Technical Appendix: Will the Covid-19 pandemic lead to job reallocation and persistent unemployment?

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1 The Measure of Dispersion

I measure the industry-level effects of Covid-19 using data on stock market returns. I separate the cross-industry dispersion in stock returns into two components, one that captures the response to aggregate shocks that affect all industries (though not in the same way) and one captures idiosyncratic shocks that are particular to each industry. Specifically, I consider the following representation of stock returns for industry i at time t:

$$r_{it} = \beta_{it} r_{mt} + \varepsilon_{it} \tag{1}$$

The first component of the industry return is related to changes in aggregate conditions, where r_{mt} denotes the return on the total stock market – a proxy for aggregate shocks – and β_{it} the sensitivity of industry i at time t to those shocks. The second component of the return, ε_{it}, captures an industry-specific idiosyncratic shock.

Under some relatively weak assumptions, expression (1) implies that the standard deviation of returns across industries can be written as

$$\text{s.d.}\left(r_{it}\right) = \Big(\big(\underbrace{\text{s.d.}\left(\beta_{it}\right) r_{mt}}_{csv\_agg}\big)^2 + \big(\underbrace{\text{s.d.}\left(\varepsilon_{it}\right)}_{csv\_idio}\big)^2\Big)^{\frac{1}{2}} \tag{2}$$

The first term in the expression, labeled *csv_agg* (for "aggregate cross-sectional volatility"), shows that when industries have different sensitivities to aggregate shocks, those shocks themselves create cross-sectional dispersion and potentially, an ensuing inter-industry reallocation of resources.[1] The second term, labeled *csv_idio*, captures cross-sectional dispersion arising from differences in idiosyncratic conditions.

To construct the empirical counterpart to *csv_agg*, I obtain monthly data on stock returns for the 49 industries defined in Fama and French (1997).[2] The data cover the period July 1926 to April 2020. To calculate measures of β_{it}, I perform monthly rolling-window regressions of

[1] David et al. (2019) provide a formal model of this mechanism in a production economy, albeit at the firm rather than industry level.

[2] Data on stock returns were obtained from https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. The 49 industries are listed in Figure 1 in the main text. In practice, throughout the analysis, I work with excess returns over the risk-free interest rate.

industry-level returns on the aggregate market return. I use a window length of 60 months. The coefficients from these regressions yields measures of β_{it} for each industry in each time period. From here, it is straightforward to construct the individual terms in expression (2). Figure 2 in the main text plots the series of csv_agg. Figure 1 below plots the monthly series of total return dispersion, i.e., $s.d.(r_{it})$.

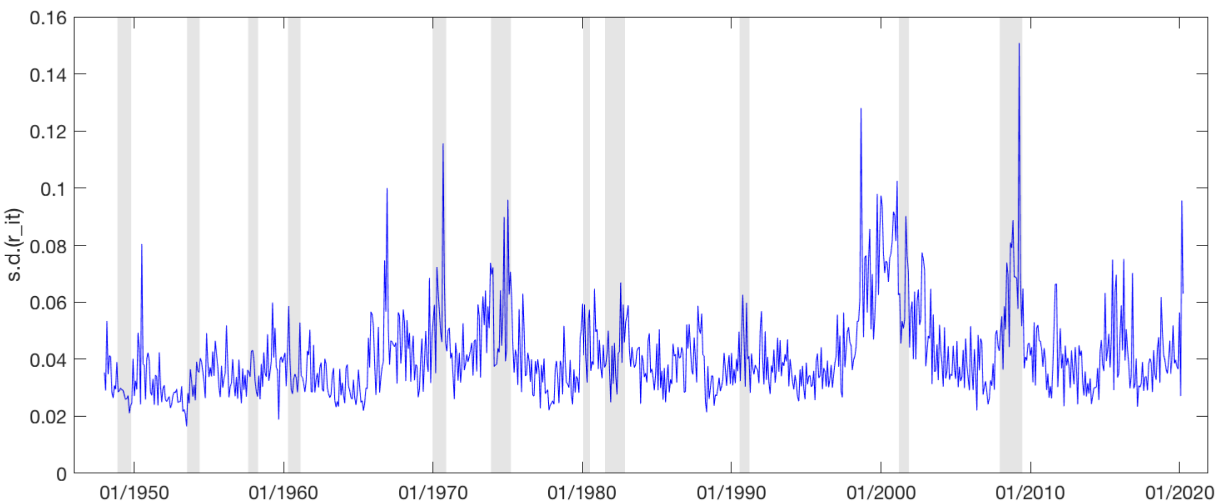

Figure 1: Historical Series of Industry-Level Stock Return Dispersion

2 Dispersion and Unemployment

I relate cross-industry dispersion to labor market conditions by estimating regressions of the future unemployment rate on the csv_agg measure of cross-sectional dispersion. Specifically, I regress the unemployment rate at month $t+h,\ h=3,6,...,45,48$ on the values of csv_agg at dates t $t-1$ and $t-2$, controlling for the date $t-2$ unemployment rate and the aggregate market return at t, $t-1$ and $t-2$. All regressions are estimated over the period 1948-2019, i.e., excluding the Covid months.[3] Table 1 reports the coefficient estimates on the csv_agg measures along with t-statistics calculated using Newey-West standard errors.

3 Application to the Covid-19 Period

Attributing all Dispersion to Covid-19. Figure 2 below displays the results when attributing all dispersion in February to April 2020 to Covid-19, i.e., by applying the regression estimates to the total cross-sectional dispersion of returns in these months, $s.d.(r_{it})$, rather than just the csv_agg component. Because the coefficients relating dispersion to unemployment are unchanged, the path of the effects (e.g., duration and date of peak) is the same as in Figure 3 in the main text. However, the magnitudes are substantially larger: the peak impact on the unemployment rate reaches as high as about 4 percentage points. The considerable increase in the size of the effects stems from the fact that $s.d.(r_{it})$ is much larger than the estimated csv_agg during the Covid-19 months.

[3] 1948 is the earliest year for which the BLS provides seasonally adjusted monthly unemployment data.

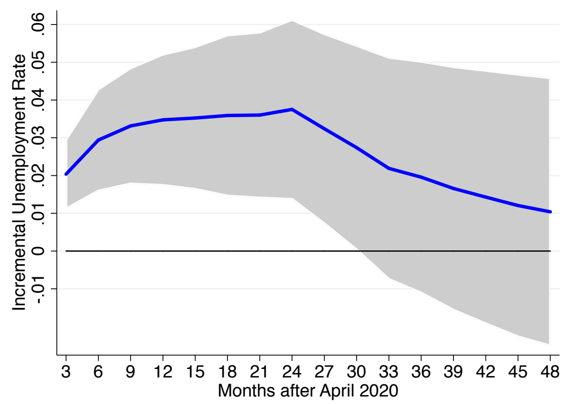

Figure 2: Predicted Unemployment Using Total Dispersion

Does return dispersion capture reallocation effects? As a rough way to isolate the effects of dispersion due solely to reallocation, I first construct the following index of cross-industry worker reallocation:[4]

$$I_{t \to t+h} = \frac{1}{2} \sum_{i} |E^i_{t+h} - E^i_t| \tag{3}$$

where E^i_t is the share of total employment in industry i at time t. The index $I_{t \to t+h}$ measures the fraction of workers who are working in a different industry in period $t+h$ than in period t. To calculate the index, I use employment data from the Bureau of Labor Statistics. In order to obtain a consistent set of industries over the entire period dating back to 1948, I use a set of 14 industries. These are: mining/logging, construction, durable goods manufacturing, non-durable manufacturing, wholesale trade, retail trade, transportation/warehouses/utilities, information, finance, professional/business services, education/health services, leisure/hospitality, other services and government. Using monthly data on employment in these industries, which add up to total non-farm employment, I compute the reallocation index over quarterly horizons ranging from one to 16 quarters, i.e., $h = 3, 6, ..., 45, 48$, which correspond to the same horizons over which I examine the unemployment rate.

Next, I perform the same regressions as above, but include the reallocation index as an additional control variable (at each horizon of the unemployment rate, I include the reallocation index over that same horizon). The coefficients on the main variable of interest, csv_agg, can be interpreted as capturing the effects of dispersion on unemployment that *do not* come through reallocation, at least as captured by the rough index I have calculated. Table 2 reports the detailed coefficient estimates on csv_agg. The coefficients are generally smaller than the baseline estimates that do not control for employment reallocation – at most horizons they are about half of the baseline estimates – and are statistically different from zero for a shorter period of time. Thus, the results suggest that the reallocation caused by industry-specific reactions to common shocks explains about half of the relationship between dispersion and unemployment.[5]

[4] This measure was developed in Kambourov (2009).

[5] As noted in the text, this may be an under-estimate due to the relatively coarse industry classification used to construct the employment reallocation index.

I illustrate these findings in Figure 3 below. I take the baseline coefficients obtained when not controlling for employment reallocation and subtract the analogous coefficients after controlling for reallocation. The difference in coefficients represents a rough measure of the effects of the dispersion measure on unemployment that are due to reallocation alone, since the difference captures the total effect of dispersion less the part that comes through forces other than reallocation. I then follow the same procedure as above and multiply the difference in coefficients by the Covid-19 dispersion to calculate the effects of that dispersion on unemployment due solely to inter-industry reallocation. The left-hand panel of the figure displays results using the values of csv_agg as the measure of dispersion in the Covid-19 period. The right-hand panel displays results using $s.d.\,(r_{it})$ to measure Covid-era dispersion. The path of the effects is the same across the panels, only the magnitudes differ. The results continue to show a significant effect of dispersion-based reallocation on unemployment. The magnitudes are generally slightly under half of the baseline estimates with the effects increasing up to 24 months – the same peak as in the baseline case – and falling thereafter. At the maximum, the results imply between 0.85 and 1.5 additional percentage points on the unemployment rate.

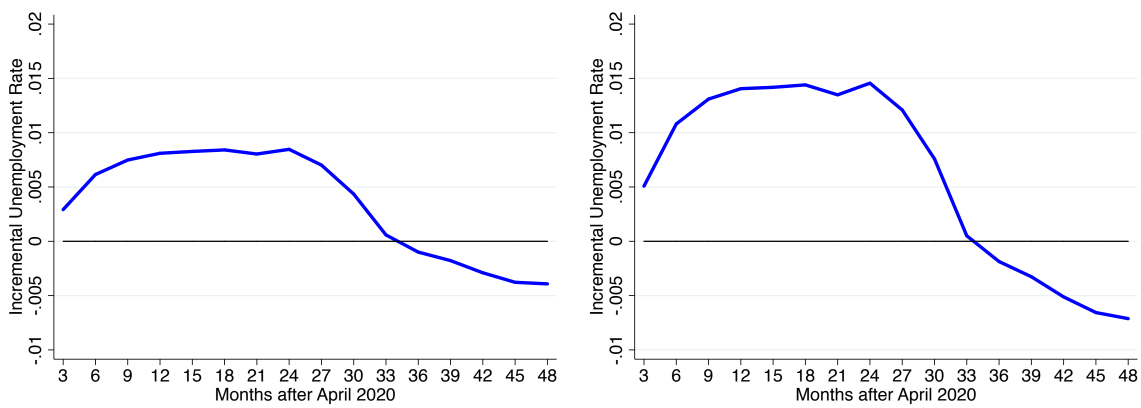

Figure 3: Predicted Unemployment from Reallocation Alone

References

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Table 1: Coefficient Estimates – Cross-Industry Dispersion in Stock Returns and Unemployment

	Horizon (Months)															
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
csv_agg	0.109	0.167	0.195	0.216	0.223	0.228	0.227	0.238	0.213	0.177	0.145	0.126	0.111	0.090	0.077	0.069
	(4.85)	(4.27)	(4.01)	(3.98)	(3.81)	(3.36)	(3.24)	(3.18)	(2.60)	(2.06)	(1.54)	(1.28)	(1.09)	(0.85)	(0.69)	(0.61)
csv_agg lag	0.080	0.112	0.130	0.139	0.138	0.137	0.146	0.142	0.122	0.128	0.140	0.130	0.124	0.123	0.111	0.104
	(3.79)	(2.97)	(2.72)	(2.44)	(2.12)	(1.97)	(2.07)	(1.91)	(1.73)	(1.72)	(1.84)	(1.70)	(1.53)	(1.46)	(1.28)	(1.23)
csv_agg 2 lags	0.130	0.185	0.203	0.221	0.231	0.232	0.232	0.220	0.194	0.156	0.135	0.117	0.094	0.089	0.061	0.060
	(4.48)	(4.47)	(4.58)	(4.51)	(4.09)	(4.06)	(3.70)	(3.20)	(2.67)	(2.01)	(1.67)	(1.41)	(1.08)	(1.00)	(0.67)	(0.64)

Notes: This table reports coefficient from regressions of future unemployment rates at horizons $t+h, h = 3, 6..., 45, 48$ on csv_agg_t, csv_agg_{t-1} and csv_agg_{t-2}. Unreported controls are the unemployment rate at date $t-2$ and the market return at dates t, $t-1$ and $t-2$. t-statistics in parentheses are calculated using Newey-West standard errors with the number of lags equal to the length of the horizon.

Table 2: Coefficient Estimates after Controlling for Employment Turnover

	Horizon (Months)															
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
csv_agg	0.080	0.088	0.094	0.093	0.098	0.103	0.104	0.108	0.100	0.088	0.092	0.112	0.096	0.090	0.096	0.088
	(3.68)	(2.60)	(2.31)	(1.94)	(1.97)	(1.89)	(1.92)	(1.91)	(1.66)	(1.44)	(1.40)	(1.60)	(1.31)	(1.19)	(1.21)	(1.12)
csv_agg lag	0.079	0.099	0.109	0.112	0.112	0.115	0.127	0.128	0.108	0.111	0.125	0.116	0.111	0.109	0.103	0.099
	(3.67)	(2.86)	(2.74)	(2.44)	(2.23)	(2.12)	(2.30)	(2.14)	(1.89)	(1.83)	(1.95)	(1.76)	(1.57)	(1.48)	(1.34)	(1.32)
csv_agg 2 lags	0.100	0.132	0.137	0.151	0.152	0.148	0.142	0.144	0.137	0.135	0.132	0.122	0.116	0.124	0.101	0.091
	(4.46)	(3.80)	(3.13)	(2.97)	(2.56)	(2.42)	(2.25)	(2.23)	(2.13)	(2.03)	(1.98)	(1.83)	(1.66)	(1.70)	(1.41)	(1.23)

Notes: This table reports coefficient from regressions of future unemployment rates at horizons $t+h, h = 3, 6..., 45, 48$ on csv_agg_t, csv_agg_{t-1} and csv_agg_{t-2} after controlling for the rate of employment turnover. Unreported controls are the unemployment rate at date $t-2$, the market return at dates t, $t-1$ and $t-2$ and, for each horizon, the rate of employment turnover over the same horizon, i.e., $t \to t+h$. t-statistics in parentheses are calculated using Newey-West standard errors with the number of lags equal to the length of the horizon.