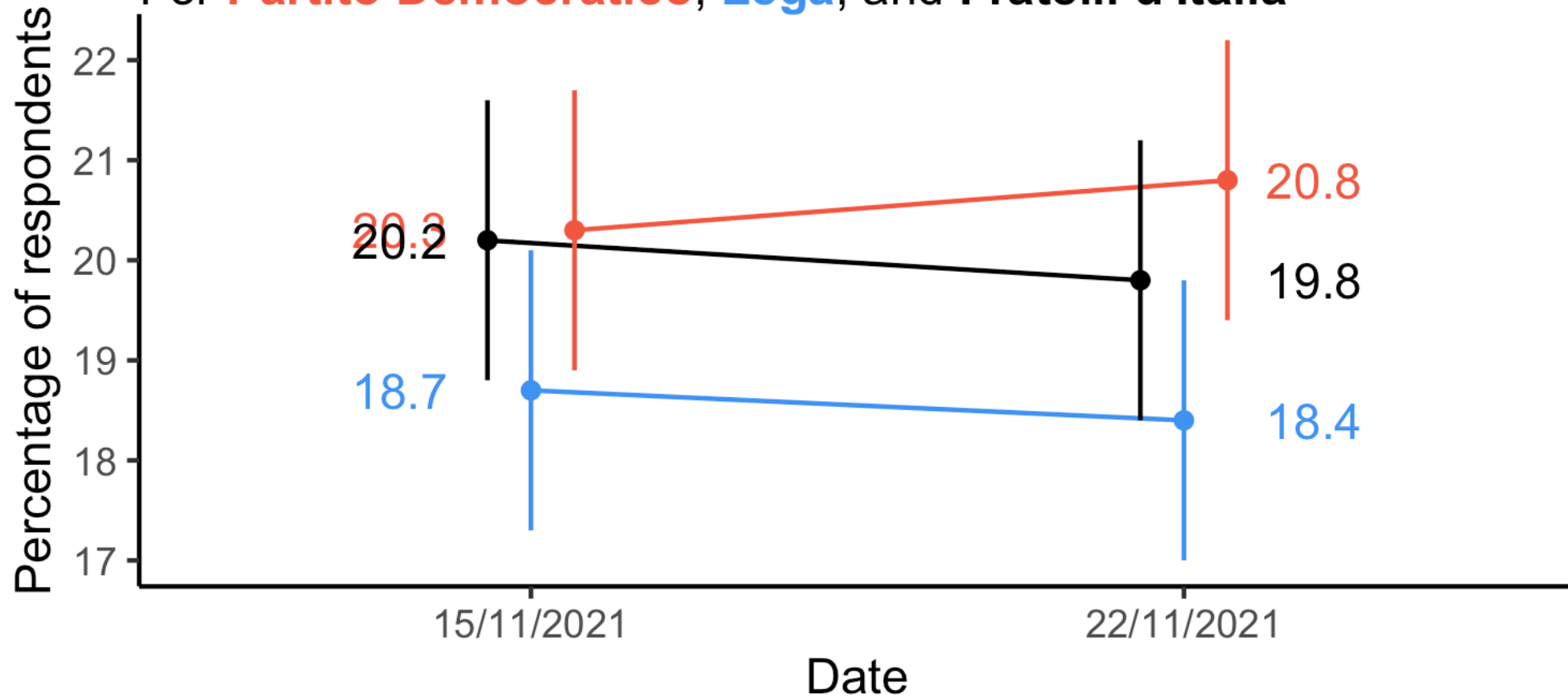
For **Partito Democratico**, **Lega**, and **Fratelli d'Italia**



Out of a sample of 1200 people, with margin of error 2.8% at a 95% confidence level.

# Declared voting intentions

For **Partito Democratico**, **Lega**, and **Fratelli d'Italia**



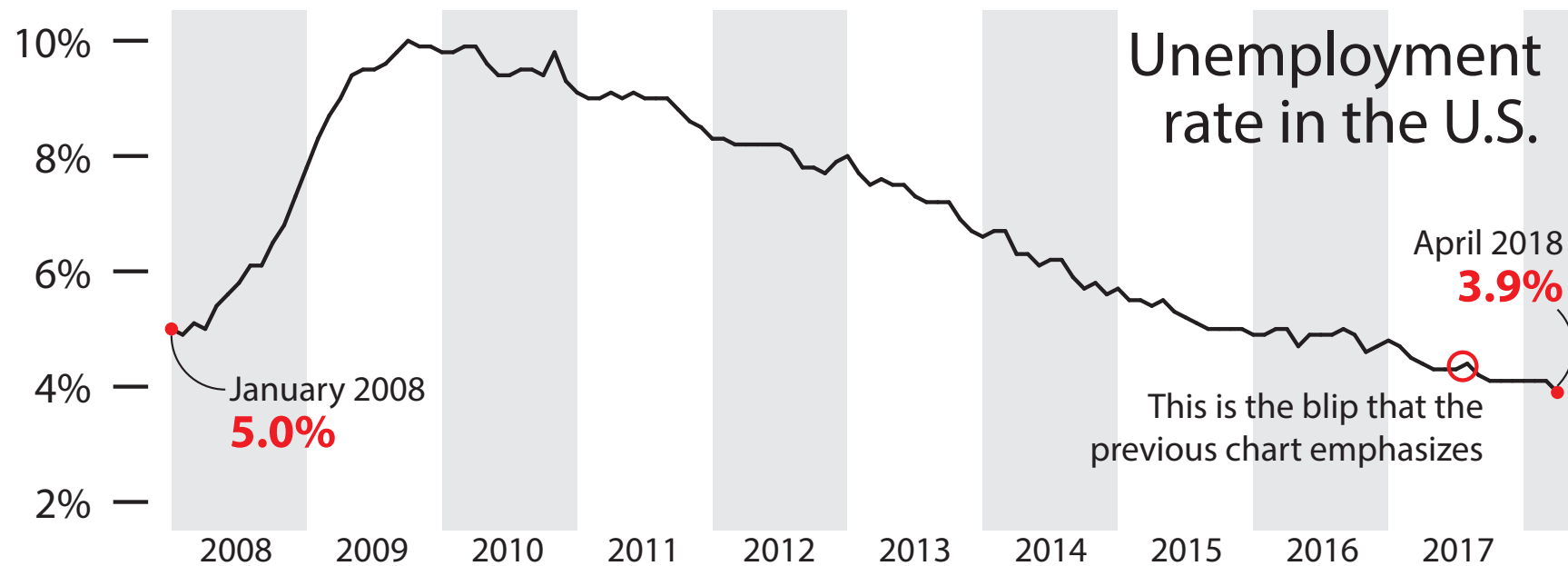
Out of a sample of 1200 people, with margin of error 2.8% at a 95% confidence level.

Unemployment rate in the U.S.

4.3% → 4.4%

July 2017

August 2017



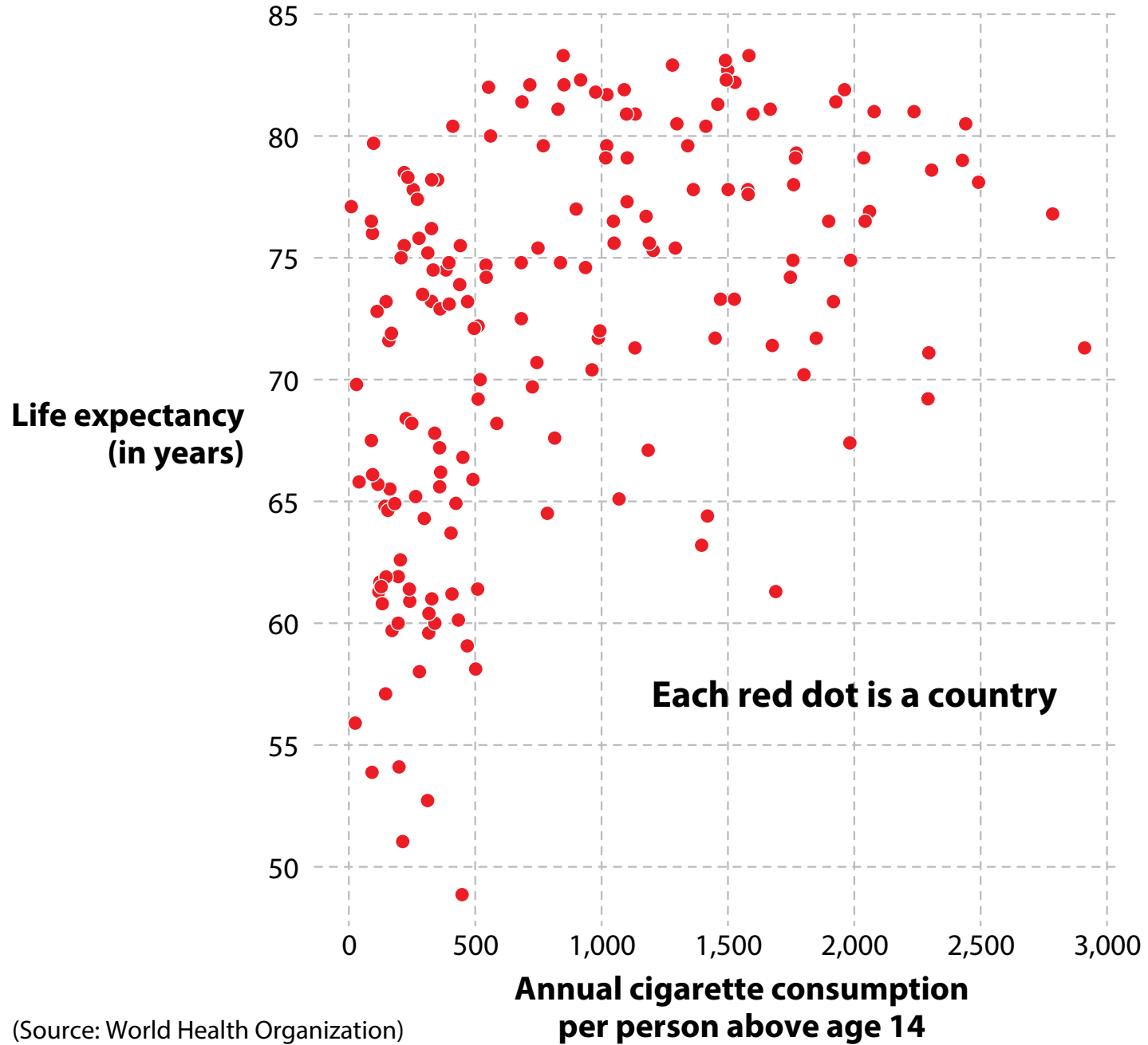
(Source: Bureau of Labor Statistics)

# Watch out

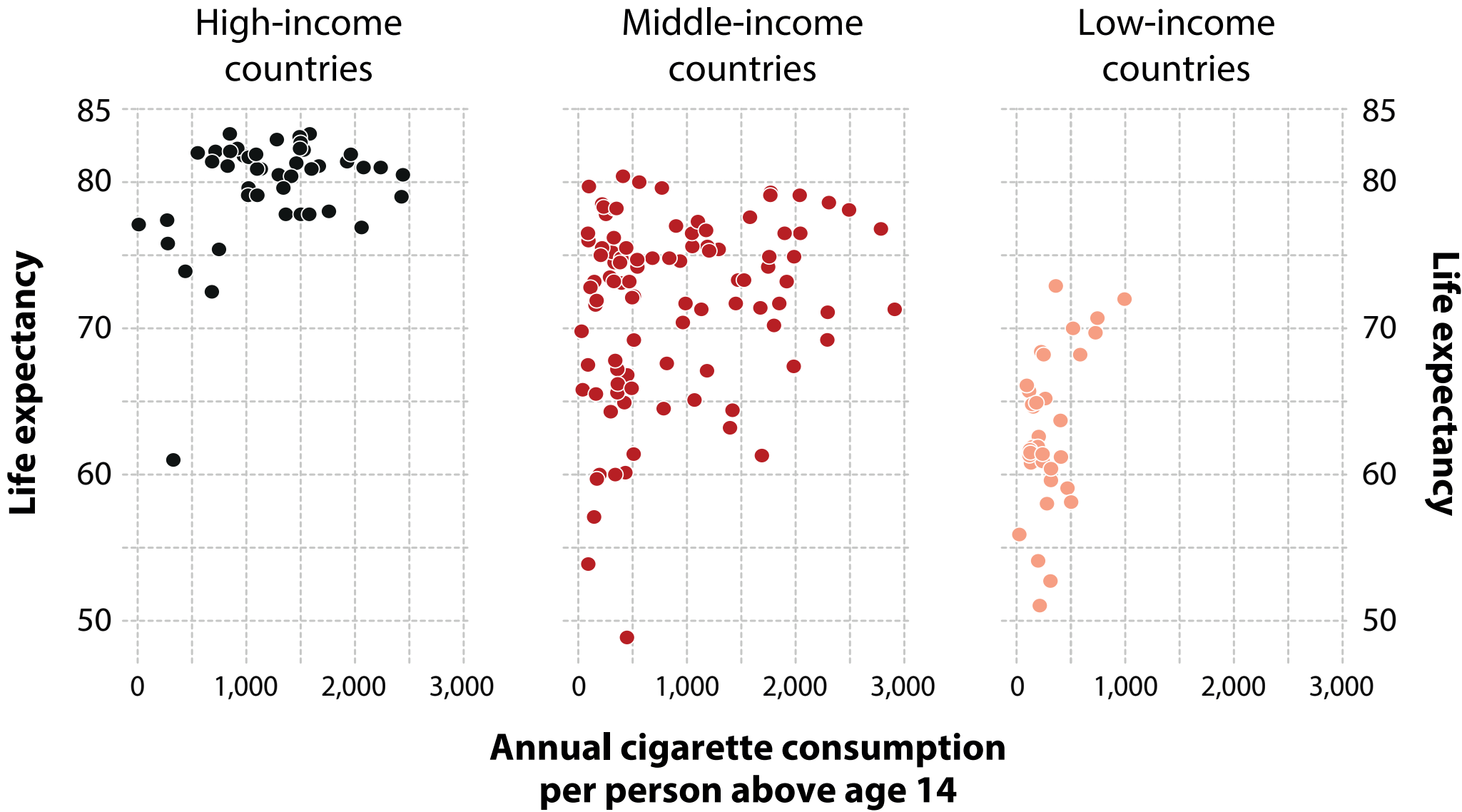
- Always report the uncertainty surrounding your estimates
- Estimates without explicit uncertainty are almost useless.

Suggesting misleading patterns





(Source: World Health Organization)

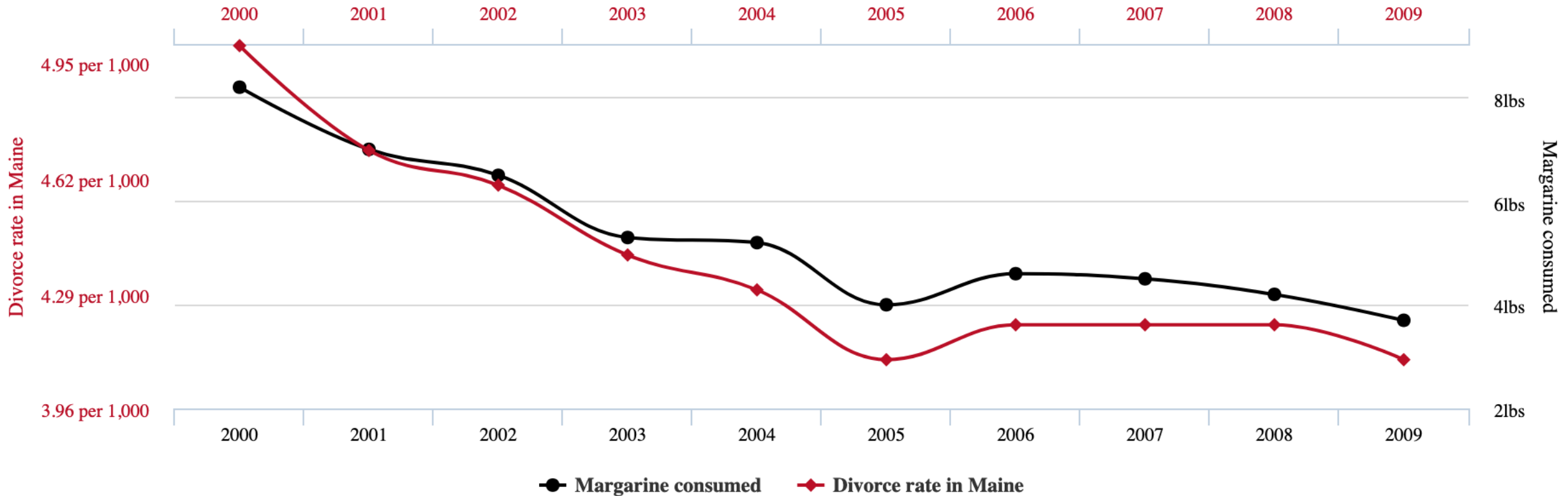


# Divorce rate in Maine

correlates with

## Per capita consumption of margarine

Correlation: 99.26% ( $r=0.992558$ )



# Watch out!

- Correlation **is not** causation!