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Motivation: Measuring the Impacts of COVID-19

- How has COVID-19 affected the American economy and what policies can best mitigate its adverse impacts going forward?

- Since Kuznets (1941), macroeconomic policy decisions have been based on data from surveys of households and businesses.

- These data provide vital aggregate information (GDP, unemployment rates), but have two key limitations:
  1. Available only at low frequencies, often with significant lags
  2. Cannot be disaggregated to examine variation across areas or subgroups
We build a publicly available economic tracker using transaction data from several private companies to measure daily economic activity by ZIP code, income group, and industry.

Use these new data to analyze economic impacts of COVID-19 pandemic:


2. [Policy Responses] Causal effects of fiscal stabilization policies enacted to date
Outline

1. Data

2. Impacts of COVID-19

3. Impacts of Stabilization Policies

4. Policy Implications
Data

Here, we construct and analyze public statistics based on private sector data rather than directly analyzing confidential sources of microdata.

Challenge: constructing public statistics that are sufficiently granular for research yet sufficiently aggregated and masked to protect privacy.

Combining data on spending, employment, and other outcomes offers a more complete picture of chain of macroeconomic events than studies that focus on one set of outcomes.
Starting from raw data, construct series suitable for economic analysis as follows:

1. **Clean** series to remove artifacts that arise in transaction data

2. **Smooth** seasonal fluctuations using data from 2019

3. **Protect privacy**: index to January 2020 values, exclude small cells, combine data from multiple companies

4. **Benchmark** to national statistics to characterize group each dataset represents to mitigate bias from non-representative selection
Retail RMSE: 4.82 p.p.

-50%
-25%
0%
25%
50%

Change in Consumer Spending (%)
Relative to January

Retail: Affinity Solutions Series
Retail: Advance Monthly Retail Trade Survey
Food and Accommodation: Affinity Solutions Series
Food and Accommodation: Advance Monthly Retail Trade Survey

Consumer Spending: National Accounts vs. Credit/Debit Card Data
Retail and Food Services in Affinity Solutions Data vs. Monthly Retail Trade Survey
Changes in Employment: Current Employment Statistics vs. Payroll Data

Changes in Employment: Current Employment Statistics vs. Payroll Data


Change in Employment (%)
Relative to January 2020

Jan Feb Mar Apr May Jun Jul Aug Sep Oct

Paychex-Intuit-Earnin Accom. & Food Services
Paychex-Intuit-Earnin Professional Services
CES Accom. & Food Services
CES Professional Services
Homebase Food Services
Produce daily/weekly series by industry (two-digit NAICS), geography (county/ZIP code), and income quartile

Automated pipeline that ingests data from companies and reports statistics typically within one week of relevant transactions

All series are freely downloadable (eliminating need for further contracts) and can be visualized at www.tracktherecovery.org

All results that follow are constructed from these publicly available statistics
Impacts of COVID-19
Gross Domestic Product

National Accounts Data: Changes in GDP and its Components

Change in Real GDP from Q1 2020 to Q2 2020 (in trillions of chained 2012 dollars)

- $1.73T (-31.7%)
National Accounts Data: Changes in GDP and its Components

Change in Real GDP from Q1 2020 to Q2 2020 (in trillions of chained 2012 dollars)

- Gross Domestic Product: -$1.73T
- Private Domestic Investment: -$0.47T
- Govt. Expend.: $0.04T
- Net Exports: $0.05T
- Personal Consumption Expend. (PCE): -$1.35T
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- Net Exports: $0.05T
- Personal Consumption Expend. (PCE): -$1.35T
- Credit Card Spending in PCE: -$1.03T
Impacts of COVID-19 on Consumer Spending

- Begin by disaggregating spending changes by household income
  - Who cut spending more – the rich or the poor?

- Impute income based on median household income in cardholder ZIP code
  - Matches estimates in JPMorgan Chase individual-level income data
    [Farrell, Greig, Cox, Ganong, Noel 2020]
Consumer Spending by Income Quartile

Credit and Debit Card Spending Per Day ($ Billions)

-3.1 Billion (41% of Agg. Spending Decline)

-1.0 Billion (54% of Agg. Spending Decline)

$-1.5 Billion (49% of Agg. Spending Decline)

$-1.0 Billion (54% of Agg. Spending Decline)
Credit and Debit Card Spending Per Day ($ Billions)

Feb 1  Mar 1  Apr 1  May 1  Jun 1  Jul 1  Aug 1  Sep 1  Oct 1

2019 Top Income Quartile
2020 Top Income Quartile

2019 Bottom Income Quartile
2020 Bottom Income Quartile

Consumer Spending by Income Quartile

-3.1 Billion (41% of Agg. Spending Decline)
-0.9 Billion (12% of Agg. Spending Decline)
-1.5 Billion (49% of Agg. Spending Decline)
-1.0 Billion (54% of Agg. Spending Decline)
+0.1 Billion
Impacts of COVID-19 on Consumer Spending

- Next, disaggregate by sector

  - Why did spending fall? Because of a reduction in purchasing power/expected income or health concerns about COVID-19?
Change in Consumer Spending by Sector

- Durable Goods
- Non-Durable Goods
- Remote Services
- Other In-Person Services
- Recreation
- Health Care
- Transportation
- Hotels & Food

Share of Decline
(Jan to Mar 25-Apr 14)

In-Person Services (68%)
Change in Consumer Spending by Sector

- **Remote Services**: 25%
- **Health Care**: 25%
- **Transportation**: 25%
- **Hotels & Food**: 25%
- **Durable Goods**: 15%
- **Non-Durable Goods**: 15%

Share of Pre-COVID Spending

- **Remote Services**: 33%
- **Health Care**: 25%
- **Transportation**: 25%
- **Hotels & Food**: 25%
- **Durable Goods**: 15%
- **Non-Durable Goods**: 15%

Share of Decline (Jan to Mar 25-Apr 14)

- **Remote Services**: 75%
- **Health Care**: 50%
- **Transportation**: 50%
- **Hotels & Food**: 25%
- **Durable Goods**: 15%
- **Non-Durable Goods**: 15%

In-Person Services: 68%

In-Person Services: 33%
Change in Consumer Spending by Category

- Restaurants and Eating Places
- Airlines
- Barbers and Beauty Shops

Change in Consumer Spending (%)

Relative to January 2020
Change in Consumer Spending by Sector
COVID vs Great Recession

<table>
<thead>
<tr>
<th>Sector</th>
<th>Great Recession</th>
<th>COVID-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durables</td>
<td>58.6%</td>
<td>19.5%</td>
</tr>
<tr>
<td>Non-Durables</td>
<td>44.3%</td>
<td>13.3%</td>
</tr>
<tr>
<td>Services</td>
<td></td>
<td>67.2%</td>
</tr>
</tbody>
</table>

Share of Peak to Trough Decline in Personal Consumption Expenditure (%)
Business Revenues
Impacts of COVID-19 on Businesses

- How did the fall in consumer spending and business revenue affect business decisions: decision to remain open, employment, job postings, etc.?

- To answer this question, use variation in size of spending shocks across ZIP codes
  
  - Spending fell primarily among high-income households for in-person services such as restaurants
  
  - Such services are mostly produced by small businesses that serve customers in their local area
  
  - Differences across ZIP codes in average household income → variation in size of spending shock that local businesses face

- Begin by analyzing impacts on small business revenue
Changes in Small Business Revenues from January to April by ZIP Code

New York
Changes in Small Business Revenues vs. Rent, by ZIP Code
From January to April 2020

Change from Jan-Apr
Slope = -13.47%/$1000 (s.e. = 0.35)

-60%
-40%
-20%
0%

Change in Small Business Revenue (%) Relative to January 2020

Median Two Bedroom Monthly Rent in 2014-2018 ($)

Changes in Small Business Revenues vs. Rent, by ZIP Code From January to April 2020

Change from Jan-Apr
Slope = -13.47%/$1000 (s.e. = 0.35)
Change from Jan-Apr
Slope = -13.47%/\$1000 (s.e. = 0.35)

Change from Jan-Jul
Slope = -13.12%/\$1000 (s.e. = 0.57)
Changes in Small Business Revenues vs. Rent, by ZIP Code
Finance and Professional Services vs Food and Accommodation Services and Retail Trade

**Food and Accommodation Services and Retail Trade**
Slope = -13.02%/$1000 (s.e. = 0.93)

**Finance and Professional Services**
Slope = 2.32%/$1000 (s.e. = 2.50)
Employment

Data

Impacts of COVID-19

Impacts of Stabilization Policies

Policy Implications
Impacts of COVID-19 on Employment

- How did businesses react to loss in revenues?

- Begin by analyzing national trends in employment by wage group (as in Cajner et al. 2020) and then turn to geographic variation
Employment Changes by Wage Quartile

Note: dashed lines are forecasts based on Kronos time sheet data and Paychex employment data for workers on weekly pay cycles.
Employment Changes by Wage Quartile

-40% (11.8m)
-37% (8.6m)
-27% (6.3m)
-20% (0.5m)
-14% (4.4m)
-20% (6.3m)
-8% (2.6m)
-3% (1.0m)
0% (0.1m)
-8% (2.4m)
-20% (6.3m)
-20% (6.3m)

Note: dashed lines are forecasts based on Kronos time sheet data and Paychex employment data for workers on weekly pay cycles
National Trends in Consumer Spending vs. Employment Rates
Bottom Wage Quartile Reweighted to Match Top Quartile by Industry and County

Change in Employment (%) Relative to January 2020

-1.5%
-17.7%
-21.4%

Feb 15 Mar 15 Apr 15 May 15 Jun 15 Jul 15 Aug 15 Sep 15
National Trends in Consumer Spending vs. Employment Rates
Retail Trade

Change Relative to January 2020 (%)
National Trends in Consumer Spending vs. Employment Rates
Retail Trade

Change Relative to January 2020 (%)

- Feb 15
- Mar 15
- Apr 15
- May 15
- Jun 15
- Jul 15
- Aug 15
- Sep 15

Consumer Spending
Employment: Top Wage Quartile
Employment: Bottom Wage Quartile

-8.0%
-0.3%
-16.9%
Changes in Wage and Employment Rates
Chained Estimates Using Wage Growth for Job Stayers from Week \( t \) to \( t+1 \)
Changes in Low-Wage (Bottom Quartile) Employment Rates by ZIP Code

San Francisco

Map showing changes in low-wage employment rates by ZIP code in San Francisco, from January to April 2020.
Low-Wage Employment Rates Over Time by Workplace Rent Quartile

(Q1 - Q4) Gap at 15 July: 15.59 p.p.

Change in Employment (%)
Relative to January 2020

Jan 15 Feb 2 Feb 20 Mar 9 Mar 27 Apr 14 May 2 May 20 Jun 7 Jun 25 Jul 13

Q1 Workplace Rent
Q4 Workplace Rent

Low-Wage Employment Rates Over Time by Workplace Rent Quartile
Change from Jan-Apr
Slope = -21.02%/$1000 (s.e. = 1.21)

Change from Jan-Jul
Slope = -26.44%/$1000 (s.e. = 1.40)
Employment Recovery from the COVID-19 Shock

- Reduction in spending by the rich led to loss of jobs for low-income individuals, especially those working in affluent areas

- Will employment of low-wage workers revert to baseline as spending recovers?
Reduction in spending by the rich led to loss of jobs for low-income individuals, especially those working in affluent areas.

Will employment of low-wage workers revert to baseline as spending recovers?

Signs of a potential “jobless recovery” in this recession as well for low-wage workers, perhaps because of technological shifts away from routine occupations [Jaimovich and Su 2018].

Evidence from Great Recession suggests that disparate job losses across regions/sectors could have persistent effects for many years because workers do not move to find jobs [Yagan 2019].

How can we mitigate the employment impacts of the crisis via macroeconomic policy?
Impacts of Stabilization Policies
In rest of talk, examine what policies can mitigate impacts of pandemic, focusing in particular on employment of low-income workers.

Focus on three major policies that target chain of events (consumer spending → business revenue → employment) at different points:

1. State-ordered re-openings
2. Stimulus payments to households
3. Loans to small businesses
State-Ordered Reopenings
State-Ordered Reopenings

- Can executive orders restore economic activity?

- Compare trends in spending and employment in states that reopened earlier vs. later
Causal Effect of Re-Opening on Consumer Spending
Case Study of New Mexico vs. Colorado
Causal Effects of Re-Openings on Economic Activity: Event Studies
Re-Opened States vs. Control States: Consumer Spending

Diff-in-Diff Estimate: +1.43p.p. (s.e. = 0.51)
Causal Effects of Re-Openings on Economic Activity: Event Studies

Re-Opened States vs. Control States: Employment

Diff-in-Diff Estimate: +0.65p.p. (s.e. = 0.51)
Stimulus Payments
Impacts of Stimulus Payments

- Coronavirus Aid, Relief, and Economic Security (CARES) Act made direct payments to nearly 160 million people, totaling $267 billion as of May 31, 2020
  - Larger payments for lower-income households
  - Vast majority of payments made exactly on April 15, 2020

- Was stimulus effective in increasing consumer spending and restoring employment?
RD Estimate of Stimulus Impact: 25.2% (s.e. = 7.2%)
Stimulus payments increased aggregate consumer spending, especially among low-income households.

Key question for determining potential multiplier effects: where was the money spent?

If spending went up in sectors where employment didn’t fall, multiplier effects could be muted [Guerrieri et al. 2020]
Impact of Stimulus Payments on Consumer Spending
Durable Goods

RD Estimate of Stimulus Impact: 20.8% (s.e. = 5.9%)
Impact of Stimulus Payments on Consumer Spending
In-Person Services

RD Estimate of Stimulus Impact: 6.6% (s.e. = 4.0%)

Change in Consumer Spending Relative to January 2020 (%)

Apr 1
Apr 8
Apr 15
Apr 22
Apr 29
Impact of Stimulus Payments on Business Revenue and Employment Rates

Revenue and Employment Changes Among Small Businesses, by ZIP Rent Quartile

Change Relative to January 2020 (%)

- Small Bus. Revenue in Bottom Rent Quartile ZIPS
- Small Bus. Revenue in Top Rent Quartile ZIPS

Jan 15 Feb 1 Feb 15 Mar 1 Mar 15 Apr 1 Apr 15 May 1 May 15 Jun 1 Jun 15
Impact of Stimulus Payments on Business Revenue and Employment Rates

Revenue and Employment Changes Among Small Businesses, by ZIP Rent Quartile

Change Relative to January 2020 (%)
Loans to Small Businesses
Paycheck Protection Program

- CARES Act also provided $500 billion in loans to small businesses starting on April 3
- Loans were forgivable if payroll was not reduced significantly relative to pre-COVID levels
- Firms with fewer than 500 employees were eligible for these loans (with some exceptions)
Impact of Paycheck Protection Program on Employment
Reweighted to Match Industries (Excl. Food Services), with NAICS x County x Income Quartile FEs

- PPP Program Begins April 3
- Estimated Effect to August 15: 1.78 p.p. (s.e. = 1.99 p.p.)

- 501-800 Employees (ineligible)
- 100-500 Employees (eligible)

Change in Employment (%) Relative to January 2020
- Feb 15
- Mar 15
- Apr 15
- May 15
- Jun 15
- Jul 15
- Aug 15
- Sep 15
Impact of Paycheck Protection Program on Employment
Reweighted to Match Industries (Excl. Food Services), with NAICS x County x Income Quartile FEs

PPP Program Begins April 3

Estimated Effect to August 15:
1.78 p.p. (s.e. = 1.99 p.p.)

Cost Per Job Saved = $377K
($119K at lower bound of 95% CI)

501-800 Employees (ineligible)

100-500 Employees (eligible)
Paycheck Protection Program

- Why has PPP had limited impact on employment despite substantial expenditure?
  - Businesses who took up loans may not have intended to lay off their workers to begin with
  - Ex: very high take-up rate among firms providing professional and scientific services despite low job losses in that sector
  - Consistent with evidence that loans flowed to areas with \textit{smaller} employment losses in March [Granja, Makridis, Yannelis, Zwick 2020]
Long-Term Impacts
Long-Term Impacts

- We have focused primarily on short-term impacts of COVID crisis on spending and employment.

- But this shock may have lasting impacts going forward on inequality and social mobility.

- To illustrate, turn to data on educational progress on an online math platform used as part of school curriculum by 800,000 students in the U.S.
Effects of COVID-19 on Educational Progress by Income Group

Change in Math Lessons Completed (%) Relative to January 2020

- Top Income Quartile
- Middle Income Quartiles
- Bottom Income Quartile

Jan 8  Jan 22  Feb 5  Feb 19  Mar 4  Mar 18  Apr 1  Apr 15  Apr 29
Policy Implications
Implications for Macroeconomic Policy in COVID-19 Pandemic

- Results suggest that there is limited capacity to restore consumer spending via traditional economic tools in the midst of the pandemic

- Impacts of stimulus and loans to small businesses may be blunted when spending is constrained by health concerns

- Long-term solution lies in addressing virus itself and public health efforts [Allen 2020, Romer 2020]
Implications for Macroeconomic Policy in COVID-19 Pandemic

- In the meantime, may be most fruitful to use economic policy to limit hardship among low-income workers who have lost their jobs
  
  - Extending unemployment benefits and social safety net may be a more impactful use of scarce resources than stimulus checks to all households or loans to all businesses
  
  - May be a role for sectoral training programs and place-based policies targeting hardest hit areas (e.g., low-income workers in affluent counties)
  
  - Important to take potential long-term impacts on children into account, e.g. in decisions on when to re-open schools vs. businesses
Broader Implications and Future Work

- **RETINA: Real Time National Accounts**
  - Current paper demonstrates that it is feasible to construct public statistics from private sector data that are useful for research and policy analysis but protect privacy.
  - Now working to construct a more permanent system of granular, real time national accounts, building on prototype constructed here.

- **Policy: real-time fine tuning based on observed state of the economy and empirical impacts of policies**
  - New measures for state-contingent policies beyond unemployment rates.
  - Re-target PPP program based on observed short-run empirical impacts?
More broadly, private sector data can provide a new tool to support economic policy in the age of big data

- Can target aid more effectively
- And diagnose what the root causes of economic failure are rapidly

Tracker constructed here is a prototype for a system of “real time” national accounts, building on the vision of Kuznets (1941) in constructing current national accounts

- All data used to produce results shown here are freely downloadable at www.tracktherecovery.org