Sectoral Shifts in the U.S. Economy During and After the Great Recession

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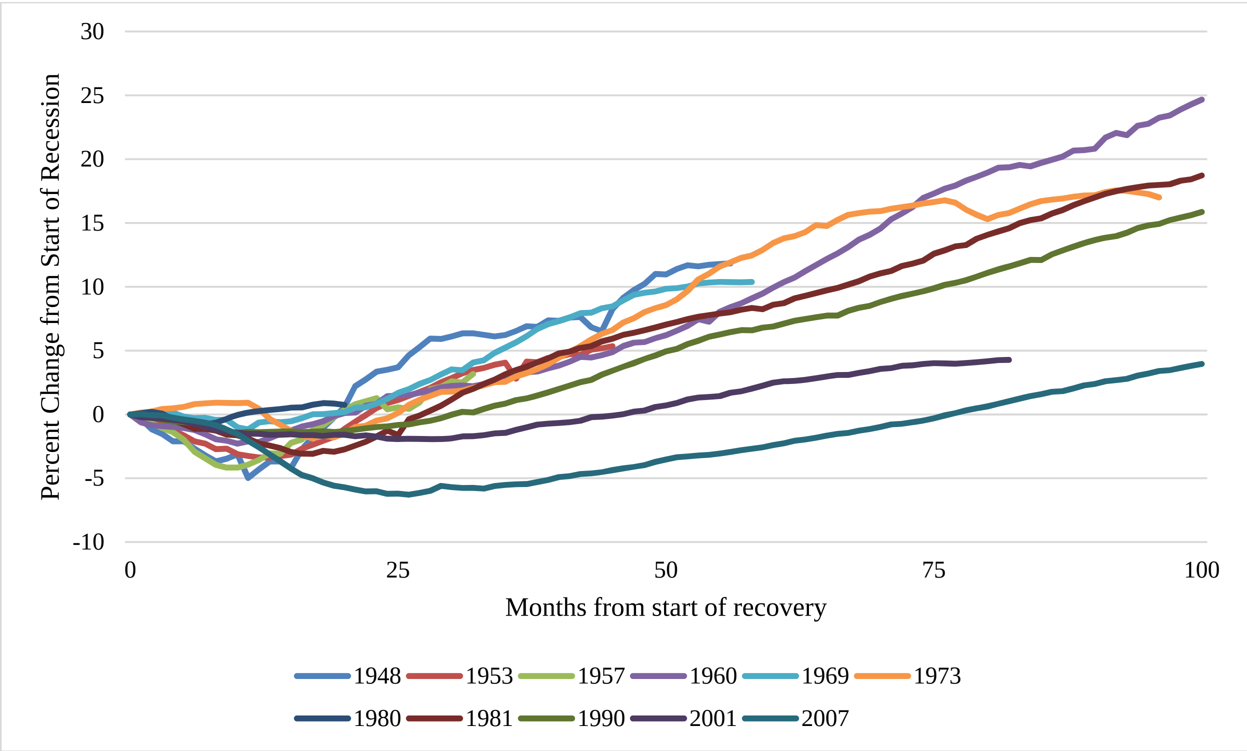
ABSTRACT: The Great Recession of 2007-2009 has primarily been analyzed in terms of the depth of the recession and its length. It is also unique in terms of the weak recovery that followed. We focus instead on sectoral shifts that took place during the massive downturn and find that there has not been a similar event since the 1973 OPEC I recession. Local sectoral changes contributed significantly to the severity of unemployment rate increases at the MSA level. Future events may have similar effects as the 4th Industrial Revolution takes place. Economic policy focusing on increased levels of education should be implemented, particularly in regions that are highly threatened by technological change.

1. INTRODUCTION

The Great Recession of December 2007 to June 2009 saw the most severe economic downturn since the Great Depression. The peak to trough episode lasted longer than any other post World War II recession (18 months) and the economy also experienced the steepest cumulative declines in real GDP (4%) and employment (6.3%). While the unemployment rate was higher during the Volcker recession (10.8% compared to 10.1%), the 1981-1982 recession came at the tail end of the double dip recession. As a result, unemployment rate increases to that peak started from a substantially higher level and hence were not as steep as in the last episode. Furthermore, the Great Recession was followed by the Not-So-Great Recovery, where it took until 2014 for employment to reach pre-recession levels; this may understand the severity of the problem since it does not take into account eight years of population growth.

Figure 1 compares the recovery with previous post-World War II recessions. Clearly the most recent episode stands out. Not only was the recession more severe, it also took substantially longer to recover employment losses. During the same period real GDP returned to previous peak levels by 2011.

Figure 1: Employment Changes, in Percent, from Start of Recession



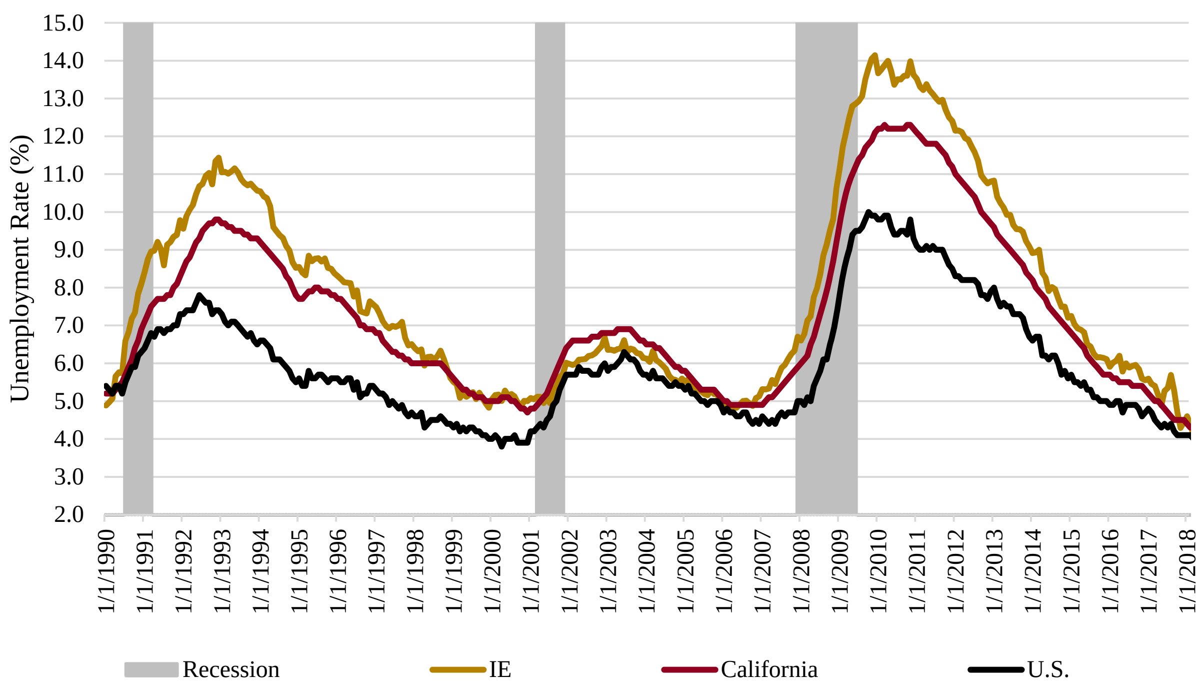
These aggregate numbers mask substantial regional and demographic differences. Male African-American teenagers, for example, experienced a peak unemployment rate of 49.5%. In this paper, we want to focus on geographic variation instead.

The national recession did not have a uniform effect on areas in the U.S. The epicenters of the housing bust were California, Nevada, and Florida, which saw peak unemployment rates of 12.3%, 13.7%, and 11.5% respectively. Michigan experienced a spike in its unemployment rate to 15.4%. To get an even better idea of the geographical variation, it is useful to look at labor market and output changes at the Metropolitan Statistical Area (MSA) level. Labor market statistics are available from 1990 on, and the Department of Commerce has calculated annual figures for MSA-GDP since the year 2000.

There are some 390 MSAs in the U.S. typically consisting of one or two counties. Take the state of California as an example. If California was a country, it would have the sixth largest economy. By population size it would easily outrank countries such as Belgium, the Netherlands, Sweden, Austria, Switzerland, and Australia. Moreover, it contains 29 MSAs which are not uniform in their industrial composition at all, such as Silicon Valley (San Jose-Santa Clara-Sunnyvale) and the Inland Empire (Riverside-San Bernardino-Ontario). Hence the Great Recession had a very different effect in certain areas.

Figure 2 shows unemployment rates for the U.S., California, and the Inland Empire since 1990.

Figure 2: Unemployment Rates, U.S., California, Inland Empire, 1990-2019



The Great Recession is also referred to as a "Mancession" since most of the jobs were lost in manufacturing and construction, industrial sectors that traditionally have had a high share of male workers. What is intriguing is that neither manufacturing nor construction have regained the jobs that were lost since the peak in employment in those sectors. Hence there must have been other sectors that made up for the losses in employment. Indeed, there has not been churning of this extent in the national labor market since the OPEC I recession of 1973-1975.

The purpose of this paper is to analyze the sectoral variation in employment caused by the Great Recession and to look at its consequences with respect to unemployment rate and economic activity changes. We will use MSA data to increase the number of observations in the cross section. The next section provides some background information of the relevant literature. This is followed by an analysis of the differential impact that sectoral variation has had. The fourth section looks at future policy implications, and a final section concludes.

2. SECTORAL VARIATION AND RECESSIONS

Much of the analysis surrounding the Great Recession has centered around its causes and an analysis of its effects on the national unemployment rate and real GDP behavior. Much less attention has been given to sectoral variation and its implications.

Figure 3a for the national economy and 3b for State of California show a little known fact: employment losses in manufacturing and construction to this day have not been recovered. Instead it is three other sectors that have guaranteed the return to pre-recession employment levels, which was achieved by 2014: (i) Healthcare and Social Assistance, (ii) Leisure and Hospitality, and (iii) Business and Professional Services. The blue part of each bar indicates the maximum loss experienced following the Great Recession. If the bar is green, then it indicates that the sector has added jobs; if it is still in the red, then the sector has not recovered to its pre-recession peak to this day.

The bottom line is that Obamacare allowed the national economy to return quicker to recover lost jobs in other sectors. While it is tempting to think of the Healthcare sector to be made up of high salary doctors, note that a home health care worker makes barely more than minimum wages and certainly is paid less than half as much as a carpenter. Leisure and hospitality is also not a high wage sector.

Figure 3a: Employment Losses and Subsequent Gain, United States, 2007M7 – 2019M1

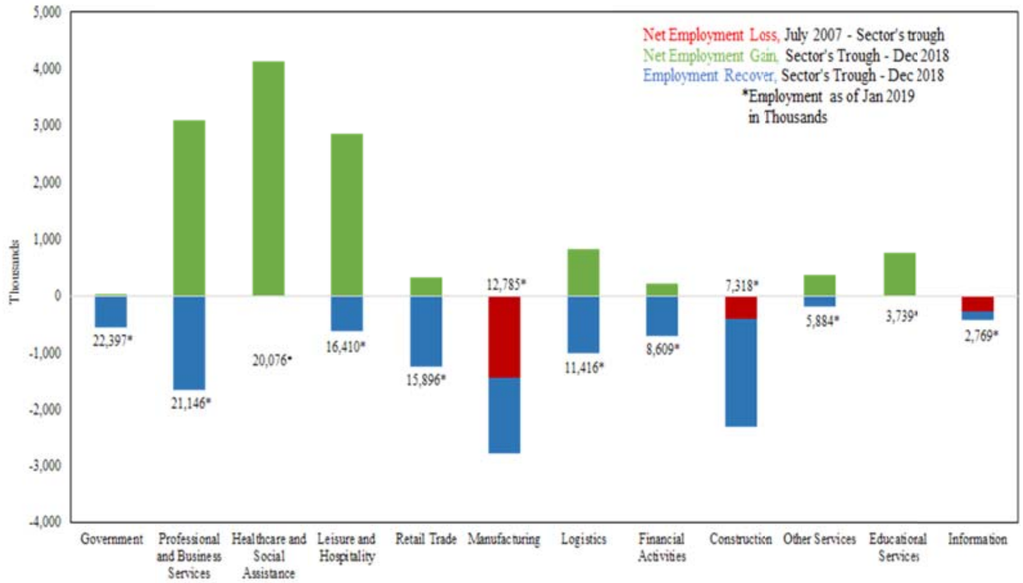
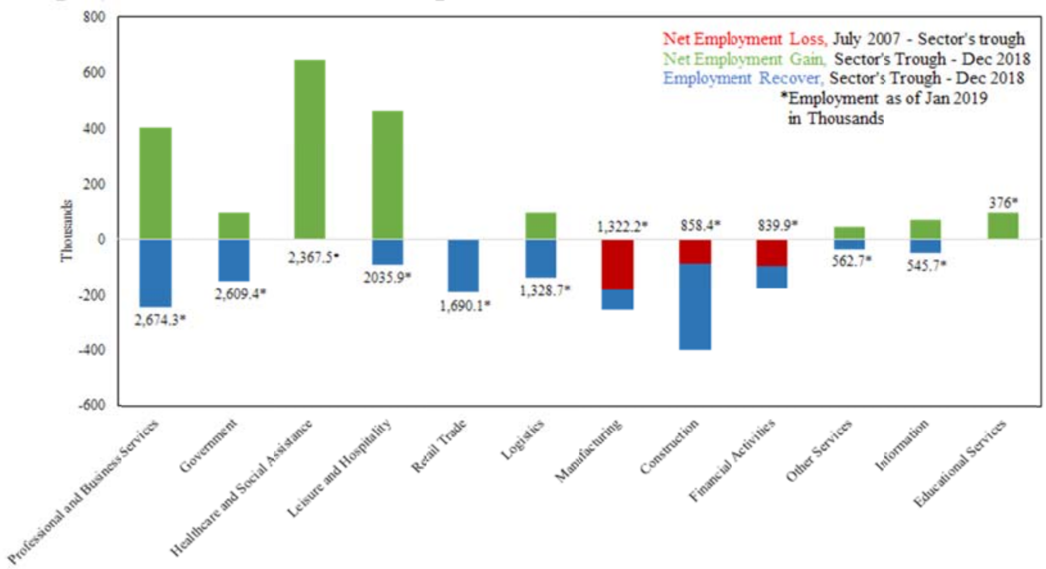


Figure 3b: Employment Losses and Subsequent Gain, California, 2007M7 – 2019M1

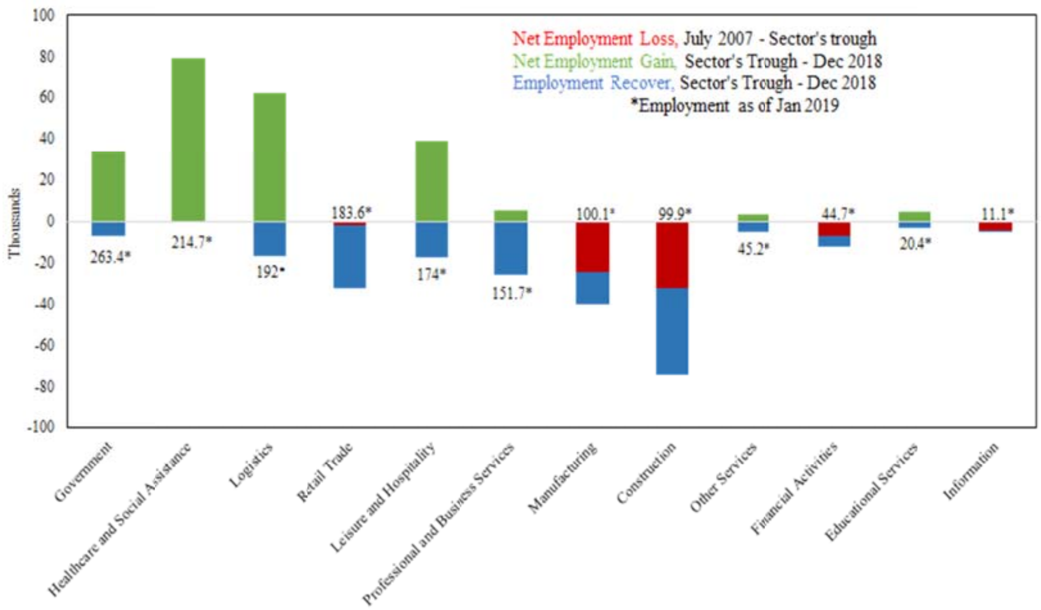


Consider two workers, one in construction and the other in manufacturing who are laid off at the beginning of the recession. Let both find a job immediately as a valet parking attendant and a home care health worker. In this scenario, overall (un)employment would not change, but real GDP would decrease. So what caused real GDP to recover faster than employment both in the nation and in California? The answer is that Professional and Business Services had a positive effect here: this sector is a high value added sector that compensates for the losses experienced from better paying jobs in manufacturing and construction.

What if such a high value-added sector was missing? We picked the Inland Empire MSA as a dramatic example. Riverside and San Bernardino County have roughly 4.5 million residents, meaning that more than 10% of Californians live east of the Greater Los Angeles area. A full 20% of its residents commute daily into Los Angeles County and Orange County and to a lesser extent into San Diego County. Clearly commuting does not yield utility and hence residents of the Inland commute in such large numbers because there are better paying jobs in the coastal areas, while housing is more affordable further inland.

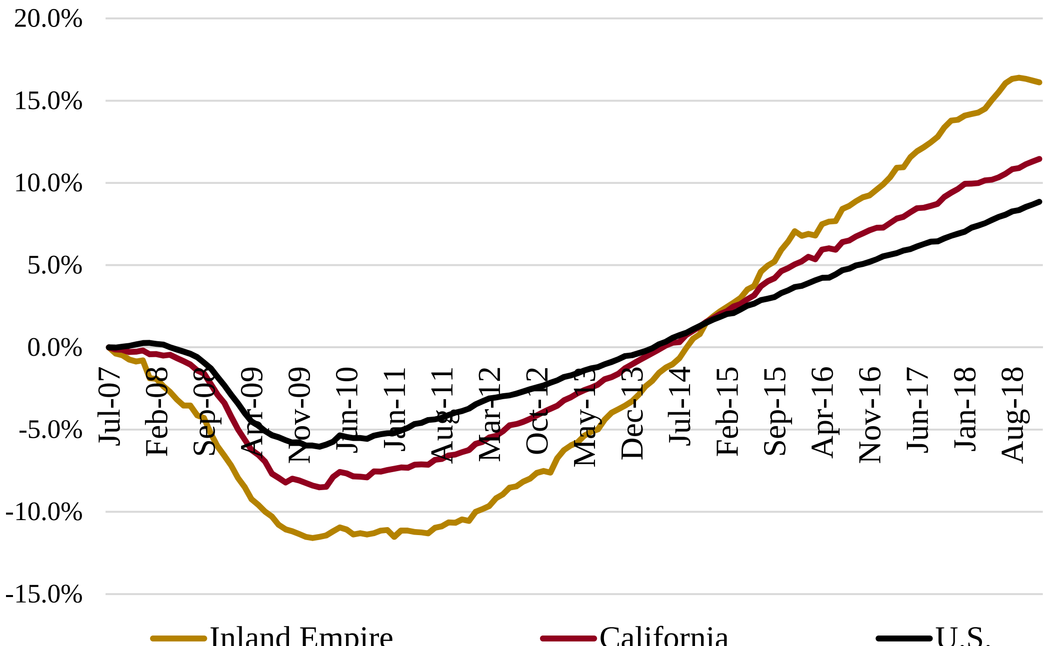
Figure 3c shows the same calculations for the Inland Empire. Here the Professional and Business Services sector has hardly seen net gains in employment. Instead it is the logistics sector (including wholesale trade) that has been instrumental in high employment growth in the area. Unfortunately workers at warehouses and logistic centers typically do not get paid as much as in manufacturing and construction.

Figure 3c: Employment Losses and Subsequent Gain, Inland Empire, 2007M7 – 2019M1



What is the effect of this difference on employment and output? Figure 4 displays employment changes for the nation, California, and the Inland Empire MSA since peak employment prior to the Great Recession. In essence, while California and the Inland Empire experienced a more severe recession in terms of jobs lost, both areas recovered by 2014 and have outpaced national employment growth since then. California and the U.S. saw a return to pre-recession GDP levels earlier (2012 and 2011). However, to this day, per capita GDP in the Inland Empire has not returned to 2007 levels: we are looking here at more than a lost decade. Relatively well paying jobs have been replaced by employment in less value-added sectors.

Figure 4: Employment Changes Relative to Pre-Recession Levels, in Percent, United States, California, Inland Empire



Data source: Federal Reserve Economic Data (2018)

How could we measure the sectoral employment changes within the economy? Lilien (1982) proposed the following measure:

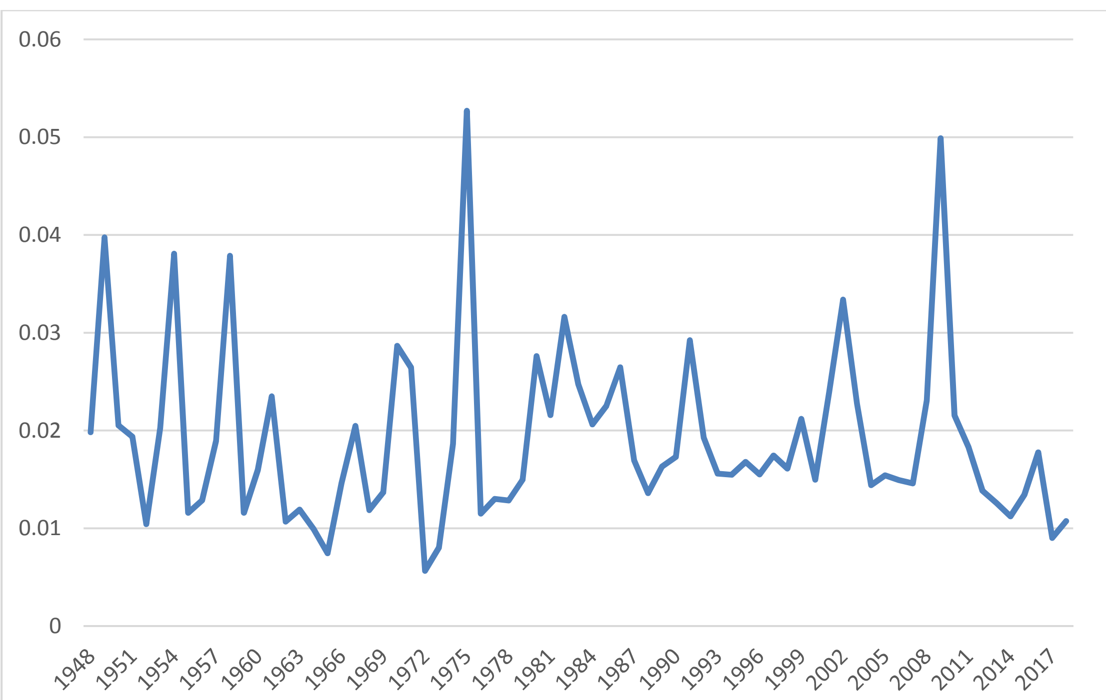
$$\hat{\sigma}_{jt} = \sqrt{\sum_{i=1}^{11}\left[\frac{X_{ijt}}{X_{jt}}(\Delta \log X_{ijt} - \Delta \log X_{jt})^2\right]}$$

Here the "standard deviation" measures how sectoral (*i*) employment (*X*) growth rates differ from overall employment growth rates within a location (*j*) at a certain point in time (*t*). If all two digit sectors experience the same employment growth/decline as the local economy, then the measure is zero. On the other hand, if manufacturing and construction, for example, have much larger employment declines than the local economy as a whole does, then the standard deviation will be large. Finally, sectors with higher employment shares receive a greater weight.

Lilien (1982) was interested in decomposing national unemployment rate changes into cyclical versus structural changes, that is, he wanted to see how much of the increase in the unemployment rate was caused by an increase in the natural rate. Modifying the Lucas and Prescott (1974) model, Lilien allowed for at least a temporary change in the natural rate. He found that the sigma-measure spiked during the 1973 OPEC I recession. The article received much attention at the time since expansionary economic policy will have to be different if it tries to tackle structural unemployment rather than cyclical unemployment.

Figure 5 updates Lilien's graph. As you can see, the four recessions following OPEC I resulted in much less churning. It was not until the Great Recession that the national economy experienced a similar event. Lilien's measure can also be viewed as a proxy for mismatch (Estevão and Tsounta, 2011).

Figure 5: Dispersion of Employment Growth, United States, 1948-2018



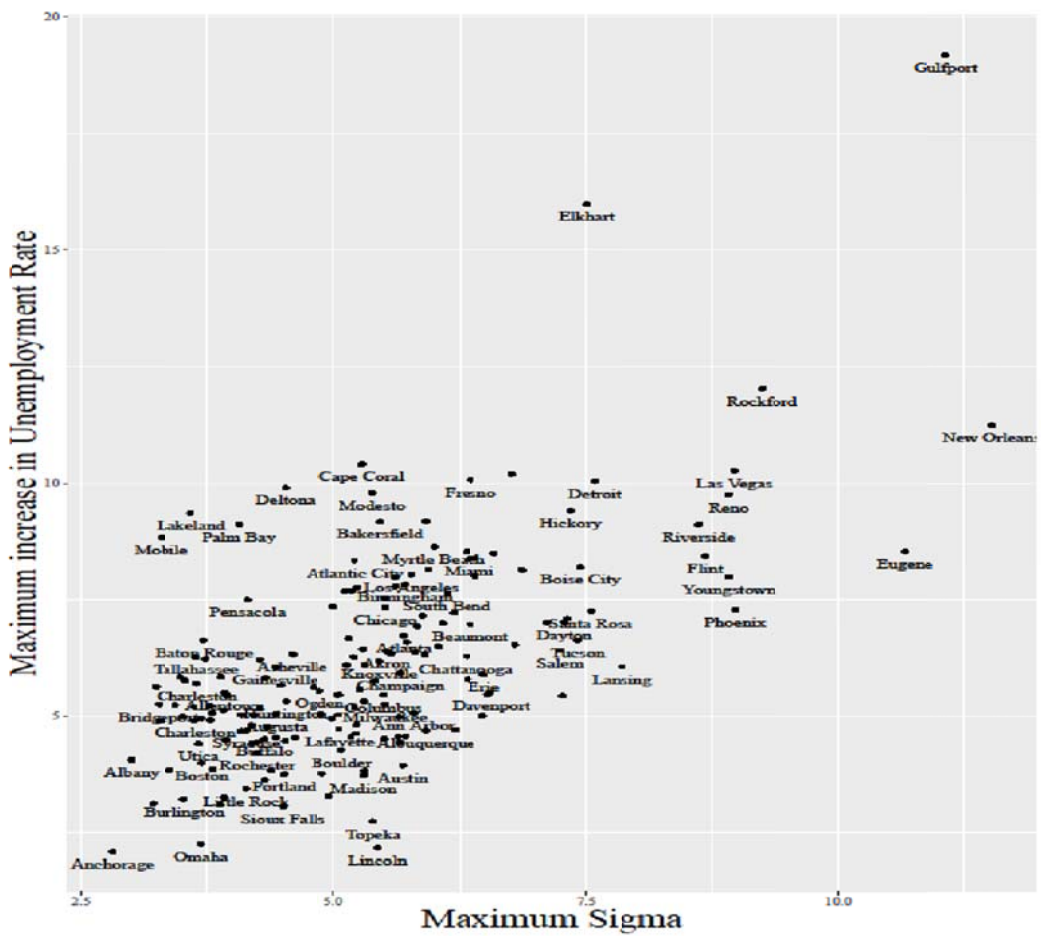
Lilien's approach is quite different from attempts by others to isolate changes in the natural rate of unemployment (Friedman, 1968; Phelps, 1967). Hall (1979) shows that the natural rate will change over time depending on factors that influence the behavior of firms and workers regarding job separation and job finding rates. Shimer (1998) finds that demographics play a significant role. Staiger *et al*. (1997) shows difficulties associated with estimating the natural rate with any degree of precision. Fortin *et al*. (2001), Keil and Pantuosco (1998), and Keil and Symons (1994) find that changes in unemployment insurance generosity have a significant effect on the natural rate.

3. ECONOMIC IMPACT OF STRUCTURAL CHANGE

In this section we quantify the effect that Lilien's (1982) measure of structural change has had on regional changes in the unemployment rate during the Great Recession. Arias *et al.* (2016), using MSA data, and Estevão and Tsounta (2011), focusing on state levels, have shown that economic effects of recessions can vary substantially across regions. Here we are interested in the effect that the standard deviation measure has in explaining the differences in the severity of the recession.

The consequence of churning between industries on the depth of recession is first measured for the twenty largest MSAs. In some ways we look at the most populous regions first before expanding the analysis to MSAs with at least 100,000 employees (there are 172 of these). The Appendix gives details regarding the specification. Figure 6 presents a crossplot between the maximum increase in MSA unemployment rates and the maximum that the sigma-measure reached during the downturn in the local economy. Not controlling for other influences, there appears to be a positive relationship: more structural change will result in higher increases in the MSA unemployment rate during the recession.

Figure 6: Unemployment Rate Changes and Structural Change, MSAs, Great Recession



The regression results in the Appendix confirm the impression gained from the crossplot. Regardless of whether we estimate the effect for the 2001 or the 2008 recession, the sigma-measure has a positive effect, although, and not surprisingly, it is significantly stronger for the Great Recession. This effect persists regardless of whether we control for other factors. The effect is also economically important: a one standard deviation increase in the maximum level of churning during the 2008 recession would have resulted in an increase in the maximum unemployment rate experienced by approximately 1.4 percentage points. This would mean that for an MSA such as New York-Newark-Jersey City, an extra 139,250 workers would have lost their jobs by February of 2009.

Education and housing market conditions have a negative effect which is consistent with the results found by Estevão and Tsounta (2011) and Arias *et al* (2016): MSAs that experienced the deepest recessions were those with lower education levels and lower housing supply elasticity. Not surprisingly, the result for housing prices is not statistically significant for the 2001 recession, since there was not a comparable fall in housing prices during the downturn. value for the largest housing price fall is not significant largely due to the fact that the housing.

We are in the process of using the same sigma-measure to determine if it had an effect on differences in the time-length of the recovery for employment and real wages. If so, then the measure could even be used to shed light on its potential effect on election outcomes: increases in structural unemployment may have contributed significantly to President Trump's win in the 2016 election even after the economy as a whole had seen a substantial recovery in overall jobs (on this, see, inter alia, Autor et al. (2016) and Dubner (2017).

4. POLICY IMPLICATIONS AND OUTLOOK

So far we have established that regional economies that experience increased turmoil during an economic downturn as a result of structural change, suffer more severe employment losses, holding other factors constant. Having a better educated labor force can counter this effect to some extent, *ceteris paribus*.

Over the last 50 years, there have only been two recessions that involved large structural changes: the OPEC I episode and the Great Recession. Currently we are on track to set a new record for the longest post World War II economic expansion (we will reach that mark by June 2019). Although expansions do not die of old age, there will be another recession – soon, if we are to follow the survey results of professional economist surveyed by the Wall Street Journal: 60% of these believe that there will be a recession by 2020, and this number rises to 80% by 2021. It is hard to predict the onset of economic downturns since they typically follow an unpredictable shock. However, given that many economic commentators believe that the 4th industrial revolution in the form of AI and automation has arrived, we believe that the next recession will again result in a high level of structural change, this time brought on by technological change.

To quantify the effect and to show how this information potentially can be used by policy makers to guard against a more severe local downturn, we have constructed a table based on the worked by Frey and Osborne (2017). The table contains an index of the vulnerability of jobs for the 29 California MSAs. Table 1 shows the automation potential of jobs in each of the MSAs. The column labeled "AP <= 0.3" indicates that no more than 30% of the jobs have an automation potential. These jobs are the least exposed to automation as their occupational tasts are either highly cognitive, unpredictable, or require complex motor skills to operate. As a result, these jobs are currently quite insulated to the replacement effects of automation. Similarly "AP >= 0.7" represents the number of the most at risk occupations to replacement. These are the routine, low-skill occupations, such as hamburger flippers, warehouse workers, or entry-level data clerks. The index in the last column gives the ratio of the previous two columns: the higher the number, the less likely jobs will be replaced by automation in the MSA.

Table 1: Vulnerability to Automation, California MSAs, 2018

		Index	
MSA	AP <= 0.3	AP >= 0.7	Index
Anaheim-Santa Ana-Irvine, CA Metropolitan Division MSA	362010	785110	46%
Bakersfield, CA MSA	53450	155280	34%
Chico, CA MSA	13810	33850	41%
El Centro, CA MSA	7190	24950	29%
Fresno, CA MSA	70660	189390	37%
Hanford-Corcoran, CA MSA	5870	13470	44%
Los Angeles-Long Beach-Glendale, CA Metropolitan Division MSA	1027690	2148570	48%
Madera, CA MSA	4400	17440	25%
Merced, CA MSA	10510	28480	37%
Modesto, CA MSA	30950	94680	33%
Napa, CA MSA	10780	38720	28%
Oakland-Hayward-Berkeley, CA Metropolitan Division MSA	280610	476870	59%
Oxnard-Thousand Oaks-Ventura, CA MSA	62150	152520	41%
Redding, CA MSA	11460	30700	37%
Riverside-San Bernardino-Ontario, CA MSA	253940	750590	34%
Sacramento--Roseville--Arden-Arcade, CA MSA	219240	412090	53%
Salinas, CA MSA	24640	96070	26%
San Diego-Carlsbad, CA MSA	350260	656720	53%
San Francisco-Redwood City-South San Francisco, CA Metropolitan Division MSA	341680	432340	79%
San Jose-Sunnyvale-Santa Clara, CA MSA	385520	396730	97%
San Luis Obispo-Paso Robles-Arroyo Grande, CA MSA	21010	49390	43%
San Rafael, CA Metropolitan Division MSA	23370	43330	54%
Santa Cruz-Watsonville, CA MSA	19060	46210	41%
Santa Maria-Santa Barbara, CA MSA	38890	90580	43%
Santa Rosa, CA MSA	39840	100510	40%
Stockton-Lodi, CA MSA	37400	129160	29%
Vallejo-Fairfield, CA MSA	24770	59390	42%
Visalia-Porterville, CA MSA	21370	86030	25%
Yuba City, CA MSA	6750	18350	37%

Not surprisingly, Silicon Valley and the San Francisco MSA show the least vulnerability. These MSAs are home to the undisputed technological hub in the U.S. For example, the San Jose-Sunnyvale-Santa Clara MSA has a high concentration of high-paying and highly cognitive jobs. Occupations that require high computing and mathematical, or management skills make up 40% of the MSA's payroll. These regions are not only safe to the increase in technology, they will actually benefit from it.

Contrast this to the Madera and Visalia-Porterville MSAs. The index is below 25% here, meaning that for every job that might not be replaced, four other occupations will be within these regions. Note that in the Visalia-Porterville MSA, 70% of workers within this region are in occupations that are mostly vulnerable to the adoption of automation. It is areas like these that will require the most systematic assistance during the next downturn which coincides with the advancement of new technologies. The Inland Empire ranks 9 out of 29 MSAs in the table.

To avoid the consequences of the downturn caused by increased automation, policy makers in the affected counties will have to undertake renewed efforts

5. CONCLUSION

Structural change played an important role in determining the depth of recessions in the past, and will continue to do so in the future. The U.S. experienced a high degree of sectoral changes during the OPEC I recession and the Great Recession. In each of these episodes, unemployment increases were particularly severe for geographical areas that experienced a high degree of sectoral employment changes. This effect can be measured while controlling for the effects of output decline, levels of education, and severity of the housing crisis.

The policy implication for future downturns is that not only can you guard against the severity of the downturn by investing additional resources into education of the labor force, but, in addition, this will also result, most likely, in less of a variation in employment between sectors as technological advances will result in fewer replacements of existing jobs. Not surprisingly, the bottom line advice for economic policy makers is to invest more resources in education.

Appendix

We use the following model to estimate the effect of structural changes on the depth of the recession per MSA:

$$\Delta UR_{it}^{\max} = \beta_0 + \beta_1 \sigma_{it}^{\max} + \sum_{j=2}^{k} \beta_j X_{ijt} + u_{it}$$

where $\Delta UR_{it}^{\max}$ is the maximum unemployment rate in region *i* minus the pre-recession unemployment rate for recession *t*, $\sigma_{it}^{\max}$ is the maximum standard deviation of sectoral employment at MSA *i* for the period surrounding recession *t*, X_{ijt} are control variables, and *u* is the error term. Note that this is not a panel despite the *t* subscript. Instead the equation will be estimated as a cross-section both for the 2007-2009 period, and the previous recession in 2001.

Table A1 presents the results. Columns (1) – (3) use the Great Recession, while columns (4) – (6) repeat the exercise for the dot.com recession around the turn of the millennium. Following Arias *et al.* (2016), we use the maximum fall in real GDP, the high school graduation rate, and the maximum fall in housing prices in the MSA as control variables. The housing price variable is intended to measure the degree of housing price elasticity, while the real GDP variable was included as a control along the lines of Okun’s Law. The high school graduation rate stands as a proxy for human capital in the MSA.

Table A1: Regressions Results, Dependent Variable: Maximum Increase Unemployment Rate

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Model 1 2008	Model 2 2008	Model 3 2008	Model 1 2001	Model 2 2001	Model 1 2008-2001
Sigma	0.924***	0.546***	0.947***	0.377***	0.313***	0.371***
	(0.137)	(0.203)	(0.227)	(0.108)	(0.0756)	(0.137)
Real GDP Fall		-0.184**	-0.182***		-0.0437*	-0.130***
		(0.0718)	(0.0687)		(0.0262)	(0.0483)
HS Grad Rate		-0.0659***	-0.0640***		-0.113***	
		(0.0223)	(0.0210)		(0.0260)	
Housing Price Fall		-0.0516***	-0.212***		0.0222	-0.0452***
		(0.0124)	(0.0319)		(0.0200)	(0.0123)
Sigma* Housing Price Fall			0.0259***			
			(0.00541)			
Constant	1.259*	7.439***	4.990**	1.582***	11.61***	1.287***
	(0.700)	(2.125)	(2.155)	(0.449)	(2.161)	(0.220)
Observations	172	172	172	172	172	172
R-squared	0.394	0.577	0.618	0.119	0.341	0.403

Heteroskedasticity robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

When sigma was interacted with the housing market in the 2008 recession, the value is slightly positive and is statistically significant. This would indicate that in the presence of very large declines in the housing market, the effect of sigma on the unemployment rate change would not be as strong. The implication is that large values of the sigma-measure result in changes in the housing market being less important in explaining unemployment rate increases.

To control for other omitted variables, we also estimated the relationship as a two period panel regression. Note that this would eliminate explanatory factors that remained constant in each MSA over the 2001 to 2008 period. Certain socio-economic factors and geography come to mind among others. In essence the results, not reported here but available by request from the authors, continued to show the same statistically significant relationship although the results were not as strong as in the previous cross-section. The results for sigma would indicate that an increase in the standard deviation of employment by sector from 4 to 5 from the 2001 to 2008 recession would lead to an increase in the maximum unemployment rate by 0.4 percentage points. This would still mean an extra 36,000 people laid off in the New York MSA using the same calculations as above.

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