Visual Design in Economics Research

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December 6, 2018

Introduction

- Your research is going well.
- You've done the hard work of estimation or simulation.

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Introduction

- Your research is going well.
- You've done the hard work of estimation or simulation.
- How to visualize your results?
  - in your slides
  - in your paper

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Introduction

- Your research is going well.
- You've done the hard work of estimation or simulation.
- How to visualize your results?
  - in your slides
  - in your paper
- This lecture will help you.

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Motivation

Why am *I* doing this?

- To share what I've learned
- To reduce information friction
- To increase knowledge diffusion rate

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Motivation

Why am *I* doing this?

- To share what I've learned
- To reduce information friction
- To increase knowledge diffusion rate

- (I wish someone had done this for me.)
- (I want to see more beauty in economics research.)

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Motivation

Why am *I* doing this?

- To share what I've learned
- To reduce information friction
- To increase knowledge diffusion rate

More importantly, do *you* want

- to better show off your work?
- to better communicate your idea?

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Resources

- I was inspired by this book
  - *Storytelling with data* (linked to its website)
  - a general purpose guide

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  - **NBER Digest** (almost always since 2018), the Economist (usually), NYTimes (often)

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  - conferences, seminars, job talks, etc.

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- For everything
  - **Google** (*duh*. . .)

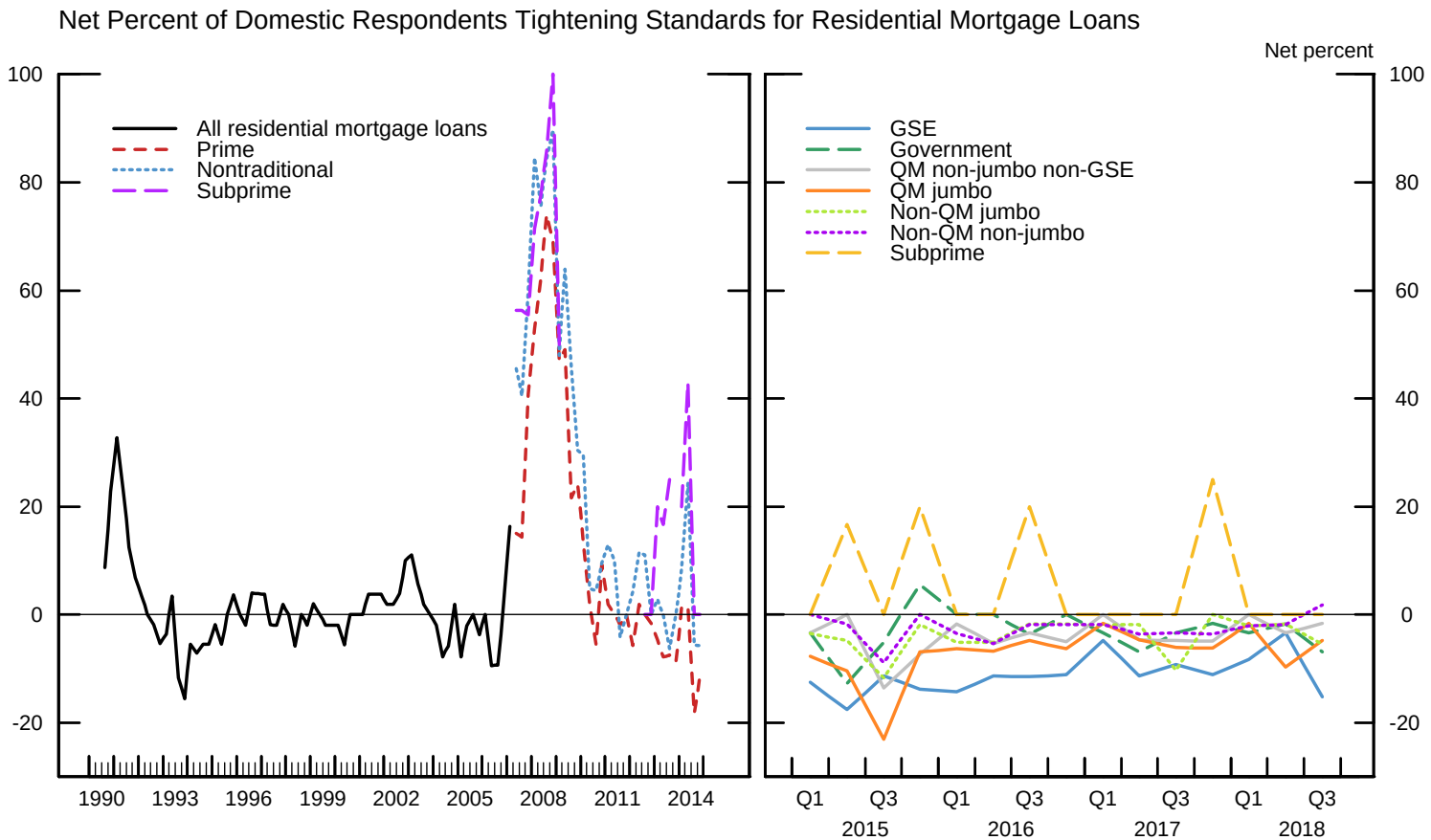
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Outline

1. Motivating examples: some figures
2. Slides vs. paper: difference?
3. Know your tools
4. Basic designing principles
5. Back to the examples: why?

Example figures

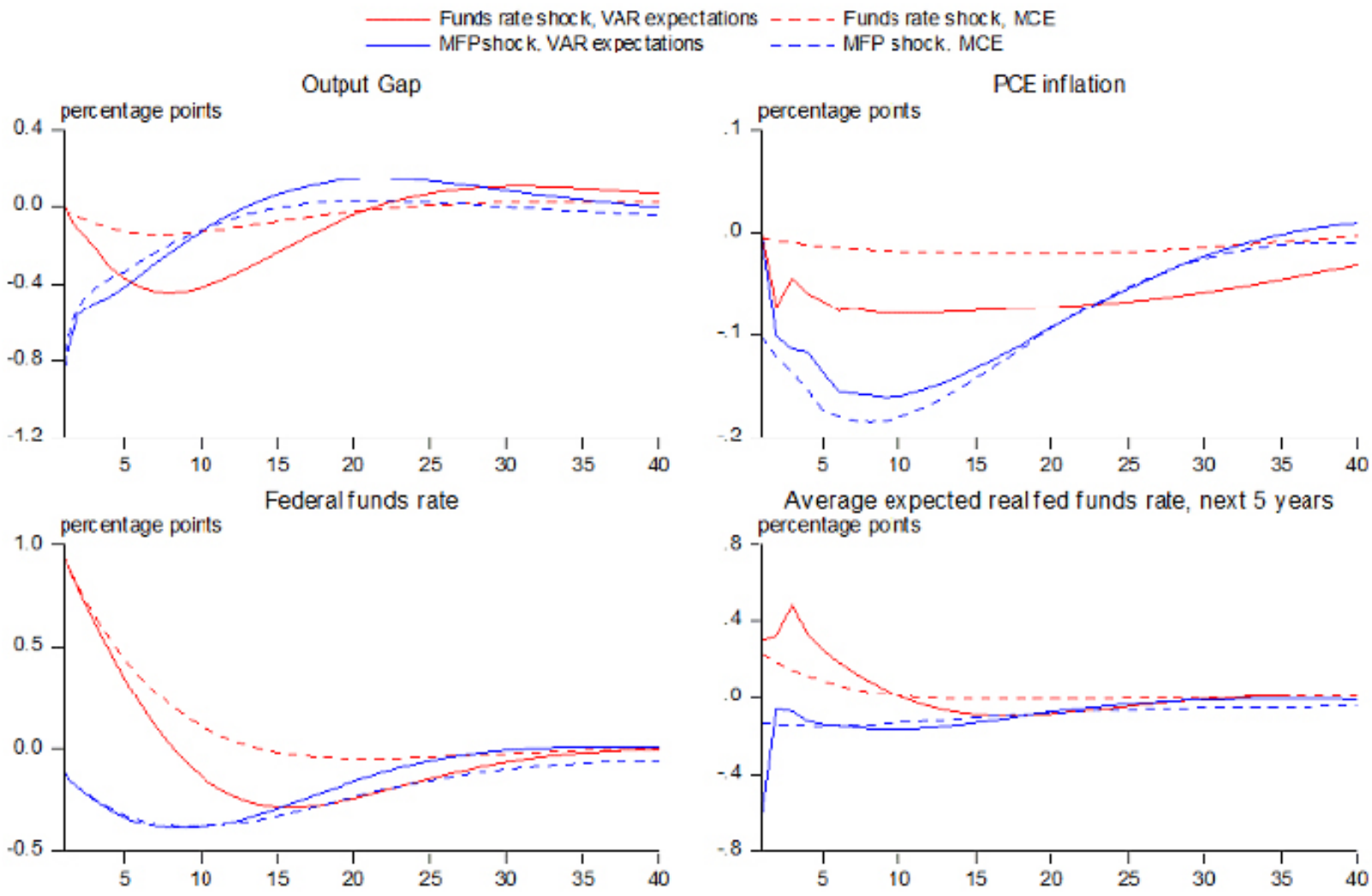
Measures of Supply and Demand for Residential Mortgage Loans



Source: The July 2018 Senior Loan Officer Opinion Survey on Bank Lending Practices

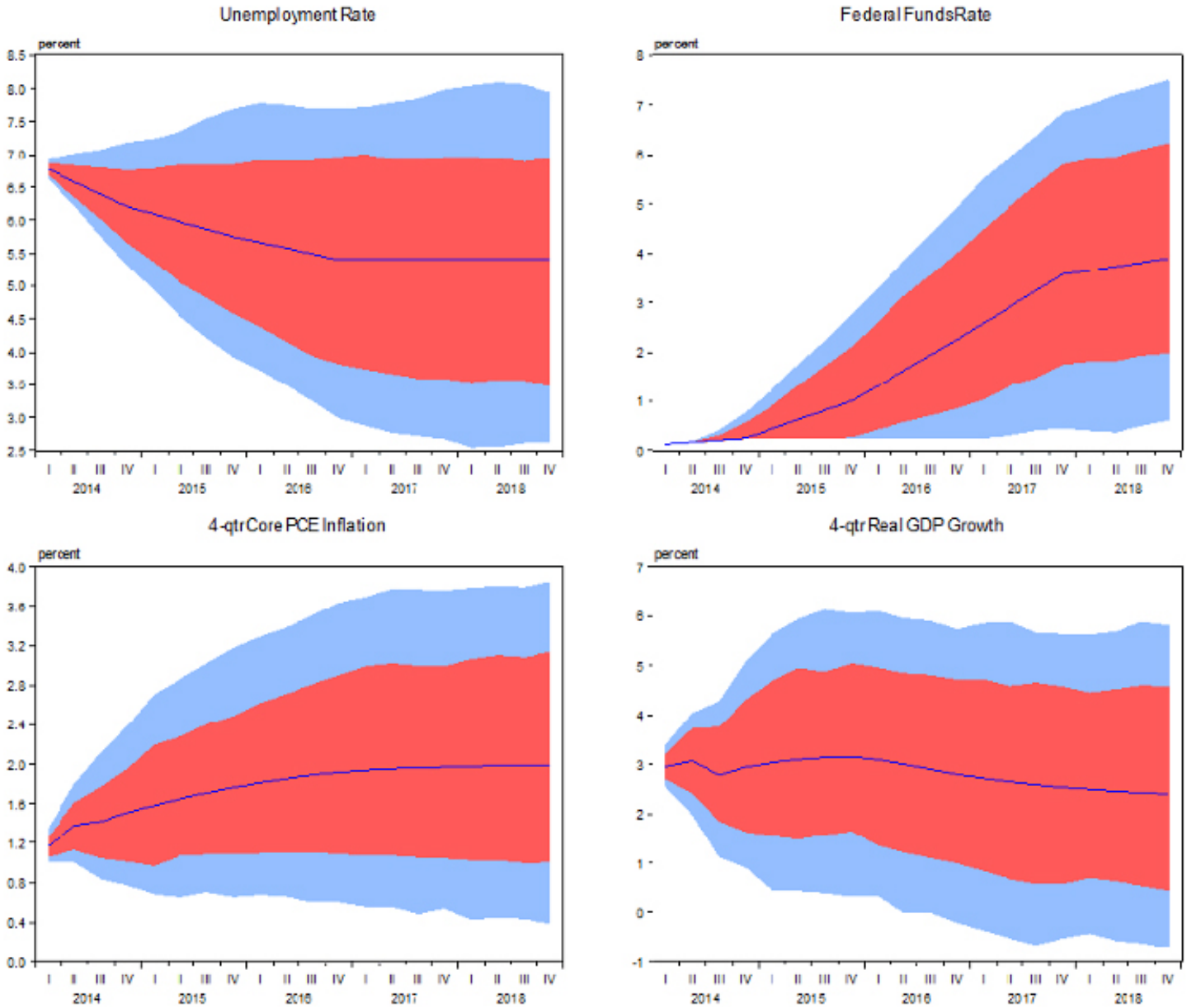
https://www.federalreserve.gov/data/sloos/sloos-201807.htm

(This style is very common in the literature.)



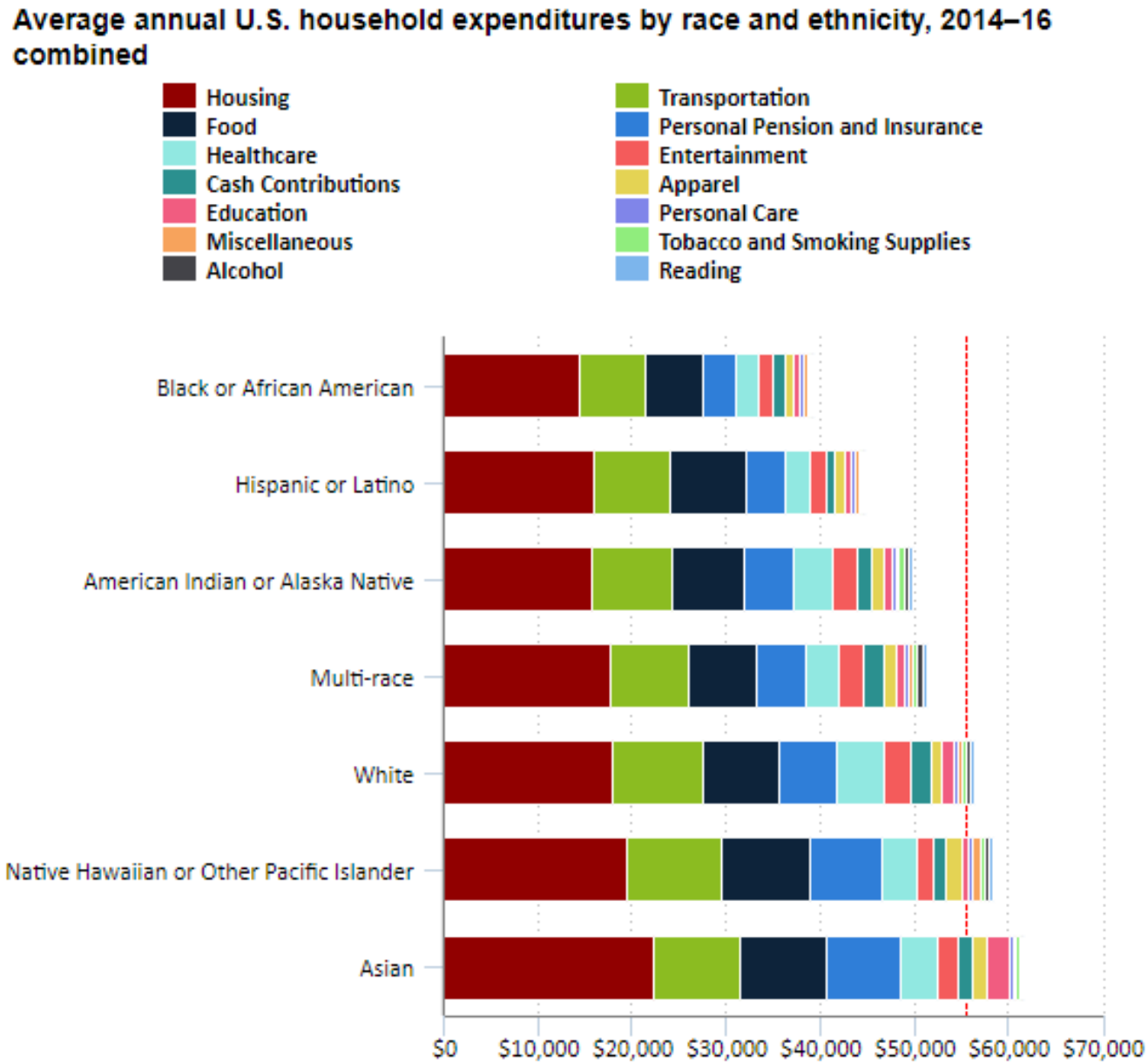
Source: The FRB/US Model: A Tool for Macroeconomic Policy Analysis

https://www.federalreserve.gov/econresdata/notes/feds-notes/2014/a-tool-for-macroeconomic-policy-analysis.html



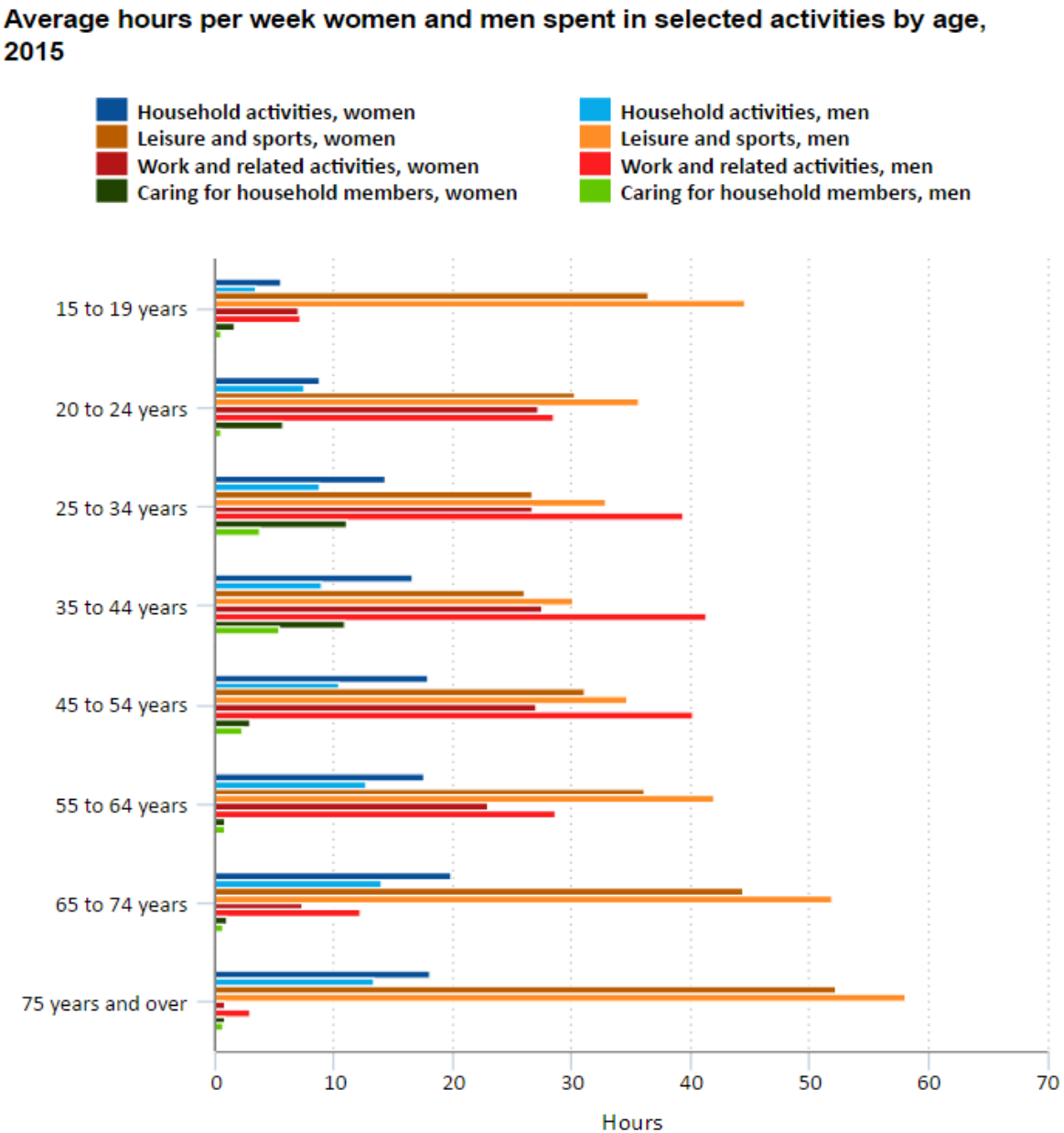
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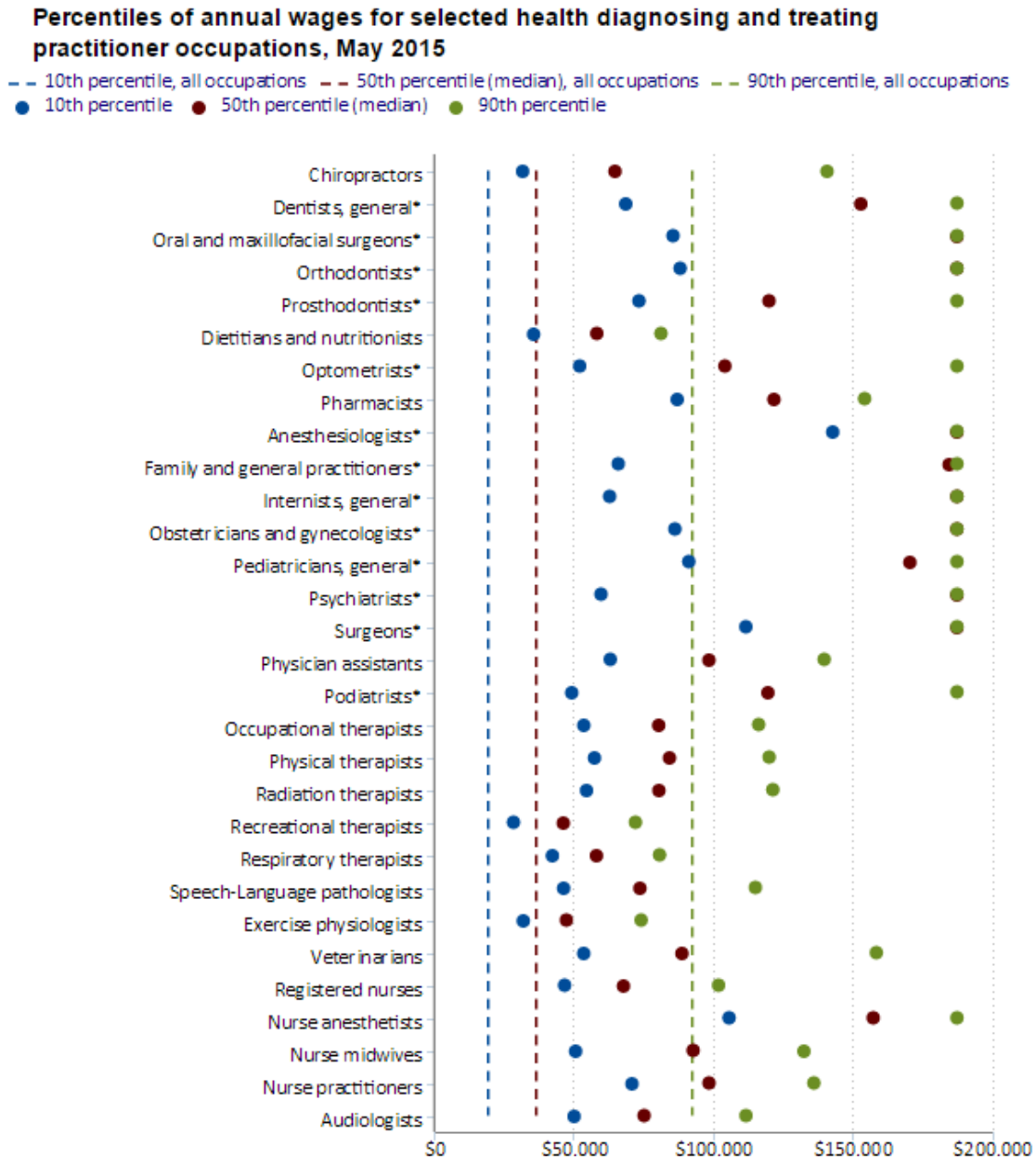
Source: MAY 2018 Spotlight: Race, Economics, and Social Status

https://www.bls.gov/spotlight/2018/race-economics-and-social-status/home.htm



Source: MARCH 2017 Spotlight: Women at work

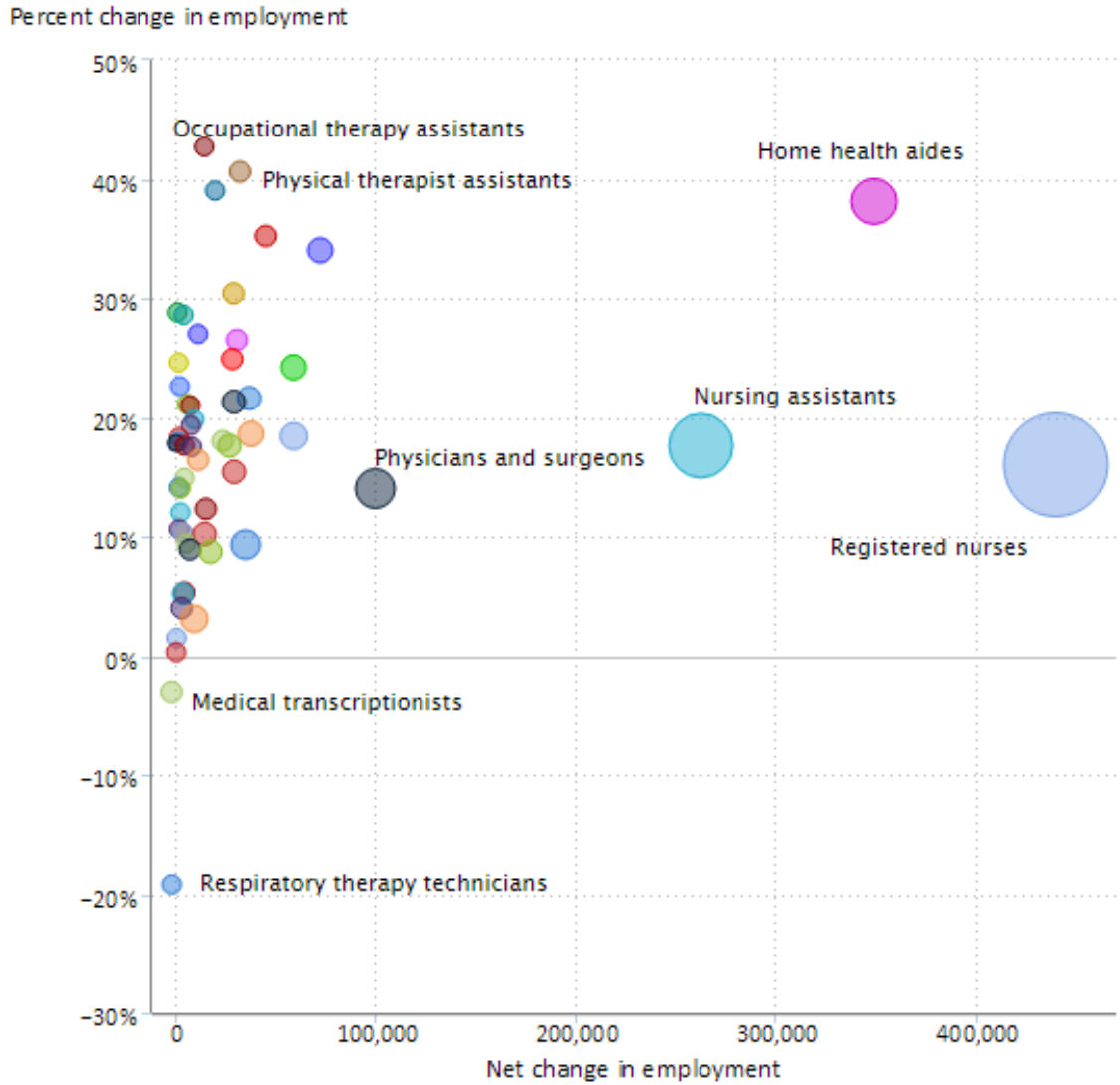
https://www.bls.gov/spotlight/2017/women-at-work/home.htm



Source: JUNE 2016 Spotlight: A look at healthcare spending, employment, pay, benefits, and prices
https://www.bls.gov/spotlight/2016/a-look-at-healthcare-spending-employment-pay-benefits-and-prices/home.htm

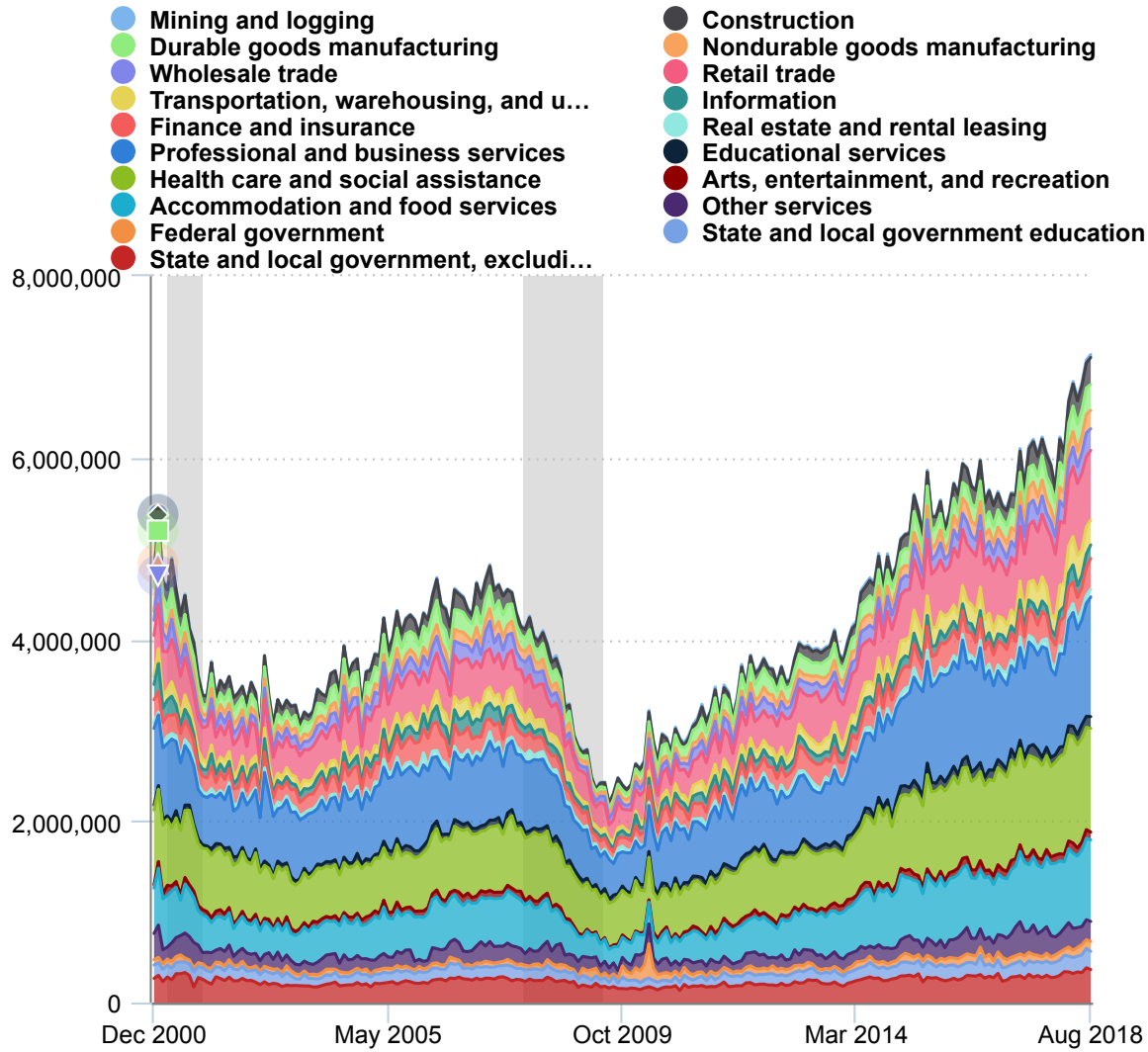
Employment projections for healthcare occupations, net and percent change in employment, 2014–2024 (projected)

Bubble size represents 2014 employment level



Source: JUNE 2016 Spotlight: A look at healthcare spending, employment, pay, benefits, and prices
https://www.bls.gov/spotlight/2016/a-look-at-healthcare-spending-employment-pay-benefits-and-prices/home.htm

Job openings by industry, December 2000–August 2018, seasonally adjusted



Source: Job openings reach series high of 7.1 million in August 2018
https://www.bls.gov/opub/ted/2018/job-openings-reach-series-high-of-7-point-1-million-in-august-2018.htm

Slides vs. Paper

Visuals in slides

In a **presentation**, you have

- More control
- A time constraint
- Other aids (talking, pointing, etc.)

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Visuals in slides

In a **presentation**, you have

- More control
- A time constraint
- Other aids (talking, pointing, etc.)
- A *live audience* who
  - May not be in your field
  - *Always* read your slides
  - Do not have perfect eyesight
  - Will ask questions
  - Have limited focus

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Features of good (visuals in) slides

Efficiency!

- A **clear message**
- The **first thing** to see is the message
- Easily read texts: titles, labels, legends
- Few distractions
- **Not** inviting unwanted questions

- Relevant to your point...

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Things to consider for (visuals in) slides

- Is the **main message** clear to others?
- Is it the **first thing** you notice?
- How **quickly** to get the idea?
  - $\leq$ **5 seconds** for figures?

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- Too many words? Notation?
- Can the audience read the text easily?
  - font size, color, **blurry**?
- Any distractions?
  - unnecessary notes, too many lines, too many numbers etc.

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- Any distractions?
  - unnecessary notes, too many lines, too many numbers etc.

- Is it **necessary**?

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Visuals in a paper

As to a paper, the **reader**

- Controls everything
- Usually likes to print it out
- *Never reads it* word for word
- Is drawn to figures and tables
- *Cannot communicate* with you immediately

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Features of good visuals in a paper

Clarity!

- Same as slides, plus being **self-contained**
- An **informative** title/caption: it can be longer

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Features of good visuals in a paper

Clarity!

- Same as slides, plus being **self-contained**

- An **informative** title/caption: it can be longer
- Tables: strategic headers, grouping
- Figures: printer-friendly line styles and colors
- Explanatory table/figure notes: there can be a lot of words

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Features of good visuals in a paper

Clarity!

- Same as slides, plus being **self-contained**

- An **informative** title/caption: it can be longer
- Tables: strategic headers, grouping
- Figures: printer-friendly line styles and colors
- Explanatory table/figure notes: there can be a lot of words

- If not fully self-contained, place it close to the relevant main text.

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Things to consider for visuals in a paper

- Same as slides, and regarding clarity:

- Can the reader get the message from the table/figure alone?
- Where is the relevant main text? Easy to find?

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Know Your Tools

Your (LaTeX) tool kit

- **Text**
  - font, size, bold, italic, color, space
- **Tables**
  - border, highlighted cells, alignment
- **Beamer templates**
  - everything
- **Figures** (in/out of `.tex` files)
  - line style, width, marker, color, edges, etc.

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Text

- LaTeX fonts (e.g. `palatino, [scaled]helvet, fourier`)
  - serif: Palatino, Utopia; sans serif: Helvetica; math: Palatino, Fourier
- A main/normal font size and variations
  - e.g. `\LARGE, \Large, \footnotesize, \scriptsize,` etc.
- Space b/w lines and paragraphs
  - e.g. `parskip, \linespread{}, \smallskip, \medskip, \bigskip,` etc.
- **Bold**, **colored bold**, ***bold italic***, ***colored bold italic*** , *colored italic*, simply colored are used in slides to draw attention

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Example: 10 waldos

Lorem ipsum dolor sit amet, consectetuer **waldo** adipiscing elit. Ut purus elit, vestibulum ut, **waldo** placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula **waldo** augue eu neque. Pellentesque habitant ***waldo*** morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra waldo metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus ***waldo*** eu tellus sit amet tortor gravida waldo placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi *waldo* dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla.

waldo

Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue *waldo* eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

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Example: 10 waldos

Lorem ipsum dolor sit amet, consectetuer **waldo** adipiscing elit. Ut purus elit, vestibulum ut, **waldo** placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula **waldo** augue eu neque. Pellentesque habitant ***waldo*** morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra waldo metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus ***waldo*** eu tellus sit amet tortor gravida waldo placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi *waldo* dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla.

waldo

Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue *waldo* eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

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Tables

- An informative caption/title
- Strategic header groups and hierarchy
- Lines
- Width, height, alignment (`tabularx, longtable`)
- Table notes (`threeparttable`, more useful in papers)
- Colored/highlighted cells or rows (`colortbl`, in slides)

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Common figure types in economics

Effective and simple ones

- Simple 2-D line plots (a variety of them)
- Flow/timing chart (`tikz`)
- Scatterplots with fitted lines/curves
- Histograms
- Heat maps

Fancy ones to show off (nothing wrong)

- Heat-map maps and geo-bubbles
- Network connections

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Common figure types in economics

Difficult but sometimes necessary ones

- (Stacked) area plots
- Vertical and horizontal bar charts
- Some versions of box plots

Ones to avoid with very few exceptions

- 3-D plots, surfaces
- Pie, donut charts

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Basic designing principles

Basic designing principles

- Esp. important in a presentation: **efficiency**

$$\max_{\text{tools}} \quad \frac{\partial(\text{your message})}{\partial\ \text{time}}$$

subject to: **time constraint** of presentation

limited focus of the audience

random shocks

- **Optimize** attention allocation
- Keep it **clean**

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Implementation of the principles

contrast $\propto$ **importance**

What affects the audience's attention?

- **Monotonicity** leads to boredom
- **Chaos** causes distraction
- **Breaking** of patterns draws attention

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Implementation of the principles

contrast $\propto$ **importance**

What affects the audience's attention?

- **Monotonicity** leads to boredom
- **Chaos** causes distraction
- **Breaking** of patterns draws attention

How to optimize it?

- **Declutter**
- Create **variation** when needed
  - Details and examples discussed later

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Implementation of the principles

But how?

- Have a clean background
- **Minimize** the number of
  - Words
  - Notation
  - Colors
  - Border lines in tables
  - Lines/markers/boxes/grids/edges in figures

We will discuss them one by one. But first. . .

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Clickers and laser pointers

- **Fast, sudden** laser dot movements are very **distracting**!
  - (There is a reason they are pet toys.)

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Clickers and laser pointers

- **Fast, sudden** laser dot movements are very **distracting**!
  - (There is a reason they are pet toys.)
- Try pointing the laser at one spot and **staying**
- Try **slow** underlining
- Control the impulse of circling
- Emphasize a point in the beamer **before** the talk

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Clickers and laser pointers

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- Try **slow** underlining
- Control the impulse of circling
- Emphasize a point in the beamer **before** the talk
- Same thing applies to the presenter! Control your movement.

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A clean beamer background

- Consider building your own beamer template
  - a fixed initial cost $\Longrightarrow$ increasing RTS
  - abandon SWP now

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A clean beamer background

- Consider building your own beamer template
  - a fixed initial cost $\Longrightarrow$ increasing RTS
  - abandon SWP now
- **Avoid** beamer themes with
  - **dark** or distracting color blocks
  - **wide** head/foot/side sections: space is valuable!
- Try and **remove** all 3-D features
  - e.g. bullet balls , and box shadows

Don't do this!

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A clean beamer background

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    Don't do this!
- **Constrast** draws attention
- Use it wisely to show off **your work**

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Text in slides

- Use **fewer**, shorter words
  - short phrases $\succ$ full sentences
- Leave enough space
  - `\linespread{1.2}` or more
- Choose a clean, easy-to-read font
  - traditional: serif (e.g. `palatino, charter, utopia`)
  - contemporary: sans serif (e.g. `roboto-light` (not standard), `helvet, iwona, avant`)
  - math often looks better in serif (e.g. `mathpazo, mathpple, pxfonts, fourier`)

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Text in slides

- Main font size

  ≥ 11 pt

- Rule of thumb: on each frame

  # of lines ≤ **10**

  # of words ≤ **60**

  or better yet: ≤ 30 words

- Use pause/overlay/step-item strategically

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Notation in slides

- Use notation **sparingly**!
- If possible, always use **standard** notation in your field
  - e.g. $u, V, c, l/h, y, k, i, p, w, r, \beta, \delta, \alpha, \mu, \sigma$
- If not, choose easy-to-remember ones
  - e.g. the first-letter(s) rule

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- If not, choose easy-to-remember ones
  - e.g. the first-letter(s) rule
- **Limit** annotation, heavy sub/super-scripts, long equations
  - e.g. $\tilde{\sigma}\left(\boldsymbol{\omega}^{\tau}_{\tau+\tau'|c,i,j,\tau}, \hat{\theta}_{c,i,j,\tau}, \boldsymbol{\Omega}^{*}_{\tau}\right)$
  - use `\underbracket` etc. to explain (`mathtools`)
  - **highlight** important parts

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An example

(I copied the content from my own slides.)

Can you tell what part I want you to focus on?

before

- Model-implied VAR-like industry-level output growth dynamics ($\Delta\hat{\boldsymbol{y}}_t \equiv \log \boldsymbol{y}_t - \log \boldsymbol{y}_{t-1}$)

$$\begin{aligned}\Delta\hat{\boldsymbol{y}}_t =& \operatorname{diag}(\boldsymbol{\alpha})\boldsymbol{\Omega}\Delta\hat{\boldsymbol{y}}_{t-1} + \Delta\hat{\boldsymbol{z}}_t + \boldsymbol{\gamma}\log\eta_t \\ &+ \boldsymbol{\gamma}\circ\Delta\hat{\boldsymbol{s}}_t + \boldsymbol{\alpha}\circ\Delta\hat{\boldsymbol{u}}_{t-1} - \operatorname{diag}(\boldsymbol{\alpha})\boldsymbol{\Omega}\Delta\hat{\boldsymbol{s}}_{t-1}\end{aligned}$$

  No need to know the information structure!

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An example

(I copied the content from my own slides.)

How about now?

after

- Model-implied VAR-like industry-level output growth dynamics ($\Delta\hat{\boldsymbol{y}}_t \equiv \log \boldsymbol{y}_t - \log \boldsymbol{y}_{t-1}$)

$$\Delta\hat{\boldsymbol{y}}_t = \overbrace{\operatorname{diag}(\boldsymbol{\alpha})\boldsymbol{\Omega}\Delta\hat{\boldsymbol{y}}_{t-1}}^{\text{downward trans.}} + \overbrace{\Delta\hat{\boldsymbol{z}}_t + \boldsymbol{\gamma}\log\eta_t}^{\text{prod. \& demand}} + \underbrace{\boldsymbol{\gamma}\circ\Delta\hat{\boldsymbol{s}}_t + \boldsymbol{\alpha}\circ\Delta\hat{\boldsymbol{u}}_{t-1} - \operatorname{diag}(\boldsymbol{\alpha})\boldsymbol{\Omega}\Delta\hat{\boldsymbol{s}}_{t-1}}_{\text{impacts of exp. changes}}$$

No need to know the information structure!

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Another example...

(I copied the content from my own paper.)

- *Nothing* can save an equation like this...

$$
\begin{aligned}
& M_t^{H,old} J_t^{H,old}(x, A) \\
=& (1-\delta)\mathbf{1}_{\{x \geq x^*(A)\}} \\
& \times \int \int_{(x^D)^{-1}(x)-a_{t+1}}^{S(A)-a_{t+1}} \left[\begin{array}{l} M_{t-1}^{H,old} \hat{J}_{t-1}^{H} \left(x - \frac{(\Delta z)^2}{2\sigma_{old}^2} - \frac{\Delta z}{\sigma_{old}} \epsilon \right) - \\ M_{t-1}^{H,old} \hat{J}_{t-1}^{H} \left(x^D(a_{t+1}+\xi) - \frac{(\Delta z)^2}{2\sigma_{old}^2} - \frac{\Delta z}{\sigma_{old}} \epsilon \right) \end{array} \right] dF^{\xi}(\xi) d\Phi(\epsilon)
\end{aligned}
$$

- Do not show it in the main body of your slides!
- Include it in a backup frame if necessary

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Colors (!!!)

- Pick **one** main color
  - neutral
  - muted
  - dark enough to contrast with the background

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Colors (!!!)

- Pick **one** main color
  - neutral
  - muted
  - dark enough to contrast with the background
- A **darker blue** is always the safest choice!
  - Blue is the default (e.g., NBER Digest, the Economist, NYTimes, etc.)
  - (Partial) color-blindness (≥ 8% of male) friendly

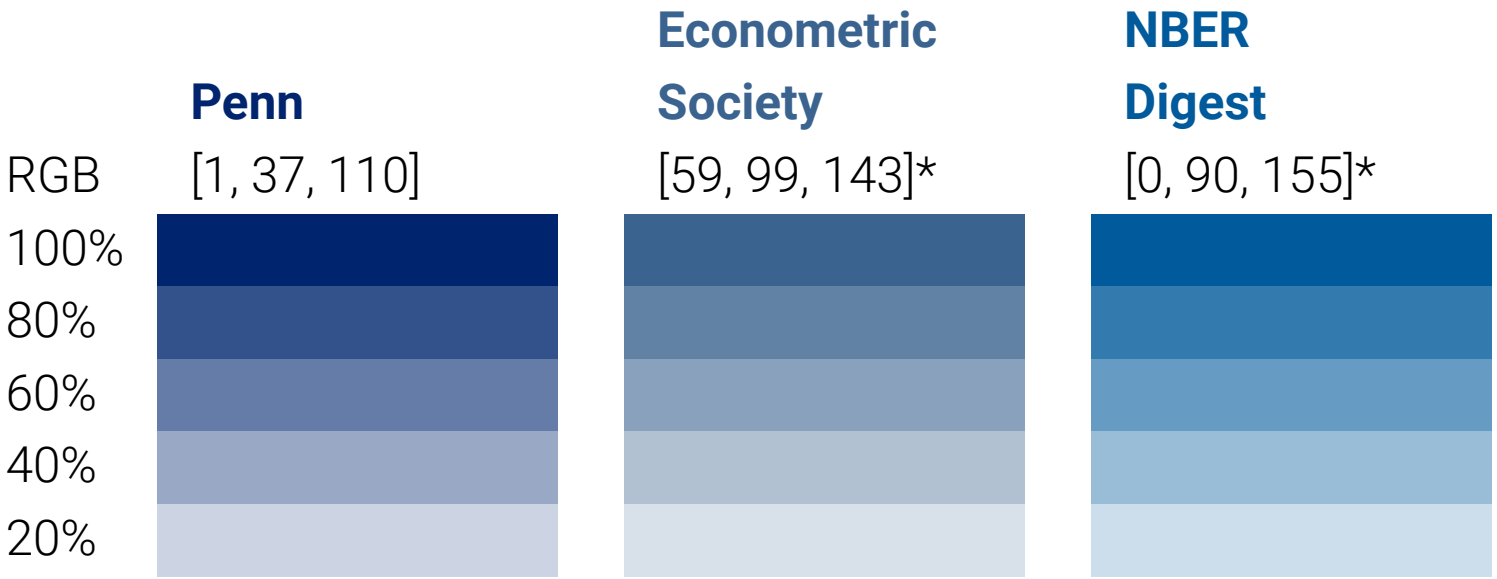
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  - Blue is the default (e.g., NBER Digest, the Economist, NYTimes, etc.)
  - (Partial) color-blindness (≥ 8% of male) friendly
- A **darker red** is good too.
  - Red can be tricky

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A few good blues



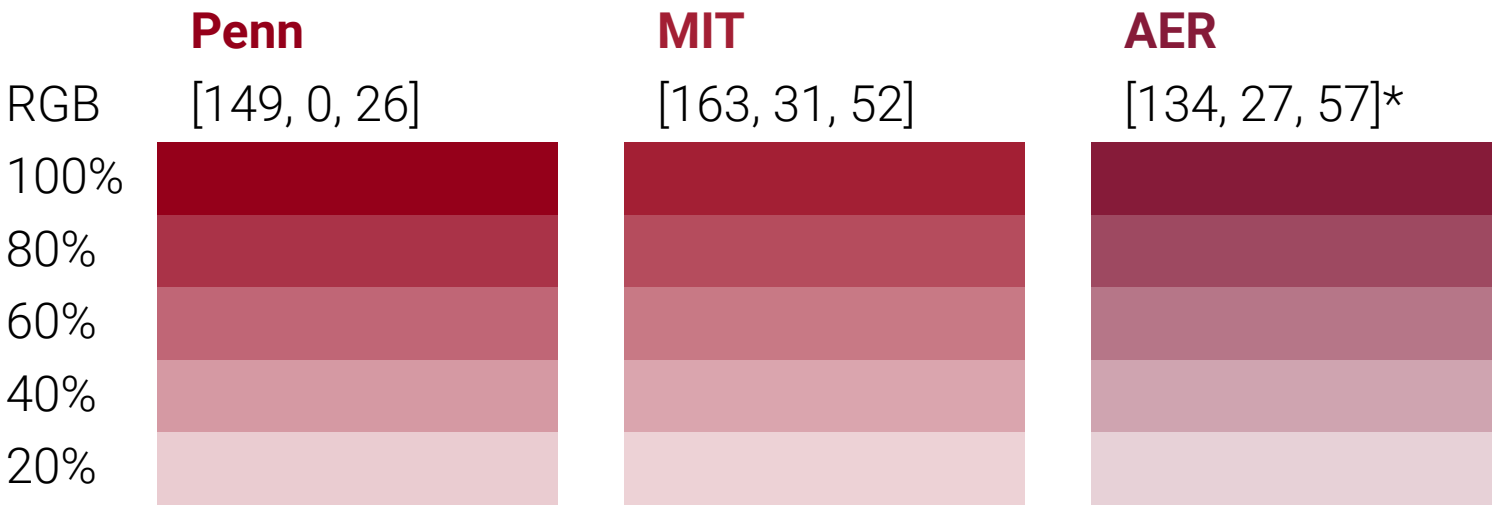
web based RGB values
* approx.

Note:

- Web **UNC Blue** [RGB] = [75, 156, 211] **80% 60% 40% 20%** may be a little light. Try UNC **Link Blue** [RGB] = [0, 127, 174] **80% 60% 40% 20%**
- If you must, **ReStud Green** [RGB] = [34, 84, 67]* **80% 60% 40% 20%** is a nice one.

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A few good reds



web based RBG values
* approx.

Note:

- Red is more visible than blue, but riskier, must be used more sparingly
- Can be used with blue

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Playing with colors in LaTeX

- General color uses: `xcolor`
- Specifying a color
  - e.g. **UNC Blue** is `\color[RGB]{75, 156, 211}`
- To use a specific color repeatedly, give it a name
  - e.g. `\definecolor{uncblue}{RGB}{75, 156, 211}`
- Color mixing
  - **70% UNC Blue + 30% black**: `\color{uncblue!70!black}`
  - **70% UNC Blue + 30% white**: `\color{uncblue!70!white}` or `\color{uncblue!70}`
- All colored elements in a beamer template
  - `\setbeamercolor{}{}`

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Color **Do's**



- Palette: **one** main color, its variations, **grays**
  - why grays: neutral; printer and color-blindness friendly; easy control of contrast
  - A secondary color: if necessary
- Use it **consistently**
  - figures, beamer theme, text highlight, etc.
- Be careful with **bold black** lines, text, area! They create maximal contrast and overusing can cause discomfort.

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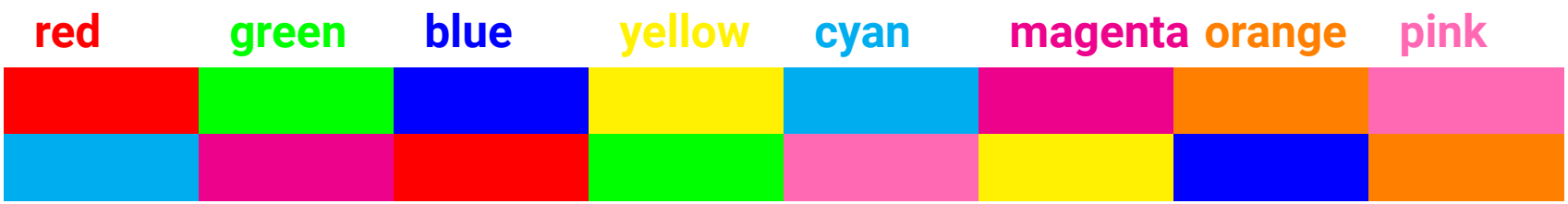
Color **Don’ts**

- Do not use more than **two** main colors
  - Exceptions are few
  - Do not use reds and greens together
- Do not overuse colors
- Do not use highly saturated, bright, conflicting colors
  - Esp. not together!
  - (That is, if you want to appear professional.)
  - Exceptions apply (e.g. pink in breast cancer studies)

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Color **Don’ts**

- Do not use more than **two** main colors
  - Exceptions are few
  - Do not use reds and greens together
- Do not overuse colors
- Do not use highly saturated, bright, conflicting colors
  - Esp. not together!
  - (That is, if you want to appear professional.)
  - Exceptions apply (e.g. pink in breast cancer studies)



Please don’t do this!

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Lines in tables

- **Avoid** vertical lines
- Rule of thumb (see tables in e.g. AER papers)
  - `\hline\hline` b/w caption and header
  - `\cline{a-b}` creates header hierarchy/groups
  - `\hline` b/w header and body
  - `\hline` or `\hline\hline` ends a table in slides or separates body and notes in a paper

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Lines in tables

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  - `\hline\hline` b/w caption and header
  - `\cline{a-b}` creates header hierarchy/groups
  - `\hline` b/w header and body
  - `\hline` or `\hline\hline` ends a table in slides or separates body and notes in a paper
- Use **spaces** for visual separation b/w columns and rows
- More lines are okay in longer tables, e.g.
  - multiple regressions: a line above entries like # of obs., FE, R^2, etc.

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Other elements of tables

- Usual alignment
  - whole table: center
  - single cells: left
  - `\multicolumn`: left or center
- Good table width **≥0.8**`\textwidth` (use `tabularx`)

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Other elements of tables

- Usual alignment
  - whole table: center
  - single cells: left
  - `\multicolumn`: left or center
- Good table width **≥0.8**`\textwidth` (use `tabularx`)
- In a paper, texts in tables are of `\footnotesize` or `\scriptsize`
  - full caption and notes: `threeparttable`
  - multiple-page appendix tables: `longtable`
- In slides, **readability** is key
  - Highlights, colors, bold fonts: `colortbl`

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An example

(I copied the content from my own slides.)

Can you tell what part I want you to focus on?

before

II. Welfare loss due to forecast errors in % of steady-state final use C per period, deviation from perfect foresight.

		Information Structure		
	Parameters (T, N, σ_ϵ)	Baseline	1 signal	0 signal
Benchmark	$(8, 0.35\kappa, 0.1\sigma_\eta)$	-0.09	-0.12	-0.11
Noisier	$(4, 0.2\kappa, 0.3\sigma_\eta)$	-0.11 $(\downarrow)$	-0.12 $(-)$	–
More accurate	$(10, \kappa, 0.1\sigma_\eta)$	-0.08 $(\uparrow)$	-0.11 $(\uparrow)$	–

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An example

(I copied the content from my own slides.)

How about now?

after

II. Welfare loss due to forecast errors in % of steady-state final use C per period, deviation from perfect foresight.

		Information Structure		
	Parameters (T, N, σ_ϵ)	Baseline	1 signal	0 signal
Benchmark	$(8, 0.35\kappa, 0.1\sigma_\eta)$	-0.09	-0.12	-0.11
Noisier	$(4, 0.2\kappa, 0.3\sigma_\eta)$	-0.11 $(\downarrow)$	-0.12 $(-)$	–
More accurate	$(10, \kappa, 0.1\sigma_\eta)$	-0.08 $(\uparrow)$	-0.11 $(\uparrow)$	–

Message:

...

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Another example

(I copied the content from my own paper.)

This is **not** how to show a table in slides!

Table 7: Cyclicality of Establishment Entry and Exit Rates Compared to Firm Birth and Death Rates

X_t	Correlation Coefficient between X_t and: gdp_t	ΔGDP_t
Establishment Entry and Firm Birth		
Firm Birth Rate	0.3229	0.6183
	(0.0585)	(0.0001)
Establishment Entry Rate	0.7901	0.2239	0.3261
	(0.0000)	(0.1960)	(0.0559)
Establishment Entry Rate due to Firm Births	0.9823	0.3238	0.5769
	(0.0000)	(0.0578)	(0.0003)
Establishment Entry Rate by Continuing Firms	0.2414	0.0123	−0.1124
	(0.1623)	(0.9443)	(0.5203)
Establishment Exit and Firm Death		
Firm Death Rate	0.0457	−0.3113
	(0.7983)	(0.0687)
Establishment Exit Rate	0.4941	−0.0217	−0.3855
	(0.0026)	(0.9017)	(0.0222)
Establishment Exit Rate due to Firm Deaths	0.9956	0.0688	−0.3062
	(0.0000)	(0.6947)	(0.0736)
Establishment Exit Rate by Continuing Firms	−0.1226	−0.0734	−0.2342
	(0.4831)	(0.6751)	(0.1757)

- Correlation results between firm birth (death) rate and gdp_t, ΔGDP_t are extracted from Table 1.
- p-values are in the parentheses.
- All variables in the first column are detrended using a Hodrick-Prescott filter with a smoothing parameter of 6.25.
- Table B.10 provides a more comprehensive comparison based on alternative business cycle indicators and additional measures of establishment entry and exit and their firm-level counterparts.

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Another example

(I copied the content from my own paper.)

Consider something like this.

Table 7 (Part I). *Cyclicality* of Establishment Entry Rates Compared to Firm Birth Rates

X_t	Correlation Coefficient between X_t and: gdp_t	ΔGDP_t
Firm Birth Rate	0.32	0.62
	(0.06)	(0.00)
Estab. Entry Rate	0.22	0.33
	(0.20)	(0.06)
Estab. Entry Rate due to Firm Births	0.32	0.58
	(0.06)	(0.00)
Estab. Entry Rate by Continuing Firms	0.01	−0.11
	(0.94)	(0.52)

(p-value)

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Another example

(I copied the content from my own paper.)

Consider something like this.

Table 7 (Part II). *Cyclicality* of Establishment Exit Rates Compared to Firm Death Rates

	Correlation Coefficient between X_t and:		
X_t		gdp_t	ΔGDP_t
Firm Death Rate		0.05	−0.31
		(0.80)	(0.07)
Estab. Exit Rate	0.49	−0.02	−0.39
	(0.00)	(0.90)	(0.02)
Estab. Exit Rate due to Firm Deaths	1.00	0.07	−0.31
	(0.00)	(0.69)	(0.07)
Estab. Exit Rate by Continuing Firms	−0.12	−0.07	−0.23
	(0.48)	(0.68)	(0.18)
			(p-value)

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Figure lines, markers, labels, boxes, grids

Examine each element of a figure and ask:

- Is this figure or element (grid, box, labels, legends) **necessary**?
  - no: delete it

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Figure lines, markers, labels, boxes, grids

Examine each element of a figure and ask:

- Is this figure or element (grid, box, labels, legends) **necessary**?
  - no: delete it
- Is this element the main **message**?
  - no: then do not let it stand out
  - yes: create **contrast** and draw attention

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Figure lines, markers, labels, boxes, grids

Examine each element of a figure and ask:

- Is this figure or element (grid, box, labels, legends) **necessary**?
  - no: delete it
- Is this element the main **message**?
  - no: then do not let it stand out
  - yes: create **contrast** and draw attention
- Can an audience **quickly** get the **right** idea?

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Figure lines, markers, labels, boxes, grids

Examine each element of a figure and ask:

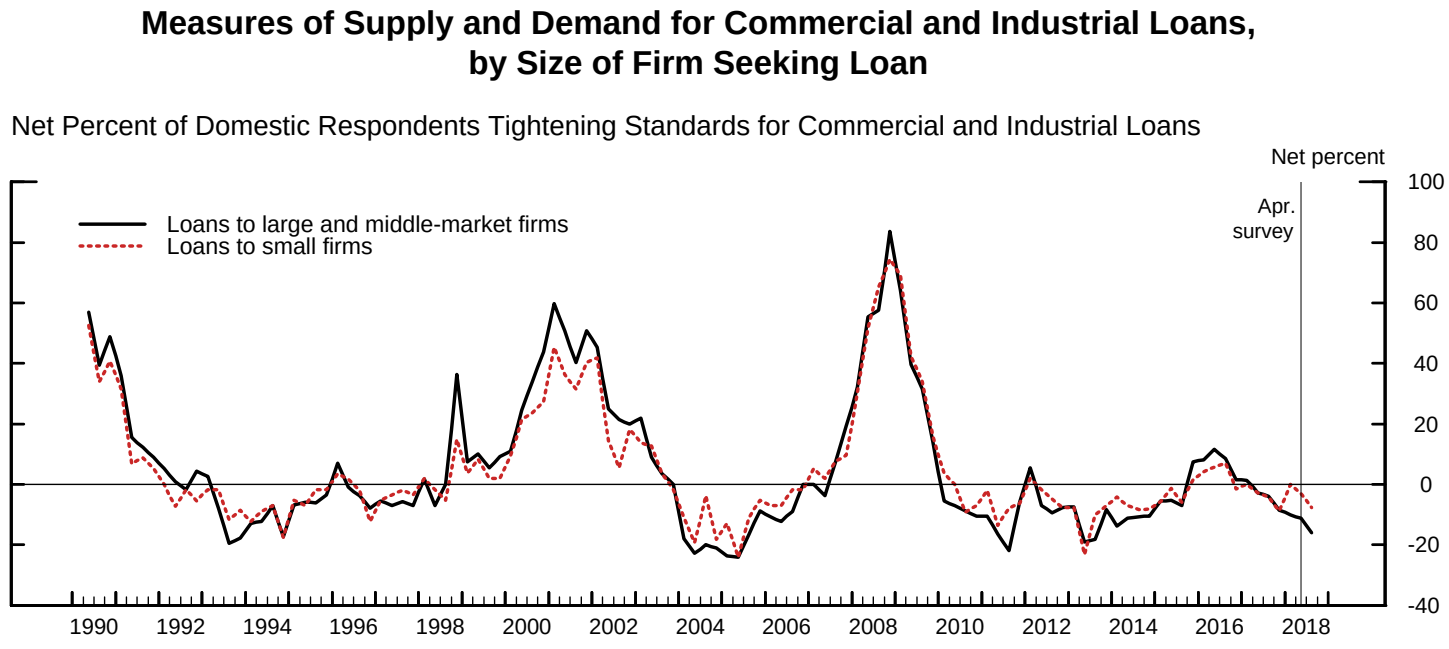
- Is this figure or element (grid, box, labels, legends) **necessary**?
  - no: delete it
- Is this element the main **message**?
  - no: then do not let it stand out
  - yes: create **contrast** and draw attention
- Can an audience **quickly** get the **right** idea?
- Is it aesthetically appealing?
  - (Optional. Ask a friend maybe?)
- How to better tell the story?
  - use your imagination, and learn

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Some example figures: good or bad?

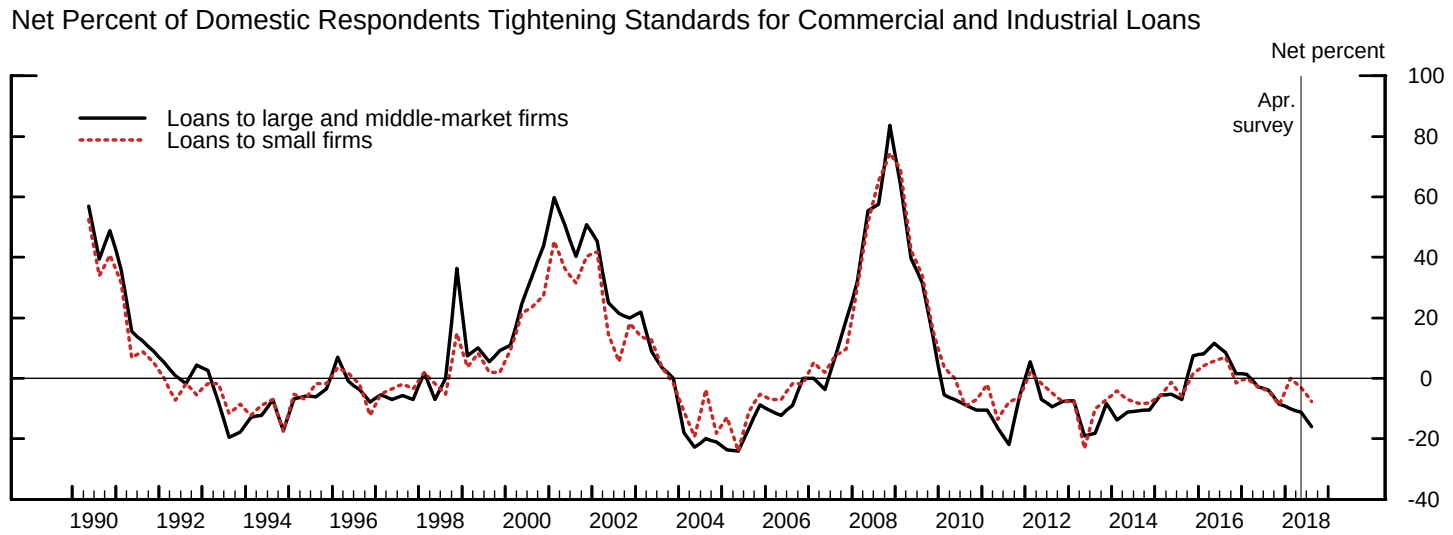
Why? How?

Examples from the Fed



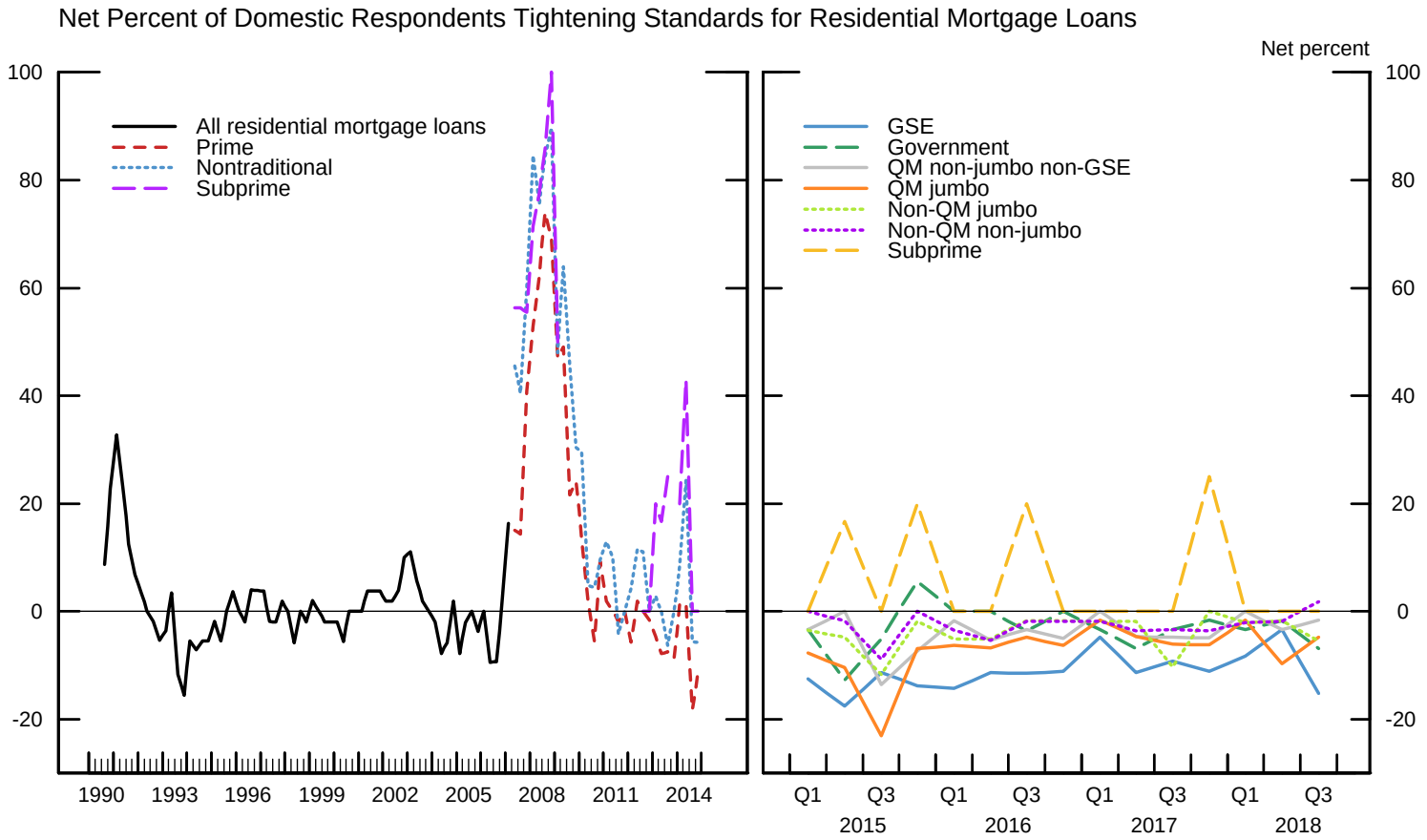
Source: The July 2018 Senior Loan Officer Opinion Survey on Bank Lending Practices

Measures of Supply and Demand for Commercial and Industrial Loans, by Size of Firm Seeking Loan



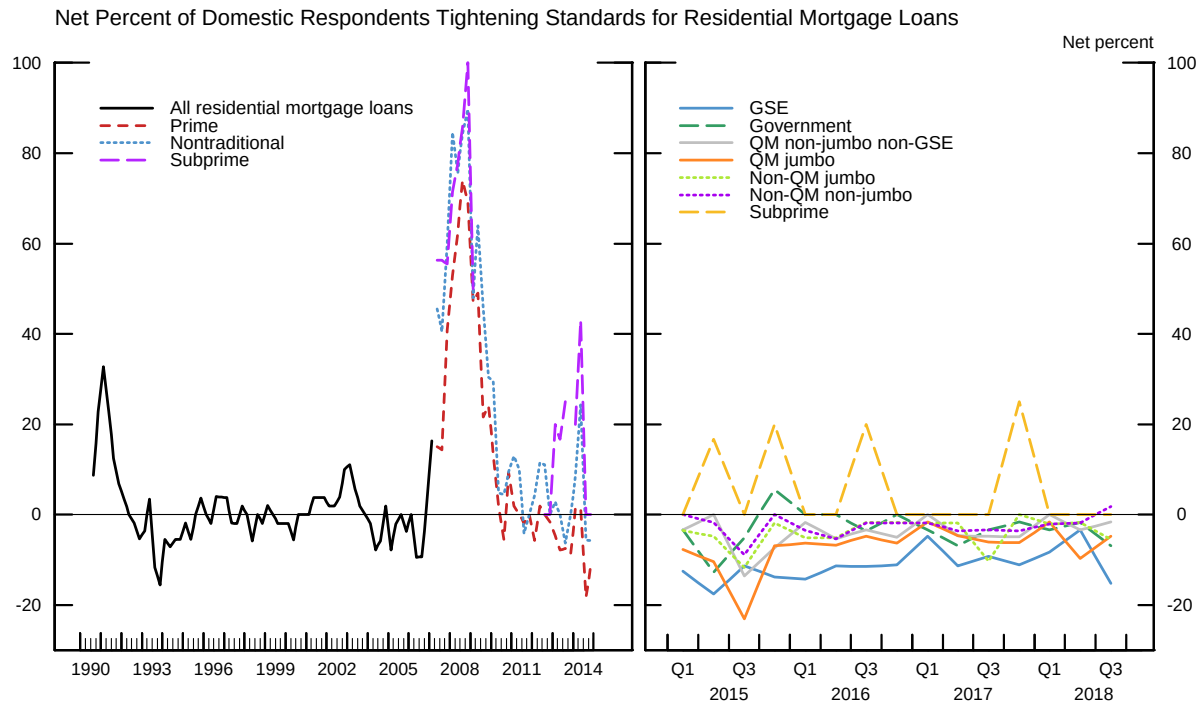
- Overall acceptable, esp. in a paper
- Possible improvements?
  - bigger font size, less distracting borders/axes, change the red dotted line

Measures of Supply and Demand for Residential Mortgage Loans

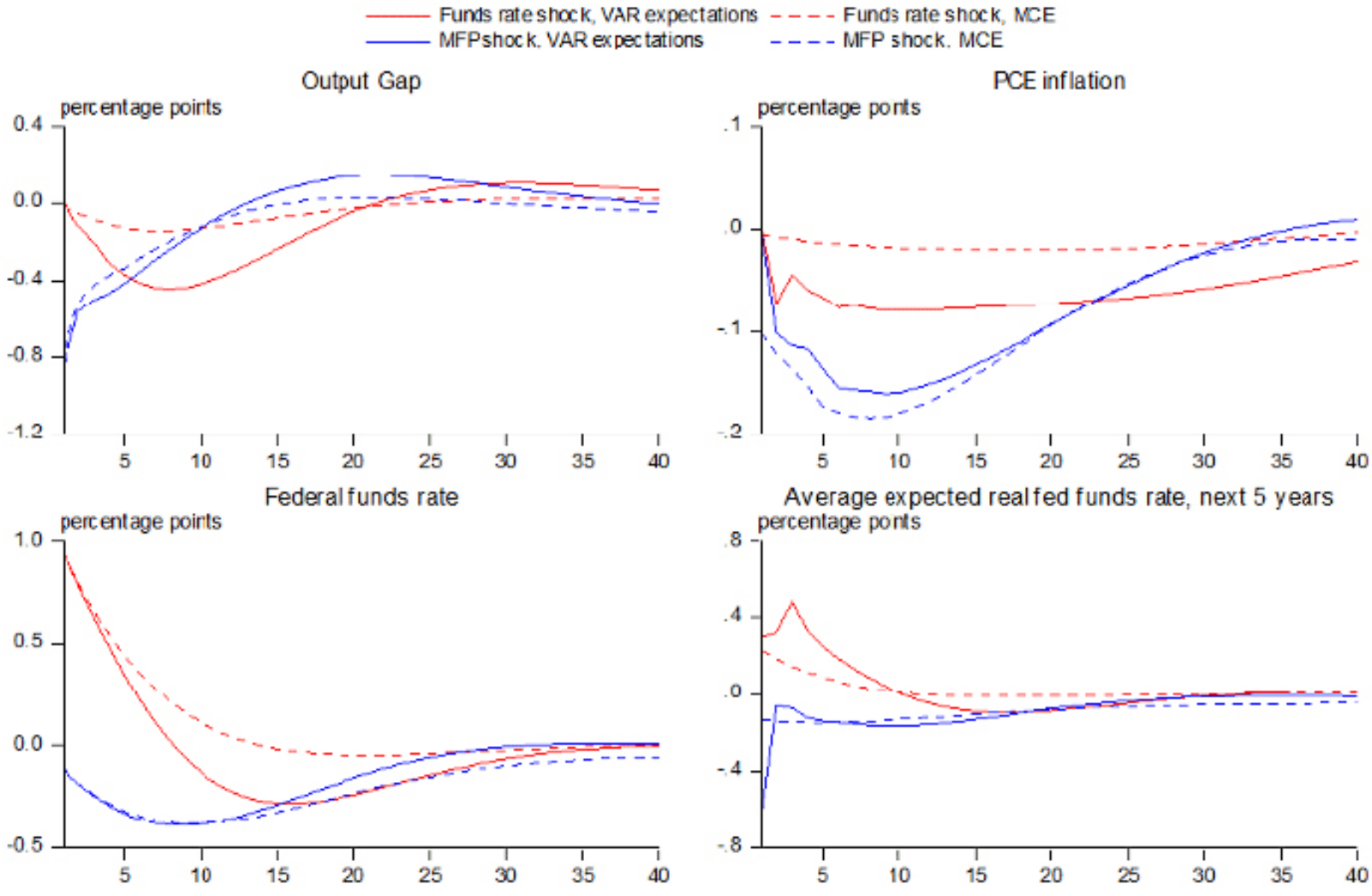


Source: The July 2018 Senior Loan Officer Opinion Survey on Bank Lending Practices

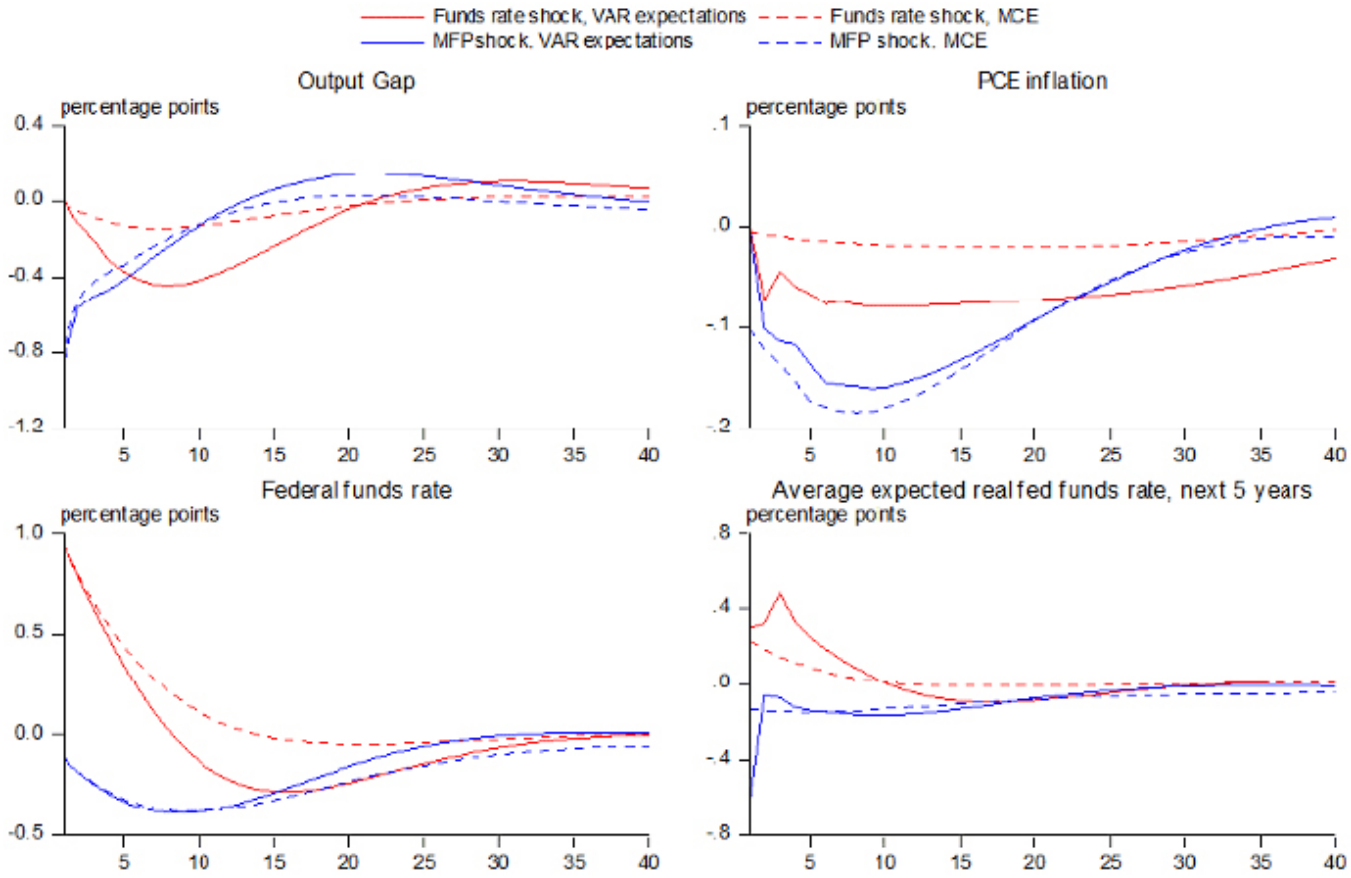
Measures of Supply and Demand for Residential Mortgage Loans



- More information is not more informative
- Depending on the story to tell, many improvement directions (a general GR story? a subprime story?)
- At least fix the axes, font size, colors, and line styles

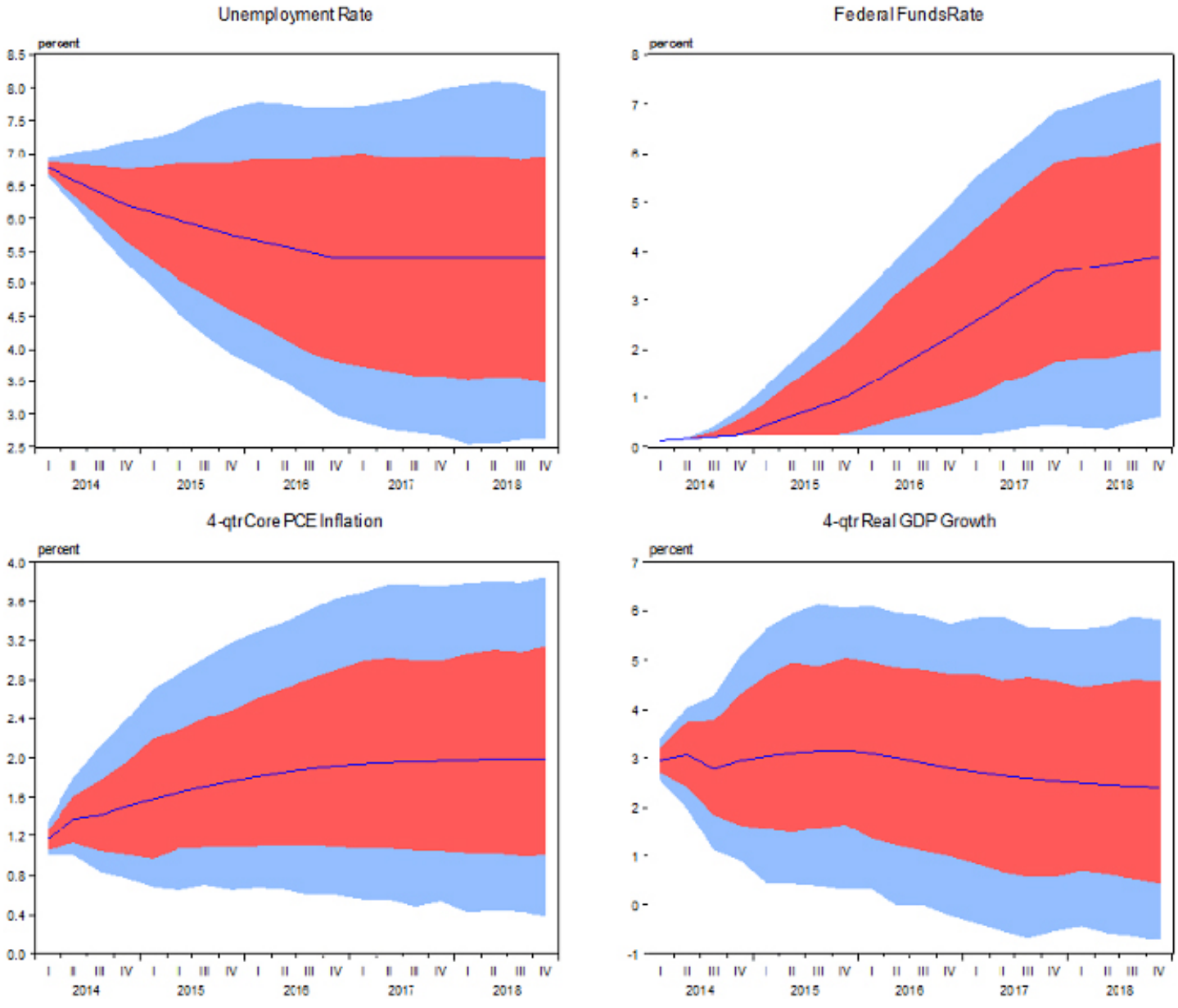


Source: The FRB/US Model: A Tool for Macroeconomic Policy Analysis

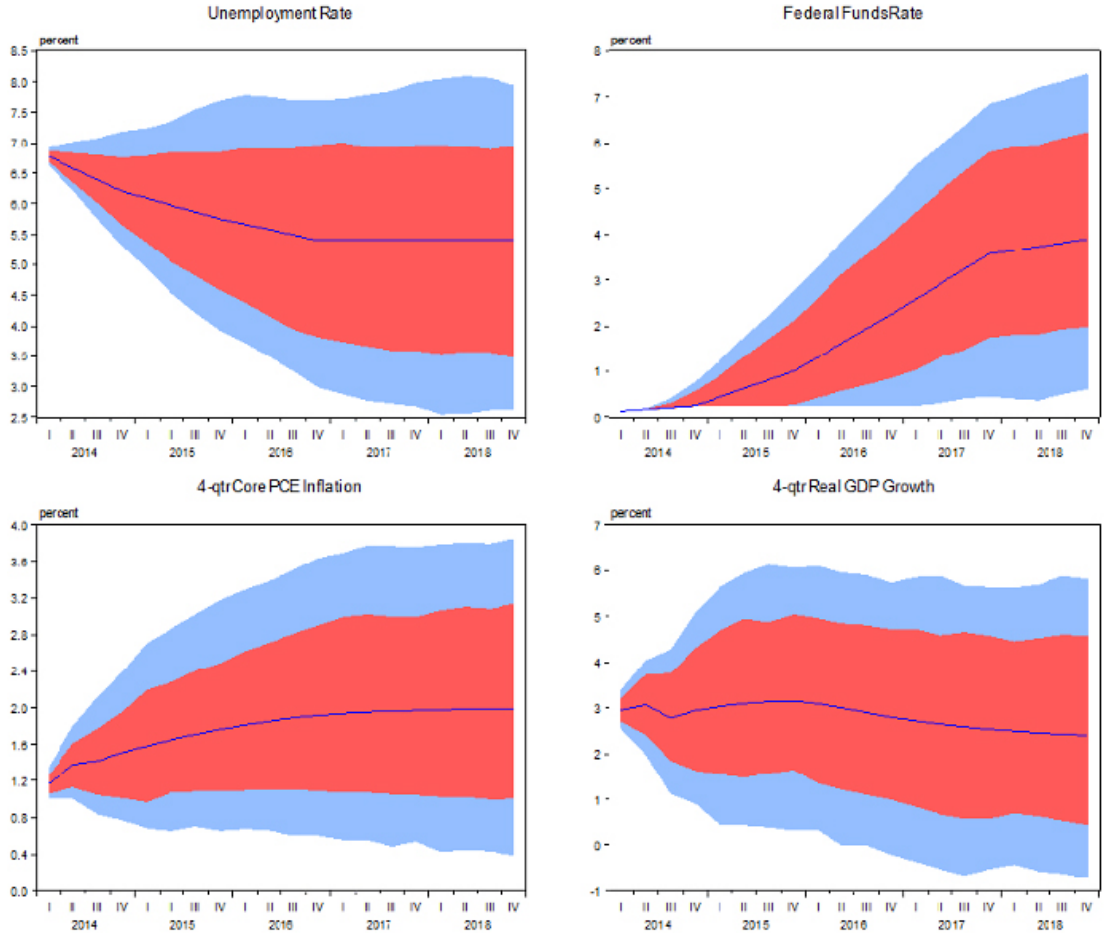


- Make the lines and words clear and in larger fonts
- Change the line colors, esp. make sure the line distinctions can survive printing
- IRF plots should usually include a thin, clear zero line

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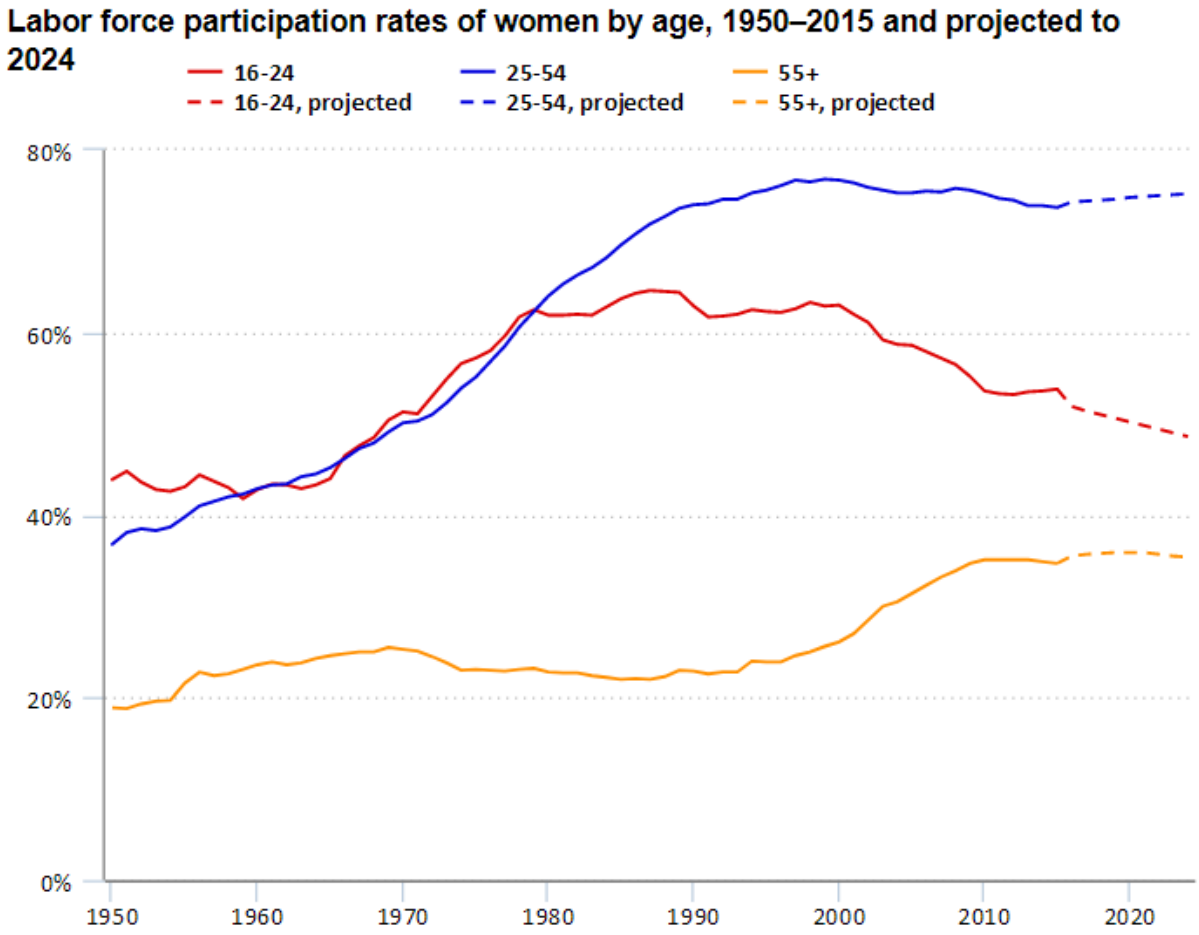
Source: The FRB/US Model: A Tool for Macroeconomic Policy Analysis



- Make the lines and words clear and in larger fonts
- A black line and 2 light gray error bands will suffice...
- IRF plots should usually include a thin, clear zero line

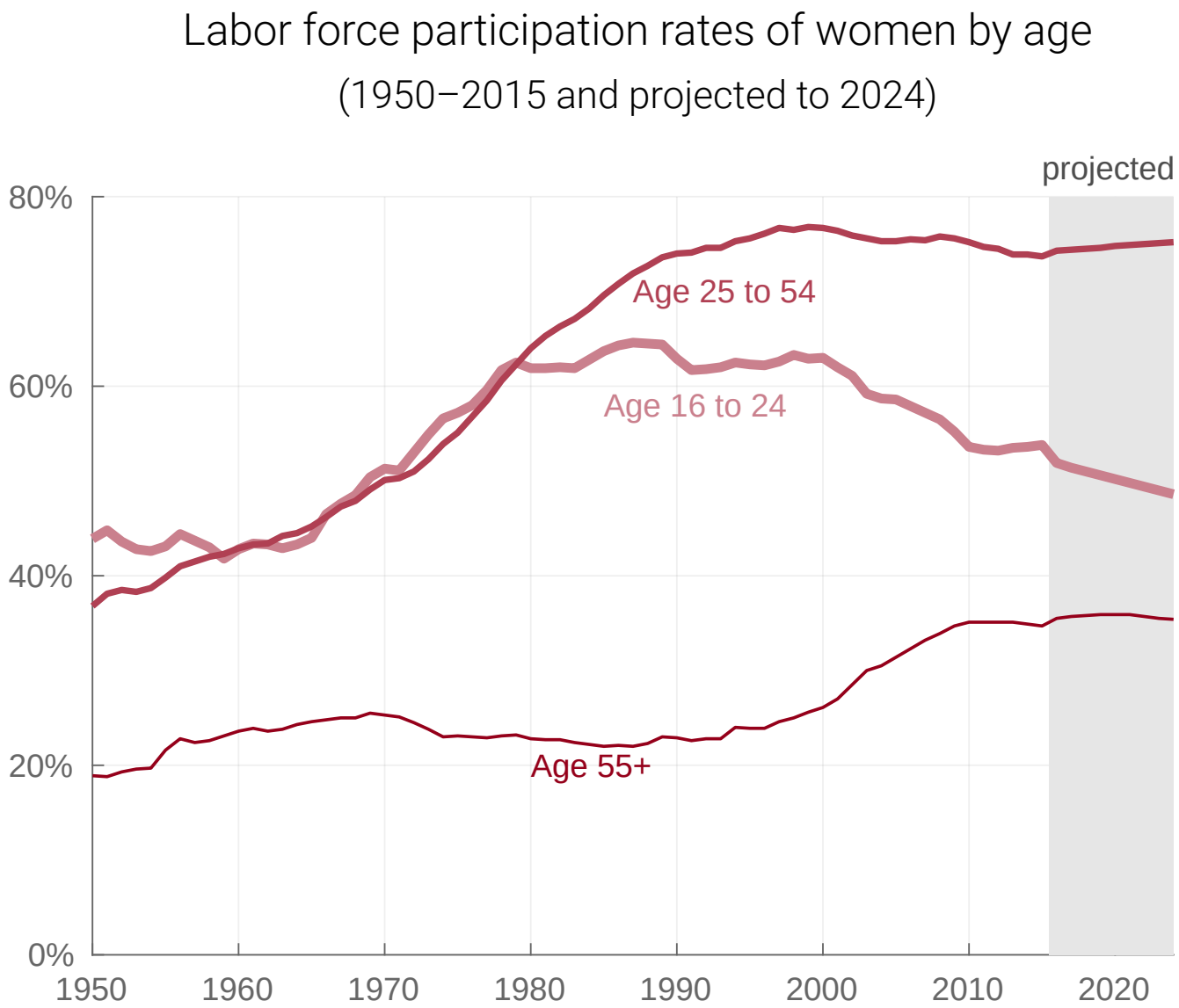
Examples from the BLS

Note: the original charts are interactive ones!

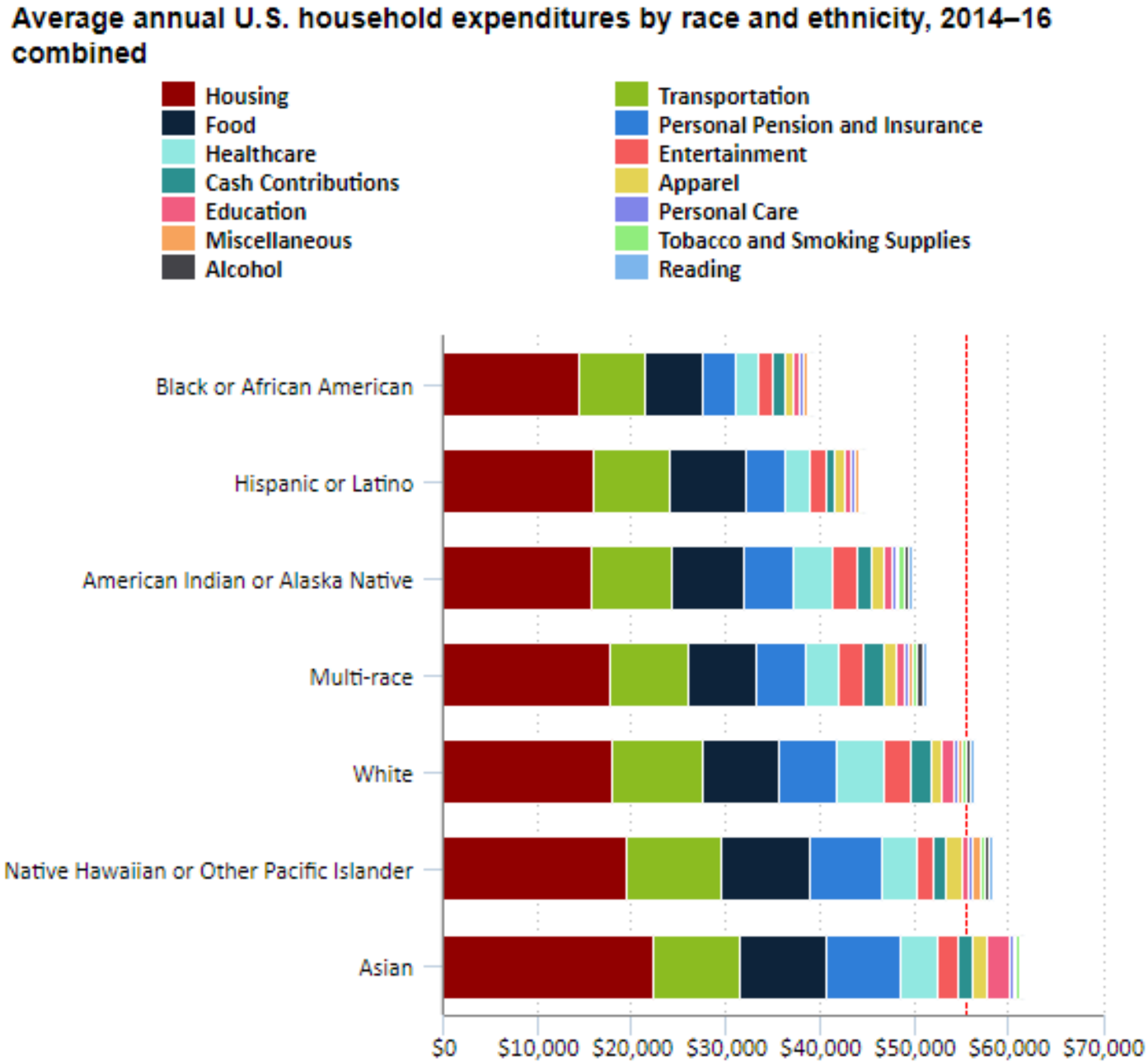


Source: JULY 2017 Spotlight: Women in the workforce before, during, and after the Great Recession

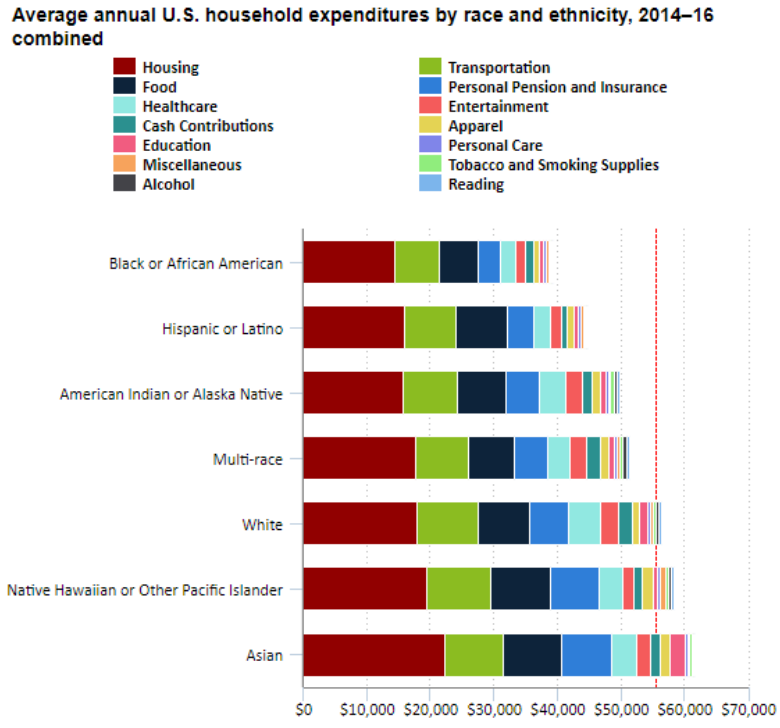
I would do something like this... (drawn in MATLAB)



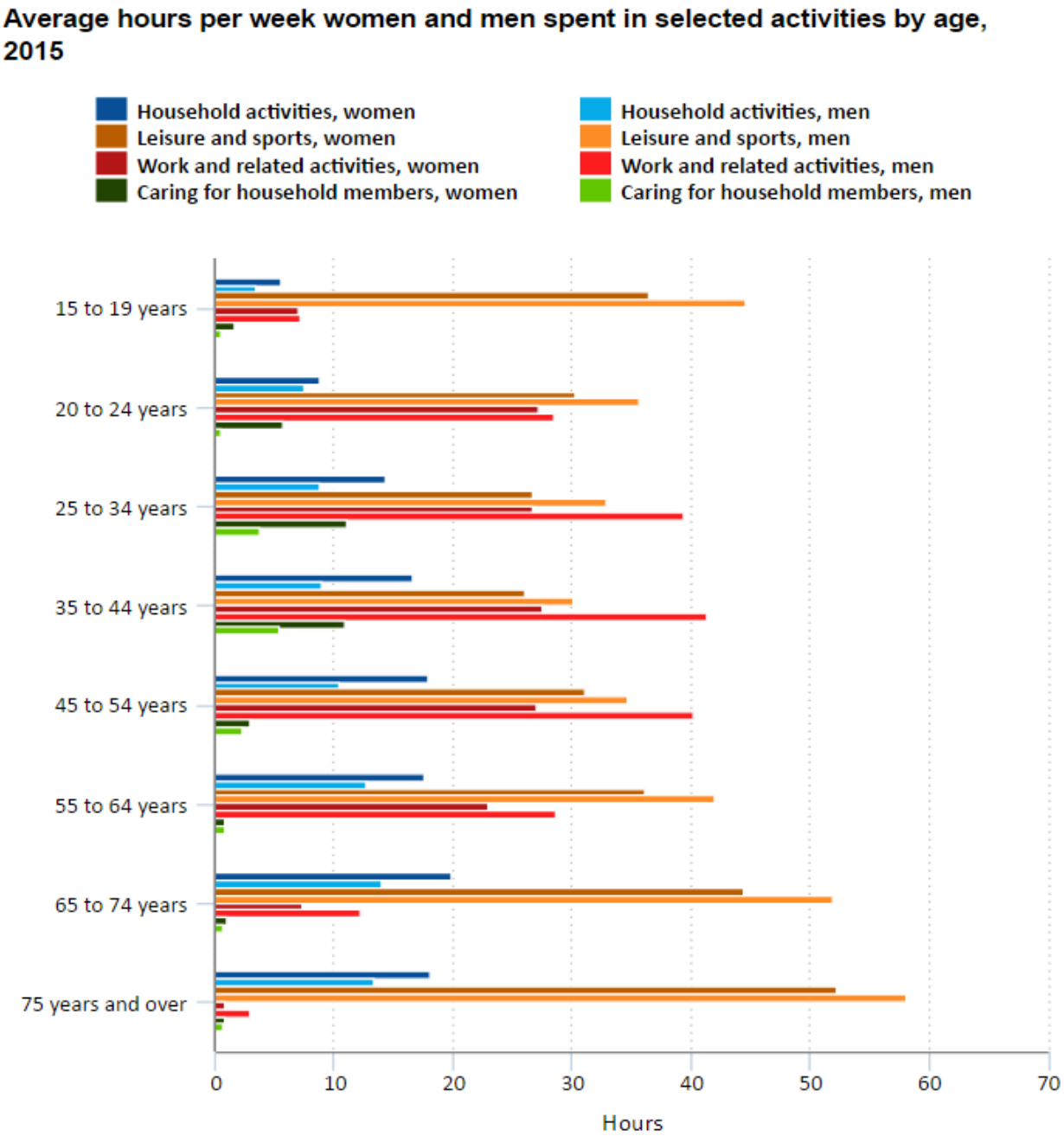
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Source: MAY 2018 Spotlight: Race, Economics, and Social Status

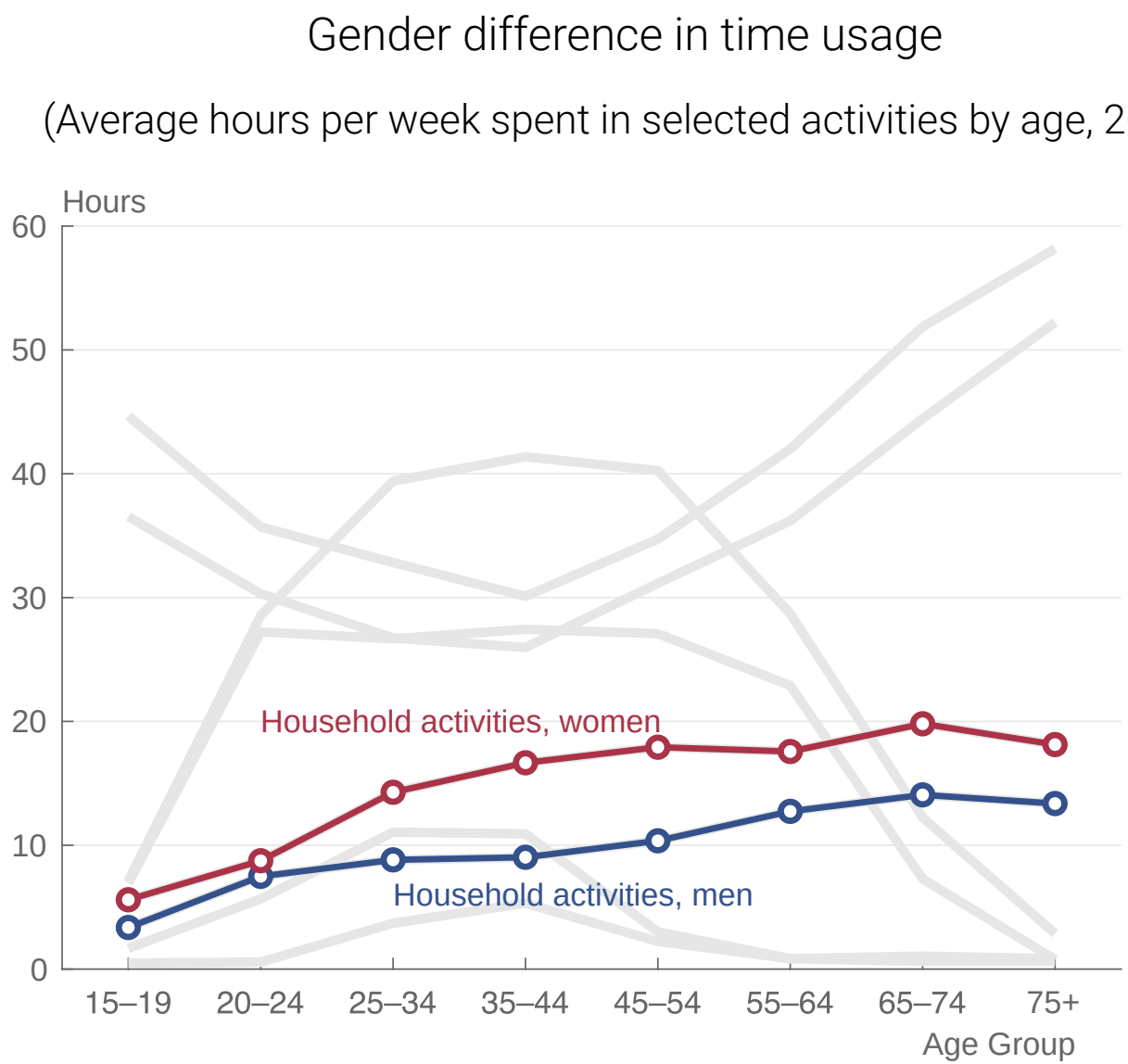


- I would not use a stacked horizontal bar chart at all...
- Line plots, x-axis: exp. cat., y-axis: $, each line a race/ethnicity group with direct labeling
- Depending on the benchmark group (BM), consider blue lines above BM and grays below [or grays above and red below], shades representing distance from BM



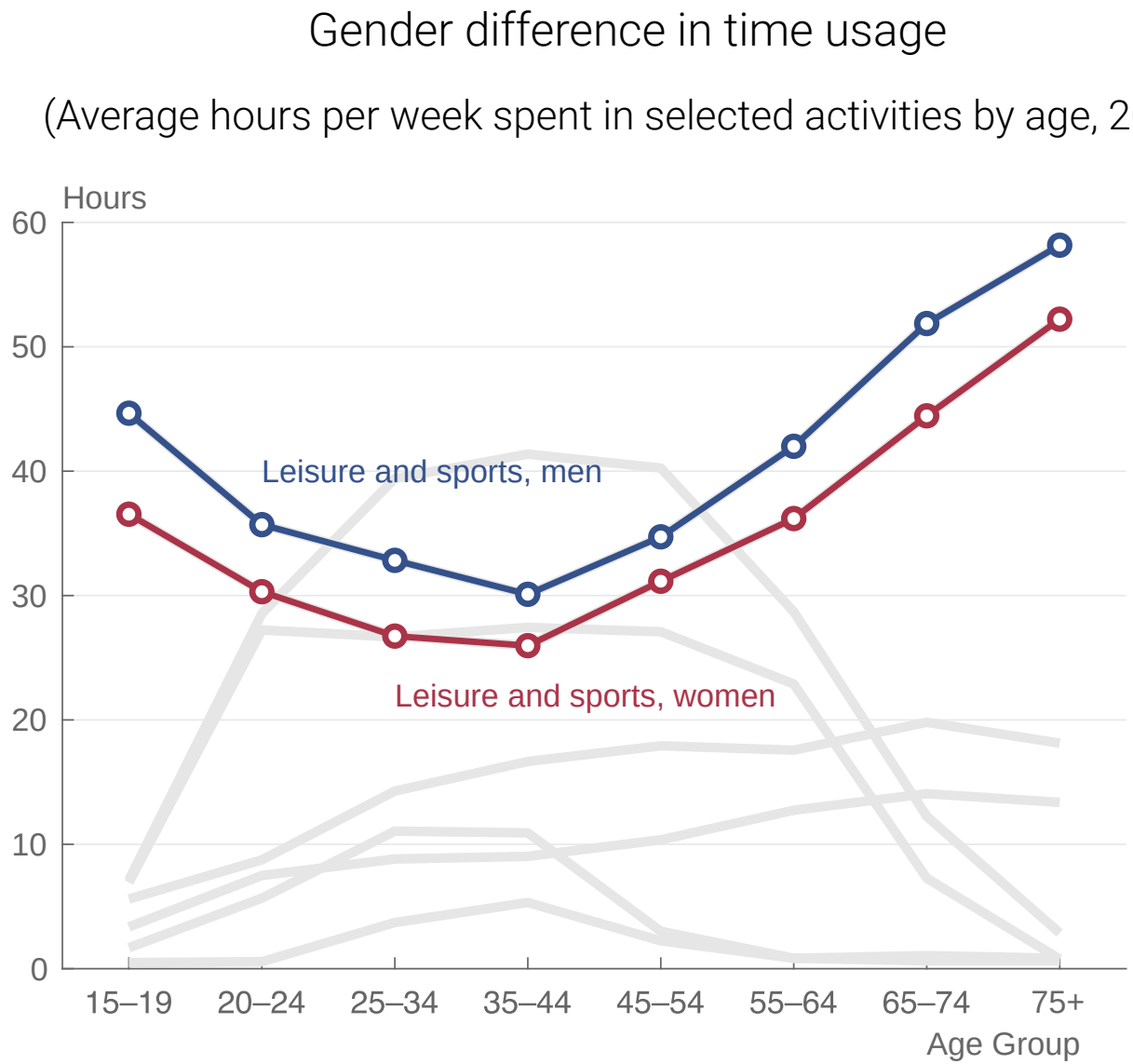
Source: MARCH 2017 Spotlight: Women at work

(Depending on the story) I would consider doing this... (drawn in MATLAB)



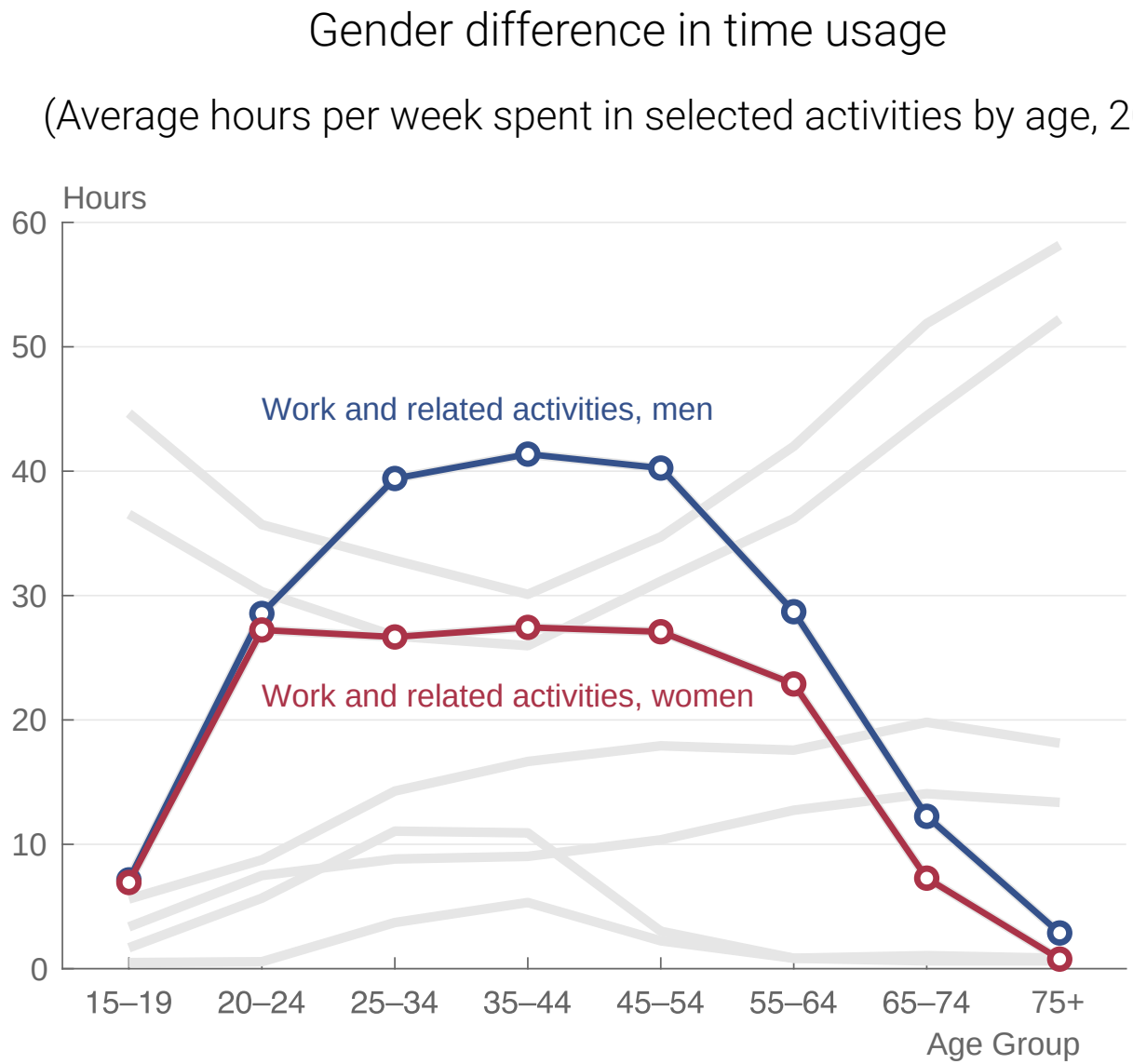
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(Depending on the story) I would consider doing this... (drawn in MATLAB)



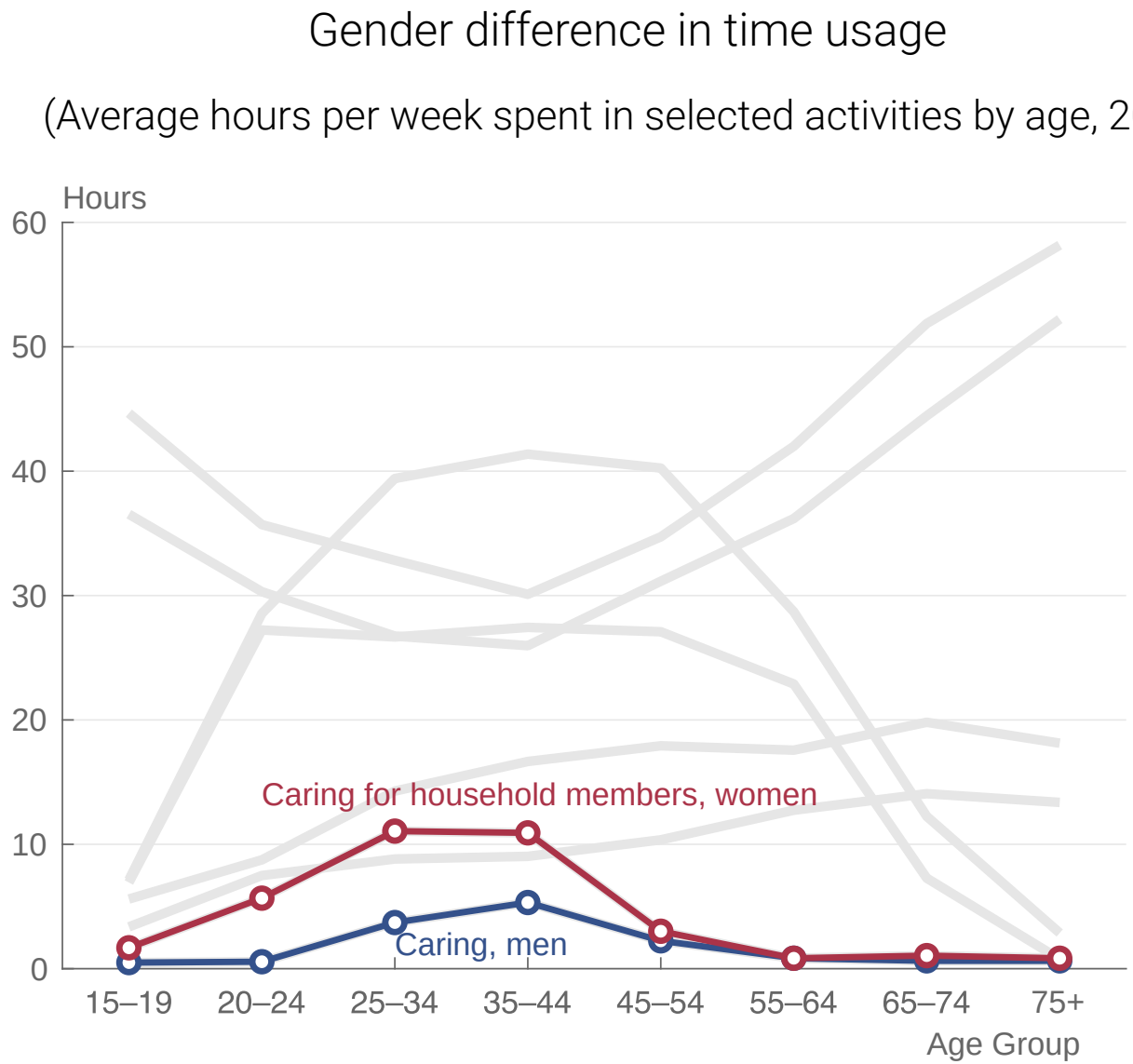
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(Depending on the story) I would consider doing this... (drawn in MATLAB)

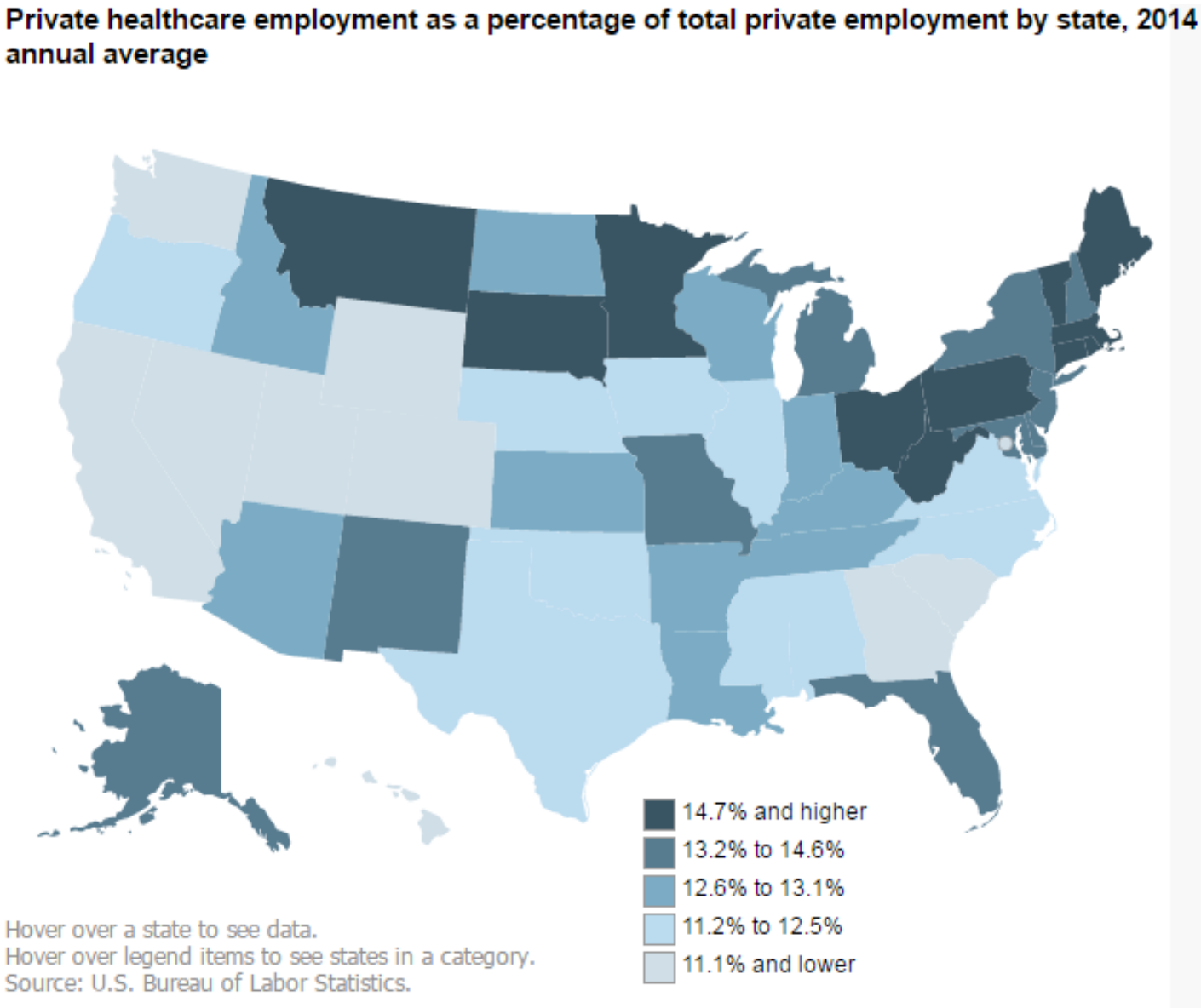


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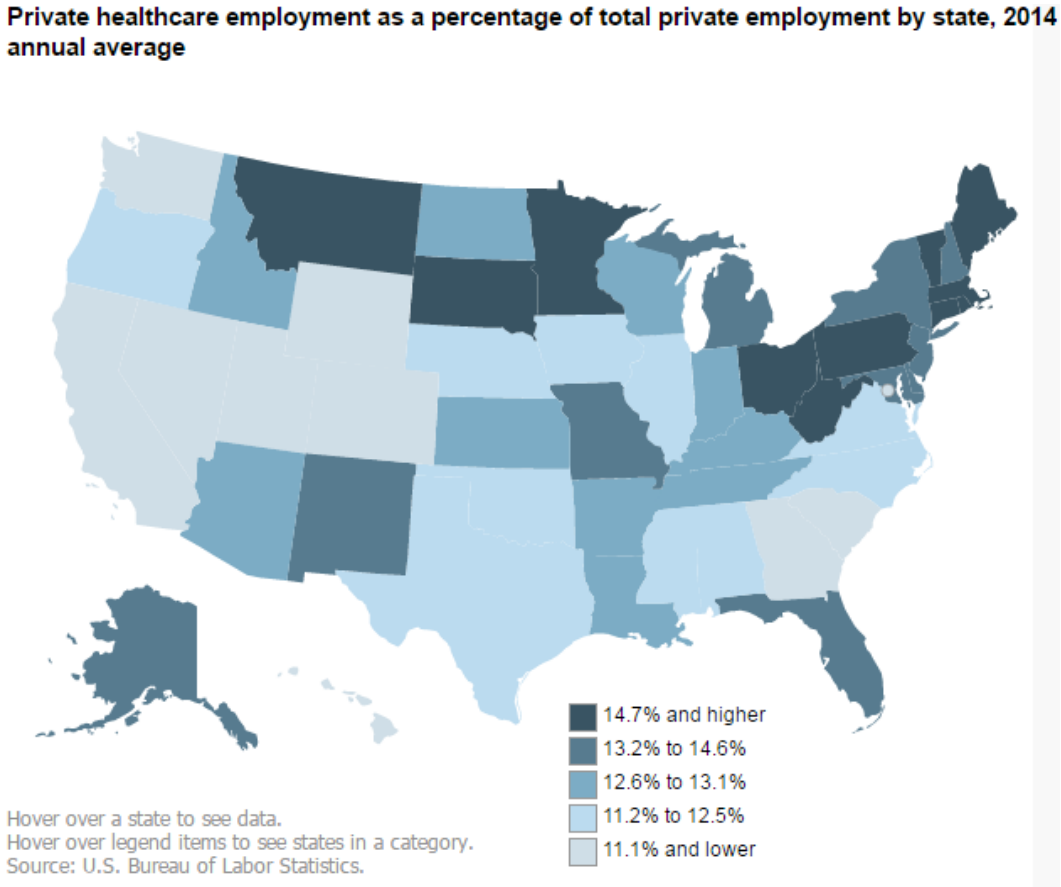
(Depending on the story) I would consider doing this... (drawn in MATLAB)



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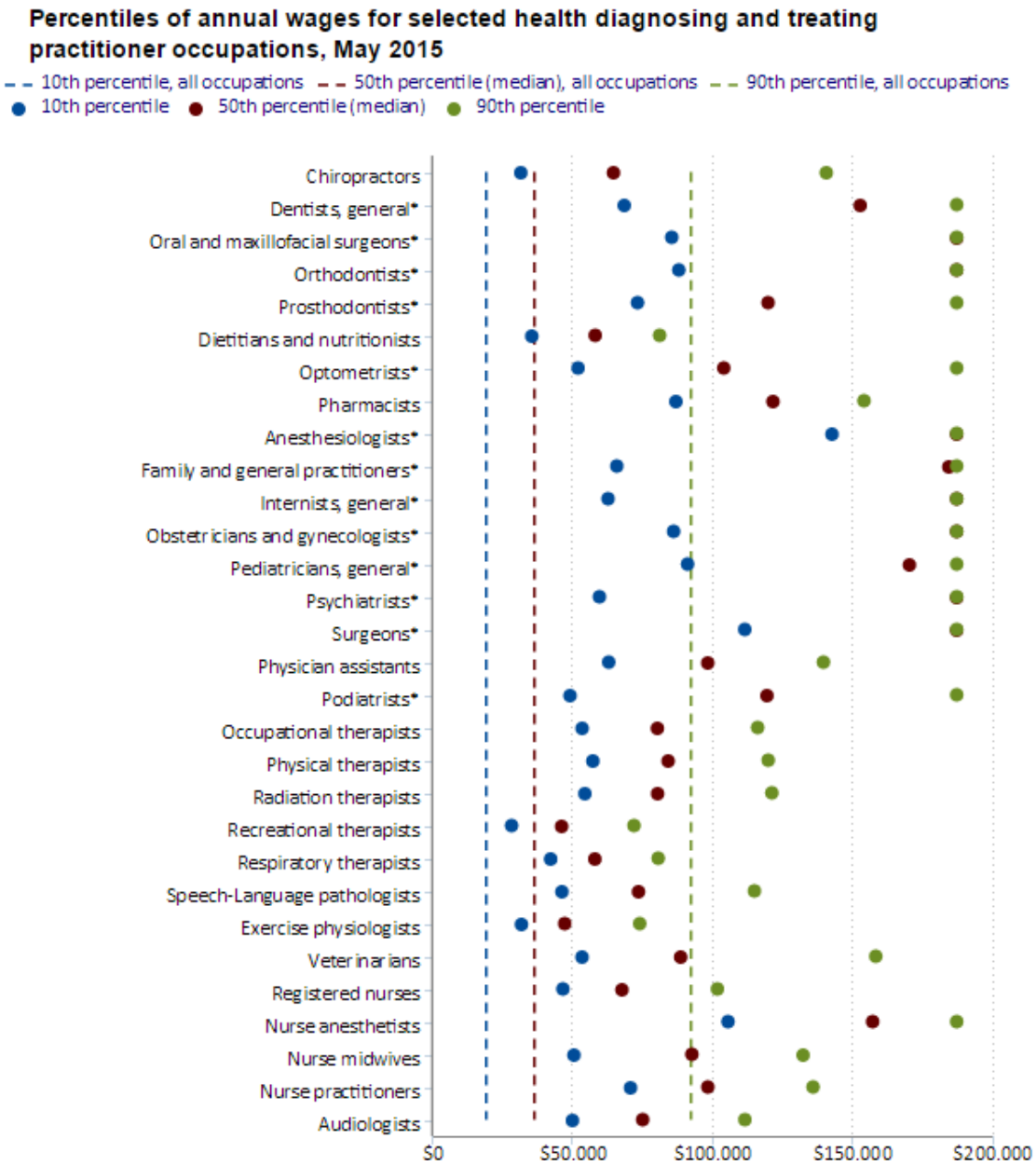


Source: JUNE 2016 Spotlight: A look at healthcare spending, employment, pay, benefits, and prices

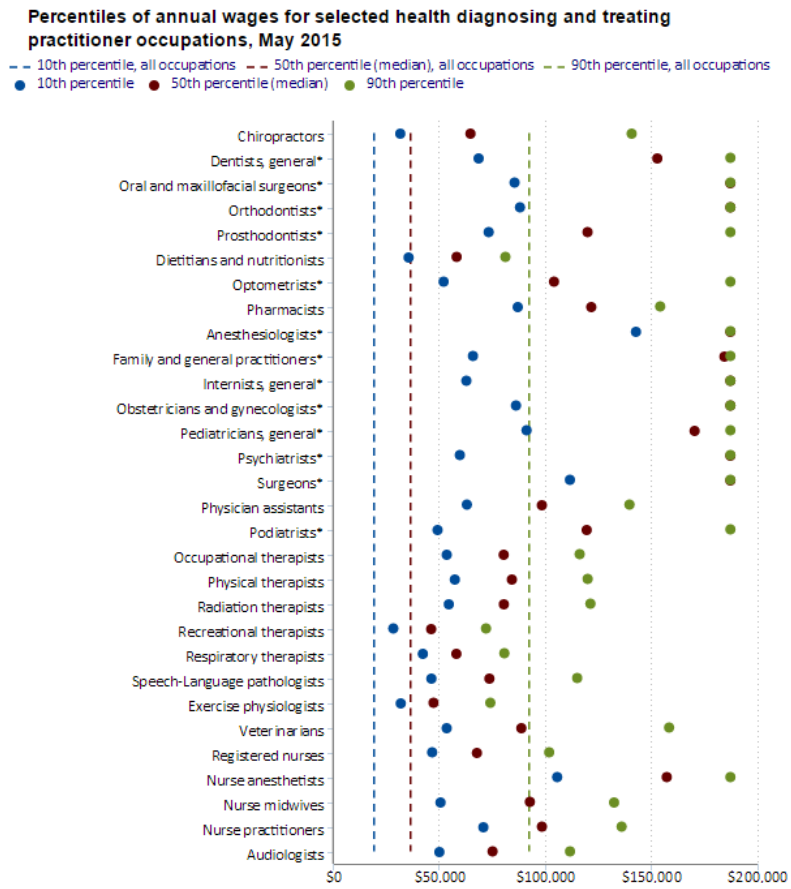


If you want to show off...

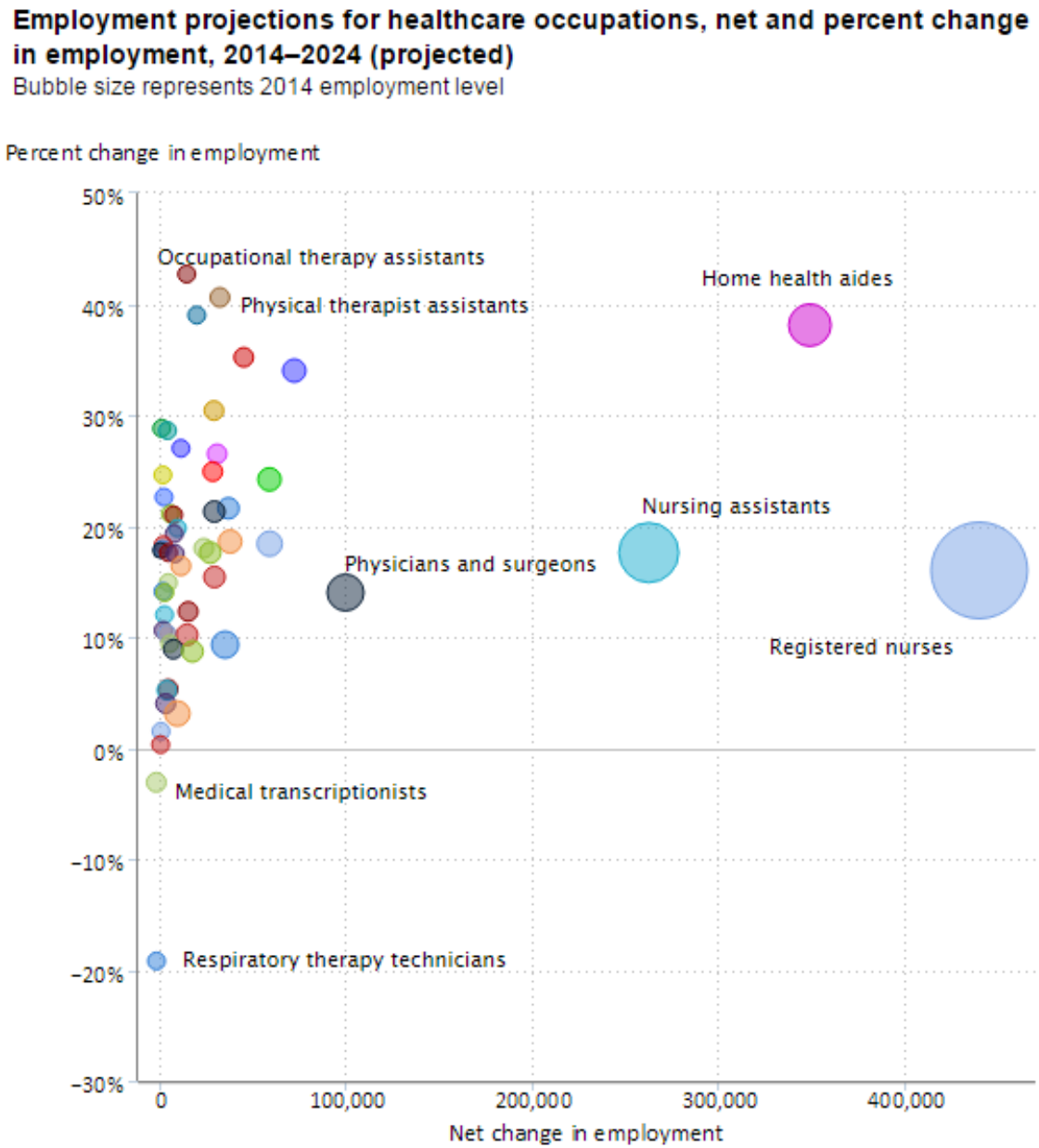
- Use shades of the same blue, make them monotone
- Draw state border lines in white



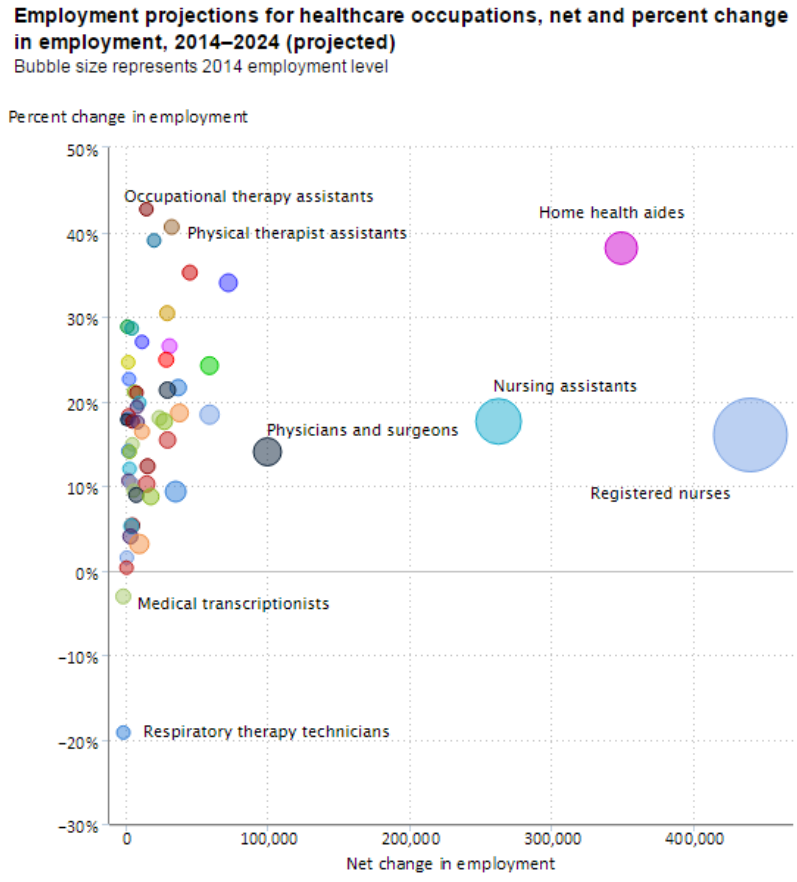
Source: JUNE 2016 Spotlight: A look at healthcare spending, employment, pay, benefits, and prices



- Order the occupations by medium wage
- Line plot or a clean bar-like box plot: draw the medium wage line with lightly-shaded 10th-90th range
- Draw all-occupation avg. 10th, 50th, 90th percentile constant lines in light gray with direct label

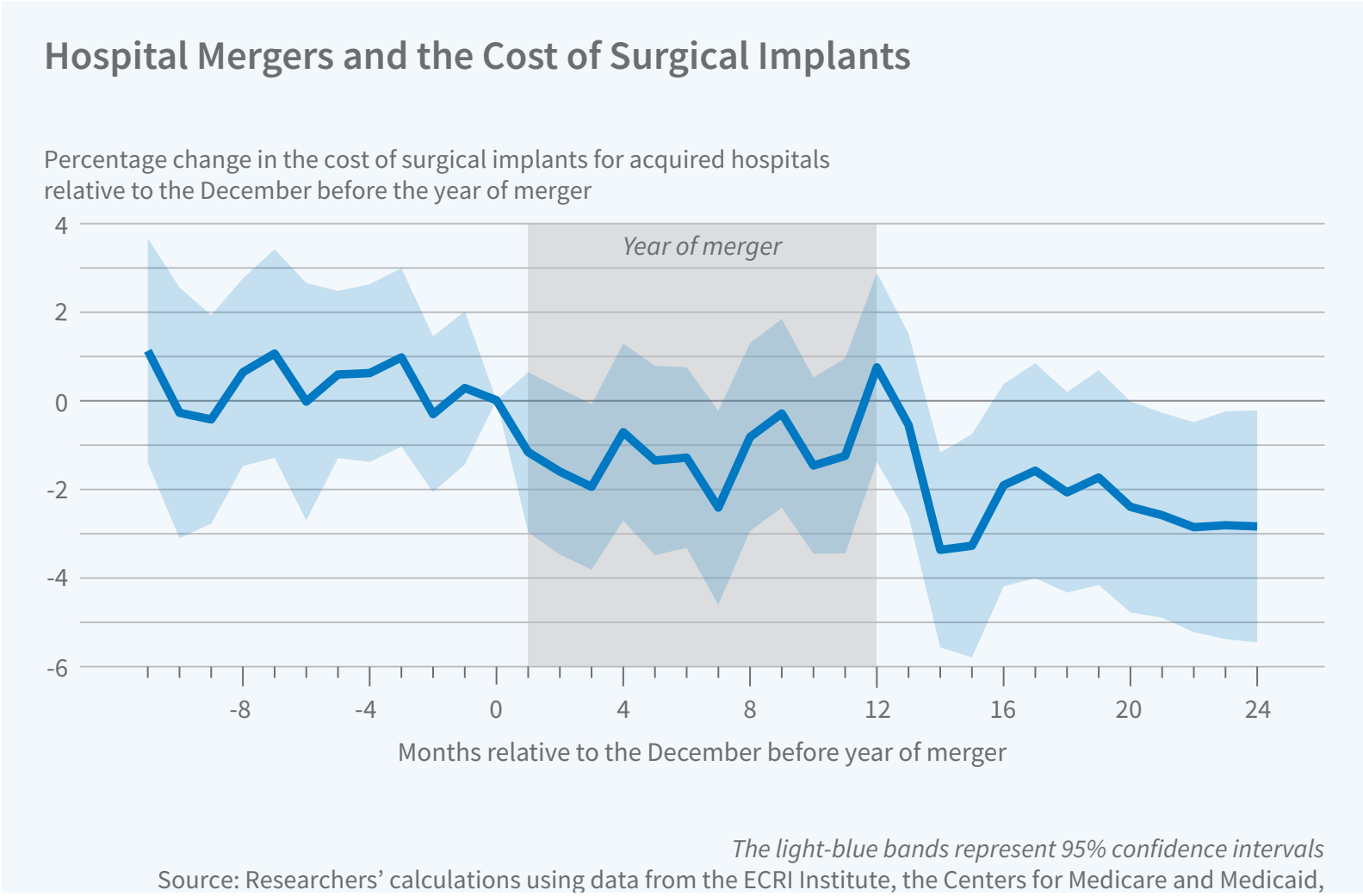


Source: JUNE 2016 Spotlight: A look at healthcare spending, employment, pay, benefits, and prices



- Okay... looks like the emp. level (bubble size) is not the point
- Focus on the selected occupations and group others together
- Bar and line hybrid w/ 2 y-axis: x-axis, occupations ranked by size; left-y, lightly-shaded bars, change in #; right-y, change in %, a solid line with clean markers.

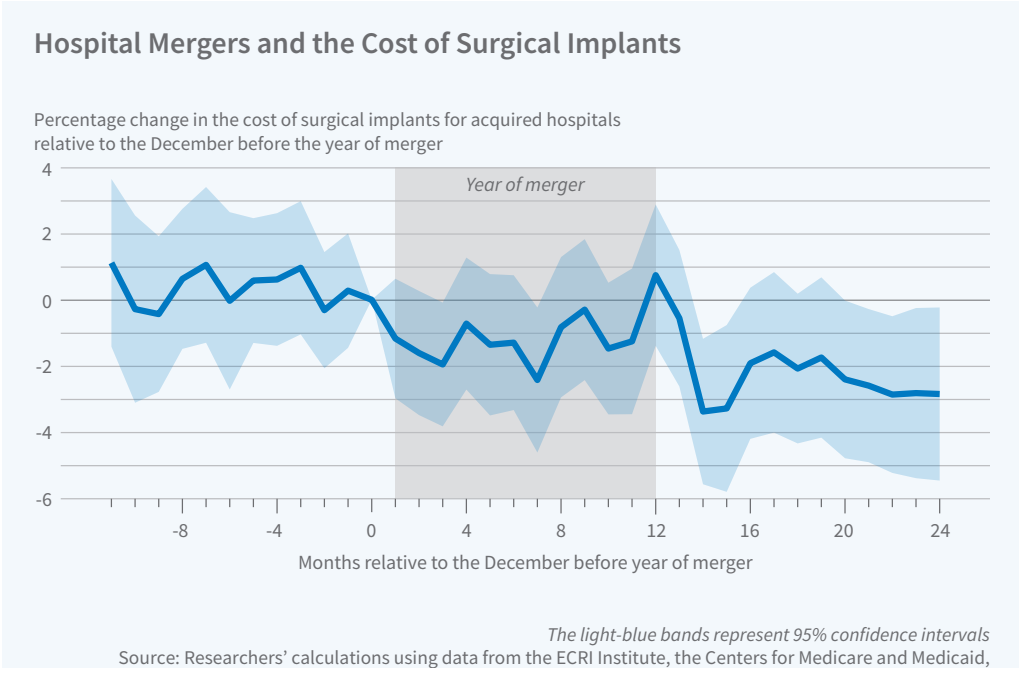
(Good) Examples from the NBER Digest



Source: The NBER Digest October 2018 Issue: Hospital Mergers Generate Relatively Small Cost Savings

Note:

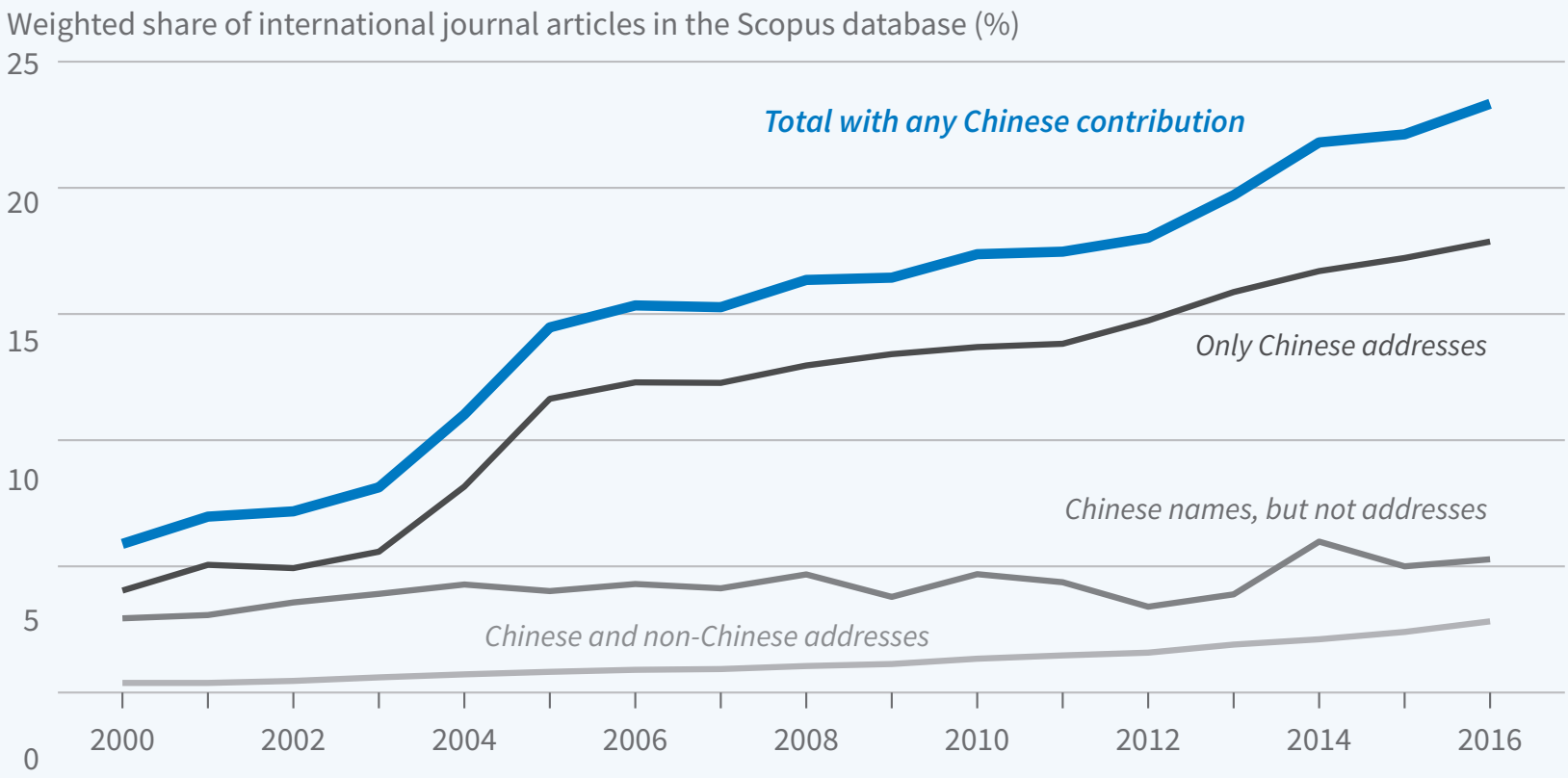
- Do not use any background color in your figures.
- As figures in slides, you also want to enhance contrast, use larger fonts, and reduce words.



Why good? A clear message!

- Execution: one clean color; clear labels; clear but quiet reference lines (notice the thicker zero line); event marker; translucent CIs

Share of International Journal Articles Attributable to Chinese Authors



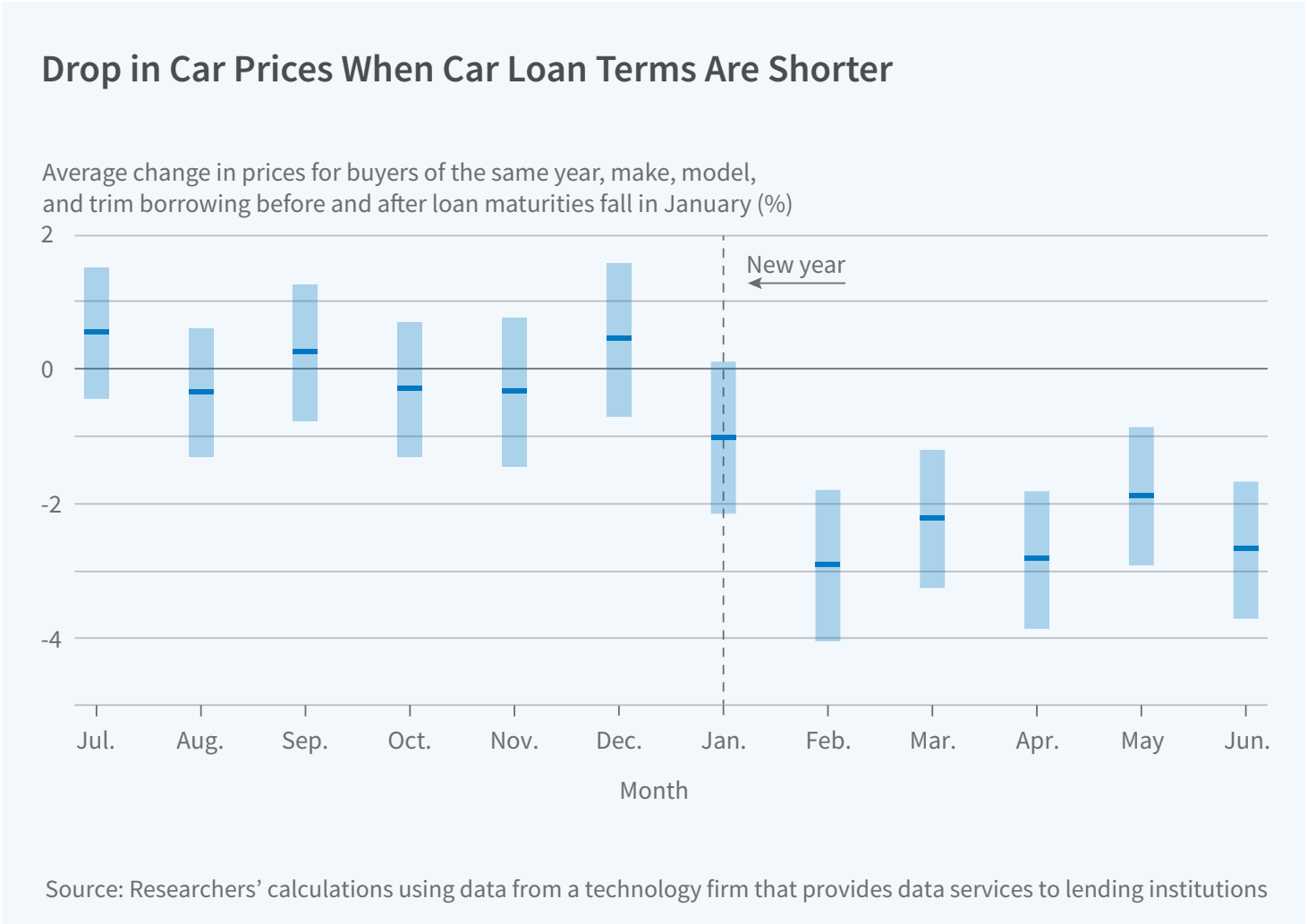
The "Total with any Chinese contribution" is a sum of all articles with only Chinese addresses, the weighted share of articles with Chinese and non-Chinese addresses, and 1/2 the proportion of Chinese names on papers without Chinese addresses

Source: Researchers' calculations using data from the Scopus database

Source: The NBER Digest October 2018 Issue: Measuring the Explosive Growth in Chinese Research

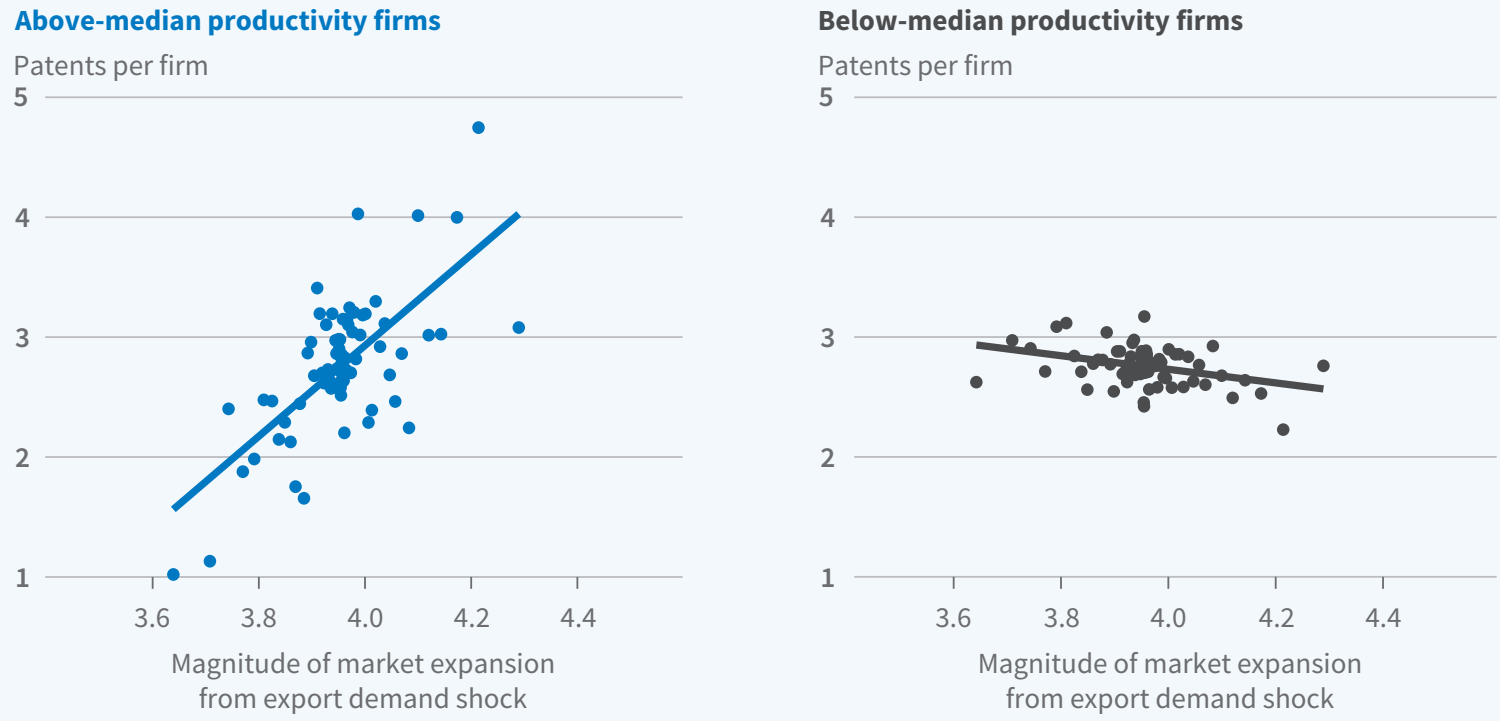


- Execution: direct labeling in the same line color; one thick colored line for the main message; shades of gray lines for supporting points



Source: The NBER Digest September 2018 Issue: When Financing Terms Are Generous, Car Buyers Pay More

Export Demand Encourages Innovation by More Productive Firms



Source: Researchers' calculations using data from the Direction Générale des Douanes et Droits Indirects, Institut National de la Statistique et des Études Économiques, Direction Générale des Finances Publiques, and the European Patent Office

Source: The NBER Digest August 2018 Issue: Access to New Global Markets Pushes Best Firms to Get Better

Common features of the good ones

- An informative caption
- The **first thing** you notice is the message!
  - A trend, a change, a difference, etc.
- Everything else helps you get this message
  - Clear background reference lines (esp. thicker 0-lines and event marks)
  - Labels, colors (or the lack of), shades
- **Clean**, without distractions such as
  - error band borders, unnecessary legends, multiple colors, chaotic line styles or markers, or bold blackest black lines (all grays)

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Some general and plot-specific suggestions

General

- No background color
- Clear but not distracting axes/labels
- Direct labeling $\succ$ legends (no box)
- Save/export figures as vector images e.g. PDF

Specific

- Simple 2-D line plots:
  - Fewer lines $\succ$ more lines
  - Variation in line width and shades $\succ$ line styles (solid, dashed, broken) $\succ$ markers ($*$, $\star$, Δ,$\circ$,$\dagger$)
- Histograms: light face color, no edge color
- Heat maps: monotone shades

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Epilogue

In case it's unclear:

- **Research** first!
  - You need a story before telling it.
- Always think about efficiency of visuals
- Work on the logic flow of your talk/paper
- Practice! Practice! Practice!

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