Budget Model

What Do We Know and Do We Actually Know It: Using Federal Economic Data for Policy Analysis

May 6, 2021

Alex Arnon

Richard Prisinzano

Introduction

1) **Headline economic indicators**: where do they come from and what do they tell us?

2) **Tracking the economy in real time**: new sources of private data and how to use them

3) **Forecasting revenue from tax changes**: the central role of behavior

1. Headline economic indicators

“Headline” economic indicators

- The jobs report (nonfarm payroll employment, unemployment rate)
- Gross domestic product (GDP)

“Headline” economic indicators

- The jobs report (nonfarm payroll employment, unemployment rate)
- Gross domestic product (GDP)

The Vaccine Solution—If We Handle It Right

REVIEW

WSJ

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What's News

World-Wide

The coronavirus pandemic continued its spread in the U.S., with rising hospitalizations, infections

Hiring Cools as Virus Saps Recovery

Monthly change in nonfarm payrolls

5 million

2019 average

0

April May June July Aug. Sept. Oct. Nov.

By Sarah Chaney Cambon

U.S. job growth slowed sharply in November, suggesting the labor-market recovery is losing steam amid a surge in coronavirus cases and new business restrictions.

Employers added 245,000 jobs last month, down from

"There is a long way to go before we actually have a vaccine in hand and make a full economic recovery."

Employers boosted jobs in transportation and warehousing last month, likely reflecting holiday hiring for e-commerce roles. Government payrolls declined by nearly 100,000, largely re-

THE WALL STREET JOURNAL.

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What's News

Business & Finance

U.S. Growth Erases Much of Slide

Quarterly GDP recoups about two-thirds of the contraction from earlier in the pandemic

By Harriet Torry

The U.S. economy grew at a record pace in the third quarter, increasing 7.4% over the prior quarter and at a 33.1% annual rate, recovering about two-thirds of the ground it

The U.S. economy grew at a record pace in the third quarter—increasing 7.4% over the prior quarter and at a 33.1%

consumer demand and government support helped power spending after disruptions related to Covid-19 eased. The increase in growth, the biggest jump in records dating to 1947, followed a record decline earlier in the pandemic when the virus disrupted business activity across the country.

That puts the economy about 3.5% smaller than at the end of last year, before the

tial economic headwind in the current fourth quarter, saying, "It's hard to reopen an economy unless workers and consumers feel safe and healthy."

The third-quarter GDP increase followed a 9% quarter-to-quarter decline in the second quarter, or a 31.4% annualized drop, adjusted for inflation and seasonal fluctuations.

U.S. GDP is normally reported at an annual rate, or as

Quarterly GDP level

Third quarter $18.58T

$18 trillion

17

Second quarter $17.3T

GDP, percentage change from previous quarter

Third quarter 7.4%

5%

0

“Headline” economic indicators

- The jobs report (nonfarm payroll employment, unemployment rate)

The Birds and the Bureaus

Where do headline statistics come from?

1. Measurement
    - Initial releases largely from surveys and projections
    - Later revised with more complete data or direct measures

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2. Philosophy
   - What do we want to measure? Is it measurable? Does it even exist?

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   - Initial releases largely from surveys and projections
   - Later revised with more complete data or direct measures
2. Philosophy
   - What do we want to measure? Is it measurable? Does it even exist?
3. Models and bureaucratic process
   - Someone has to make decisions

The Monthly Jobs Report (Employment Situation)

Prepared by the Bureau of Labor Statistics (BLS)

Released on the first Friday following the end of the month (i.e. Jobs Friday)

Covers the pay period or week that includes the 12th day of the month

The Monthly Jobs Report (Employment Situation)

Wall Street Journal, December 5, 2020:

> "**Employers added 245,000 jobs last month**, down from 610,000 jobs in October, the Labor Department reported Friday. **The unemployment rate edged down slightly to 6.7%** in November from 6.9% a month earlier."

1. "Employers added 245,000 jobs" → change in nonfarm payroll employment
2. "The unemployment rate edged down to 6.7%" → unemployment rate

Nonfarm Payroll Employment – Definition

Number of persons who worked or received pay at a nonfarm business or civilian government agency for any part of the pay period that includes the 12th of the month.

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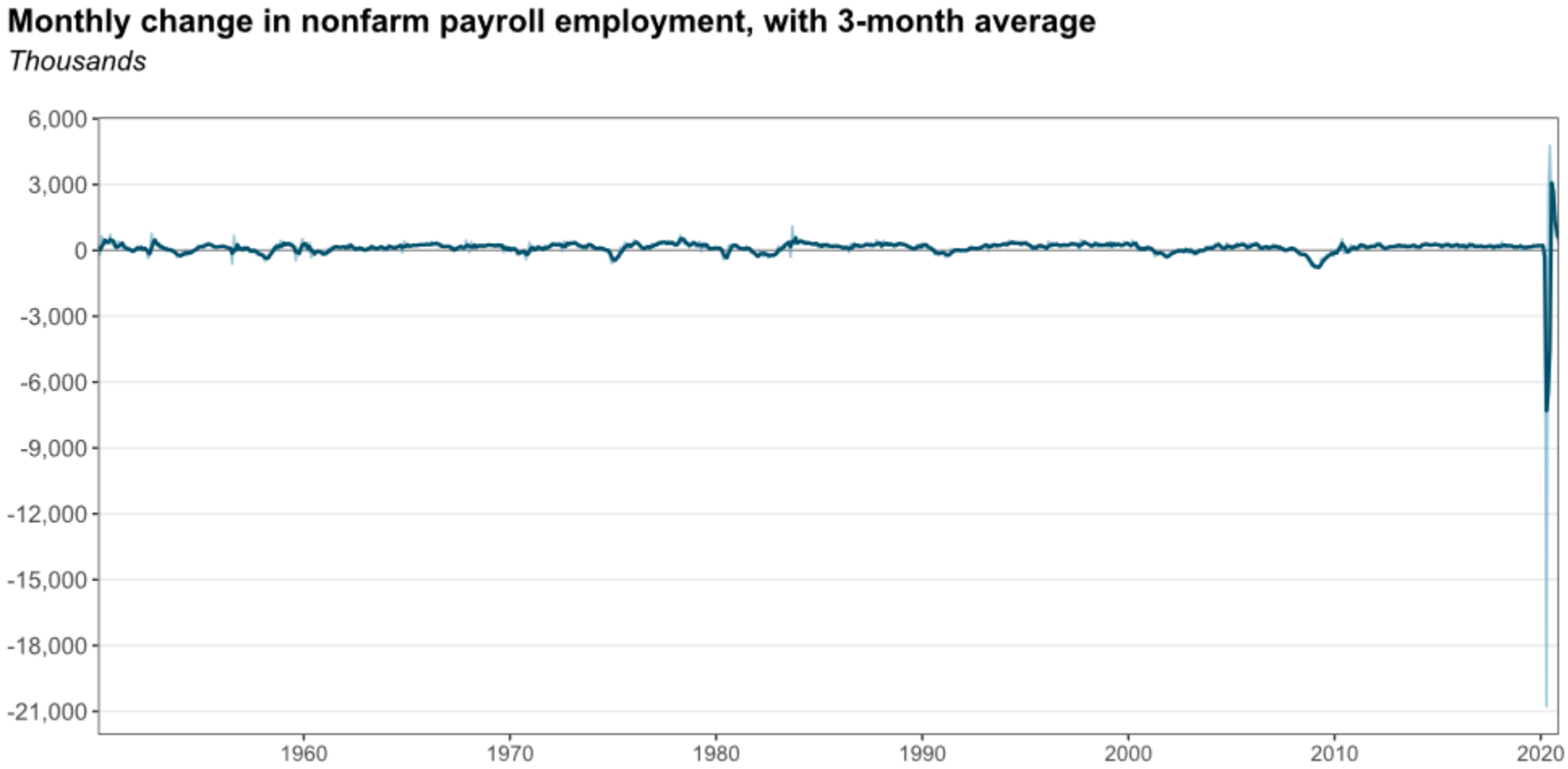
Not included:

- Farm workers
- Self-employed (unless on own payroll, e.g. because of incorporation)
- Household employees and unpaid family workers
- Military personnel
- Intelligence agencies

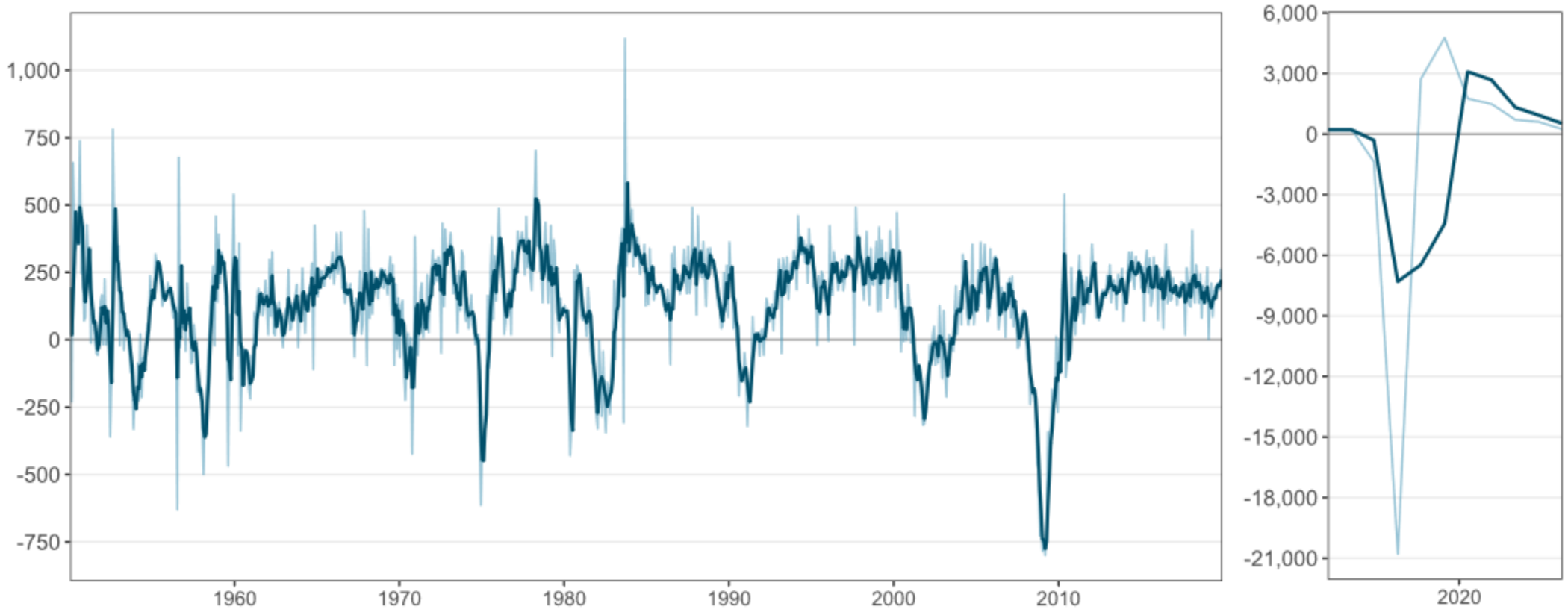
Nonfarm Payroll Employment – Monthly Change



Nonfarm Payroll Employment – Monthly Change

Monthly change in nonfarm payroll employment, with 3-month average

Thousands



Nonfarm Payroll Employment – Source

Current Employment Statistics (CES), aka establishment/payroll survey

- Survey of 145,000 nonfarm businesses and government agencies.
- Covers 700,000 “establishments” (worksites) out of a total 10.2 million.
- Covered establishments employed 46 million workers in 2019 – 31% of total payroll employment

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How do we go from 31% to 100%?

- Survey results are weighted by state, industry, and size (# of employees).
- BLS models the impact of business births (startups) and deaths (closures).

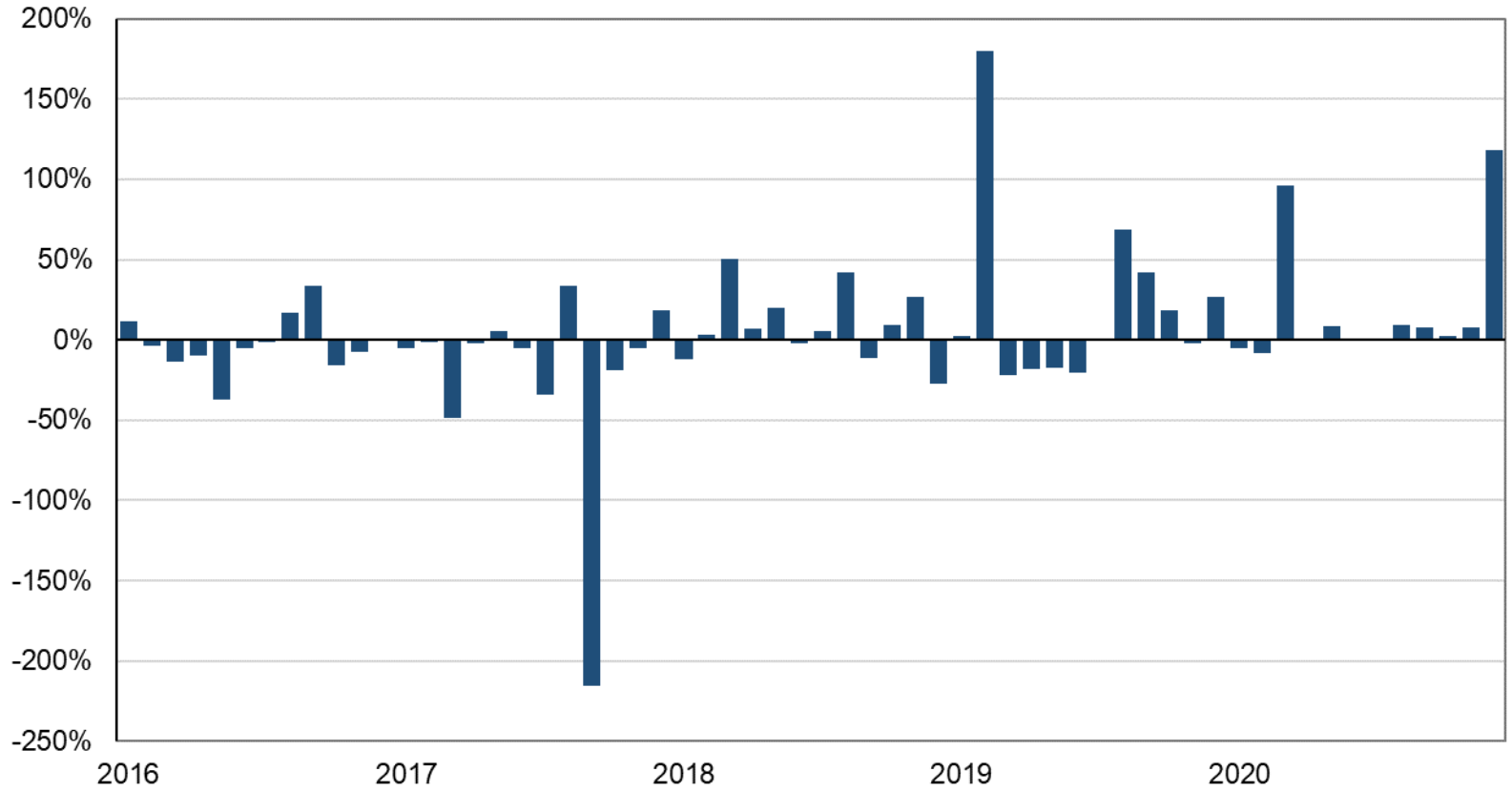
Nonfarm Payroll Employment – What Does It Tell Us?

Interpretation of a given number depends on context:

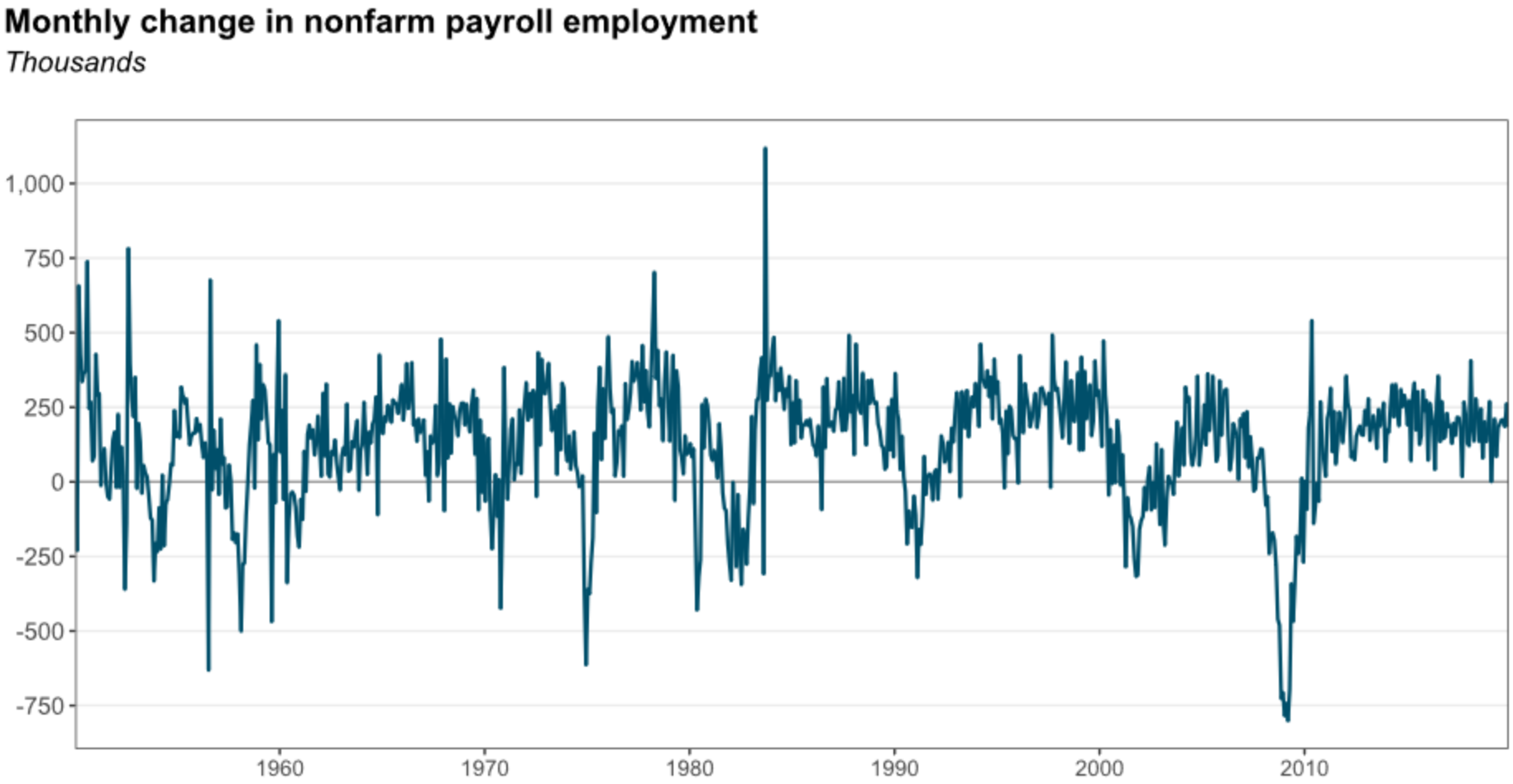
- November 2019: +266 thousand → great news!
- November 2020: +245 thousand → disaster!

Nonfarm Payroll Employment – Revisions

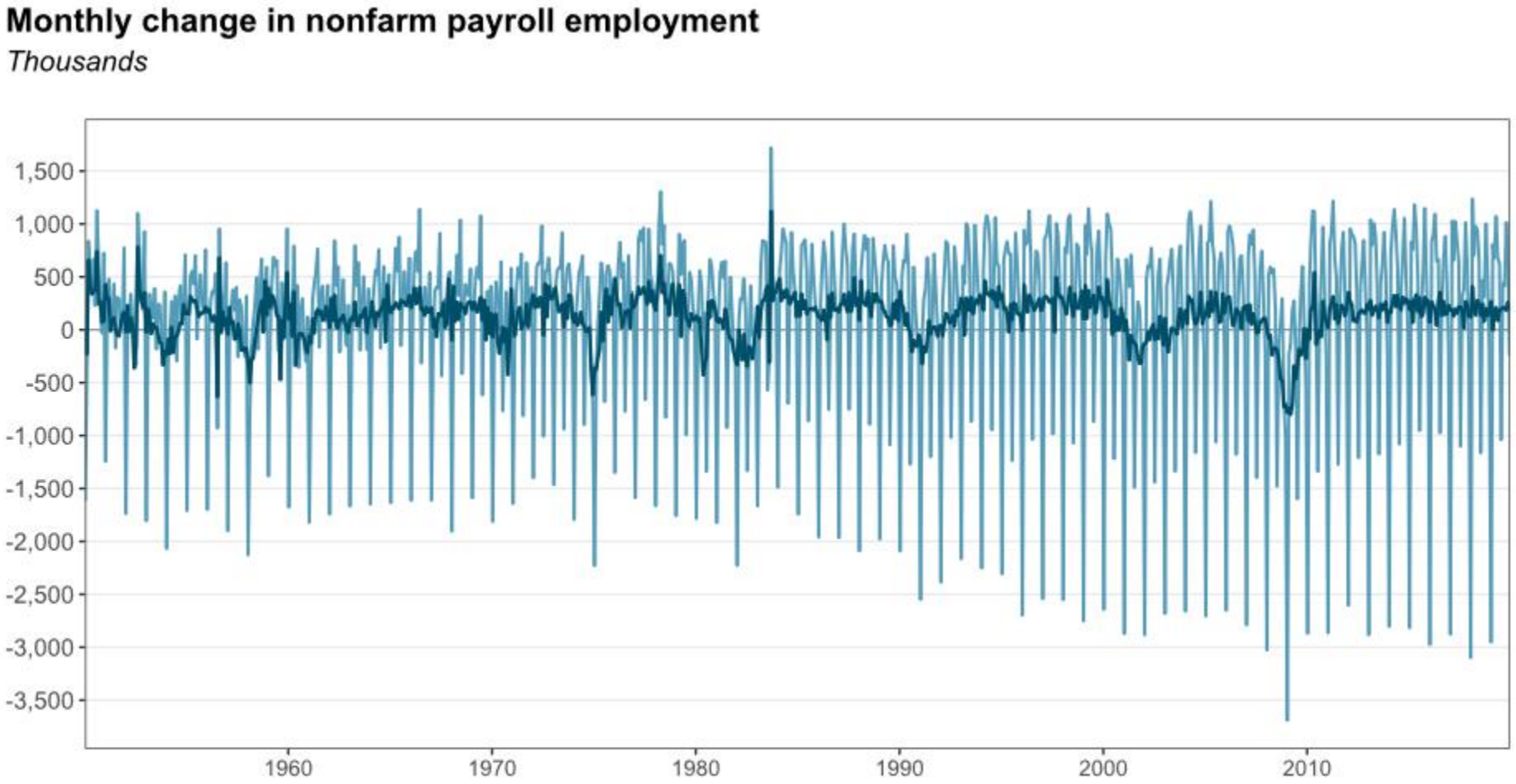
Monthly change in nonfarm payroll employment:
Revision from 1st to 3rd estimate as a % of 1st estimate



Nonfarm Payroll Employment – Seasonal Adjustment



Nonfarm Payroll Employment – Seasonal Adjustment



Nonfarm Payroll Employment – Pros and Cons

Pros:

- Concept is straightforward
- Very good sample coverage

Cons:

- Incomplete coverage of employment
- Interpretation is highly context-dependent
- Monthly change is noisy (+ revisions) → always average!

Unemployment Rate – Definition

A person is unemployed if they are…

- Not working and available for work in the week that includes the 12th.
- Engaged in “active job search” in the prior four weeks OR on temporary layoff

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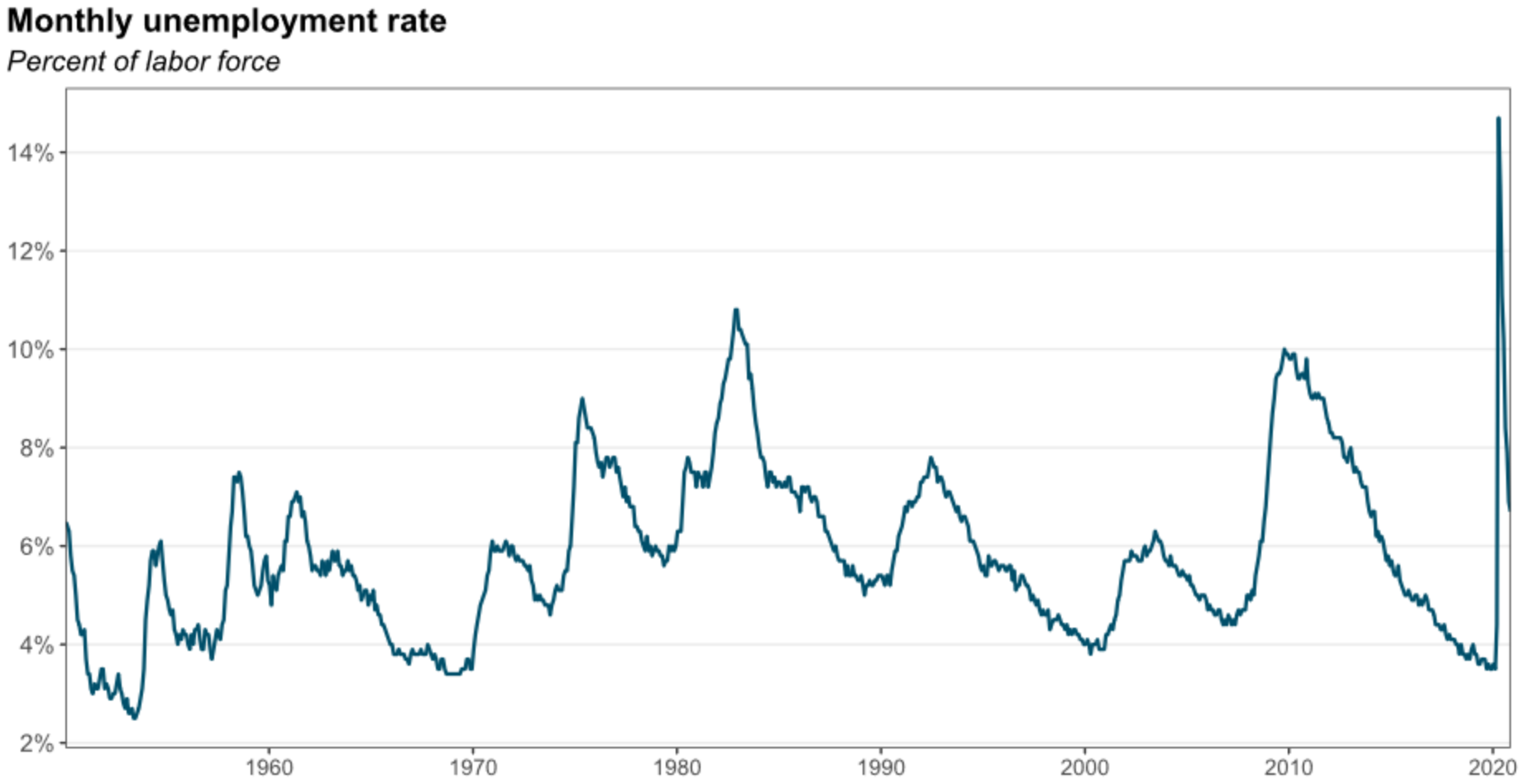
$$Unemployment\ Rate = \frac{Unemployed}{Labor\ Force} = \frac{Unemployed}{Employed + Unemployed}$$

Covers the civilian noninstitutional population age 16 and older.

Not included: military personnel, incarcerated persons, residents of nursing homes and other institutions.

Unemployment Rate



Unemployment Rate – Source

Current Population Survey (CPS), aka household survey

- Survey of about 60,000 households (residential addresses).
- Sample includes 120,000 persons out of a total civilian noninstitutional population age 16 and older of 260 million – about 0.04%.
- Each person in the survey represents about 2,500 people in the population.

Unemployment Rate – Source

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- Sample includes 120,000 persons out of a total civilian noninstitutional population age 16 and older of 260 million – about 0.04%.
- Each person in the survey represents about 2,500 people in the population.

How do we go from 0.04% to 100%?

- Survey results are weighted by state, age, sex, race, ethnicity.
- But population targets have to be modeled between Decennial Censuses.

Unemployment Rate – What Are We Measuring?

A person is unemployed if they are…

- Not working and available for work in the week that includes the 12th.
- Engaged in "active job search" in the prior four weeks OR on temporary layoff

Some issues:

- "Active job search" is arbitrary
- More newly employed were previously "not in labor force" than unemployed
- Doesn't capture **under**employment
- Misclassification of workers on temporary layoff

Unemployment Rate – What Does It Tell Us?

Q. When the unemployment rate goes down, is that good or bad?

Unemployment Rate – What Does It Tell Us?

Q. When the unemployment rate goes down, is that good or bad?

A. It depends:

- Good if unemployed persons became employed
- Bad if unemployed persons stopped “active job search” and exited the labor force:

> “The unemployment rate fell to 6.3% in January from 6.7% a month earlier, in part reflecting **fewer people searching for jobs**.”
>
> - *Wall Street Journal*, February 5, 2021

Unemployment Rate – Pros and Cons

Pros:

- Very useful concept
- Not very noisy
- Minimal revisions and seasonal adjustment
- Straightforward interpretation of level

Cons:

- Concept is difficult to define and measure
- Interpretation of changes is ambiguous

Wall Street Journal, December 5, 2020:

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Wall Street Journal, April 2, 2021:

> "U.S. employers added a **seasonally adjusted** 916,000 jobs in March, the best gain since August, the Labor Department said Friday, and the unemployment rate, **determined by a separate survey**, fell to 6.0%"

2. Tracking the economy in real time

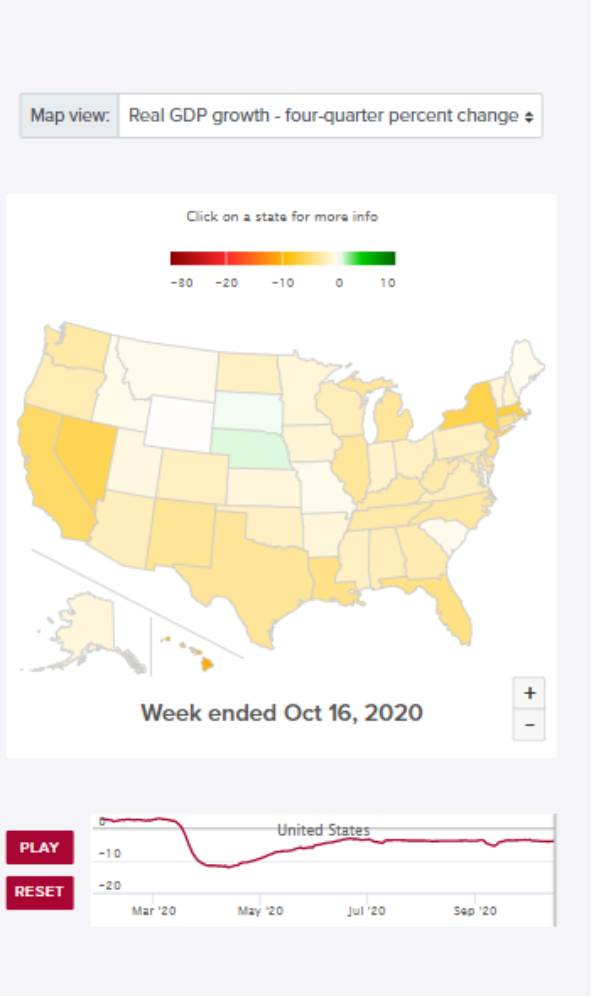
The Real-Time Data Revolution

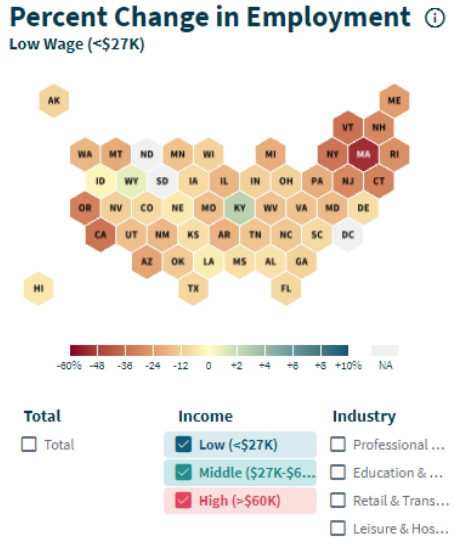
Private entities opened up the data vaults in 2020:

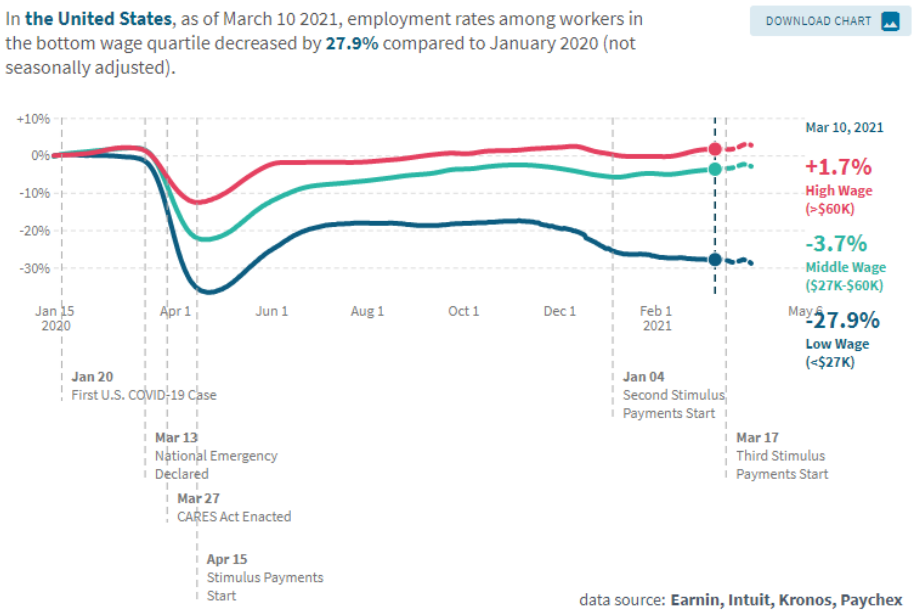
- Mobile device location data
- Enterprise services software
- Payroll and earnings management services
- Payments platforms

Daily frequency, geographic detail, available in near-real-time

The Real-Time Data Revolution







Drawbacks of Nontraditional Data Sources

Sample composition is opaque, not representative, inconsistent over time

Daily data for small geographic units → very noisy

Many imperfect proxies for a true variable of interest

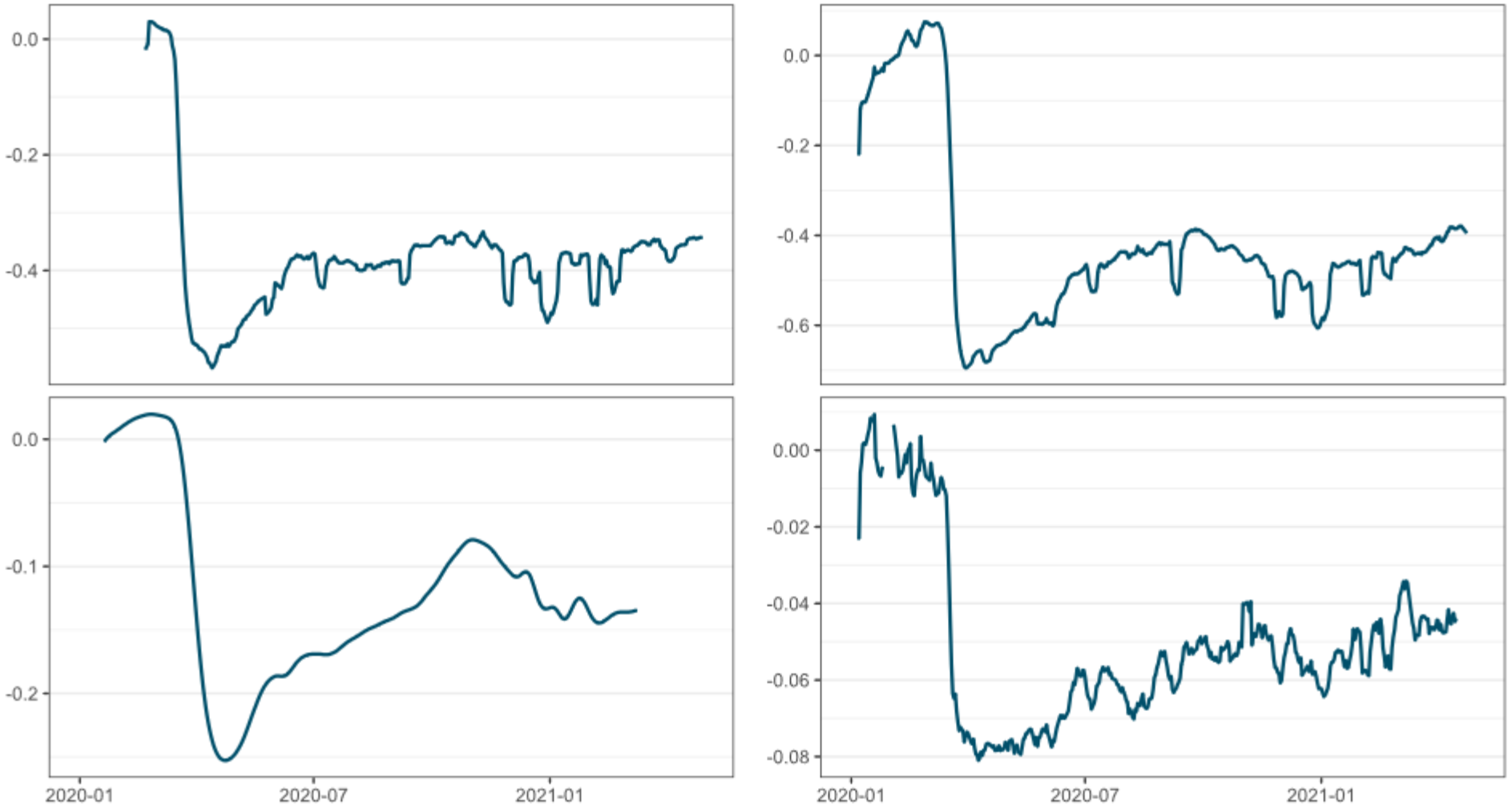
Real-Time Measurement of Employment

Types of indicators for employment:

- hours recorded by employer
- earnings reported by employee
- time spent at “workplaces”
- web searches (UI, hiring forms)

Sources: *Intuit, Earnin, Kronos, SafeGraph, Google Mobility, Google Trends, Homebase*

Four Daily Employment Indicators for Philadelphia



Constructing a Real-Time Employment Tracker

We construct county-level indexes of daily employment:

1. Normalize all indicators relative to pre-pandemic “normal” (by day of the week)

2. Take the first principal component of all indicators

3. Scale to official (monthly) employment

Principal Components Analysis

Relatively simple dimensionality reduction method

The “first principal component” is the weighted average of indicators that best summarizes the information in all of them

- Extracts the latent common signal across all indicators
- Filters out idiosyncratic variation and noise
- Weights on each indicator are county-specific

Scaling to the Target Variable

PCA produces a unitless daily index → rescale mean and standard deviation so they match official monthly employment

Mean level and variance are given, but shape and change over time reflect the underlying indicators

PWBM Employment Index vs. Official Employment Level

Other Applications

Social distancing

- device proximity
- common locations
- time spent at “home”
- distance travelled

Daily GDP

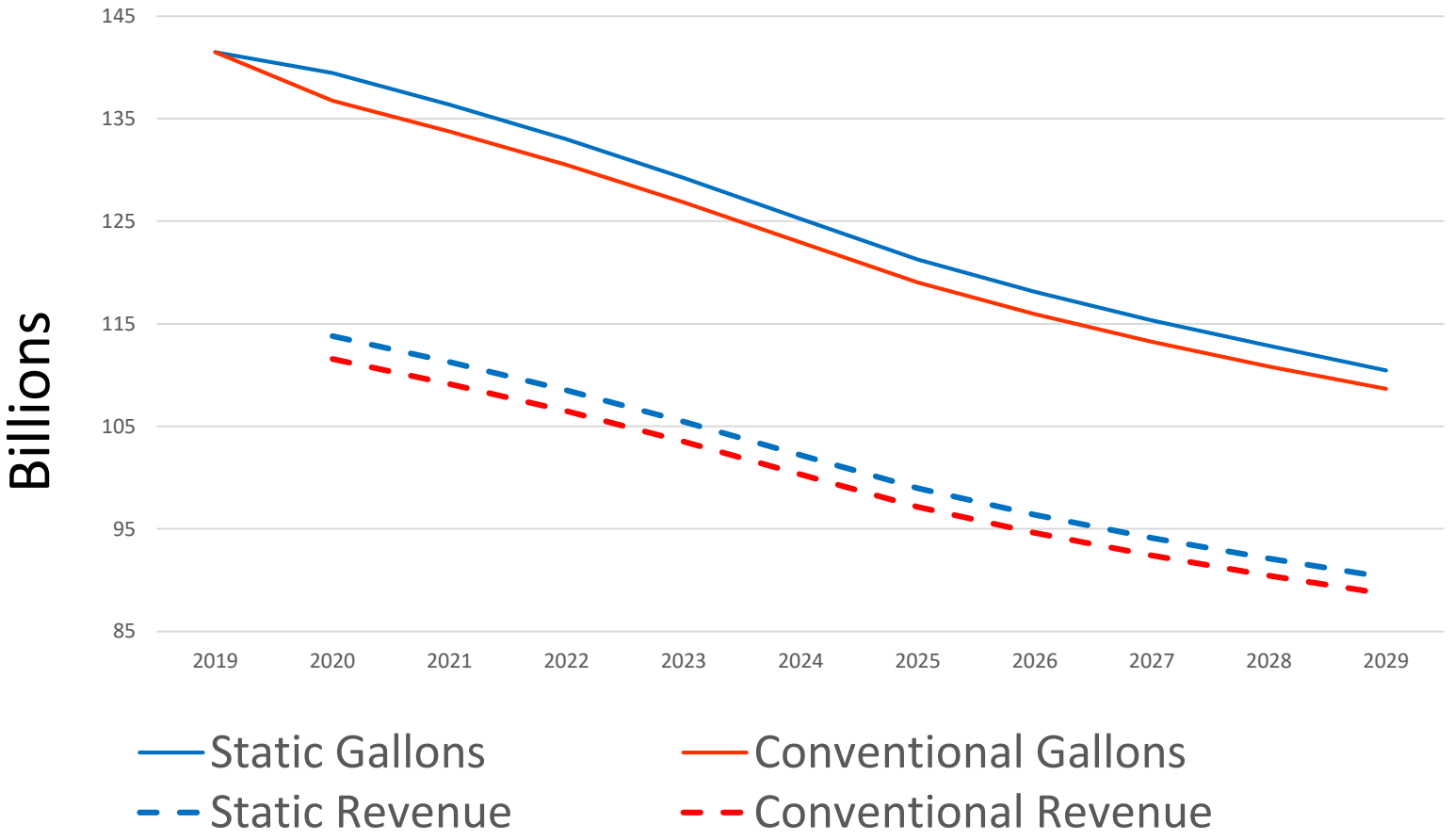
- employment indicators
- commercial visits
- card transactions
- businesses open or closed
- air quality
- more...

3. Forecasting revenue from tax changes

Types of Revenue Estimates

- "Wicked Static"
  - Base of Tax remains unchanged
- Conventional
  - Includes Behavioral Responses
- Dynamic (not discussed today)
  - Includes Macroeconomic feedbacks

Gasoline Tax Example



Flexibility of Income

- Intertemporal Shift
  - Capital Gains
- Base Shift
  - Choice of Entity
- Flavor Shift
  - Capital vs. Labor
- Combination

Pass-Through vs. C-Corporation

A Firm's choice of business structure is likely a function of both tax and non-tax concerns.

- C-corporations: double taxation, limited liability, broad access to capital markets, deferral.
- Sole Proprietors: single layer of tax but includes Self Employment Contributions Act (SECA) rates
- S-Corporations: single layer of tax, limited liability, some income avoids SECA, subject to closely held rules
- Partnerships: single layer of tax (individual partners), limited liability, some income avoids SECA, flexibility in distribution/form.

Ease of Conversion

- Check-the-Box rules allow Pass-Throughs to choose taxation under the corporate system.
- Corporate Taxation is simpler than Partnership
- Conversion to C-corporation is largely costless
- Conversion to Pass-Through is *not* costless

Tax Rates of Types of Businesses

Tax wedge between the corporate and individual tax base is:

$$W = T_{\text{net corp}} - T_{\text{ind}}$$

Where:

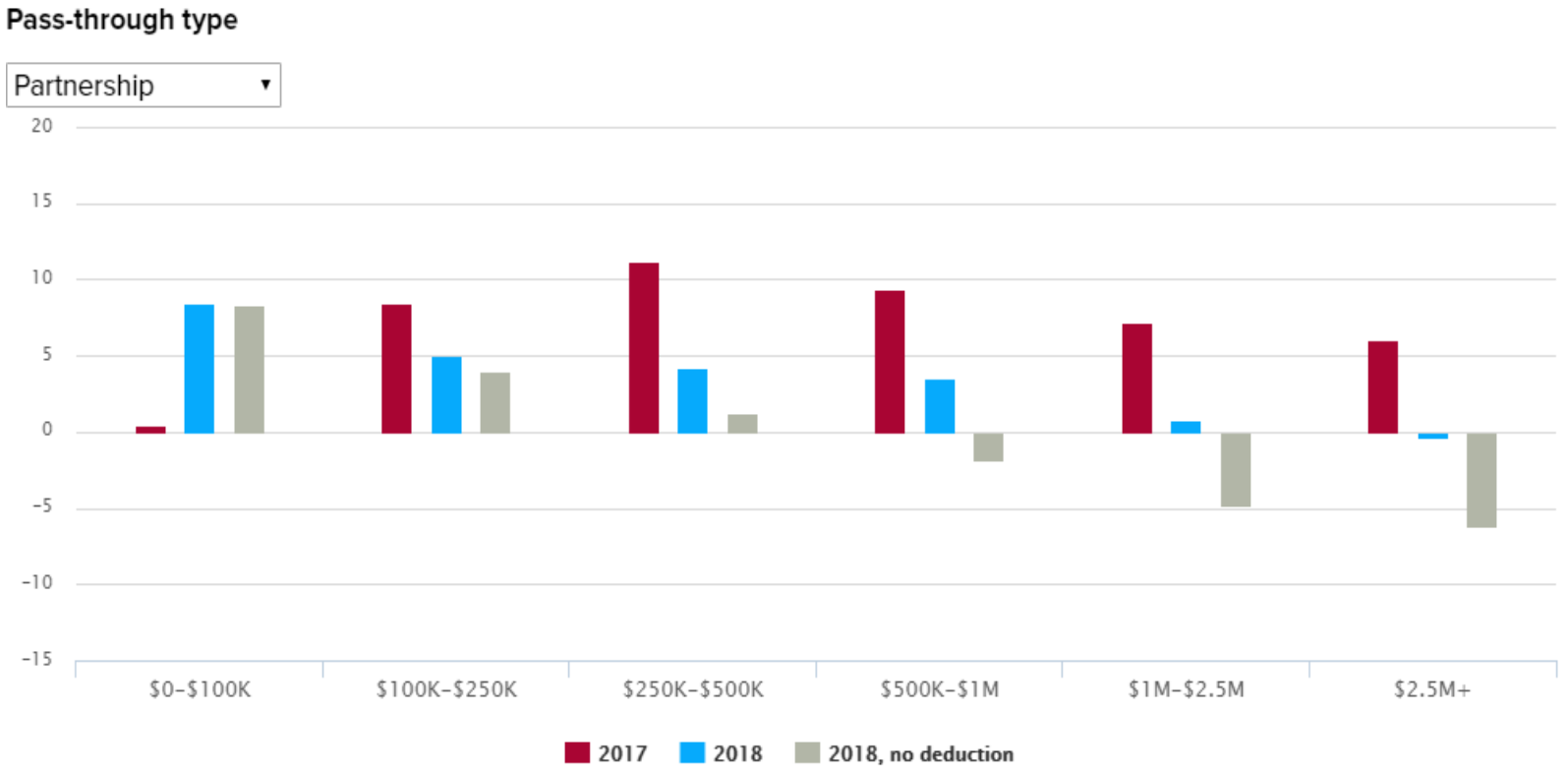
$$T_{\text{net corp}} = T_{\text{corp}} + (1 - T_{\text{corp}}) \cdot (\alpha \cdot T_{\text{div}} + (1 - \alpha) \cdot \beta \cdot T_{\text{cg}})$$

α = share of corporate income paid out as dividends

β = a measure of the benefits of capital gains deferral

Table 1: Top Statutory Tax Rates in 2017 and 2018					
	0% Retained				
	2017		2018		
Type of Tax	C-corporation	Pass-through	C-corporation	Pass-through	with 20% Deduction
Entity Tax	35.0%	0.0%	21.0%	0.0%	0.0%
Individual Tax	20.0%	39.6%	20.0%	37.0%	29.6%
Net Investment Income Tax	3.8%	3.8%	3.8%	3.8%	3.8%
Net Rate	50.5%	43.4%	39.8%	40.8%	33.4%
Rate Differential		7.1		-1.0	6.4
	100% Retained				
	2017		2018		
Entity Tax	35.0%	0.0%	21.0%	0.0%	0.0%
Individual Tax	0.0%	39.6%	0.0%	37.0%	29.6%
Net Investment Income Tax	0.0%	3.8%	0.0%	3.8%	3.8%
Net Rate	35.0%	43.4%	21.0%	40.8%	33.4%
Rate Differential		-8.4		-19.8	-12.4

Tax Rate Differential – 52% Retained



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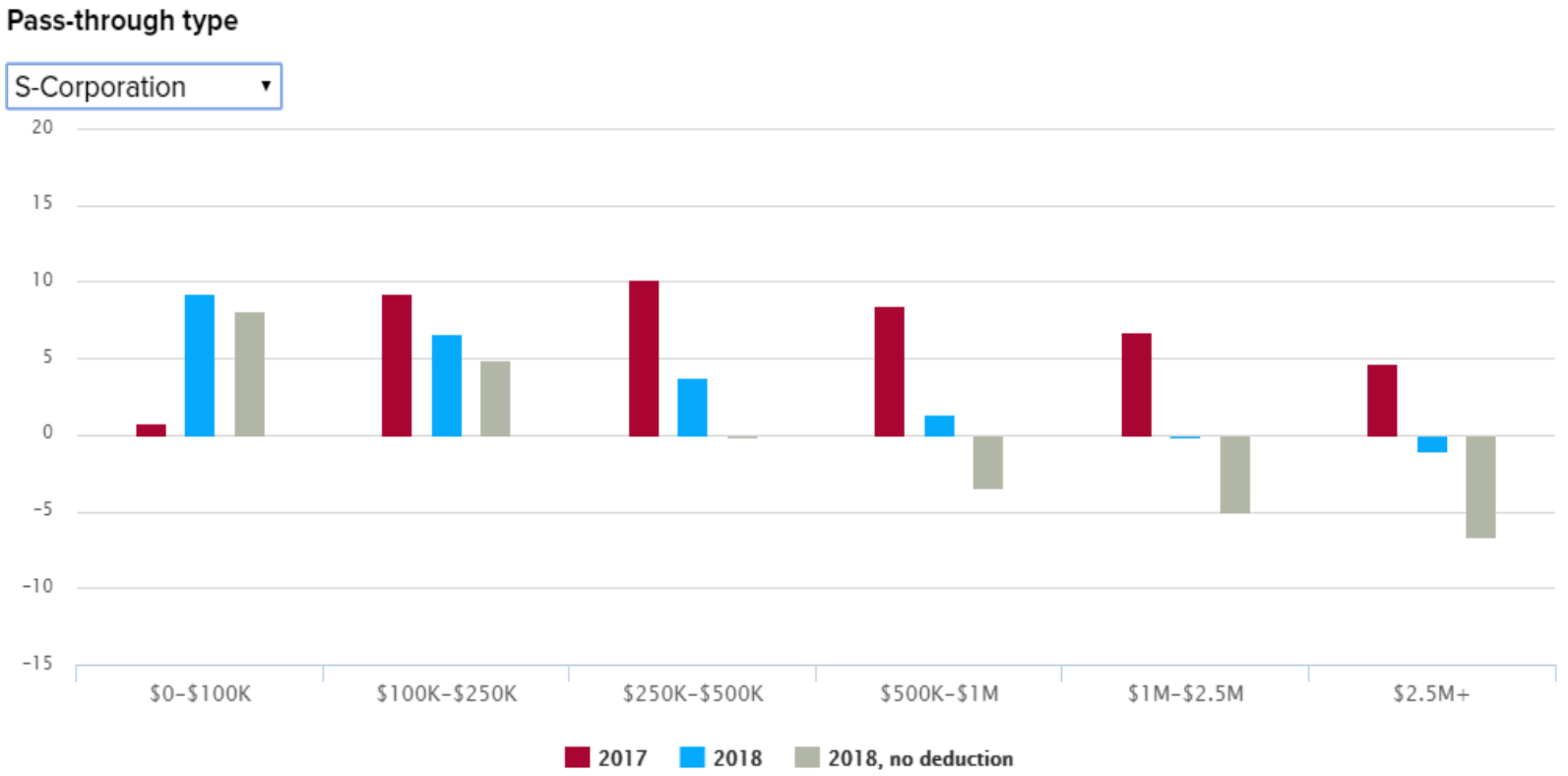
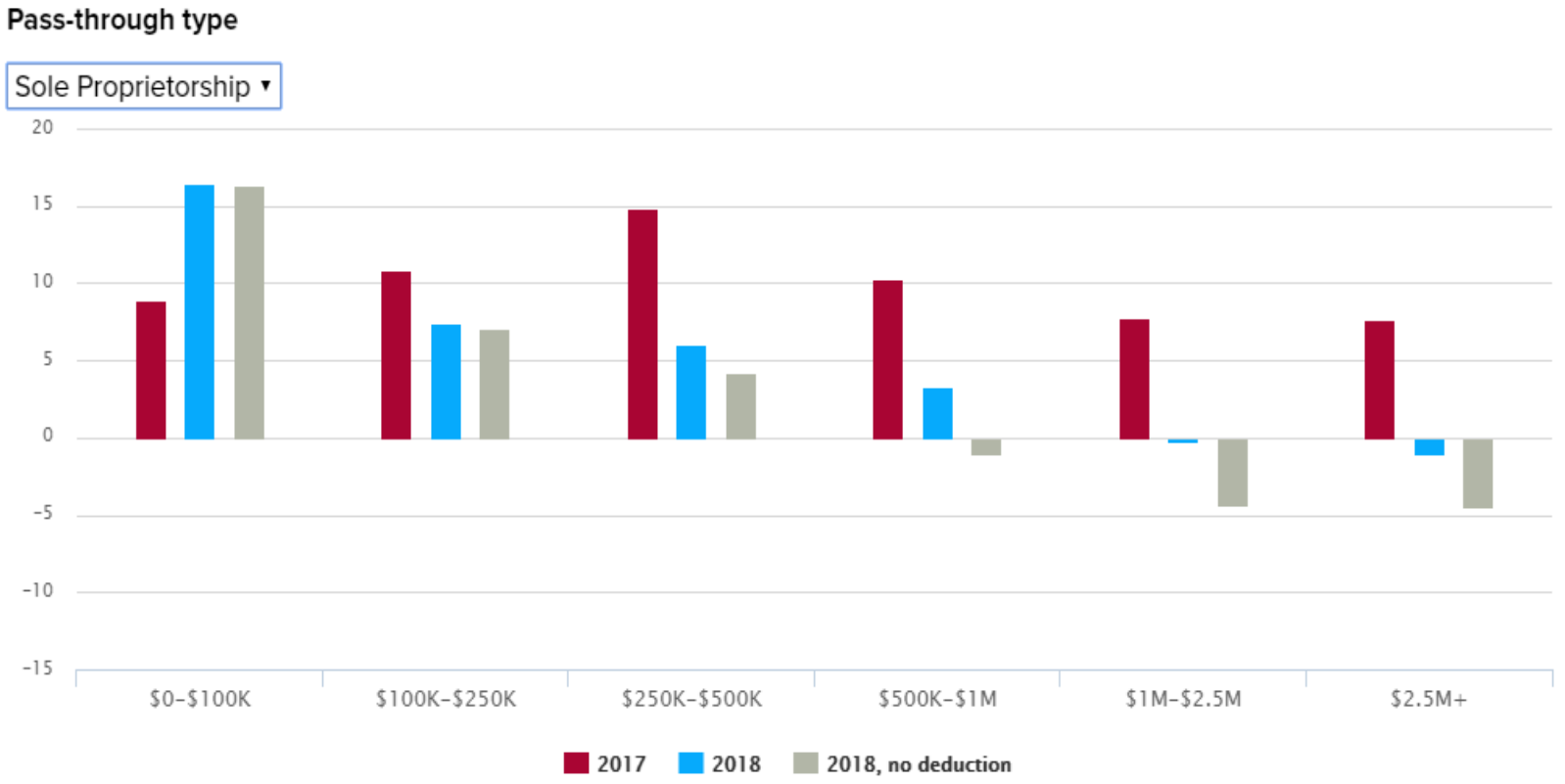


Tax Rate Differential – 52% Retained



Observations

- Not everyone optimizes their Tax Position
- 235,780 of 24.4M “Business Owners”
- 77% of beneficiaries > $500K in AGI
- 17.5% of Pass-Through Ordinary Business Income

PENN WHARTON
UNIVERSITY of PENNSYLVANIA

Budget Model

Gross Domestic Product

Prepared by the Bureau of Economic Analysis (BEA) as part of the National Income and Product Accounts (NIPAs)

Quarterly estimates, released one month after the end the quarter

Additional detail for the quarter released over subsequent months

Gross Domestic Product – Definition

BEA: *The market value of goods and services produced by labor and property in the United States, regardless of nationality.*

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"Product"

- "Real" economic activity → financial activity is irrelevant
- Current production → existing goods or assets are irrelevant
- Production, not sales → should include the value of goods and services produced, even if not actually sold

Gross **Domestic** Product – Definition

BEA: *The market value of goods and services produced* ***by labor and property in the United States, regardless of nationality.***

"Domestic"

- Production occurring within the 50 states and DC (plus military installations and embassies)
- Contrast with Gross **National** Product: production by labor and property *supplied by U.S. residents*, regardless of where it occurs

Gross Domestic Product – Definition

BEA: *The **market value** of goods and services produced by labor and property in the United States, regardless of nationality.*

"Gross"

- Not adjusted to reflect *depreciation*, the reduction in the value of property as a result of their use in production.
- Contrast with **Net** Domestic Product: GDP minus depreciation.

Gross Domestic Product – Sources

Anything they can get their hands on:

- Surveys (manufacturing, wholesale and retail trade, services, construction…)
- Administrative data (tax returns, UI system, utilities, building permits, customs, government spending and revenues…)
- Benchmark: Economic Census

Gross Domestic Product – Sources

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Better source data is incorporated into earlier estimates as it becomes available → quality of GDP estimate increases over time (revisions), impact of models/projections decreases

Gross Domestic Product – What Are We Measuring?

GDP is the sum of producers' **value added**:

$$GDP = Gross\ Output - Intermediate\ Inputs$$

Some issues:

- Inputs vs. assets
- Nominal vs. real
- Imputed output

Gross Domestic Product – Inputs vs. Assets

Intermediate inputs: *Goods and services that are used in the production process of other goods and services.*

Fixed assets (property): *Produced assets that are used repeatedly, or continuously, in processes of production for an extended period of time.*

Gross Domestic Product – Inputs vs. Assets

Reclassified in 2013 from intermediate inputs to fixed assets: R&D, movies and TV, music, books → GDP “increased” more than 2.5%

Gross Domestic Product – Inputs vs. Assets

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Soloveichik (2013):

1. Nominal Book Production

What is a Book?

In this paper, I track the production of original books. I define original books as any work that could reasonably be published in a book, regardless of what form it is actually published in. This definition includes not only printed books, but also audio books, digital books and books licensed to magazines for serial publication.[1] There is no requirement for literary critics to approve of the book – I include Harlequin romances and textbooks along with great literary works. I also include works such as short stories, poetry, etc. that could be collected and published in books.

Gross Domestic Product – Nominal vs. Real

Nominal GDP is the market value of goods and services in current dollars. But the quantity is what matters for economic activity and for living standards.

How to aggregate quantities of different goods and services?

Gross Domestic Product – Nominal vs. Real

Nominal GDP is the market value of goods and services in current dollars. But the quantity is what matters for economic activity and for living standards.

How to aggregate quantities of different goods and services?

- Not feasible, but can track change over time in a quantity index
- For most goods and services, BEA estimates a price index and “deflates” the nominal value
- Indexes must account for changes in quality → lots of models
- Quantity indexes are aggregated using expenditure shares → also a model

The American Families Plan: Taxes

AFP raises taxes on high income individuals

- Individual taxes on ordinary income
  - Raise the top individual rate to 39.6 percent
- Capital gains taxes
  - Tax unrealized capital gains above $1 million at death
  - Tax LTCG/Dividends at ordinary rates for individuals making more than $1 million
  - Tax carried interest at ordinary rates
  - Disallow deferral of tax on like-kind exchanges for gains greater than $500,000
- Pass-through business taxes
  - Make all income above $400,000 face 3.8%
  - Extend the limitation of business losses for noncorporate taxpayers

The American Families Plan: Taxes

AFP dedicates resources towards IRS enforcement

- Additional audits
- IT modernization
- New information reporting aimed at deterring evasion in pass-through businesses
- Taxpayer services

The American Families Plan: Taxes

AFP extends certain tax credit expansions under the recent stimulus:

- Child Tax Credit, through 2025
  - Remove refundability rules past 2025
- Premium Tax Credit
- Earned Income Tax Credit
- Child and Dependent Care Credit

AFP: Revenue (Billions of $), 2022 - 2036

Provision	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	10 year total	15 year total
Raise the top rate on ordinary income to 39.6%	17	23	24	25	16	4	1	0	0	0	111	111
Tax unrealized gains above $1M at death; tax long-term capital gains and preferred dividends at ordinary rates for filers making more than $1M; tax carried interest at ordinary rates	9	23	31	37	39	40	44	46	51	55	376	699
Disallow deferral of tax on like-kind exchanges for gains greater than $500,000	3	4	4	4	4	4	4	5	5	5	41	68
Ensure all income above $400,000 faces 3.8% Medicare tax	10	14	15	17	13	13	14	14	14	15	139	222
Extend limitation on business losses for noncorporate taxpayers	0	0	0	0	0	25	32	33	35	36	162	362
Increase IRS funding for audits; institute information reporting regime for gross flows in financial institutions	2	5	11	20	30	43	59	78	101	129	480	1359
Total budget effect of revenue-raisers	**40**	**69**	**85**	**103**	**103**	**130**	**155**	**176**	**205**	**241**	**1308**	**2821**
Extend the ARP's expansion of the Child Tax Credit through 2025; remove refundbility requirements permanently	-78	-107	-108	-112	-30	-1	-1	-1	-1	-1	-439	-443
Extend the ARP's expansion of the Earned Income Tax Credit for childless workers	-9	-12	-12	-12	-13	-13	-13	-13	-13	-14	-125	-199
Extend the ARP's expansion of the Premium Tax Credit	-24	-33	-35	-36	-38	-39	-41	-42	-44	-46	-378	-629
Extend the ARP's expansion of the Child and Dependent Care Tax Credit	-6	-8	-9	-9	-9	-10	-10	-10	-10	-11	-92	-152
Total budget effect of tax credits	**-117**	**-160**	**-164**	**-170**	**-90**	**-62**	**-65**	**-66**	**-69**	**-71**	**-1033**	**-1423**
Net budget effect of tax-related provisions	**-77**	**-91**	**-79**	**-67**	**13**	**68**	**90**	**110**	**137**	**170**	**275**	**1398**

AFP: Outlays (Billions of $), 2022 - 2036

Provision	2022-2031	2022-2036
Free, universal pre-kindergarten for all three- and four-year-olds	426	671
Tuition-free two-year community college	299	497
Increase Pell Grants for low-income students	66	104
Other education initiatives	117	191
Family and childcare initiatives	493	806
Child Tax Credit expansion	439	443
Earned Income Tax Credit expansion	125	199
Premium Tax Credit expansion	378	629
Child and Dependent Care Tax Credit expansion	92	152
IRS funding	80	176
Total spending	**2515**	**3868**

Macroeconomic Effects, AFP Tax Increases Alone

First, the macroeconomic effects of just the tax increases, with no new spending:

- Increased taxes on investment income discourages households from saving.
- Raised tax revenue reduces government debt and crowds in capital investment.

Year	GDP	Capital	Average Hourly Wage	Hours Worked	Debt Held by the Public
2031	0.01%	0.79%	0.33%	-0.32%	-4.10%
2040	0.09%	0.94%	0.41%	-0.32%	-5.90%
2050	0.29%	1.44%	0.54%	-0.24%	-7.03%

The American Families Plan: Spending

AFP proposal includes about $2.2 trillion in spending through 2030:

- ~$1.0 T of the AFP through 2030 goes toward productivity-increasing educational spending.
- The other ~$1.2T of the AFP goes toward various tax credits and *transfers* to qualifying households, which includes:
  - Child Tax Credit
  - Extending the ACA premiums tax credit
  - Several health and nutrition programs

Macroeconomic Effects, AFP Spending Alone

Macroeconomic effects of just the new spending (with no tax increases), assuming the AFP spending begins in 2022 and is fully deficit-financed:

Year	GDP	Capital	Average Hourly Wage	Hours Worked	Debt Held by the Public
2031	-0.33%	-0.86%	0.05%	-0.39%	6.22%
2040	-0.44%	-1.59%	-0.15%	-0.28%	9.41%
2050	-0.68%	-2.58%	-0.46%	-0.22%	11.56%

Notice that productivity increases from the new investments are outweighed by *crowding out* from higher deficits.

Macroeconomic Effects, Full AFP Proposal (Taxes and Spending)

Now the *combined* effects of the AFP's education expenditures including productivity boosts, transfers, tax changes, investment effects of taxes, and debt crowding out effects:

Year	GDP	Capital	Average Hourly Wage	Hours Worked	Debt Held by the Public
2031	-0.34%	-0.09%	0.41%	-0.75%	2.16%
2040	-0.36%	-0.67%	0.26%	-0.62%	3.54%
2050	-0.39%	-1.16%	0.12%	-0.50%	4.55%