How Labor–Management Disputes Influence Commercial Aircraft Manufacturing

Aggregate Labor Conditions and Aerospace Cycles: The Impact of Two Defense Cuts on Los Angeles

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Abstract

Adjustment to structural change has been the subject of much discussion at the macro-economic level. This paper focuses on understanding labor market adjustment speed in two Los Angeles aerospace downturns through an empirical analysis of episodes of structural change. It is found that larger contractions in the declining industries result in fewer prospects in the local economy for immediate employment. This tends to retard the speed of adjustment and explains in part the differential recoveries in Los Angeles.

Overview

Labor market adjustment to large cyclical and structural changes in the demand for goods from significant sectors has been the subject of much discussion at the macro-economic level [some examples of many: Elsby, Hobijn, and Sahin (2010) and Lazear and Spletzer (2012)]. The questions posed are "How does one identify structural adjustment of a magnitude that there are potential policy implications?" and "What is the character of the adjustment process?"

On a regional basis, identification of large structural changes is less challenging. For example, the aerospace sector in Los Angeles has been one of the dominant sources of employment in the 20th century, and it has experienced more volatility in employment than most other sectors in the region. While most of the volatility is the result of cyclical variations in the demand for commercial aircraft, the defense durable goods sector has contributed as well. Two of these events, the defense cutbacks after the Vietnam War and the defense cutbacks after the end of the Cold War, can be viewed as exogenous structural changes because the prospect of a ramp-up in defense demand as seen by labor market participants in 1975 and in 1991 was remote.

This paper focuses on understanding these episodes of structural change in the Los Angeles aerospace sector through an empirical examination of regional-level structural change episodes in the U.S. economy in the late 20th century. The paper proceeds with a discussion of the literature on structural change and of the two defense cutbacks as they impacted employment in Southern California. Following Nickelsburg and Timmons (2012), an empirical model of the adjustment process is proposed and the data and econometric specification are described. The results suggest that the ability of the balance of the Southern California economy to absorb an influx of workers from aerospace without a large wage adjustment was perhaps the most important determinant of the length of the episode.

Literature Review

The research on permanent worker displacement is relatively deep and focuses on the identification, costs, and potential mitigating policy of structural change or what has been called Schumpeterian shocks.

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Hamermesh (1989) surveyed previous worker displacement research and conducted an analysis of the 1980s in the U.S., showing significant permanent worker displacement unrelated to the business cycle. This provides one of the key criteria to the identification of structural change relative to cyclical change for a regional economy. The literature on structural changes in Europe is extensive and identifies institutional factors as barriers to labor market adjustment. Baker, Glyn, Howell, and Schmitt (2004), however, found evidence in OECD countries that structural adjustments, while influenced by institutional environments, have a significant institutional free component to them. Their results suggest the research design herein—one that examines changes occurring over different years and in different parts of the business cycle.

Research on the length of the adjustment process, the topic of this paper as it relates to the Los Angeles defense aerospace episodes, has been surveyed by Fallick (1996). He concluded that structural change results in persistent unemployment but that the impact on the individual worker tends to fade after about 4 years. Huttunen, Moen, and Salvanes (2006) and Schoeni, Dardia, McCarthy, and Vernez (1996) described the process as one in which workers seek out alternative employment—some at the same level, some moving to lower-wage sectors (as described in the model herein), and some leaving the labor force altogether. The latter are those for whom a rate of return on investing in new skills is insufficient to keep them in the labor force.

A Tale of Two Downturns

U.S. defense budgets for durable goods, much of which is allocated to purchases from aerospace manufacturers, is uncorrelated with the business cycles (Figure 1). Over the period 1960 to 2012, there have been two episodes of budget cuts resulting in net negative investment in defense goods. The first, and smaller of the two, began in the latter part of the Vietnam War and continued throughout the 1970s. The second, a considerably larger episode, began in the early 1990s and continued until 2002. The fact that neither episode was associated with a recession and that both impacted Los Angeles labor markets provides a contrast of labor force adjustments.

In both of the defense-induced downturns, the impact on manufacturing employment in Los Angeles County is clear (Figure 2). In the 1970s, employment dropped by 15% between 1969 and 1971, and in the 1990s by 29% between 1990 and 1995 In 1970, manufacturing was 26% of all Los Angeles County employment, and in 1990 it was 17—representing a loss of 3.9% and 4.9% of total payroll employment, respectively. The most telling difference between the two episodes is the number of years until the previous peak in employment was achieved (Figure 3). In the earlier episode, employment had recovered 3 years after the beginning of the contraction and in the latter one, 8 years. Does that 1% differential in the impact on total employment matter? The empirical analysis herein suggests that it does in fact matter a great deal.

FIGURE 1
Net Government Investment: National Defense Goods

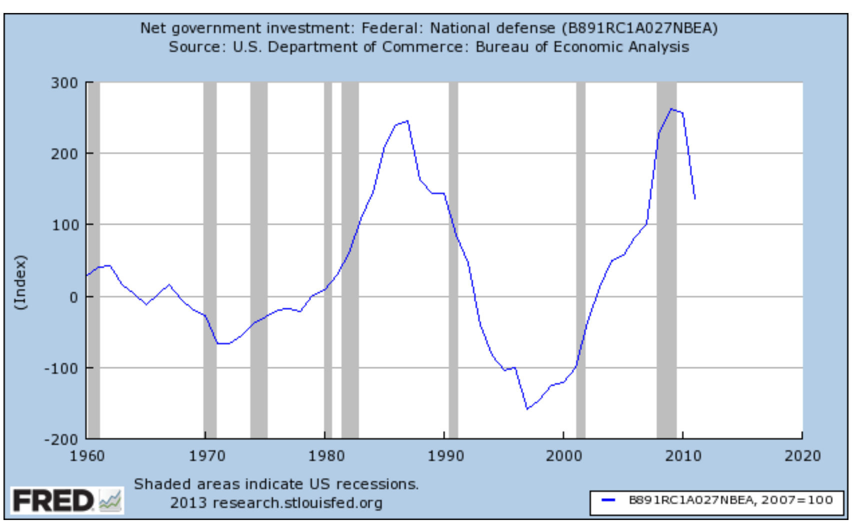


FIGURE 2
Total Payroll Employment in Manufacturing: Los Angeles

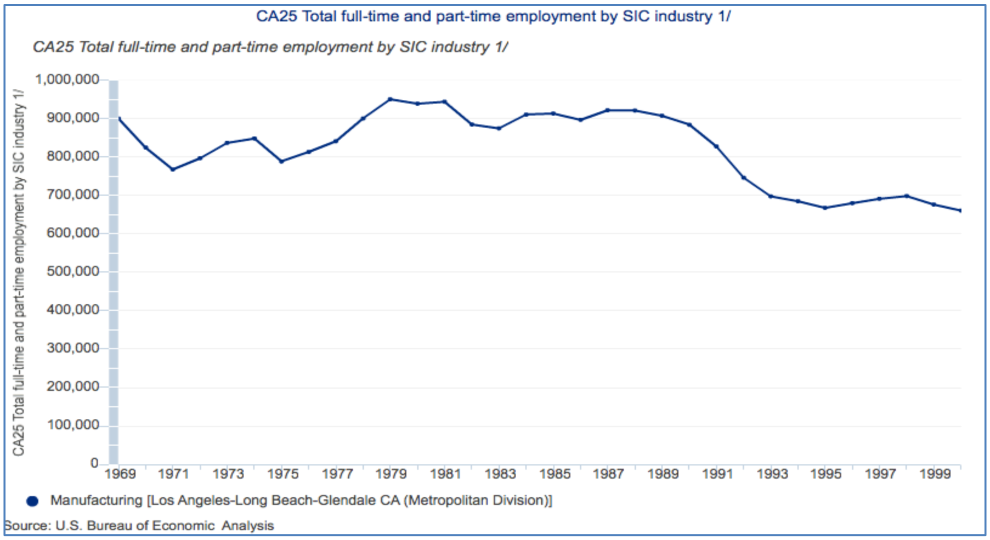
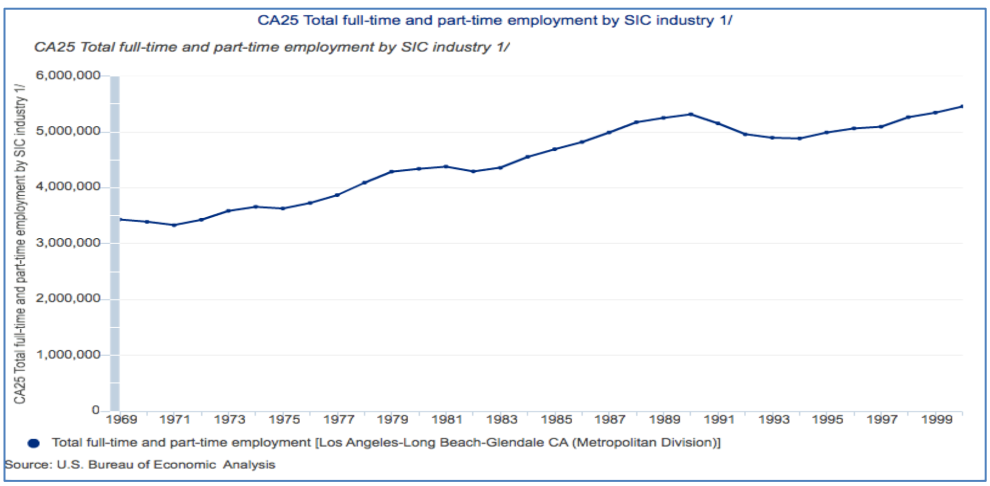


FIGURE 3
Total Payroll Employment: Los Angeles



Empirical Strategy and Data

The decision facing a displaced worker in an industry that is in decline is generally not one of never working in the industry again (thus having a zero expected rate of return on his or her investment in skills specific to the industry) and investing in skills that provide entrance to another line of work. Rather, it is one of waiting for a now less-frequent job opening in the smaller industry or investing in skills to enter another line of work. Formally, the displaced worker evaluates

$$\mu = \psi_1(V(W(S_1),\omega_1)) - \psi_2(V(W(S_2))) \tag{1}$$

The quantity μ is a measure of the difference in utility between those who possess skill level S_2, which has now become somewhat obsolete, and those who possess skill level S_1. ψ_1 is a function that incorporates the forward-looking expected utility of obtaining skills to enter Sector 1 and is increasing in the probability of employment in Sector 1, and the wage in Sector 1 is decreasing in the required investment in entry to Sector 1, ω_1. ψ_2 is performs the same role for Sector 2; however, there is no additional investment on the part of the displaced worker entering Sector 2.

The value of μ increases with the shedding of jobs in Sector S_2, but as workers move from Sector S_2 to Sector S_1, $W(S_1)$ falls. The wage decline will decrease μ, and if the decrease is sufficient to make $\mu = 0$, movement from S_2 to S_1 will cease. When the contraction in Sector S_2 is large, the ability of migration to depress wages and probabilities of employment in Sector S_1 plausibly increase. On the other hand, learning the true probability of unemployment in Sector 2 is more likely dependent on signal extraction from market data in the sector. Because structural change often (but not always) begins at a time of slowing of the macro-economy, we postulate that, in fact, the larger the downturn in Sector S_2 relative to total employment, the longer the structural adjustment period will be simply because of the more limited ability of the balance of the economy to absorb the additional workers at a wage that induces investment in market entry in a shorter time.

The process of sectoral adjustment that is discernible from employment data is that which extends beyond the contraction portion of the business cycle and which is defined as complete when the level of total regional employment returns to its previous peak.

Let Y be the adjustment duration, then $Y = \eta(\mu)$. Linearizing η with respect to the factors determining the values of probability of employment and the relative wage rates yields

$$Y_i = \alpha_0 + \alpha_1 Drop_i + \alpha_2 CNB_i + \alpha_3 RELU_i + \alpha_4 SPEED_i + \alpha_5 FE_i + \xi_i \qquad (2)$$

where

Y_i is the number of years peak to peak for episode i.

$Drop_i$ is the total decrease in employment in the affected sector divided by the total employment in the region at its peak.

CNB_i is a variable to account for a larger city nearby. CNB_{i1} is a fixed effect for a larger city without a concurrent structural change, and CNB_{i2} is the peak employment in the affected region divided into the same year employment in the nearby city.

$RELU_i$ is a measure of the relative unemployment in the affected sector compared with the national unemployment rate. This variable is designed to pick up signal extraction problems owing to the timing of the business cycle and the structural change in the region.

$SPEED_i$ is the speed with which the affected sector contracts as measured by the proportion of the sectoral labor force lost in the 2 years following the peak.

FE_i are fixed effects that measure the region of the country and type of industry where the structural change occurs.

ξ_i is the error term that captures regional idiosyncrasies as well as estimation error on the part of unemployed workers in Sector S with respect to the variables in Equation 2).

Lilien (1982) estimated structural shifts in the unemployment rate using a measure of dispersion of employment (in our context, the variable DROP) and previous unemployment rates. The latter is subsumed in the duration variable Y. The strategy will be to analyze data on structural change at the metropolitan statistical area and county levels in the United States to ascertain the importance, or lack thereof, of the variables developed in the described theory.

The data used in the current study were developed for and described in detail in Nickelsburg (2013). A total of 51 instances of structural change were identified in the United States over the period 1969 to 2001. For each city, the nearest city larger than itself was identified and a distance between the two computed using Google Maps. If the distance was less than an hour of Google driving time, a fixed effect and a size variable were computed. In addition, where available, the change in housing prices from peak to trough were collected.

Empirical Findings

The key variables of the model are uncorrelated one to another with the exception of CNB_2 and CNB_1, and SPEED and RELU. In both cases, the correlation coefficient is in the 0.6 to 0.7 range and is a potential source of multicolinearity. The data points are relatively well spread across the years from 1969 to 2002 with the exception of 1979, whose idiosyncratic impact will be examined by entering a fixed-effect variable. There are four principal sectoral categories of structural change: hard rock mining, oil and gas, manufacturing, and military base closures. Finally, fixed-effect variables were constructed for structural changes in the North/North East and in the South.

For regressions using all of the variables, including the North/North East but not the South fixed effect, all of the variables except DROP and Hard Rock Mining are insignificant. When North/North East is replaced with South, only DROP remains significant. One of the reasons for the weak results is the lack of degrees of freedom when the full complement of variables is included. Narrowing the set of explanatory variables to exclude all of the fixed effects, with the exception of the Hard Rock Mining fixed effect, yields clearer results.

In the selected variable regressions, the DROP and Hard Rock Mining variables are significant at the 5% level, and the CNB_1 variable (city nearby) is significant at the 10% level. The intercept term is between 5 and 6 for the two regressions for which it is significant. In other words, when there is a significant enough structural change for there to be an adjustment period longer than the downturn in a recession or were the drop to occur during an expansion period, the minimum time to fully recover is in the range of 5 to 6 years. In part, but not entirely, this represents selection bias. Structural changes that were resolved through market adjustments in relatively short time frames were not defined as such. Rather, they were considered to be part of the normal cyclical and random variation in the time series data.

The first implication of the regressions is that the size of the drop matters. For every 1% drop in aggregate employment caused by the structural change, there is an approximately 0.7 additional year of adjustment. Thus, a 7% drop in aggregate employment will result, all other things equal, in a decade-long adjustment period. This is exacerbated by another 6 years if the drop was in hard rock mining, perhaps because the structural changes in that sector occurred in remote areas such as Sweetwater County, Wyoming, and St. Louis County, Minnesota.

Second, the presence of a larger city nearby—one that did not have the same structural change at the same time—decreased the time to adjustment by 3 years. While important to the regressions, this is not relevant to an analysis of the aerospace sector in Los Angeles.

Finally, the role of housing in limiting mobility has been discussed recently in the literature. Housing price data were available for 27% of the sample. For this reduced sample, the change in housing prices in the local region was correlated with the time to recovery. While the correlation was significantly different from 0, the coefficient on the regressions reported here, with the limited sample, were not significant. The reason is most likely that the inability of the local economy to absorb the redundant workers without wages falling too fast is what caused the decline in housing prices—therefore, housing prices are endogenous to the process of structural change and recovery.

TABLE 1
Regressions Using the Full Complement of Variables

	Fixed Effect For North / North East			Fixed Effect for South		
R-Square	0.52063			0.53238		
No. Obs.	51			51		
	Coefficient	St. Error	Probability	Coefficient	St. Error	Probability
Intercept	10.2876	6.79876	0.1381	14.35055	7.84087	0.07468
DROP	69.22247	15.3492	0.00006	72.51747	15.50426	0.00003
CNB1	-3.77326	2.85229	0.19339	-3.93043	2.80593	0.169
CNB2	-0.06675	0.32251	0.83707	-0.10309	0.31608	0.74601
SPEED	-3.47129	9.89936	0.72768	-7.06794	10.41451	0.50126
RELU	1.36395	1.7579	0.44237	1.88031	1.80707	0.30434
Hard Rock Mining	6.20172	3.04052	0.04802	4.47278	3.46267	0.20387
Manufacturing	0.92136	3.03825	0.76327	0.01445	2.87449	0.99601
Military Closure	-3.16915	3.76705	-4.73933	-4.73933	3.93112	0.23506
1979	1.68041	2.20637	0.45075	1.20499	2.22499	0.59112
NE/NC	0.59005	2.12229	0.78243			
South				-2.83653	2.72374	0.30394

TABLE 2
Selected Variable Regressions

R-Square	0.49257			0.49054		
No. Obs.	51			51		
	Coefficient	St. Error	Probability	Coefficient	St. Error	Probability
Intercept	4.04236	4.8643	0.41035	6.00449	1.4958	0.00022
DROP	73.53835	14.03568	0.	75.10558	13.41975	0.
CNB1	-3.67085	2.01957	0.07578	-3.84338	1.9605	0.05602
SPEED	-5.37615	8.93533	0.55041	-7.9286	6.54799	0.23214
RELU	-0.50779	1.19672	0.67336			
Hard Rock Mining	6.99921	2.09795	0.00171	6.99172	2.0791	0.00156

R-Square	0.48849			0.49054		
No. Obs.	51			51		
	Coefficient	St. Error	Probability	Coefficient	St. Error	Probability
Intercept	1.93628	3.35418	0.56657	5.37603	1.4098	0.0004
DROP	70.73879	13.14984	0.	71.58986	13.16669	0.
CNB1	-3.31091	1.9155	0.09061	-3.31679	1.92111	0.09083
SPEED						
RELU	-0.99253	0.87874	0.26455			
Hard Rock Mining	6.87695	2.07356	0.00179	6.64269	2.0692	0.00239

Some Concluding Remarks

We find that the adjustment process is related in an important way to the impact of the drop in employment on wages and the probability of unemployment in other sectors. The affected industry (or similar industries in the same location) ordinarily does not close up entirely at the outset of the decline; therefore, the interaction between the fall in wages of those in the sectors that workers are moving to and the increased probability of unemployment in those sectors once retraining has taken place will retard the process of adjustment because the alternative is to wait for a job to open in the declining sector.

For our two episodes, the models estimated yield a range of 4.7 to 8.2 years for the 1970s and 5.1 to 8.9 years for the 1990s. These ranges are closer than the actual data would suggest, though the actual time in the latter period was 8 years and well captured by the model. What explains the smaller than estimated time for the 1970s episode? The answer most likely lies in the nonlinear structure of labor markets. In the 1970s, growth in other sectors was sufficiently high to better absorb the redundant workers, thereby shortening the adjustment period. The incorporation of this growth, which is in part endogenous to the regional economy, was not possible in the empirical analysis but should to be ignored in the interpretation. The lesson of noncyclical aerospace contractions in Southern California, and regional structural adjustment in general, is clear. When permanent displacements of workers occur, the size of those displacements relative to other sectors and the growth rate of the other sectors will determine the length of time to recovery. Moreover, lowering the costs to move between sectors will speed the recovery process.

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