ATTACHMENT A

ORANGE COUNTY BUSINESS COUNCIL

OCTA Next 10: Market Conditions Forecast and Risk Analysis

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PREPARED FOR:

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Executive Summary

This research develops cost forecasts for the public works construction environment, as a tool to help guide implementation of the Orange County Transportation Authority's (OCTA's) Next 10 Delivery Plan. Following the Great Recession of 2008, cost pressures in transportation construction in Southern California were muted. The level of the California Department of Transportation (Caltrans) construction cost index (CCI) dropped by 26.6 percent from 2006 to 2010. Yet from 2012 to 2016, the Caltrans CCI rose 78 percent. Certainly some of that was a correction following the substantial drop in the CCI from 2006 to 2010, but several factors indicate that public works construction in Southern California has shifted from a low-demand/low-cost environment to one of high-demand and cost pressure.

OCBC modeled the relationship between the Caltrans CCI and several economic indicators, to forecast growth in public works construction costs five years and ten years into the future. The OCBC team found that the time trends in the Caltrans CCI are most associated with building permits and the unemployment rate. Regression-based models forecast a two percent increase in the level of the CCI in 2017 (from 2016), and then relatively stable levels going forward after 2017.

There are several reasons to believe that the forecasting model cannot capture all of the cost risk that will be present in the next five to ten years. One of the best predictors of the recent change in the CCI was changes in the state's unemployment rate. With the California unemployment rate at 5.35 percent for 2016, further declines are unlikely, and forecasting models will not be able to capture the full effect of sustained cost pressures from a full employment economy. For that reason, OCBC conducted a risk analysis to identify risk factors that could affect OCTA's construction costs.

Seven risk factors were analyzed and discussed:

1. Sustained low unemployment
2. Increases in residential construction
3. Consolidation in the public works construction industry
4. Increases in interest rates
5. Neighboring county transportation construction programs
6. Construction wage pressure
7. Future recession

Of these, the OCBC team believes that near term cost risks will be particularly influenced by sustained low statewide unemployment, residential construction demand and the effect on the public works construction market, neighboring county transportation construction programs, and construction wage pressures.

- **Sustained low unemployment:** The California economy is approaching unemployment levels that, in the past, have been considered full employment. While wage growth has, until recently, been slow, the possibility of sustained and prolonged low unemployment raises the potential for continued construction cost pressures.

- **Increased residential construction:** California has underbuilt new housing, relative to demand, for years. A 2015 state Legislative Analyst Office (LAO) analysis found that between 1980 and 2010, California's major metropolitan areas added approximately 120,000 new housing units each year, while the LAO estimated that 210,000 new units per year would have been needed to meet demand. Several bills have been introduced in the state legislature to address housing needs, and some policy proposals might substantially streamline the approval process for new housing. If such proposals dramatically increase new housing construction, which OCBC analysis finds possible but not likely, that will increase demand for construction labor and materials.

- **Neighboring county transportation construction programs:** The passage of Los Angeles' County's Measure M in 2016 was a highly visible indicator that neighboring counties are proceeding with ambitious construction programs. OCBC examined 1,388 projects reported in the Southern California Association of Governments financially constrained regional transportation plan. Our analysis shows that Los Angeles county is currently in the midst of a construction program that, in dollar value in five-year windows to 2030, will be from four to six times the size of OCTA's Next 10 plan, and Riverside and San Bernardino are both pursuing construction programs that are at least as large as OCTA's Next 10 plan.

- **Construction wage pressure:** In Orange, Los Angeles, Riverside, and San Bernardino Counties, construction wage growth ranged from 0.49 to 2.36 percent annually from 2012 to 2014, increasing to 4.39 to 5.3 percent annually from 2014 to 2016 (the most recent year for which data are available.)

In light of these factors, OCBC analysis suggests that OCTA can mitigate cost risk through the following policies:

- **Develop early warning indicators** that track data that can provide information about risk factors. This would include, but not be limited to, data on building permits, construction employment and wages, executive opinion about the local economy, and construction commodity costs.

- **Explore apprenticeship programs** that can increase the pipeline of skilled construction labor.

- **Explore ways to continue to be a preferred client** for public works construction companies, to maintain bid competition.

- **Explore further accelerating the Next 10 program**, to the extent possible, as the near-term risks mostly suggest increased rather than decreased public works construction costs.

I. Market Forecast, Quantitative Analysis

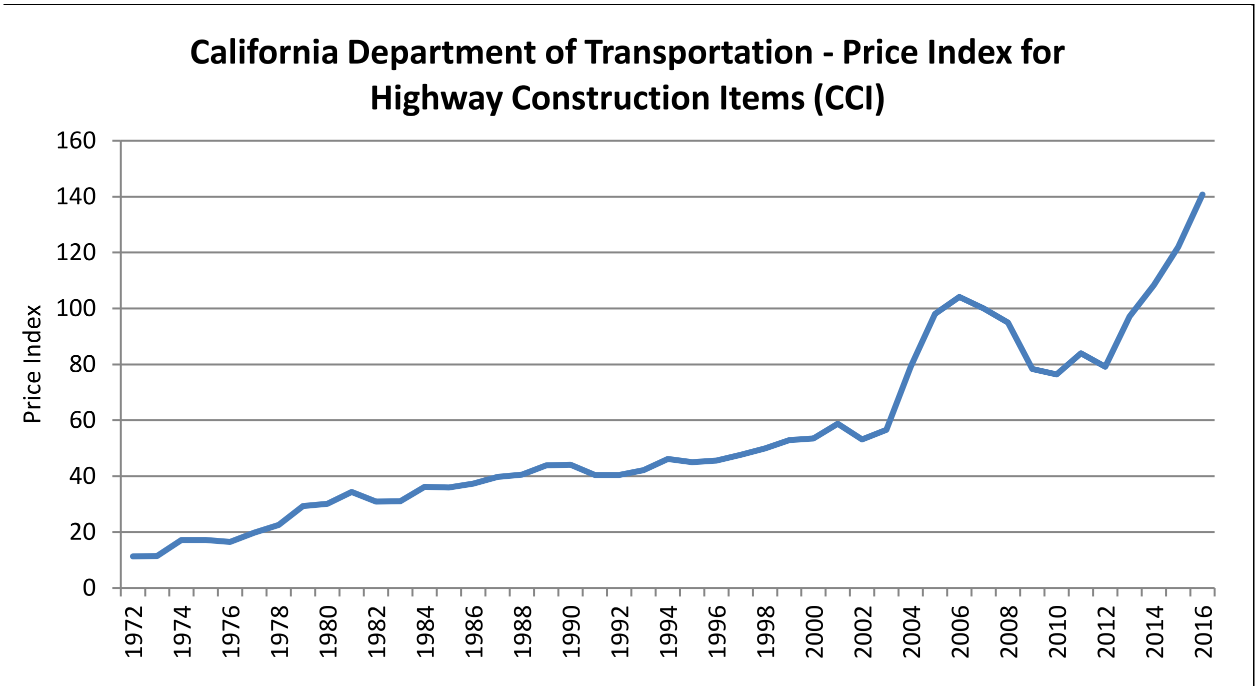
In 2008, the Orange County Business Council (OCBC) conducted the market conditions forecast for the Orange County Transportation Authority's (OCTA) M2 Early Action Plan (EAP). That forecast was done at the onset of the Great Recession, and OCBC predicted that construction costs would fall in the years immediately after 2008. The forecast predicted a falling or stable California Department of Transportation (Caltrans) construction cost index (CCI) to approximately the year 2012, which proved accurate. The Caltrans construction cost index fell from 100 in 2007 to 76.4 in 2010, and the Caltrans CCI did not rise to exceed its 2007 value until 2014 (See Table 1 and Figure 1). Yet the Caltrans CCI has risen rapidly in recent years, reaching 140.75 in 2016, suggesting that the after-effect of the Great Recession has ended.

Table 1: California Department of Transportation (Caltrans) Construction Cost Index (CC) by year, 1972-2016

California Department of Transportation - Price Index for Highway Construction Items (CCI)					
1972	11.3	1987	39.7	2002	53.1
1973	11.4	1988	40.5	2003	56.6
1974	17.2	1989	43.9	2004	79.1
1975	17.2	1990	44.1	2005	98.1
1976	16.5	1991	40.4	2006	104.1
1977	19.8	1992	40.4	2007	100
1978	22.6	1993	42.2	2008	95
1979	29.3	1994	46.2	2009	78.4
1980	30.1	1995	45	2010	76.4
1981	34.4	1996	45.6	2011	84
1982	30.9	1997	47.6	2012	79.2
1983	31	1998	49.9	2013	97.09
1984	36.2	1999	52.9	2014	108.32
1985	36	2000	53.5	2015	122.02
1986	37.3	2001	58.7	2016	140.75

Source: California Department of Transportation, Price Index for Selected Highway Construction Items

Figure 1: Time Trend of Caltrans Construction Cost Index (CCI), 1972 to 2016



Source: California Department of Transportation, Price Index for Selected Highway Construction Items

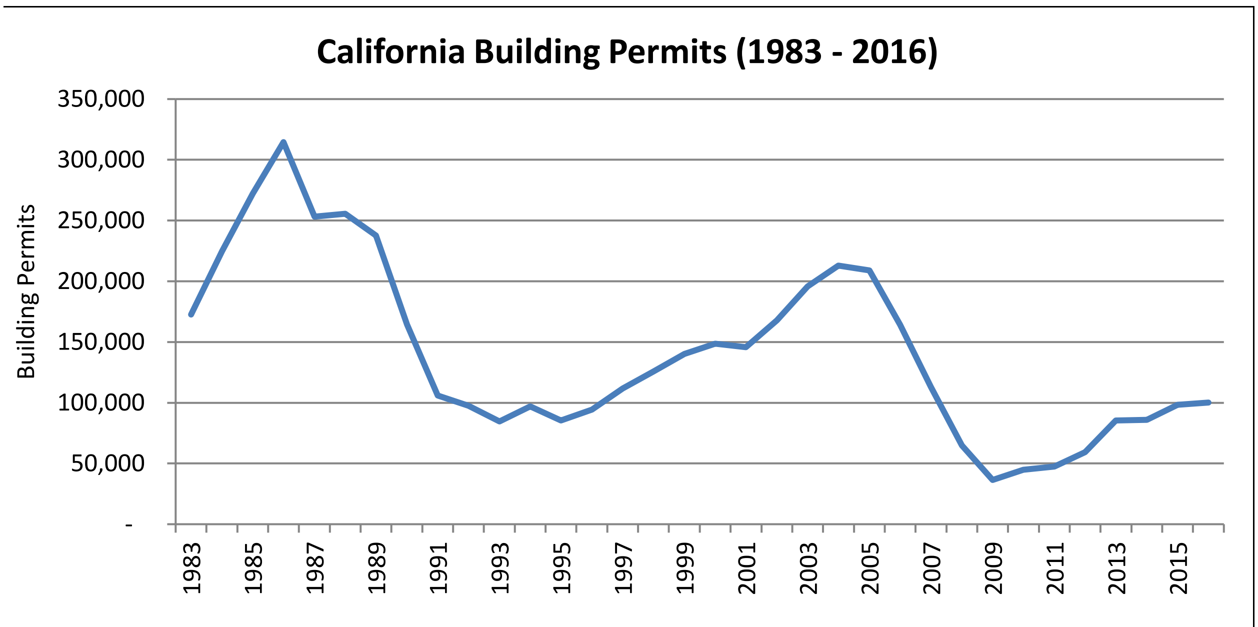
The 2008 M2 EAP market conditions forecast was based on a regression analysis that examined how four variables – building permits, population, employment, and income – are associated with the Caltrans CCI and other cost factors. In the 2008 analysis, building permitting activity was the best predictor of the Caltrans CCI (and of cost factors generally), and the large drop in building permitting activity that preceded the Great Recession predicted a period of slack markets for construction materials and labor. Table 2 and Figure 2 show the time trend of building permits in California from 1983 through 2016. Note that building permits in the state dropped from 208,972 in 2005 to 36,421 in 2009 and stayed below 100,000 every year until 2016, which saw 100,265 building permits issued in California – slightly less than half the "housing bubble" year values of 2004 and 2005.

Table 2: California Building Permits by Year

California Total Building Permits (1983-2016)					
1983	*172,569*	1995	*85,293*	2007	*113,034*
1984	*224,845*	1996	*94,283*	2008	*64,962*
1985	*272,317*	1997	*111,716*	2009	*36,421*
1986	*314,569*	1998	*125,707*	2010	*44,762*
1987	*253,171*	1999	*140,137*	2011	*47,343*
1988	*255,559*	2000	*148,540*	2012	*59,225*
1989	*237,747*	2001	*145,757*	2013	*85,472*
1990	*164,313*	2002	*167,761*	2014	*85,844*
1991	*105,919*	2003	*195,682*	2015	*98,233*
1992	*97,407*	2004	*212,960*	2016	*100,265*
1993	*84,656*	2005	*208,972*		
1994	*97,047*	2006	*164,280*		

Source: U.S. Census Bureau, Building Permit Survey

Figure 2: Time Trend of California Building Permits



Source: U.S. Census Bureau, Building Permit Survey

The forecast from 2008 was influenced by the housing bubble's coincident rise in building permits, the increasing level of the Caltrans CCI, and the substantial decline in permitting. This led to a prediction of a slack construction materials and labor market for the years following 2008.

Looking forward toward developing a forecast for the next five and ten years, the earlier M2 EAP forecast provides context, but what is striking is how conditions have changed. The economy has recovered, cost factors (including the Caltrans CCI) are rising, suggesting tightening demand, but building permitting activity has seen at best a slow and still incomplete recovery. The following observations and questions help set the stage for the analysis.

1. Building permitting activity may have been, at least in part, a proxy for broader factors (such as coincident increases and then contractions in world demand, from 2000 to 2012) in the 2008 forecast. Certainly, to some extent, building activity is a structural factor that affects the cost of public works construction. The question is to what extent materials and labor are substitutable over public- and private-sector markets, and to what extent the relationship observed in the 2008 analysis continues to be a useful forecasting tool today.
2. Will price and supply factors, going forward, be most strongly influenced by the national and world economy or by local conditions, including the public works construction program in Orange and other southern California counties?
3. Around 2012, the Caltrans CCI began to increase rapidly while state building permitting activity, while also increasing, remained well below peaks from previous time periods. Does this signal a weakening of the relationship between building permits and public sector construction costs going forward?

To foreshadow our results by briefly summarizing the answers to the above questions, the OCBC team believes that a market forecast going forward should rely less exclusively on building permits than did the M2 EAP forecast. The relationship between permits and, for example, the Caltrans CCI shows signs of change, and there is discussion later in this report how supply-side factors, including consolidation in the construction and engineering services industry in the years after 2008, might importantly affect cost pressures. Before going into that in detail, our analysis starts with descriptive analytics.

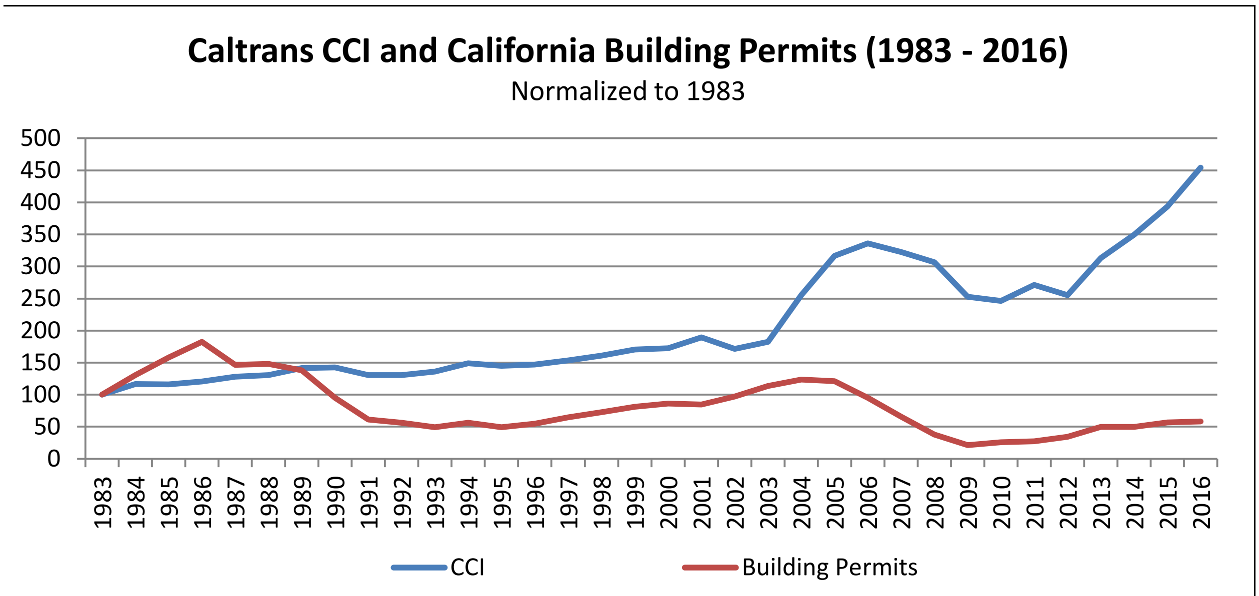
Descriptive Analysis

The graph of the Caltrans CCI in Figure 1 shows clear time trends that follow the business cycle. The rapid increase in the CCI during the housing bubble years following 2002 is followed by a decline after 2008, and then an increase in the past four years. The long-term trend, judging by Figure 1, suggests an increase in the growth rate of the Caltrans CCI following 2003. The average annual growth rate of the Caltrans CCI was 5.3 percent from 1972 to 2003 and 7.3 percent from 2003 to 2016.

Figure 3 graphs both the Caltrans CCI and statewide building permits, from 1983 to 2016. Both series, the CCI and building permits, are normalized to a value of 100 in 1983. The value in each year is divided by the 1983 value, such that the values of both series in any year show the percentage change from 1983 to that year. For example, the normalized Caltrans CCI value in 2006 is 335.8, indicating that the CCI had increased 235.8% (335.8 minus 100) from 1983 to 2006. Normalizing values allows both series to be represented with the same y-axis, despite dramatically different values in the underlying data, and allows readers to easily see percent change from the 1983 base year.

In Figure 3, starting in 2000, building permits increased in California, while the Caltrans CCI showed an increase that was more dramatic, in percentage growth terms, than building permits. Both series fall following 2006, but the increase in the Caltrans CCI beginning in 2012 is not accompanied by much of an increase in building permits.

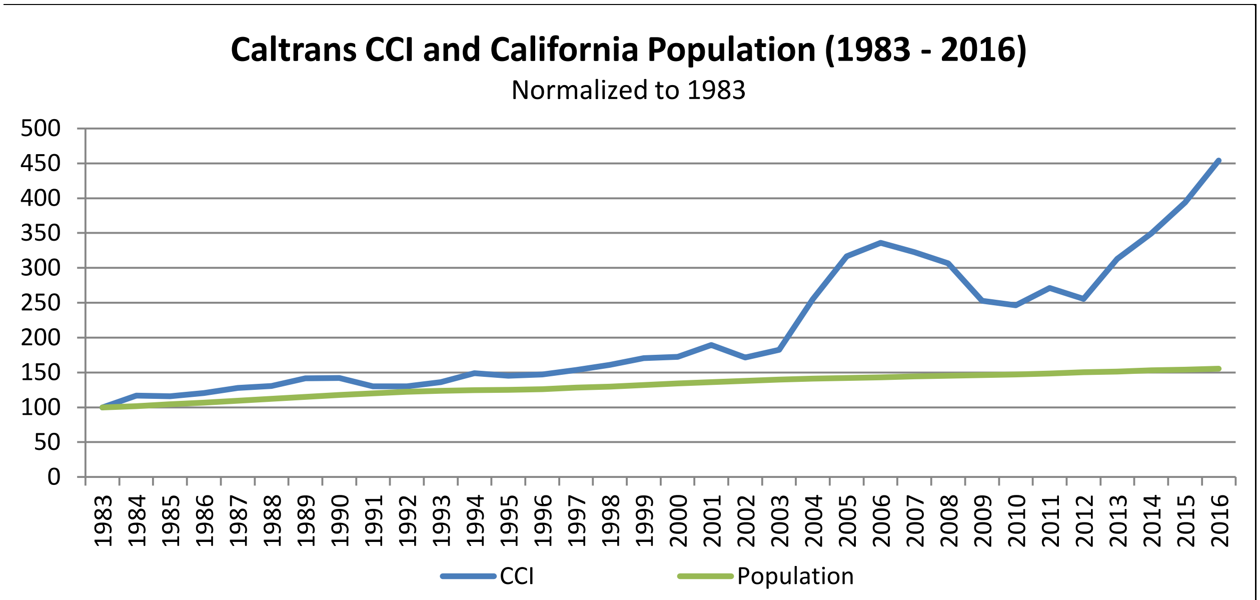
Figure 3: Normalized Caltrans Construction Cost Index (CC) and California Building Permits, 1983 to 2016



Source: California Department of Transportation, U.S. Census Bureau, Building Permit Survey

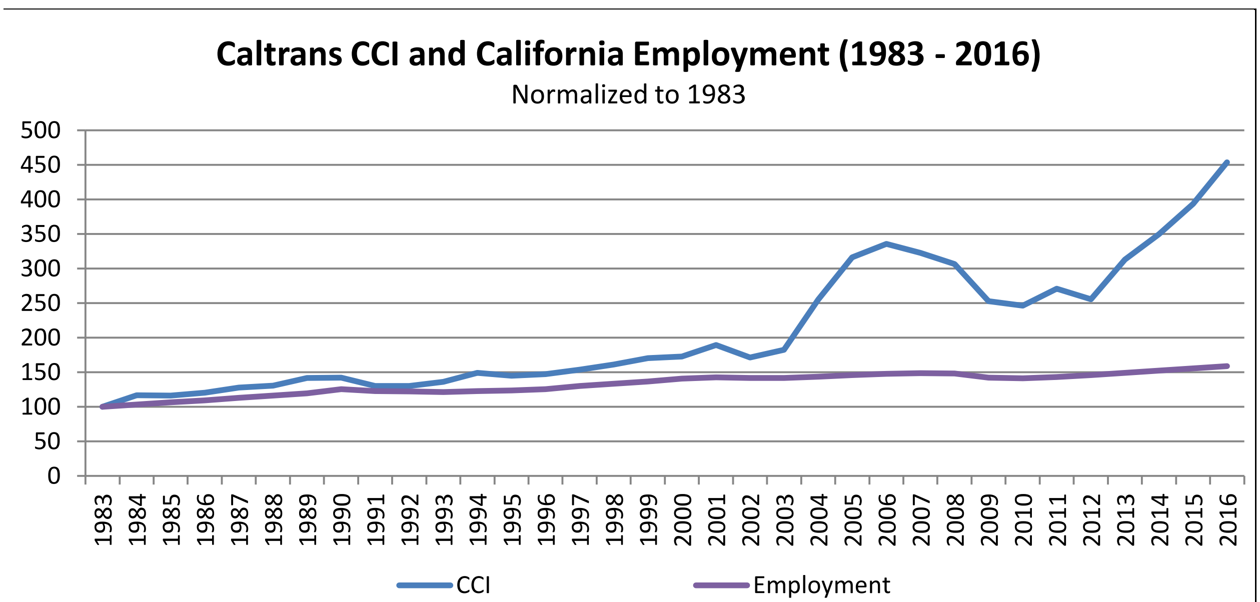
Figures 4, 5, 6, and 7 show the same normalized time trend for the Caltrans CCI compared to population (Figure 4), employment (Figure 5), total wages (Figure 6), and per capita personal income (Figure 7). Wages and income are in nominal dollars, not adjusted for inflation. All values are for California. Data sources and raw data are shown in appendix table A1.

Figure 4: Normalized Caltrans Construction Cost Index (CCI) and California Population, 1983 to 2016



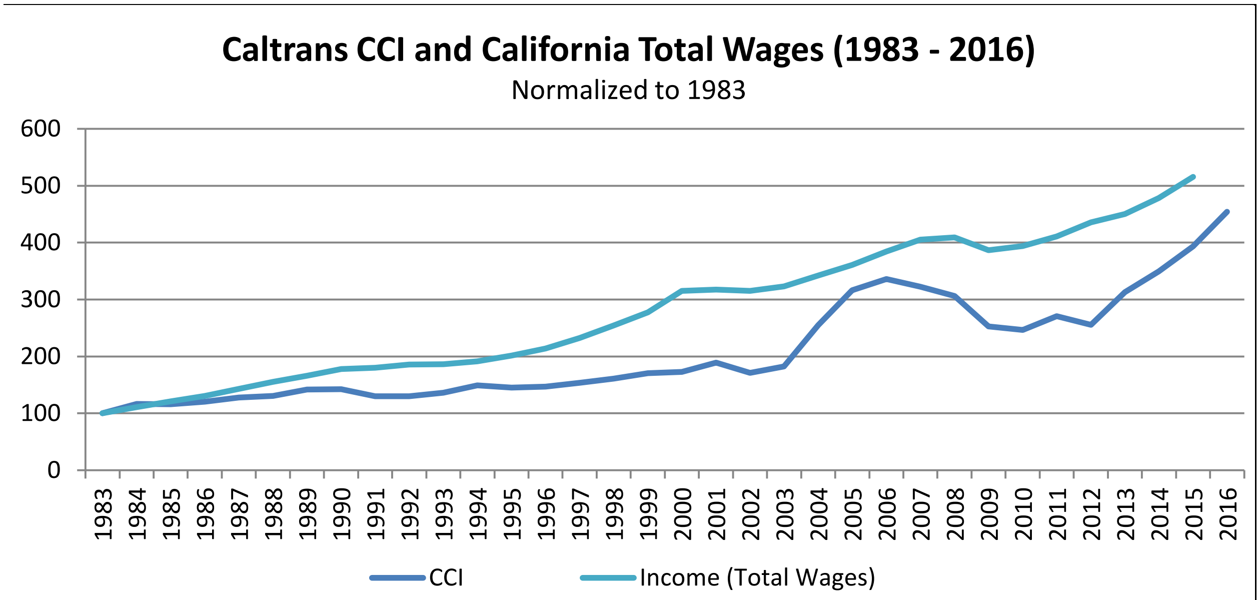
Source: California Department of Transportation, U.S. Census Bureau

Figure 5: Normalized Caltrans Construction Cost Index (CCI) and California Employment, 1983 to 2016



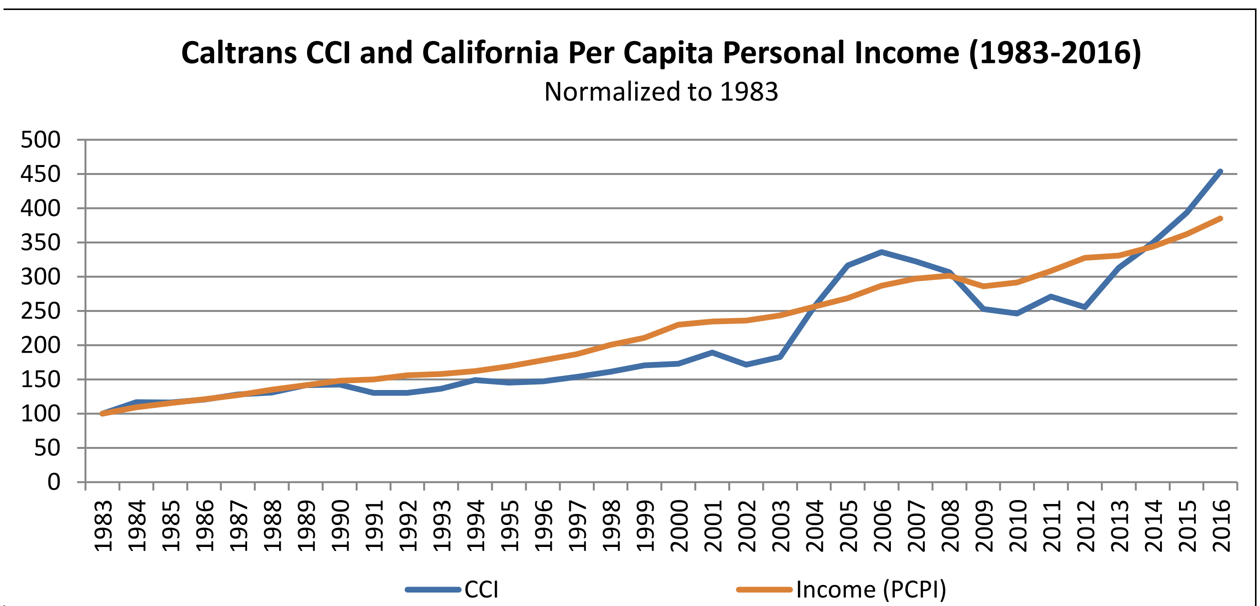
Source: California Department of Transportation, California Employment Development Department

Figure 6: Normalized Caltrans Construction Cost Index (CCI) and California Total Wages, 1983 to 2016



Source: California Department of Transportation, California Employment Development Department

Figure 7: Normalized Caltrans Construction Cost Index (CCI) and California Per Capita Personal Income (PCPI), 1983 to 2016



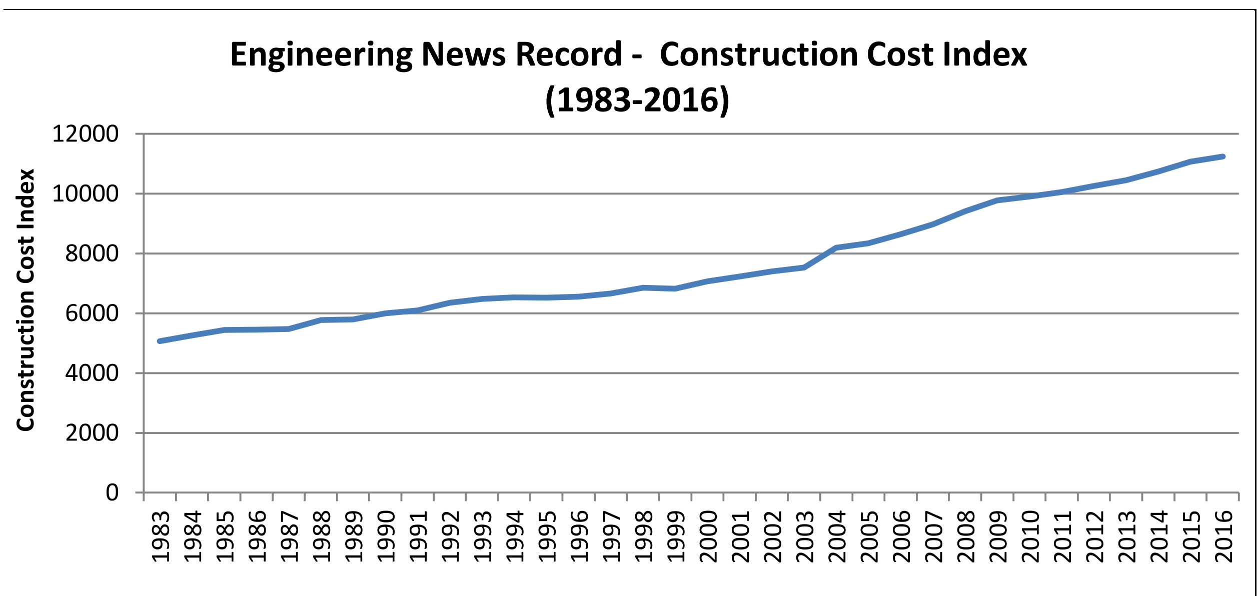
Source: California Department of Transportation, U.S. Bureau of Economic Analysis

In addition to the CCI, Caltrans reports cost factors for materials, which will be discussed later in this report. The OCBC team also analyzed data from Engineering News Record, which reports a construction cost index (ENR CCI) and a building cost index (ENR BCI) for the Los Angeles metropolitan area.

The ENR Cost Index formula contains four pricing components including: steel, lumber, cement and labor costs. This price data for the three building materials are gathered from a single supplier of each building material in each city. Therefore, the suppliers may be located within Los Angeles city limits, or they may not, but instead may be somewhere within the greater metropolitan area. Considering that these building material prices are collected from a single source for each material in each city/metropolitan area, the price is a spot price; it is not a comprehensive price based on multiple sources. ENR has no way of knowing if their sources are charging the average price for their large metropolitan area for a given material, or a higher or lower than average price. For that reason, the ENR data and indices are not capable of determining average prices but rather are better suited to tracking the change (fluctuation) of the commodity price in a specific city over time.

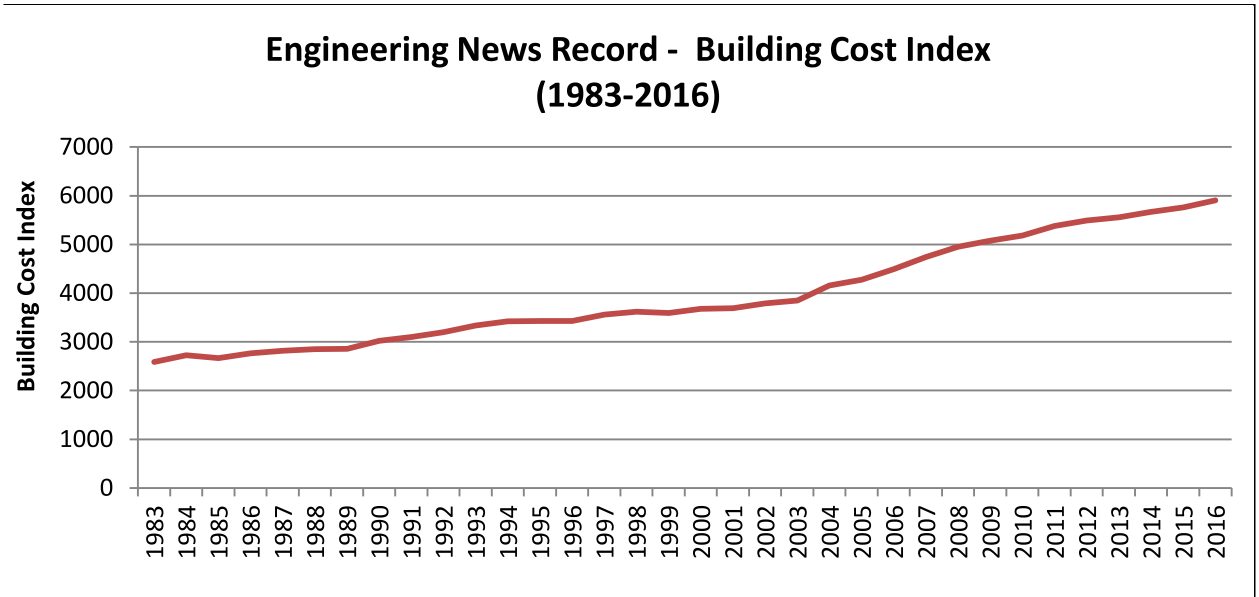
The ENR indices measure construction and building costs that can apply to both the private and public sectors, whereas the Caltrans CCI is designed to measure public sector transportation infrastructure costs. Figures 8 and 9 show the time trend of the ENR CCI and BCI respectively, and the data are in Appendix Table A-2.

Figure 8: Engineering News Record Construction Cost Index (CCI), 1983 – 2016



Source: Engineering News Record Monthly Release

Figure 9: Engineering News Record Building Cost Index (BCI), 1983 – 2016



Source: Engineering News Record Monthly Release

The trends for the ENR CCI and BCI are smoother than for the Caltrans CCI, suggesting that it will be difficult to associate those variables with changes in structural variables such as building permits, population, employment, or wages. The M2 EAP analysis did not find the ENR CCI and BCI as useful as the Caltrans CCI, and our analysis similarly finds those less useful for the Next 10 forecast. Appendix Figures A-1 through A-5 show the normalized values of the ENR CCI and ENR BCI versus, respectively by appendix figure, Los Angeles metropolitan (five-county) area building permits, Los Angeles metropolitan area population, Los Angeles metropolitan area employment, Los Angeles metropolitan area wages, and Los Angeles metropolitan area per capita personal income. None show visual relationships to the ENR CCI or BCI. For that reason, our analysis does not use the ENR indices in the forecast model.

Regression Models

1. Models from 2008 Market Conditions Report

The OCBC team reran models that reproduced, as closely as possible with available data, the regression models in the 2008 market conditions report. Those models were classified into two types – levels models (regressing the level of the Caltrans CCI on the levels of the four key independent variables – building permits, population, employment, and total wages – all for California), and change models, regressing the level of the Caltrans CCI on the changes of the same four key independent variables. Both the levels and change models include first and second lags of Caltrans CCI on the right hand side. The regression equations are shown below.

Levels Model

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \beta_3 BP_t + \beta_4 BP_{t-1} + \beta_5 BP_{t-2} + \beta_6 INC_t + \beta_7 INC_{t-1} + \beta_8 INC_{t-2}$$
$$+ \beta_9 EMP_t + \beta_{10} EMP_{t-1} + \beta_{11} EMP_{t-2} + \beta_{12} POP_t + \beta_{13} POP_{t-1} + \beta_{14} POP_{t-2} + u$$

where Y = cost or price index

BP = building permits

INC = total wages

EMP = total employment

POP = population

u = the regression error term

and the subscripts "t", "t-1" and "t-2" indicate years ("t" being the current year, "t-1" is a one year lag, and "t-2" is a two year lag)
β's are regression coefficients

Changes Model

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \beta_3 BP\_CH_t + \beta_4 BP\_CH_{t-1} + \beta_5 BP\_CH_{t-2} + \beta_6 INC\_CH_t$$
$$+ \beta_7 INC\_CH_{t-1} + \beta_8 INC\_CH_{t-2} + \beta_9 EMP\_CH_t + \beta_{10} EMP\_CH_{t-1} + \beta_{11} EMP\_CH_{t-2}$$
$$+ \beta_{12} POP\_CH_t + \beta_{13} POP\_CH_{t-1} + \beta_{14} POP\_CH_{t-2} + u$$

where the term "CH" behind a variable indicates the year-to-year change

(e.g. $BP\_CH_t = BP_t - BP_{t-1}$)

The results are shown in Appendix Tables A3 and A4. Table A3 shows the two regressions, levels and changes models, for the Caltrans CCI. Table A4 shows the same models fit on data for the Los Angeles Metropolitan Area, with the Engineering News Record (ENR) construction cost index (ENR CCI) as the dependent variable in the first two columns of Table A4. The ENR building cost index (BCI) is the dependent variable in the second two columns of Table A4. The dependent variables in Tables A4 are the same variables in Table A3, but measured for the Los Angeles metropolitan statistical area.

The variables for building permits are only significant, at the ten percent level, for the two lags in the changes model for the Caltrans CCI. That pattern of insignificance or marginal (10% significance level), coupled with the graphical analysis in the previous section, led us to conclude that building permits, by themselves, are not a good predictor of cost pressures for the OCTA Next 10 delivery timeframe, to the year 2027. Our analysis developed additional regression models, described below.

2. Regressing Caltrans CCI on Building Permits and Unemployment Rate

Given that the descriptive analysis suggests a relationship between the Caltrans CCI and the state's unemployment rate, in year-on-year percent changes, and until recent years suggests a similar relationship with building permits, our analysis fit simple regression models, shown in Tables 3 and 4 below. The models regressed the year-on-year percent change in the Caltrans CCI on (1) the year-on-year percent change in building permits in the state, (2) the year-on-year percent change in the state's unemployment rate, and (3) the year-on-year percent change in both building permits and the unemployment rate. Results are shown in Table 3. Table 4 repeats the same model with all variables as three-year moving averages of annual percent changes, which smooths the data.

Table 3: Caltrans CCI Year-on-Year Percent Change Regressed on Percent Change of Building Permits and Unemployment Rate

	Building Permits only		Unemployment. Rate only		Both	
	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic
Building permits, year-on-year % change	**0.2141**	**2.62**			0.0066	0.06
Unemployment rate, year-on-year % change			**-0.4218**	**-4.33**	**-0.4164**	**-3.1**
sample size	33		27		27	
Years	1984-2016		1990-2016		1990-2016	
R-squared	0.1809		0.4284		0.4285	
Note: All data are for California						
Coefficients statistically significant at 5% level shown in bold						

Table 4: Caltrans CCI Year-on-Year Percent Change, 3-year Moving Average Regressed on Percent Change of Building Permits and Unemployment Rate, 3-year Moving Average

	Building Permits only		Unemployment. Rate only		Both	
	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic
Building permits, year-on-year % change	**0.2186**	**3.12**			-0.0334	-0.32
Unemployment rate, year-on-year % change			**-0.405**	**-5.03**	**-0.4344**	**-3.54**
sample size	31		25		25	
Years	1986-2016		1992-2016		1992-2016	
R-squared	0.251		0.5241		0.5263	
Note: All data are for California						
Coefficients statistically significant at 5% level shown in bold						

The coefficient on the unemployment rate is always statistically significant and highly stable in magnitude across all models in Tables 3 and 4. The coefficient on building permits is similarly stable in magnitude when it is statistically significant, which is only in the bivariate regression shown in the first column of Tables 3 and 4. When both building permits and the unemployment rate are included in the percent changes and three-year moving average percent change models, only the unemployment rate is statistically significant. For that reason, the OCBC team used the unemployment rate to develop a simple forecasting model for Caltrans CCI, shown in the next sub-section. The ENR data are too smooth and likely not sufficiently focused on public works costs to provide a reliable cost forecast. The forecast of the Caltrans CCI is the best available numerical forecast that can be applied to OCTA's conditions.

3. Forecasting Model for Caltrans CCI

The estimated regression coefficients from the second column of Table 3 (the bivariate regression of the percent annual change in the Caltrans CCI on the percent annual change in the California unemployment rate) were used to develop a forecast of the Caltrans CCI, to the year 2027. The results are shown in Table 5, below.

Table 5: Five-Year Forecast (to 2022) and Ten-Year Forecast (2027) for Caltrans CCI, from Unemployment Rate Year-on-Year Percent Change Model

Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2027
CA Unemp. Rate	7.50	6.20	5.35	5.10	5.05	5.00	5.05	5.00	5.00	4.60
% YOY change, CA Unemp		-17.33%	-13.71%	-4.67%	-0.98%	-0.99%	1.00%	-0.99%	0.00%	-1.65%*
Caltrans CCI level, actual	108.32	122.02	140.85							
Predicted CCI % YOY change			5.78%	1.97%	0.41%	0.42%	-0.42%	0.42%	0	0.70%
Predicted CCI Level				149.00	151.93	152.56	153.20	152.55	153.19	158.61

* Total percent change in forecast unemployment rate from 2022 value is -8%, which is -1.65% annually over five years.
Note: California unemployment rates are forecast values after 2016.

Note that the predicted unemployment rate values, after 2016, are averages of the forecasted values from the California Legislative Analyst Office, the California Department of Finance, the Los Angeles Economic Development Corporation, and the California Department of Transportation (Caltrans). Only Caltrans has forecasted state unemployment rates for years beyond 2020, and so the 2021 and 2022 and later values for the state unemployment rates are Caltrans forecasts. The forecasted unemployment rate data to 2022 that are used to obtain the average forecast unemployment rates in Table 5 are shown in Appendix Table A5.

The forecast in Table 5 shows a leveling of the Caltrans CCI at levels not much higher than the current level. With the 2016 California unemployment rate at 5.35 percent, close to full traditional "full employment" levels, the model will imply that the increase in the Caltrans CCI will slow and level off.

While changes in the state unemployment rate are an excellent correlate of changes in the Caltrans CCI, particularly in approximately the past fifteen years, a forecasting model based on changes in the unemployment rate cannot capture sustained public works cost pressure from an economy operating at or near full employment. The OCBC team experimented with models that relate the levels of the Caltrans CCI to the level of the state unemployment rate, but those predicted the same leveling of the Caltrans CCI. Any forecasting model will be limited when the future is unlike the past, and California may be entering a period of relatively full employment – very different from the past few years. OCBC does not believe that a simple forecasting model based only on demand-side proxies such as the unemployment rate or building permits can capture cost pressures that might arise during sustained periods of full or near-full employment. While our analysis finds the slowing of the increase in the Caltrans CCI after 2017 to be credible, the OCBC team believes that the five-year forecast might understate – possibly importantly so – cost pressures and hence increases in the Caltrans CCI going forward. This report discusses reasons for that possible understatement in the context of a risk analysis, in the next sub-section.

Ten-Year Forecast: The only available unemployment rate forecasts beyond 2022 are from Caltrans who project that the California unemployment rate will decrease from 5.0 percent in

2022 to 4.6 percent in 2027.[1] Given that unemployment rate forecast, the model predicts an increase in the Caltrans CCI to 158.36 in 2027. The OCBC team believes that the unemployment rate estimate and the model relationship at the ten-year window is too uncertain to be useful, and while the ten-year forecast is shown in Table 5, our analysis cautions against reading much into the 2027 forecast. At the ten-year timeframe, the OCBC team believes that a risk analysis will be more useful, and the key risks are described below. A risk analysis will be important even for near-term years, and the OCBC team encourages OCTA to view the risk analysis described in Section II as an integral part of their cost forecasting exercises.

II. Discussion and Risk Analysis

There are several factors which could modify the forecast shown in Table 5. Potential risk factors are summarized and listed below, along with possible OCTA mitigation strategies for each risk factor, in Table 6, at the end of this sub-section.

A. Sustained Low Unemployment

In May of 2017, the national unemployment rate was 4.3 percent, a 16-year low compared to when the unemployment rate registered a reading of 4.2 percent in February 2001, according to the U.S. Bureau of Labor Statistics. The unemployment rate will likely not fall much lower. Wages have not shown much upward pressure during the recovery from the Great Recession, generally increasing from 2 percent to 2.5 percent per year during the recovery, suggesting that the economy may still have some slack, and if so the unemployment rate might remain at or near current levels for the next few years.[2]

Models based on historical data may not be able to represent the cost pressures endemic in a state economy that is near full employment and that remains so for at least a few years. In the past, full employment prompted the Federal Reserve Bank to raise interest rates, inducing recessions, and hence limiting the time that the national economy remained at full employment. Given slack wage pressure, the Federal Reserve Bank may be less likely to rapidly raise interest rates, and a global savings glut (discussed below) will exert downward pressure on interest rates. On net, it is possible that unemployment could remain low for the foreseeable next several years, and possibly within the timeframe of at least the five-year Table 5 prediction.

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[1] See http://www.dot.ca.gov/hq/tpp/offices/eab/index_files/2016/FullReport2016.pdf.

[2] For information on wage growth, see the Economic Policy Institute's nominal wage tracker, at http://www.epi.org/nominal-wage-tracker/.

The pressures on infrastructure costs will be difficult to predict, and would depend in part on supply response. Briefly, it is unlikely that raw materials supplies would expand to meet demand. (In Section III our analysis discusses cost pressures on raw materials.) Overall, sustained near-full employment will likely exert more cost pressure than the Table 5 model predicts, and could place OCTA in a structurally high-cost and increasing-cost environment for transportation projects.

B. Residential Construction Accelerates

Building permits were correlated with the Caltrans CCI in the approximately dozen or so years before 2012, but building permitting activity has not recovered as the state's economy has rebounded from the Great Recession. Statewide, building permitting activity is at relatively low levels, particularly so for an economy with low unemployment. The problem is in part political – local governments are reluctant to approve large or even medium-size residential construction projects due to "not in my backyard" (NIMBY) pressures from neighbors. The California Legislative Analyst Office (LAO) has demonstrated that construction in Los Angeles County, in particular, has lagged well behind what would be needed to accommodate population growth. A 2015 LAO analysis found that between 1980 and 2010, California's major metropolitan areas added approximately 120,000 new housing units each year, while the LAO estimated that 210,000 new units per year would have been needed to meet demand.[3]

The housing shortage and underbuilding is, in part, a characteristic of California's politics, and the risks to OCTA related to building permitting and construction are as much political as economic. The state's housing crisis has sparked political attention. There were over 100 bills dealing with housing in the California legislature as of early May, and while many if not most will not pass, for the second year in a row Sacramento is debating policies that might structurally change the incentives for localities to approve or deny building projects.[4] In 2016, Governor Brown suggested a "by-right" zoning legislation that would have provided presumptive (by right) approval for any residential construction project that was consistent with the local zoning code and that provided affordable units that met 20% (far from transit) or 10% (near transit) targets. That proposal met with opposition in the legislature, and the governor's 2016 proposal was not introduced in the assembly or state senate.[5] Yet the large amount of legislative activity related to housing in this session indicates that the debate has, if anything, intensified. If the state enacts changes that require localities to approve residential construction projects that would have

[3] California Legislative Analysts Office, "California's High Housing Costs: Causes and Consequences," 2015, available at http://www.lao.ca.gov/reports/2015/finance/housing-costs/housing-costs.aspx, accessed June 10, 2017.
[4] Libby, Sara, "California's Legal Assault on NIMBY's begins," Citylab, May 9, 2017, available at https://www.citylab.com/equity/2017/05/californias-legal-assault-on-nimbys-begins/525840/, accessed June 10, 2017.
[5] Barmann, Jay, "Governor Brown's 'By-Right' Housing Fast-Track Proposal Dead in the Water," SFist, Aug. 22, 2016, http://sfist.com/2016/08/22/governor_browns_by_right_housing_fa.php.

otherwise been blocked, or if reforms to the California Environmental Quality Act reduce the ability of citizens to oppose projects or that expedites challenges, California might see a substantial increase in construction. Already the Inland Empire – a location of relatively more affordable housing in Southern California – is seeing large increases in residential construction. The Inland Empire saw the fastest growth in construction jobs among any U.S. metropolitan area in March versus a year earlier.[6]

If California's political environment changes in ways that reduce the power of NIMBY opposition, the state might see a rapid and large increase in building permits, as many of the state's urban and coastal counties have backlogs of residential building that has lagged population growth. That could create substantial cost pressure as materials and skilled labor could be diverted from public works to private residential construction. Even absent such policy changes, the residential construction industry is growing rapidly in the Inland Empire. If policies change to allow more rapid residential permitting and construction, the resulting "burst" of residential construction might be temporary, if supply eventually meets pent-up demand, but that could take a few years and the result would be a large cost pressure on OCTA projects if residential building accelerates. Such a dramatic change in California's residential construction regulatory framework should be regarded as unlikely, but the pent-up pressure for more homes is structural. Despite the increasing political attention to the state's housing affordability crisis, the trend of the past four decades has been toward a more rigid and delay-prone residential construction environment. Overall, a change that allows more building in California would be an unlikely outcome, albeit an outcome that is growing more likely and an outcome that could exert substantial cost pressure on OCTA projects. Without policy change, there is still likely to be increasing residential construction, but likely concentrated in inland counties where permitting is politically easier.

C. The Public Works Construction and the Associated Professional Support Industries Continue to Consolidate

Supply-side factors, such as market structure and competition in the public works construction and associated architecture-engineering support services industries, are likely an important factor in current cost pressures. During and immediately following the Great Recession, the public works construction industry saw several consolidations, particularly among architecture, engineering, and design firms. Smaller firms merged with larger, often multi-national practices. At the same time, our earlier 2008 market conditions analysis suggested that firms during the 2008 time period may have been reducing their bid price to win enough business to cover variable costs. During the depths of the recession, there is anecdotal evidence that firms might have bid below their typical profit margin, and public works agencies reported bids coming in below estimated costs during the recession years. Those days have passed. The recent

[6] Lansner, Jonathan, "California, Inland Empire in Building Booms, 6 Things to Know," Orange County Register, May 2, 2017, available at http://www.ocregister.com/2017/05/02/california-inland-empire-in-building-booms-6-things-to-know/, accessed June 10, 2017.

consolidations pruned marginal firms and, when combined with growth in the economy, have likely allowed firms to return to pre-recession bid practices.

Going forward, the question is whether the public works construction market will see further consolidation. If so, competition for bids might decrease. Our analysis suggests this as a risk factor that OCTA should monitor, continuing their tracking of the number of bidders. Following the 2008 market conditions analysis, OCTA successfully implemented several of OCBC's recommendations and measures to facilitate the bid process. In response to risk from consolidation of bidders, OCTA can continue and, where possible, enhance those efforts that make the agency a preferred client. Additionally, look to do what can be done to increase competition in the public works infrastructure market, acknowledging that OCTA has worked hard to be a client of choice.

D. Increasing Interest Rates

The Federal Reserve Bank began what most observers expect to be a program of sustained, moderate interest rate increases in December of 2015.[7] Interest rates are still near the lowest levels seen in the past several decades, and the U.S. is likely to be in a low but increasing interest rate environment going forward. The aging of the Baby Boom population in all developed countries, and rapid aging in middle income countries, has created a global savings glut in the form of Baby Boomer retirement savings. That will exert downward pressure on interest rates. While rates will likely increase in future years due to Federal Reserve Bank policy activity, the OCBC team expects the increases to be more moderate but possibly sustained over a longer period of time than following the peak of the business cycles in the 1970s through the 1990s. A return to the high interest rate environment of the 1980s is unlikely, even though interest rates will rise. This will increase OCTA's borrowing costs and, to the extent that rising interest rates reduce the demand for residential construction, exert a downward cost pressure on public works projects.

E. Growth in Public Works Demand from Neighboring Counties

With the passage of Measure R in 2008 and Measure M in 2016, Los Angeles County is in the midst of a large transportation construction program. That program, and similar half-cent sales tax infrastructure programs in other Southern California counties, will create cost pressures as private firms have more opportunities to bid on projects and hence those firms may be less

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[7] See, e.g., the discussion in Tankersley, Jim, "Federal Reserve Raises Interest Rates for Second Time in a Decade," Washington Post Wonkblog, Dec. 14, 2016, available at https://www.washingtonpost.com/news/wonk/wp/2016/12/14/federal-reserve-expected-to-announce-higher-interest-rates-today/?utm_term=.f811c5091e1f, accessed June 10, 2017.

willing to reduce bid prices. Our analysis sees and highlights this as one of the primary cost risks for OCTA in the next few years. The construction activity from neighboring counties is programmed by self-help sales tax increases that have been approved by voters. Those neighboring county construction programs are part of the structural landscape for public works projects. Public sector demand for public works construction will increase as Los Angeles' Measure M funds become available, creating increasing demand for materials and skilled labor.

To better understand pressure from building programs in neighboring counties the OCBC team examined the construction program reported in the 2016 SCAG Regional Transportation Plan (RTP). Our analysis examined 1,388 projects in Los Angeles, Riverside, and San Bernardino Counties, that are part of the financially constrained RTP, with completion years from 2016 to 2030.[8] Tables 6 and 7 list the estimated cost (in current year dollars) for these projects, by county, with Orange County Next 10 projects removed, which explains the lack of cost estimates for Orange County during the 2021-2025 time period. In other words, if a project is part of Next 10 and part of the SCAG financially constrained RTP, those project cost estimates will not be in Table 6 or Table 7, but rather in Table 8. Projects are grouped by highway (Table 6) and transit (Table 7), and listed in five-year bands based on project end date. All data are from the 2016 RTP Transportation System project list, appendix, adopted April, 2016.[9]

The 2016 RTP project list is divided into three parts: the 2015 Federal Transportation Improvement Program (FTIP), the financially constrained plan, and the strategic plan. The 2015 FTIP contains six years of projects that use federal funds or that require federal approval; the financially constrained plan includes projects for which revenues have been reasonably identified; the strategic plan is additional projects that the RTP proposes to program if additional revenues become available. The financially constrained plan is the most reasonable starting point, and unlike the FTIP the financially constrained plan includes projects with completion dates throughout the life of the RTP (2016 through 2040) and lists clear classifications that categorize each project as either transit or highway. Hence Tables 6 and 7 are based on summaries of the financially constrained plan.

[8] Our analysis excluded projects for which OCTA is listed as the lead agency, to capture work in counties that neighbor Orange County. Ventura and Imperial Counties were also excluded, again to focus on counties that neighbor Orange County. Hence the project list studied is a subset of the complete RTP project list.

[9] See http://scagrtpscs.net/Documents/2016/final/f2016RTPSCS_ProjectList.pdf.

Table 6: Freeway Construction Cost Estimates, by County, 2016-2030, SCAG RTP/SCS

Freeway Construction Cost Estimates (SCAG RTP/SCS)				
Counties	***2016-2020***	***2021-2025***	***2026-2030***	***Total 2016-2030 Costs***
Los Angeles	$16,037,920,000	$14,051,669,000	$5,347,696,000	$35,437,285,000
Orange	4,561,804,000	-	2,419,044,000	6,980,848,000
San Bernardino	8,271,850,000	3,409,228,952	5,547,552,000	17,228,630,952
Riverside	3,131,576,000	5,476,784,000	2,784,322,000	11,392,682,000
Total Regional Costs	**$32,003,150,000**	**$22,937,681,952**	**$16,098,614,000**	**$71,039,445,952**

Source: Authors analysis of SCAG 2016 RTP/SCS project list, available at http://scagrtpscs.net/Documents/2016/final/f2016RTPSCS_ProjectList.pdf.

Table 7: Transit Construction Cost Estimates, by County, 2016-2030, SCAG RTP/SCS

Transit Construction Cost Estimates (SCAG RTP/SCS)				
Counties	***2016-2020***	***2021-2025***	***2026-2030***	***Total 2016-2030 Costs***
Los Angeles	$8,790,582,000	$8,782,094,000	$4,072,768,000	$21,645,444,000
Orange	543,164,000	-	-	543,164,000
San Bernardino	44,080,000	185,452,000	149,265,000	378,797,000
Riverside	647,540,000	756,335,000	611,915,000	2,015,790,000
Total Regional Costs	**$10,025,366,000**	**9,723,881,000**	**4,833,948,000**	**$24,583,195,000**

Source: Authors analysis of SCAG 2016 RTP/SCS project list, available at http://scagrtpscs.net/Documents/2016/final/f2016RTPSCS_ProjectList.pdf.

Tables 6 and 7 show neighboring counties (Los Angeles, Riverside, San Bernardino), and any project with OCTA as a lead agency was subtracted from totals in the above tables. OCTA's Next 10 plan is shown in Table 8. The OCBC team cautions against a direct comparison of Table 8 to Tables 6 and 7. The Next 10 plan includes projects with OCTA Measure M funding, but would exclude projects that do not receive such funding, and hence Table 8 is not a complete accounting of projects in Orange County. Table 9 shows OCTA costs from the 2016 RTP, for projects with OCTA as the lead agency (which are excluded from Tables 6 and 7.) Differences in project end dates, differences in the timing of the data, and differences in fund source create differences in the tables, particularly so when placing project spending into five-year windows. While the five-year summary is useful, it also assumes that all spending falls within the five-year window that contains the project completion date, which can be misleading (more discussion of this follows below) but was the best approach possible given the available data.

Table 8: OCTA Next 10 Delivery Plan Cost Phasing, 2016-2030 (based on project end dates)

Next 10 Project Construction Cost Estimates from Next 10 Plan				
Sector	***2016-2020***	***2021-2025***	***2026-2030***	***Total 2016-2030 Costs***
Freeways	$1,731,440,801	$1,751,074,028	$761,976,213	$4,244,491,043
Transit	747,864,728	557,208,964	624,258,500	1,929,332.192
Streets and Roads	687,083,897	574,777,031	597,036,839	1,858,897,767
Water / Environmental	27,459,164	40,775,606	49,345,968	117,580,738
Total Costs	**$3,193,848,589**	**$2,923,835,629**	**$2,032,617,521**	**$8,150,301,739**

Source: Authors analysis of OCTA Next 10 delivery plan, available at http://www.octa.net/pdf/M2_Next10DeliveryPlan.pdf.

Table 9: OCTA Freeway and Transit Project Costs from 2016 SCAG RTP/SCS, 2016-2030

OCTA Specific Costs from SCAG RTP/SCS				
	2016-2020	***2021-2025***	***2026-2030***	***Total***
Freeways	$90,469,000	S1,854,552,000	S1,133,266,000	$3,278,287,000
Transit	2,770,999,000	300,879,000	-	3,071,878,000
Total Costs	**$3,061,468,000**	**$2,155,431,000**	**$1,133,266,000**	**$6,350,165,000**

Source: Authors analysis of SCAG 2016 RTP/SCS project list, available at http://scagrtpscs.net/Documents/2016/final/f2016RTPSCS_ProjectList.pdf.

Tables 6 and 7 illuminate overall patterns, even with the shortcomings inherent in comparing data based on project end date and different time periods. First, note that transportation construction spending from neighboring counties is substantial, with Los Angeles County programming approximately four to six times as much construction as Orange County in the 2016-2020 and 2021-2025 time periods (highlighted in Table 10 below). Riverside and San Bernardino Counties are pursuing construction programs that are at least as large as Orange County's Next 10 program.

Table 10: Regional Construction Costs for Freeways and Transit, 2016-2025

Overall Southern California Regional Construction Costs for 2016-2025 Period (Freeways and Transit)	
Los Angeles	$47,662,265,000
San Bernardino	$11,910,610,952
Riverside	$10,012,235,000
Orange County Measure M (Next 10 Projects) Total	$4,787,588,521
Orange County Overall Total[10]	**$9,892,556,521**

Source: Authors analysis of SCAG 2016 RTP/SCS Project List available at http://scagrtpscs.net/Documents/2016/final/f2016RTPSCS_ProjectList.pdf and Authors analysis of OCTA Next 10 delivery plan, available at http://www.octa.net/pdf/M2_Next10DeliveryPlan.pdf.

[10] Orange County Overall Total may include potential double counting of some costs of certain construction projects from the SCAG RTP/SCS and Next 10 Delivery Plan and, as such, this total should be seen as the upper limit of overall construction costs in Orange County.

Some cautions are necessary. The data in Tables 6 through 10 allocate project costs based on completion dates. For projects in the 2016-2020 time period, contracts may have already been signed, staffing might be in place, and the cost pressure might be present and may have been for some time. The pattern in Tables 6 and 7 shows a higher level of spending in 2016-2020 and a drop-off in 2026-2030, and both are likely artifacts of the necessity of assigning project cost based on end year. For projects ending in 2016-2020 (some are likely now complete), assigning all costs to the current five-year window includes expenditures that were likely from earlier, before 2016, time periods. For 2026-2030, some projects with end dates after 2030 will likely be in progress, but those costs will not be included. Hence there should be caution against interpreting that expenditures in the region will decline during the time trend from 2016 through 2030.

OCBC's analysis reaches the following conclusions:

1. Expenditures in neighboring counties are large, and will be a source of potential price pressure for OCTA now and through the next ten years. While Los Angeles County's program is the largest, Riverside and San Bernardino are also pursuing ambitious transportation programs and will be a source of cost pressure.

2. The region's transportation program, through the next ten years, is more focused on highways than transit. OCTA, with a relatively highway focused program, might view highway programs as the primary competition for materials and labor. That focus may be too narrow – transit infrastructure likely uses some of the same materials and skilled labor as do highways. The analysis in Tables 6 and 7 shows that, regardless of assumptions about how transit construction competes for inputs with highway construction, the programs in neighboring counties provide more funds for highways than for transit.

On net, Tables 6 and 7 show that transit is approximately 26 percent of the projects with end dates between 2016 and 2030 in the three counties that border Orange County. That is a relatively highway-focused construction program. The OCBC team compared that to two other data sources. Los Angeles County's Measure M, passed in 2016, allocates 35 percent of its funds for transit construction, 17 percent for highway construction, and 16 percent to local return.[11] If local return is spent mostly on street and road projects, Measure M, the most recent sales tax measure in Los Angeles, will split roughly 50-50 across transit and highway construction, and other funds (state, federal) are consistent with more total expenditures on highway than on transit construction, even in Los Angeles County. Our analysis also examined the funding split for capital projects in the SCAG RTP, 2016 through 2030. Of those capital projects, 33.3 percent are

[11] Proposed Ordinance #16-01, Measure M, Los Angeles County Traffic Improvement Plan, available at http://theplan.metro.net/wp-content/uploads/2016/09/measurem_ordinance_16-01.pdf.

for transit and passenger rail, again suggesting that the bulk of SCAG region capital projects will be for roads and highways.[12]

Overall the SCAG region is in the midst of an ambitious capital construction program, with neighboring counties commissioning work that, in Riverside and San Bernardino, at least matches and, combined, exceeds the scale of Orange County. Los Angeles County's work program is approximately four to six times larger than Orange County's over the course of the 2016-2025 period. This creates the potential for substantial market pressures from demand for construction materials and skilled labor from neighboring county programs.

[12] Data on capital projects for SCAG region are from SCAG 2016 RTP, Transportation Finance appendix, Table 8, p. 20, available at http://scagrtpscs.net/Documents/2016/final/f2016RTPSCS_TransportationFinance.pdf.

F. Increasing Construction Wage Pressure

Table 11 shows construction sector wages from the U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages for Los Angeles, Orange, Riverside, and San Bernardino Counties, 2012 to 2016.

Table 11:Construction Wages and Growth Rate, Orange and Neighboring Counties, 2012-2016

County	2012	2013	2014	2015	2016	% annual growth, 2012-2014	% annual growth, 2014-2016
Los Angeles	$ 55,774.83	$ 56,610.48	$ 57,995.30	$ 61,304.54	$ 63,366.75	1.97%	4.53%
Orange	$ 61,830.50	$ 61,441.55	$ 63,494.49	$ 66,898.66	$ 69,195.51	1.34%	4.39%
Riverside	$ 48,063.63	$ 48,520.23	$ 50,358.97	$ 53,819.94	$ 55,834.20	2.36%	5.30%
San Bernardino	$ 51,890.65	$ 52,297.51	$ 52,397.23	$ 55,594.93	$ 57,341.12	0.49%	4.61%

Source: U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages, NAICS codes 2362 (nonresidential building construction), 2361 (residential building construction), 237 (other heavy construction), 2382 (building equipment contractors), 2381 (building foundation and exterior contractors), 2383 (building finishing contractors), 2389 (other specialty trade contractors.)

Construction wage growth in all four counties has accelerated since 2014, likely reflecting labor demand pressures in those sectors. Since 2014, annualized wage growth has ranged from 4.39 percent (Orange) to 5.3 percent (Riverside). This reflects stronger wage growth than the national economy. The Federal Reserve Bank of Atlanta tracks wage growth, and has estimated that since 2014, monthly year-on-year wage growth in the national economy has ranged from 2.3 percent (January, 2014) to 3.9 percent (October, 2016).[13]

This is consistent with recent evidence that building construction, particularly in the Inland Empire, has accelerated.[14] Historical data suggest that construction employment can expand or contract substantially with economic cycles, but periods of high construction employment have coincided with periods of high public sector infrastructure costs when measured by the Caltrans CCI. If the private sector economy continues to grow, coupled with the large public sector construction programs in southern California, pressure on construction wages and hence on public sector construction costs will likely increase.

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[13] The Federal Reserve Bank of Atlanta national wage tracker is available at https://www.frbatlanta.org/chcs/wage-growth-tracker.aspx?panel=1.

[14] The Orange County Register reported in May of 2017 that Riverside and San Bernardino Counties added 12,200 construction jobs, year on year, as of March 2017. See Jonathan Lansner, "California, Inland Empire in building booms: 6 things to know," Orange County Register, May 2, 2017, available at http://www.ocregister.com/2017/05/02/california-inland-empire-in-building-booms-6-things-to-know/.

Apprenticeship programs and other education and training programs such as those offered by community colleges can help build the pipeline of skilled construction labor, and hence mitigate construction cost pressures. The construction industry has an extensive internship tradition. Approximately two-thirds of all apprenticeships registered with the U.S. Department of Labor are in the construction industry.[15] Seventy-four percent of all construction apprenticeships are represented by the North America's Building Trades Unions (NABTU), which operates apprenticeship programs through approximately a billion dollars of funding nationally in more than 1,600 teaching centers.[16]

Locally, the Los Angeles and Orange Counties Building and Construction Trades Council is an umbrella association representing 48 local unions and district councils in 48 trades and over 100,000 members.[17] Given that public sector construction is often unionized, the Building and Construction Trades Council could be a possible partner in launching or expanding apprenticeship programs aimed at the public works market. Such apprenticeship programs would be particularly appropriate given the prospects for continued sustained demand for public works construction.

G. Recession

The current economic expansion is eight years old.[18] A recession during the ten-year extended Next 10 forecasting window is likely if historic patterns of economic expansion and contraction are any guide. Yet timing such an economic contraction is highly difficult, and beyond the scope of this research. A recession will slow demand for residential construction, and exert downward cost pressure on public works projects, but that effect will be countervailed by the large public works programs in Los Angeles and neighboring counties. Those programs are not immune from economic contractions – sales tax revenues typically drop during recessions. But the base level of public sector infrastructure spending in Southern California will be high due to county sales tax infrastructure construction programs regardless of the status of the business cycle.

These risk factors, and possible OCTA mitigating actions, are summarized in Table 12 below:

Table 12: Risk Factors, Effect on Public Works Costs, and Some Possible OCTA Mitigations

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[15] Case Western Reserve University and U.S. Department of Commerce, *The Benefits and Costs of Apprenticeship: A Business Perspective*, Nov., 2016, p. 65, available at http://www.esa.gov/sites/default/files/the-benefits-and-costs-of-apprenticeships-a-business-perspective.pdf.

[16] Ibid.

[17] See http://laocbuildingtrades.org/about-building-trades/.

[18] According to the National Bureau of Economic Research, which dates business cycles and hence recession start and end dates, the Great Recession ended in June of 2009. See http://www.nber.org/cycles.html.

Risk Factor	Impact on Costs	Likelihood	Comments	Possible OCTA Mitigations
Sustained low unemployment	Increases costs beyond Table 5 model prediction	Likely in the next 2 to 5 years	Wage pressure is still low, suggests that the economy has continued room to expand without necessitating policy efforts (i.e. interest rate increases) that would induce a recession	Accelerate the next 2 to 3 years of the Next 10 plan. Increase the supply of contractors.
Increased Building Permitting (and hence residential construction)	Increases costs	Unlikely given long-term political factors, but regulatory change could be sudden	Increasing permitting depends in part on state or local political changes, but Inland Empire construction has been increasing rapidly	Accelerate next 2 to 3 years of the Next 10 plan. Labor force training to increase supply of skilled construction labor.

Risk Factor	Impact on Costs	Likelihood	Comments	Possible OCTA Mitigations
Continued Consolidation in Construction and Architecture/Engineering Industry	Increases costs in near-term, then pressure for costs to remain high	Likely, given recent consolidation trends	The industry has been consolidating. Unclear whether that trend has played out or will continue.	OCTA becomes a preferred client Reduce barriers to new entrants into OCTA bid process Innovate in ease of doing business with OCTA
Interest Rate Increases	Short-term cost increases as financing costs, for OCTA and contractors, increase – long-term downward cost pressure if recession ensues	Highly likely to have moderate interest rate increases in next 2 to 5 years	U.S. is near historically low interest rates; global savings glut will exert downward pressure on interest rates; on net, rate increases likely to be moderate and sustained	Complete financing agreements in the near-term to avoid higher interest rates

Risk Factor	Impact on Costs	Likelihood	Comments	Possible OCTA Mitigations
Neighboring County Transportation Programs Exert Cost Pressure	Increases Costs	Highly Likely; current work programs in neighboring counties meet or exceed level in Orange County	Recent self-help sales tax increases “lock in” sustained demand for public works contractors in Southern California	OCTA becomes a client of choice Simplify the bid process and process of doing business with OCTA Accelerate Next 10 plan to lock in prices before peak market pressure from neighboring counties
Increasing Construction Wage Pressure	Increases Costs	Likely in foreseeable future, unless residential market reverses course (which would likely coincide with a recession)	Construction wages increases by from 4.39 to 5.3 percent annually, 2014 to 2016, in Orange and neighboring SCAG region counties	Accelerate Next 10 plan in advance of additional increases in construction wages Support efforts to increase the pool of construction labor

Risk Factor	Impact on Costs	Likelihood	Comments	Possible OCTA Mitigations
Recession	Decreases Costs	Likely within the next 10 years, but timing highly uncertain	Recession will reduce demand for private sector residential and commercial construction, but public sector demand will remain although sales tax revenues will drop in a recession	Timing uncertainty makes mitigation measures, beyond those listed above, difficult to implement.

The risk factors above create cost pressures that are in opposing directions, with varying possible timing and certainty, and with varying mitigation measures that may, in some cases, be at odds with each other. Our research judges the most likely risk factors (near-term) to be sustained low unemployment, increases in residential construction, cost pressure from neighboring county public works programs, and increasing construction wage pressure. . All are features of today's environment. The largest risk, in terms of magnitude on public works costs, would be changes in the residential construction regulatory environment – an unlikely outcome but one that has the potential to create large cost pressures if that leads to a residential building boom. Such a regulatory risk hinges on political factors, and our analysis suggests that OCTA monitor the politics surrounding the regulatory approval process for residential permitting and construction. Note that changes that simplify or speed the project approval process could lower OCTA's costs, and the increased cost pressure from residential building if permitting and approvals became easier could be countervailed by lower costs to OCTA from more rapid approval of the agency's projects.

The OCBC analysis predicts cost pressures that will remain high, with the potential for cost increases that exceed model predictions at least in the near-term (next 2 to 5 years). When possible, OCTA might accelerate the first five years of the Next 10 Plan to avoid cost increases. Our analysis notes that significant additional near-term acceleration in the Next 10 Plan may be unrealistic, given that OCTA has worked to accelerate projects to the extent possible. More importantly, the supply of public works contractors and competition for their services promises to be a key cost factor going forward. For that reason, OCTA should do what it can to increase the supply of bidders for projects, doing what it can to remain a preferred client for public works contractors.

III. Cost Factor Analysis

OCBC collected data from 1983 through 2016, annually, for cost factors from two data sources – Caltrans and Engineering News Record (ENR). As with the indices analyzed in the previous section, the Caltrans data are for the entire state, and the ENR data are for the Los Angeles metropolitan area. The Caltrans data are from bids, and reflect data for public works transportation projects from what can be relatively small samples. The ENR data are from a survey of businesses, and represent private sector construction costs better, but each ENR cost factor is from one supplier, limiting the ability of the ENR data to reflect market averages. In many cases, materials costs across public and private sector jobs may be the same, but differences in contracting practices, the size of the job, and the timespan of the project could lead to differences in buying power across public and private entities.

Table 13 lists the Caltrans cost factor data, with units shown in the column headers, and Table 14 lists the ENR cost factor data, also with units in the column headers.

Table 13: Caltrans Cost Factors, 1983 through 2016, State of California

Year	*Roadway Excavation ($/Cu Yd)*	*Aggregate Base ($/Ton)*	*Asphalt Concrete Pavement ($/Ton)*	*PCC Pavement ($/Cu Yd)*	*Class A PCC Structure ($/Cu Yd)*	*Bar Reinforcing Steel ($/Lb)*	*Structural Steel ($/Lb)*
1983	2.1	9.2	27.57	52.04	225.84	0.335	2.155
1984	3.19	13.67	28.38	55.79	238.48	0.375	2.155
1985	2.77	11.55	30.15	64.13	232.39	0.413	2.288
1986	3.01	12.76	28.82	60.49	249.74	0.412	2.388
1987	2.97	17.57	27.54	70.62	280.4	0.418	2.546
1988	4.16	10.13	27.46	58.66	284.55	0.44	3.956
1989	4.19	10.62	29.43	73.78	303.49	0.483	3.103
1990	4.73	12.05	30.77	68.93	295.24	0.469	2.209
1991	3.08	10.07	33.43	62.64	295.21	0.431	2.284
1992	3.62	9.76	32.46	66.78	265.31	0.419	3.073
1993	4.53	9.89	35.41	66.76	243.79	0.464	2.706
1994	4.68	10.39	37.15	66.45	277.92	0.547	2.334
1995	4.1	10.18	35.29	63.85	298.8	0.499	2.266
1996	3.8	9.74	37.66	65.93	321.88	0.512	2.172
1997	5.25	10.29	36.07	78.48	308.54	0.496	2.337
1998	4.95	11.55	38.78	75.91	319.95	0.553	2.595
1999	6.55	12.86	40.14	77.95	321.22	0.521	3.215
2000	6.21	11.14	45.12	78.14	363.59	0.507	2.754
2001	5.83	14.58	43.89	75.74	425.17	0.612	3.906
2002	4.84	12.42	49	74.15	363.5	0.508	3.248
2003	5.05	15.05	48.35	109.96	362.75	0.6	1.71
2004	13.11	16.97	53.55	135.94	399.64	0.947	5.39
2005	14.13	20.61	75.72	171.22	567.31	0.968	2.666
2006	12.8	20.26	86.04	179.67	630.16	1.039	3.734
2007	10.84	20.54	85.48	204.69	566.25	0.935	6.966
2008	11.39	17.9	78.5	177.91	553.62	0.938	5.183
2009	9.37	14.91	80.38	125.41	484.78	0.593	4.492
2010	7.94	14.2	80.25	122.82	483.64	0.716	2.149
2011	11.82	14.12	87.11	135.4	427.76	0.83	2.102
2012	8.24	14.66	89.36	132.52	461.23	0.927	2.497
2013	8.98	18.6	100.11	157.26	538.01	1.01	5.57
2014	17.49	23.1	96.97	206.22	660.64	1.12	10.132
2015	15.87	22.85	105.09	194.14	652.86	1.2	15.54
2016	21.1	25	121.43	210.83	702.98	1.62	19.62

Source: California Department of Transportation, Highway Construction Price Index Reports;
http://www.dot.ca.gov/hq/esc/oe/hist_price_index.html

Table 14: Engineering News Record Cost Factors, 1983 – 2016, Los Angeles Metropolitan Area

Year	Asphalt Average ($/Ton)	Portland Cement ($/Ton)	Gravel (>3/4 Inch; $/Ton)	Gravel (<3/4 inch; $/Ton)	Crushed Stone ($/ Ton)	Sand Concrete ($/Ton)	Std. Structural Shapes ($/CWT)	I-Beams ($/CWT)	Reinforcing Bars ($/CWT)
1983	165.00	66.06	5.40	5.47	3.97	6.18	42.63	44.63	14.00
1984	173.00	62.75	7.67	7.82	8.15	7.88	43.42	45.14	13.66
1985	180.50	63.86	7.93	8.01	8.23	8.04	43.40	44.82	12.97
1986	187.00	63.93	8.05	8.07	8.32	8.13	43.49	44.87	13.02
1987	196.00	63.94	8.20	8.19	8.44	8.30	43.69	45.01	12.25
1988	163.55	65.95	8.23	8.24	7.70	8.33	34.01	35.94	14.81
1989	115.10	66.40	8.20	8.25	6.97	8.35	25.65	28.77	17.80
1990	118.08	66.75	8.38	8.48	7.03	8.40	25.72	28.90	17.93
1991	115.50	64.93	8.65	8.58	6.99	8.35	26.33	28.78	18.15
1992	94.63	63.48	8.78	8.08	6.68	6.68	23.77	24.70	18.90
1993	96.93	63.85	9.15	8.65	6.94	6.10	23.10	23.68	21.43
1994	108.95	63.58	9.20	8.72	7.36	6.25	24.62	25.83	23.90
1995	115.04	65.55	9.28	9.05	7.20	6.33	25.80	25.91	25.90
1996	120.23	70.84	9.70	9.31	7.45	6.56	26.32	24.47	27.00
1997	128.07	74.11	9.86	9.68	7.67	6.63	26.48	25.20	26.86
1998	134.74	76.91	9.92	9.56	7.76	6.97	27.30	27.11	26.79
1999	125.42	77.91	9.83	8.87	7.94	6.90	27.03	26.86	25.60
2000	126.61	79.04	9.42	8.66	8.13	6.94	26.83	26.88	26.57
2001	145.03	79.63	9.35	8.86	7.82	6.97	27.11	27.02	27.33
2002	147.19	81.02	9.93	9.66	7.96	7.10	26.97	27.24	26.08
2003	165.35	81.99	10.94	10.20	8.02	7.48	26.15	25.96	24.91
2004	175.34	82.48	10.81	10.25	8.09	7.52	29.51	29.74	29.57
2005	214.55	86.41	10.26	10.41	8.30	7.63	32.98	34.03	34.40
2006	232.28	88.77	10.50	10.46	8.44	7.94	35.52	37.31	35.52
2007	268.39	94.60	10.52	10.41	8.55	8.05	38.25	39.97	35.99
2008	283.31	98.00	10.50	10.04	8.90	8.29	42.83	44.17	39.16
2009	284.26	98.02	10.50	10.01	8.90	8.30	45.49	46.71	41.41
2010	284.26	98.02	10.50	10.01	8.93	8.30	45.49	46.71	41.41
2011	284.26	98.02	10.50	10.01	8.93	8.30	43.97	42.85	32.78
2012	309.57	101.76	10.65	10.36	8.93	8.68	43.62	42.34	31.99
2013	345.00	107.00	10.87	10.86	8.93	9.20	43.40	42.18	31.97
2014	345.00	107.00	10.87	10.86	8.93	9.20	43.45	42.23	32.03
2015	348.83	112.79			8.95	9.25	44.75	43.18	34.23
2016	358.52	114.90			9.25	9.22	49.74	50.73	45.00

Source: Engineering News Record Construction Economies Archive, http://www.enr.com/economics/current_costs

Graphing these cost factor trends over time is instructive, but because that involves seven graphs for the Caltrans cost factors and nine graphs for the ENR cost factors, those graphs are shown in Figures A6 through A21 of the appendix. Figures A6 through A12 display the Caltrans cost factors over time, and Figures A13 through A21 show the time trend of the ENR cost factors. Each figure shows the cost factors normalized to 100 in the beginning year of 1983, so that later years can be quickly interpreted as a percentage of the 1983 value. Each figure also shows the normalized building permit data, 1983 through 2016, for visual comparison with the cost factor time trend. Building permit data are for California when shown on the Caltrans cost factor graphs and for the Los Angeles metropolitan area when shown for the ENR cost factor graphs.

Some trends are evident from Appendix Figures A6 through A21. First, the cost factors increase after 2012 or 2013 – a trend that is consistent with the Caltrans CCI trend. The Caltrans cost factors show rapid increases after 2012, with the largest percentage increases for roadway excavation costs and structural steel (Figures A6 and A12, respectively.) The ENR cost factors also increase starting around 2012, but the increase is smoother and more modest than for the Caltrans cost factors. For the ENR cost factors, those related to steel (Figures A19 through A21) show the largest percentage increases, qualitatively consistent with the Caltrans information, although the magnitude of increases are generally smaller in the ENR cost factors. The smoother ENR trend is likely due to the fact that ENR samples one supplier of each cost factor, and individual suppliers likely change prices smoothly over time.

The individual cost factors do not display trends that are qualitatively different from the Caltrans CCI, ENR CCI, or BCI indices. Those indices are formed from the cost factors, so this is not surprising. Also, the individual cost factors show little visual relationship to building permitting activity in recent years. For both reasons, there is little reason to believe that forecasting models for individual cost factors will give insights beyond the forecasting model for the indices. For that reason, OCBC believes that an analysis of risk and uncertainties in the overall market is more important, and readers should refer to the risk analysis in Section II.

IV. Recommendations and Indicators

Going forward, risk management will be complex but important for OCTA's Next 10 Plan. OCBC suggests that OCTA develop a set of data indicators that function as an early warning system, alerting the agency to possible changes in risk factors. The following are a list of possible indicators to consider, with suggested frequency shown in parentheses:

- Overall employment/unemployment trends from the California Employment Development Department (EDD) (monthly)
- Federal Research Labor Market Conditions Index (monthly)
- Employment in construction jobs, based on the NAICS codes used in Table 11, Bureau of Labor Statistics' Quarterly Census of Employment and Wages and EDD (quarterly)

- Data on wages in construction jobs, based on the NAICS codes in Table 11, from the Bureau of Labor Statistics' Quarterly Census of Employment and Wages (quarterly)
- Building permit data, focused on Los Angeles, Orange, Riverside, San Bernardino Counties (quarterly)
- Number of bidders on County Transportation Commission projects (quarterly)
- Executive opinion from the California State University Fullerton Orange County Business Expectations (OCBX) Survey (quarterly)
- Chapman University Orange County Composite Index (quarterly)
- Chapman University Consumer Sentiment Index
- Commercial and industrial vacancies, CoStar (quarterly)
- Commodity prices, focused on aggregate base, concrete and PCC pavement, and bar and structural steel, from Caltrans (statewide) and from Los Angeles (ENR), (quarterly)

Of these data, the number of bidders would require collaboration between OCTA and agencies in neighboring counties. If appropriate, OCBC suggests exploring such data sharing, to the extent feasible and allowed by law, so that agencies can see trends in the number of bids and hence any effect of industry consolidation.

More generally, the development of a data tracking system will be important in allowing OCTA to identify trends early to assess how risks are changing. In the next several years, increasing cost pressures will likely dominate factors that would tend to reduce costs.

IV. Appendix

Appendix Table A-1: California Department of Transportation Construction Cost Index (CCI), California Building Permits, Population, Employment, Total Annual Payrolls and Per Capita Personal Income Levels and Normalized (1983-2016)

California Department of Transportation Construction Cost Index (CCI), California Building Permits, Population, Employment, Total Annual Payrolls and Per Capita Personal Income Levels (1983-2016)						
	Caltrans CCI	Building Permits	Population	Employment	Total Annual Payroll	PCPI
1983	31	*172,569*	*25,337,000*	*11,372,808*	*195,054,946,160*	*14,538*
1984	36.2	*224,845*	*25,816,000*	*11,765,867*	*216,618,428,420*	*15,864*
1985	36	*272,317*	*26,402,000*	*12,125,483*	*236,522,988,980*	*16,767*
1986	37.3	*314,569*	*27,052,000*	*12,440,467*	*255,170,888,000*	*17,573*
1987	39.7	*253,171*	*27,717,000*	*12,870,917*	*279,366,221,300*	*18,491*
1988	40.5	*255,559*	*28,393,000*	*13,233,408*	*302,871,575,460*	*19,606*
1989	43.9	*237,747*	*29,142,000*	*13,583,867*	324,027,212,800	*20,576*
1990	44.1	*164,313*	*29,828,496*	*14,264,200*	*346,973,875,947*	*21,494*
1991	40.4	*105,919*	*30,458,613*	*13,960,000*	*351,494,177,154*	*21,824*
1992	40.4	*97,407*	*30,987,384*	*13,880,900*	*362,212,067,130*	*22,644*
1993	42.2	*84,656*	*31,314,189*	*13,817,000*	*363,604,887,659*	*22,964*
1994	46.2	*97,047*	*31,523,690*	*13,944,700*	*373,510,553,612*	*23,535*
1995	45	*85,293*	*31,711,849*	*14,048,200*	*392,794,301,814*	*24,595*
1996	45.6	*94,283*	*31,962,949*	*14,300,400*	*417,660,266,084*	*25,885*
1997	47.6	*111,716*	*32,452,789*	*14,784,600*	*453,907,544,517*	*27,147*
1998	49.9	*125,707*	*32,862,965*	*15,184,500*	*496,463,173,957*	*29,133*
1999	52.9	*140,137*	*33,418,578*	*15,555,300*	*541,647,241,978*	*30,663*
2000	53.5	*148,540*	*34,000,835*	*16,033,200*	*615,026,413,391*	*33,391*
2001	58.7	*145,757*	*34,512,742*	*16,197,700*	*619,146,651,267*	*34,091*
2002	53.1	*167,761*	*34,938,290*	*16,108,700*	*614,542,438,304*	*34,306*
2003	56.6	*195,682*	*35,388,928*	*16,102,800*	*630,692,095,035*	*35,381*
2004	79.1	*212,960*	*35,752,765*	*16,304,000*	*667,521,587,162*	*37,244*
2005	98.1	*208,972*	*35,985,582*	*16,582,700*	*703,992,717,929*	*39,046*
2006	104.1	*164,280*	*36,246,822*	*16,789,400*	*749,504,649,781*	*41,693*
2007	100	*113,034*	*36,552,529*	*16,931,600*	*790,444,530,437*	*43,182*
2008	95	*64,962*	*36,856,222*	*16,854,500*	*797,791,743,140*	*43,786*
2009	78.4	*36,421*	*37,077,204*	*16,182,600*	*754,405,951,731*	*41,588*
2010	76.4	*44,762*	*37,253,956*	*16,091,900*	*768,071,900,576*	*42,411*
2011	84	*47,343*	*37,674,954*	*16,258,100*	*801,387,207,989*	*44,852*
2012	79.2	*59,225*	*38,041,489*	*16,602,700*	*849,471,063,227*	*47,614*
2013	97.09	*85,472*	*38,373,434*	*16,958,700*	*878,441,319,278*	*48,125*
2014	108.32	*85,844*	*38,739,410*	*17,348,600*	*933,404,857,793*	*49,985*
2015	122.02	*98,233*	*39,059,809*	*17,723,300*	*1,005,383,368,506*	*52,651*
2016	140.75	*100,265*	*39,354,432*	*18,065,000*	*N/A*	*55,987*

Source: U.S. Census Bureau, California Employment Development Department, U.S. Bureau of Economic Analysis

Appendix Table A-1 Continued

California Department of Transportation Construction Cost Index (CCI), California Building Permits, Population, Employment, Total Annual Payrolls and Per Capita Personal Income Normalized (1983-2016)						
	Caltrans CCI	Building Permits	Population	Employment	Total Annual Payroll	PCPI
1983	100	100	100	100	100	100
1984	116.8	130.3	101.9	103.5	111.1	109.1
1985	116.1	157.8	104.2	106.6	121.3	115.3
1986	120.3	182.3	106.8	109.4	130.8	120.9
1987	128.1	146.7	109.4	113.2	143.2	127.2
1988	130.6	148.1	112.1	116.4	155.3	134.9
1989	141.6	137.8	115.0	119.4	166.1	141.5
1990	142.3	95.2	117.7	125.4	177.9	147.8
1991	130.3	61.4	120.2	122.7	180.2	150.1
1992	130.3	56.4	122.3	122.1	185.7	155.8
1993	136.1	49.1	123.6	121.5	186.4	158.0
1994	149.0	56.2	124.4	122.6	191.5	161.9
1995	145.2	49.4	125.2	123.5	201.4	169.2
1996	147.1	54.6	126.2	125.7	214.1	178.1
1997	153.5	64.7	128.1	130.0	232.7	186.7
1998	161.0	72.8	129.7	133.5	254.5	200.4
1999	170.6	81.2	131.9	136.8	277.7	210.9
2000	172.6	86.1	134.2	141.0	315.3	229.7
2001	189.4	84.5	136.2	142.4	317.4	234.5
2002	171.3	97.2	137.9	141.6	315.1	236.0
2003	182.6	113.4	139.7	141.6	323.3	243.4
2004	255.2	123.4	141.1	143.4	342.2	256.2
2005	316.5	121.1	142.0	145.8	360.9	268.6
2006	335.8	95.2	143.1	147.6	384.3	286.8
2007	322.6	65.5	144.3	148.9	405.2	297.0
2008	306.5	37.6	145.5	148.2	409.0	301.2
2009	252.9	21.1	146.3	142.3	386.8	286.1
2010	246.5	25.9	147.0	141.5	393.8	291.7
2011	271.0	27.4	148.7	143.0	410.9	308.5
2012	255.5	34.3	150.1	146.0	435.5	327.5
2013	313.2	49.5	151.5	149.1	450.4	331.0
2014	349.4	49.7	152.9	152.5	478.5	343.8
2015	393.6	56.9	154.2	155.8	515.4	362.2
2016	454.0	58.1	155.3	158.8	N/A	385.1

Source: U.S. Census Bureau, California Employment Development Department, U.S. Bureau of Economic Analysis

Appendix Table A-2: Engineering News Record Construction Cost Index (CCI) and Building Cost Index (BCI), 1983-2016; Levels and Normalized Data to 1983

Engineering News Record Construction Cost Index (CCI) and Building Cost Index (BCI), 1983-2016; Levels and Normalized Data to 1983				
	CCI	BCI	CCI (Normalized)	BCI (Normalized)
1983	5063.9	2586.6	100.0	100.0
1984	5259.9	2726.4	103.9	105.4
1985	5446.7	2664.6	107.6	103.0
1986	5452.2	2762.6	107.7	106.8
1987	5474.1	2816.5	108.1	108.9
1988	5770.8	2851.7	114.0	110.2
1989	5789.8	2855.3	114.3	110.4
1990	5994.6	3020.5	118.4	116.8
1991	6090.1	3097.8	120.3	119.8
1992	6348.6	3198.7	125.4	123.7
1993	6477.8	3334.4	127.9	128.9
1994	6533.0	3420.4	129.0	132.2
1995	6526.2	3427.3	128.9	132.5
1996	6558.4	3426.7	129.5	132.5
1997	6663.6	3560.5	131.6	137.7
1998	6852.0	3617.0	135.3	139.8
1999	6826.0	3591.0	134.8	138.8
2000	7068.0	3680.3	139.6	142.3
2001	7226.9	3694.2	142.7	142.8
2002	7402.8	3787.8	146.2	146.4
2003	7531.8	3847.3	148.7	148.7
2004	8192.1	4155.2	161.8	160.6
2005	8346.9	4274.2	164.8	165.2
2006	8640.5	4489.9	170.6	173.6
2007	8979.1	4744.4	177.3	183.4
2008	9410.6	4950.4	185.8	191.4
2009	9779.4	5076.3	193.1	196.3
2010	9906.0	5182.7	195.6	200.4
2011	10057.0	5379.8	198.6	208.0
2012	10258.7	5493.8	202.6	212.4
2013	10454.6	5553.8	206.5	214.7
2014	10740.0	5671.1	212.1	219.3
2015	11075.6	5762.0	218.7	222.8
2016	11247.8	5907.1	222.1	228.4

Source: Engineering News Record Monthly Release

Appendix Table A-3: Regression of California Department of Transportation Construction Cost Index (CCI) on California Building Permits, California Employment, California Total Annual Wages and California Population; Levels and Changes Models

Dependent Variable = California Department of Transportation Construction Cost Index (1983-2016)				
	Levels Model		Changes Model	
Caltrans CCI	Coefficient	t-statistic	Coefficient	t-statistic
CCI_{t-1}	0.5790417	1.83	1.112234	5.43
CCI_{t-2}	-0.2159114	-0.72	0.054816	0.27
California Building Permits (BP)	2.28e-06	0.03	7.56E-05	1.75
BP_{t-1}	0.0000436	0.53	0.000079	1.75
BP_{t-2}	0.000063	0.94	-5.29E-06	-0.12
California Employment (EMP)	-3.34e-06	-0.33	0.000012	1.55
EMP_{t-1}	-0.0000108	-0.91	2.26E-06	0.26
EMP_{t-2}	3.66e-06	0.40	6.09E-06	0.75
California Total Annual Wages	1.34e-10	1.20	2.65E-11	0.29
$WAGE_{t-1}$	7.32e-11	0.52	1.08E-10	1.27
$WAGE_{t-2}$	-1.33e-10	-1.27	-2.33E-10	-2.23
California Population (POP)	-0.0000203	-1.08	-2.4E-05	-1.67
POP_{t-1}	0.0000227	0.84	-7.52E-06	-0.50
POP_{t-2}	1.78e-06	0.10	4.38E-05	3.55
_Cons	5.415306	0.04	-14.1453	-1.88

Sample Size:	31	30
R-Squared:	0.9719	0.9795

Appendix Table A-4: Engineering News Record Construction Cost Index (CCI) and Building Cost Index (BCI) Regressed on Building Permits, Employment, Total Annual Wages, and Population, Los Angeles Metropolitan Area; Levels and Changes Models

Dependent Variable = Engineering News Record Construction Cost Index and Building Cost Index (1983-2016)				
	Coefficient			
	ENR CCI Levels	ENR CCI Changes	ENR BCI Levels	ENR BCI Changes
CCI ENR_{t-1} / BCI ENR_{t-1}	0.4785932	0.8609058	0.2031473	0.9382157
CCI ENR_{t-2} / BCI ENR_{t-2}	0.2711119	0.1763995	0.3854375	0.0771721
LAMSA Bldg Permits (BP_LA)	0.0004867	0.0006004	-0.0018291	-0.0002938
BP_LA_{t-1}	-0.0021584	-0.0008503	0.001916	0.0007705
BP_LA_{t-2}	-	0.0021532	-	0.0012561
LA MSA Employment (EMP)	-0.0003014	-0.0004747	-0.0002912	-0.000429
EMP_{t-1}	-0.0001717	-0.0004079	-0.000387	-0.0001544
EMP_{t-2}	0.0002593	-0.0001594	0.0001608	-0.0002407
LA MSA Total Wages	5.76e-09	6.12e-09	4.14e-09	5.75e-09
$WAGE_{t-1}$	7.02e-09	8.87e-09	7.22e-09	3.77e-09
$WAGE_{t-2}$	-4.76e-09	6.85e-09	-3.22e-09	2.95e-09
LA MSA Population (POP)	0.0000273	0.0000507	0.0000499	0.0000524
POP_{t-1}	-0.0000583	-0.0000105	-0.0000185	-6.58e-06
POP_{t-2}	-0.0000624	0.0000247	-0.0000483	0.000013
_Cons	3099.81	-211.7501	3302.414	-25.03666
Sample Size:	31	30	31	30
R-Squared:	0.9974	0.9965	0.9982	0.9967

	t-statistics (corresponding to above coefficients)			
	ENR CCI Levels	ENR CCI Changes	ENR BCI Levels	ENR BCI Changes
CCI ENR_{t-1} / BCI ENR_{t-1}	2.06	3.49	0.73	2.95
CCI ENR_{t-2} / BCI ENR_{t-2}	1.25	0.69	1.89	0.23
LAMSA Bldg Permits (BP_LA)	0.22	0.29	-1.50	-0.22
BP_LA_{t-1}	-0.79	-0.35	1.47	0.61
BP_LA_{t-2}	-	0.91	-	0.94
LA MSA Employment (EMP)	-0.58	-0.94	-1.21	-1.58
EMP_{t-1}	-0.27	-0.69	-1.25	-0.45
EMP_{t-2}	0.73	-0.40	0.95	-1.10
LA MSA Total Wages	0.87	0.84	1.41	1.47
$WAGE_{t-1}$	0.74	1.06	1.52	0.78
$WAGE_{t-2}$	-0.75	0.97	-1.07	0.76
LA MSA Population (POP)	0.43	0.83	1.66	1.57
POP_{t-1}	-0.83	-0.15	-0.54	-0.17
POP_{t-2}	-0.98	0.38	-1.48	0.38
_Cons	1.49	-1.33	2.86	-0.30

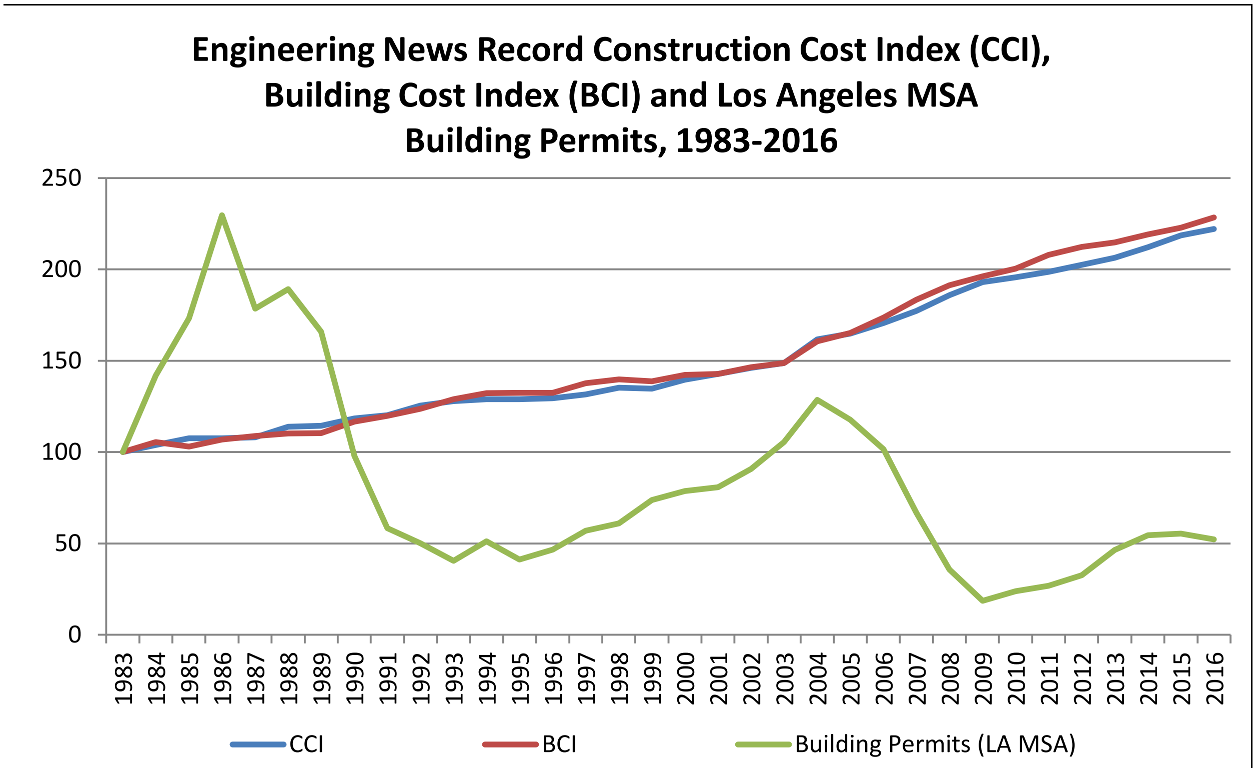
Note: "—" indicates variable dropped due to collinearity

Appendix Table A-5: California Unemployment Rate Forecasts from California Legislative Analyst's Office, California Department of Finance and California Department of Transportation, 2017-2022

California Unemployment Rate Forecasts (2017-2022)						
	2017	2018	2019	2020	2021	2022
California Legislative Analyst's Office[19]	5.3%	5.2%	-	-	-	-
California Department of Finance[20]	5.1%	5.0%	5.0%	5.0%	-	-
California Department of Transportation[21]	4.9%	5.0%	5.0%	5.1%	5.0%	5.0%

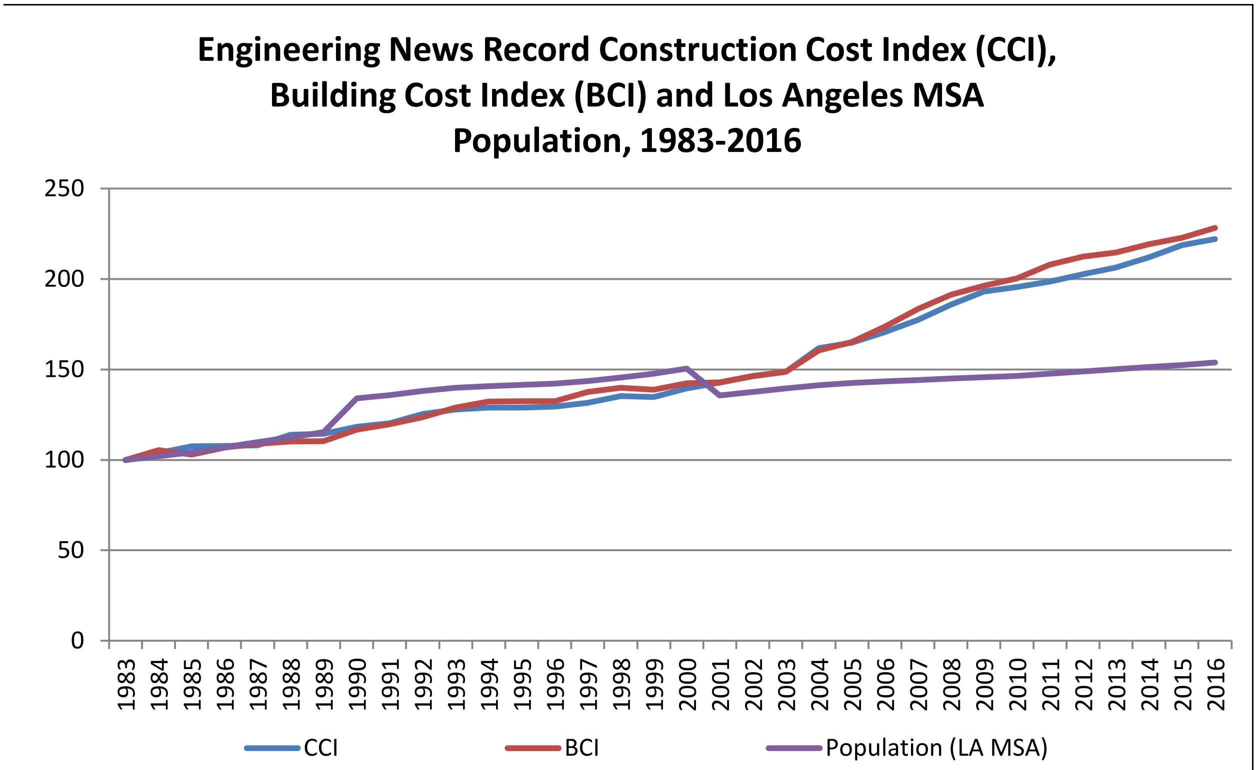
[19] http://www.lao.ca.gov/reports/2016/3507/Fiscal-outlook-111616.pdf
[20] http://www.dof.ca.gov/Forecasting/Economics/Eco_Forecasts_Us_Ca/index.html
[21] http://www.dot.ca.gov/hq/tpp/offices/eab/index_files/2016/FullReport2016.pdf

Appendix Figure A-1: Engineering News Record Construction Cost Index (CCI), Building Cost Index (BCI) and Los Angeles Metropolitan Statistical Area Building Permits (1983-2016); Normalized to 1983



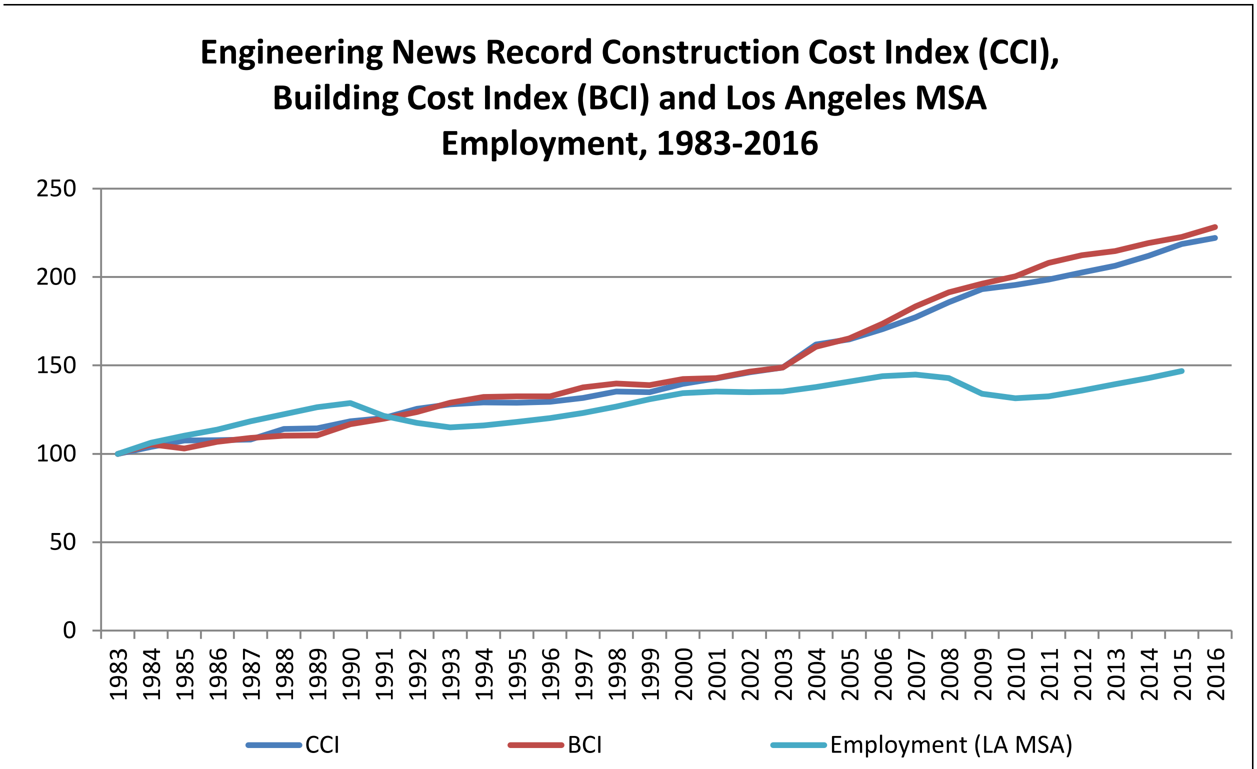
Source: Engineering News Record Monthly Release, U.S. Census Bureau Building Permit Survey

Appendix Figure A-2: Engineering News Record Construction Cost Index (CCI), Building Cost Index (BCI) and Los Angeles Metropolitan Statistical Area Population (1983-2016); Normalized to 1983



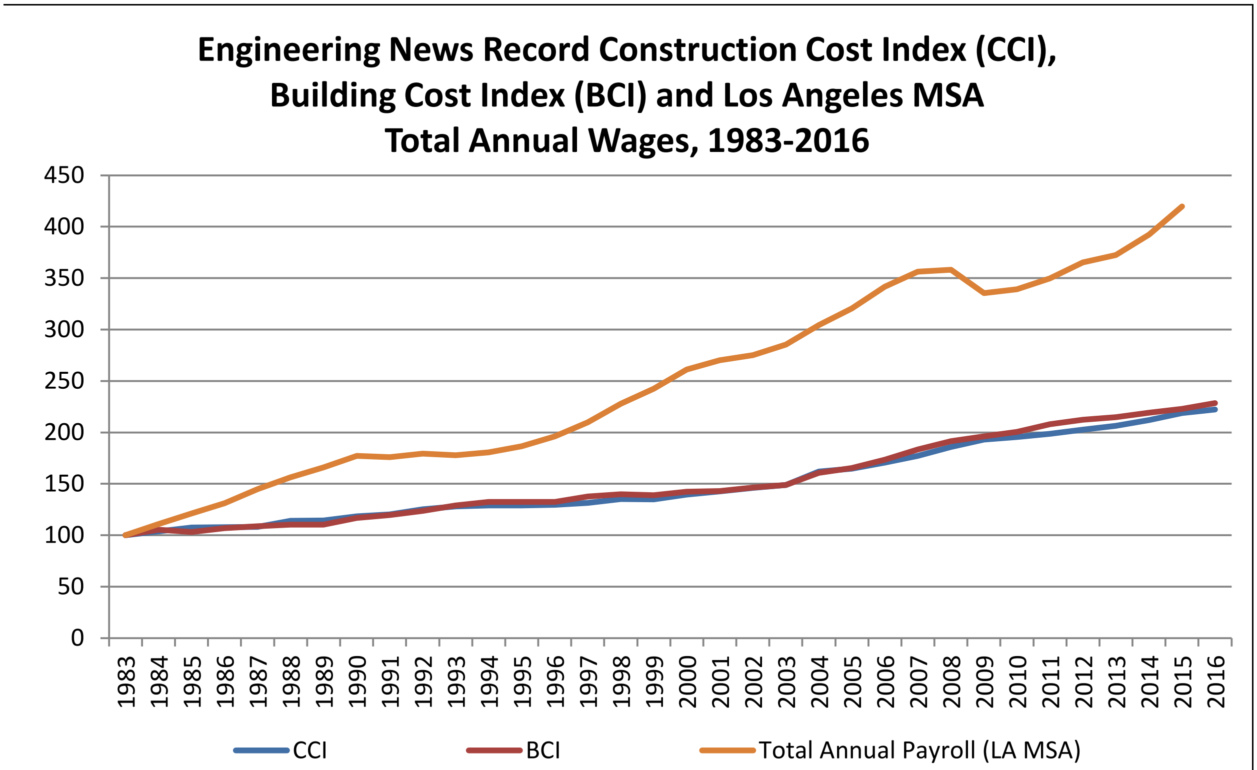
Source: Engineering News Record Monthly Release, U.S. Census Bureau

Appendix Figure A-3: Engineering News Record Construction Cost Index (CCI), Building Cost Index (BCI) and Los Angeles Metropolitan Statistical Area Employment (1983-2016); Normalized to 1983



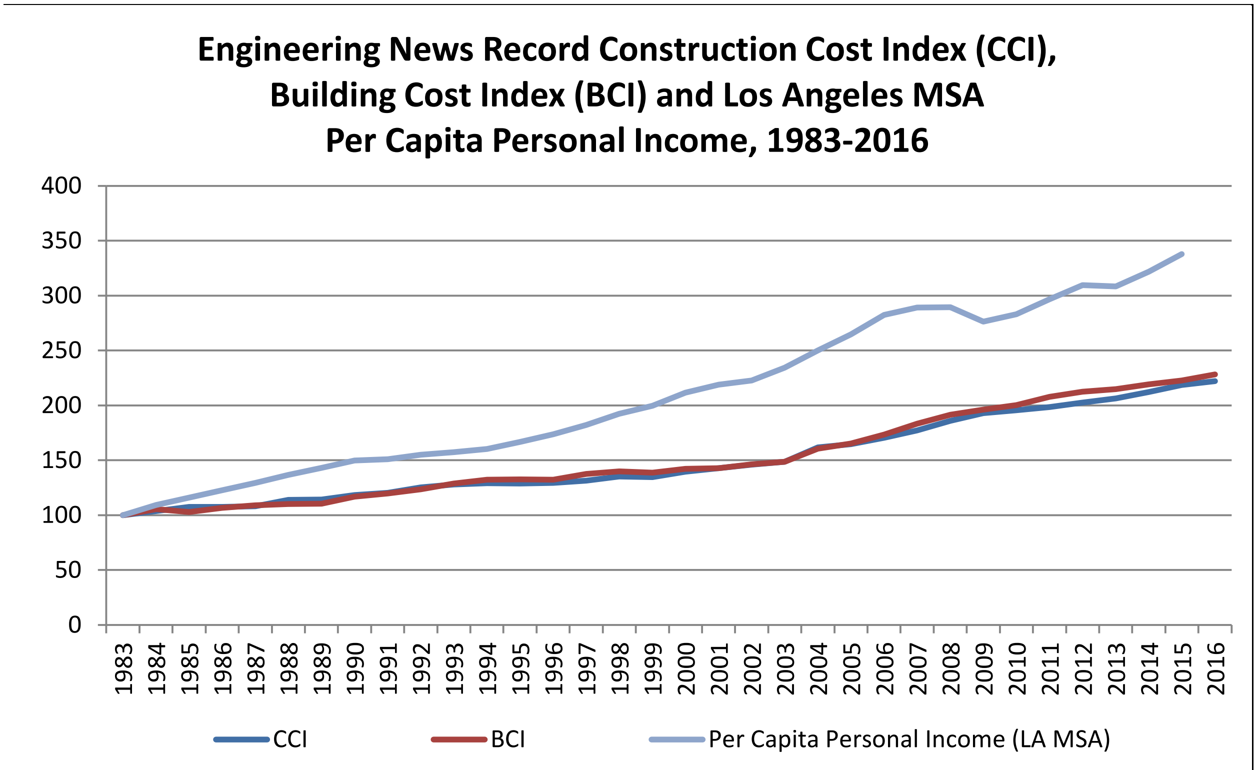
Source: Engineering News Record Monthly Release, California Employment Development Department

Appendix Figure A-4: Engineering News Record Construction Cost Index (CCI), Building Cost Index (BCI) and Los Angeles Metropolitan Statistical Area Total Annual Wages (1983-2016); Normalized to 1983



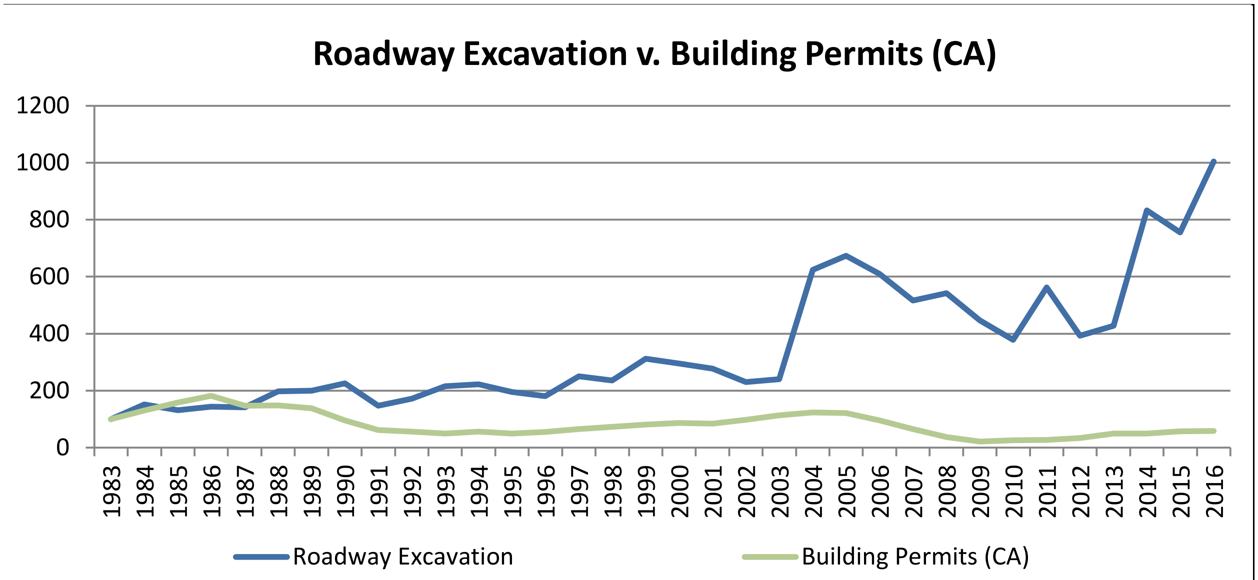
Source: Engineering News Record Monthly Release, California Employment Development Department

Appendix Figure A-5: Engineering News Record Construction Cost Index (CCI), Building Cost Index (BCI) and Los Angeles Metropolitan Statistical Area Per Capita Personal Income (1983-2016); Normalized to 1983



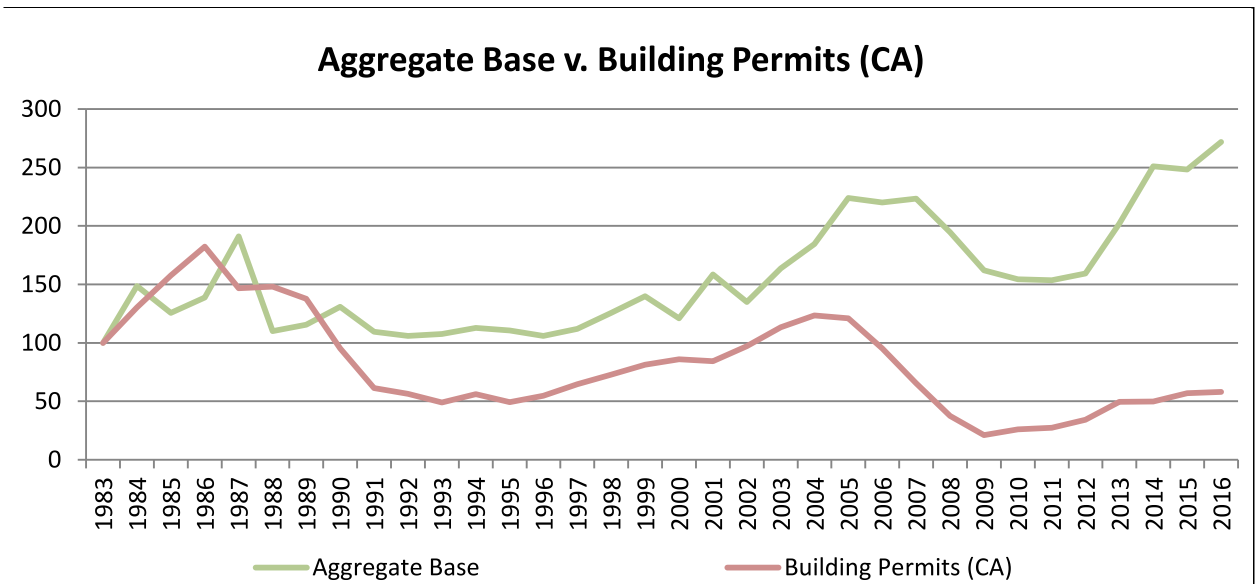
Source: Engineering News Record Monthly Release, U.S. Bureau of Economic Analysis

Appendix Figure A6: Roadway Excavation Costs versus California Building Permits, Normalized to 1983 = 100



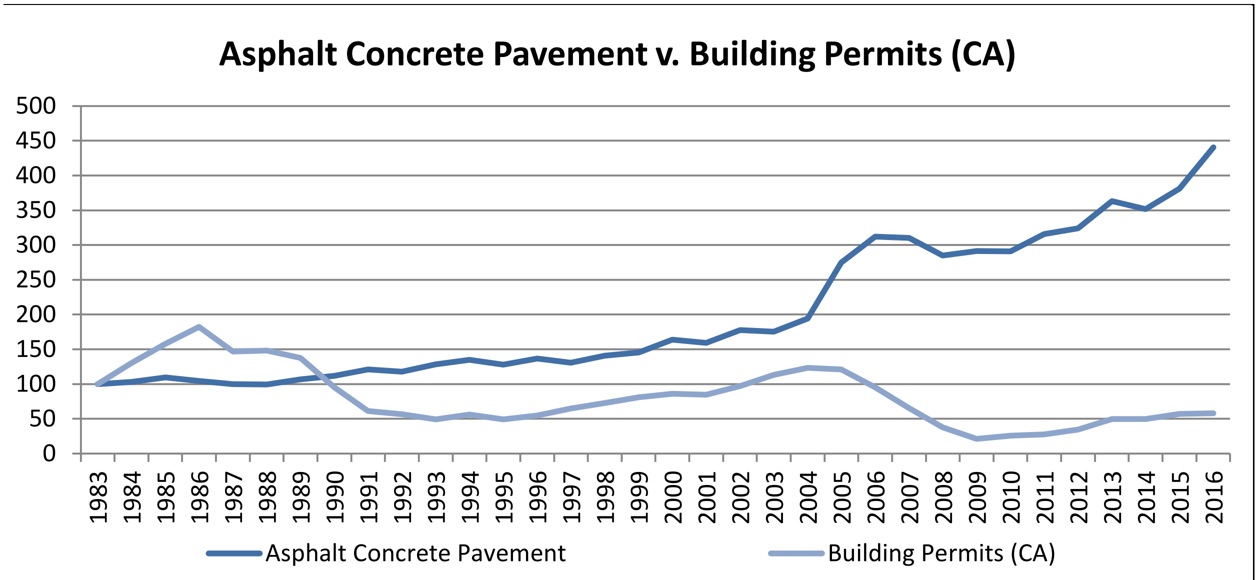
Source: California Department of Transportation, U.S. Census Bureau Building Permit Survey

Appendix Figure A7: Aggregate Base Cost versus California Building Permits, Normalized to 1983 = 100



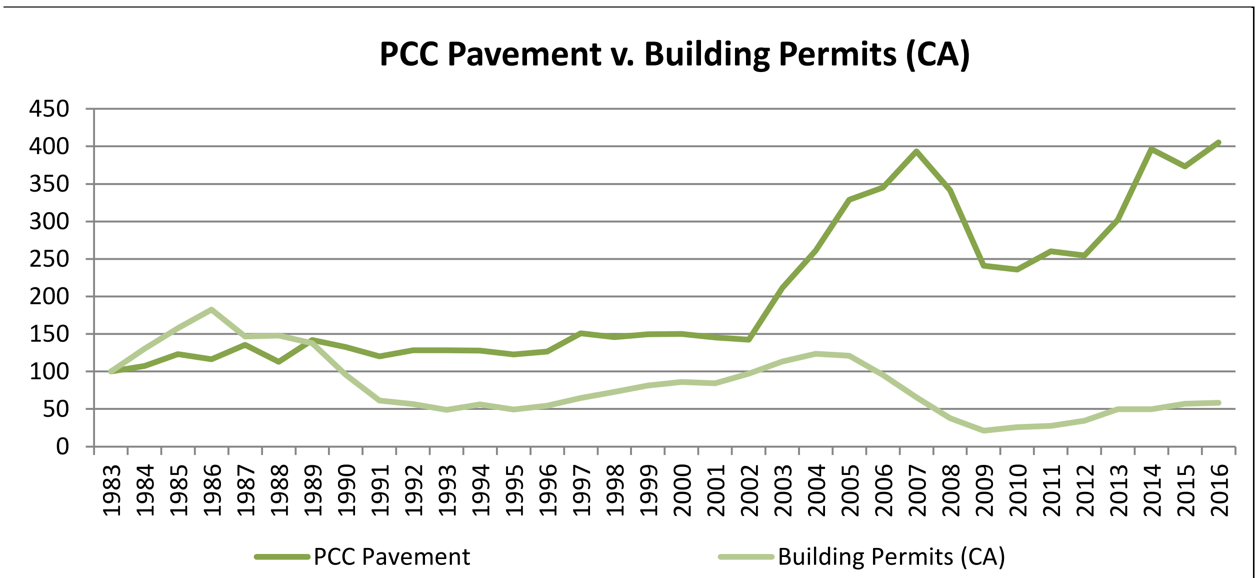
Source: California Department of Transportation, U.S. Census Bureau Building Permit Survey

Appendix Figure A8: Asphalt Concrete Cost versus California Building Permits, Normalized to 1983 = 100



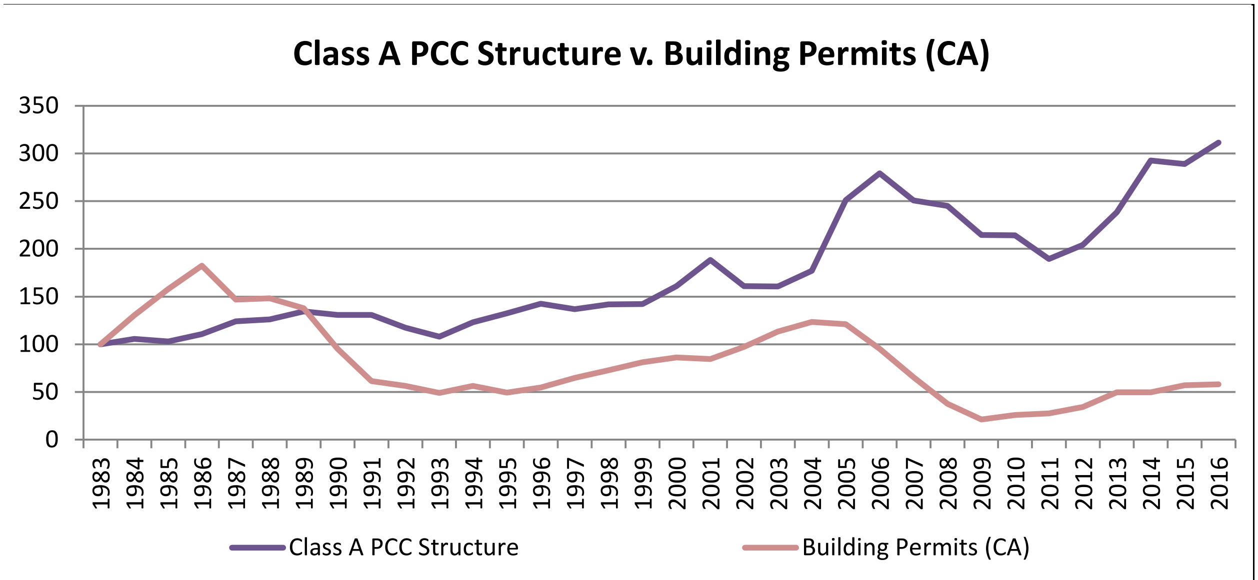
Source: California Department of Transportation, U.S. Census Bureau Building Permit Survey

Appendix Figure A9: PCC Pavement Cost versus California Building Permits, Normalized to 1983 = 100



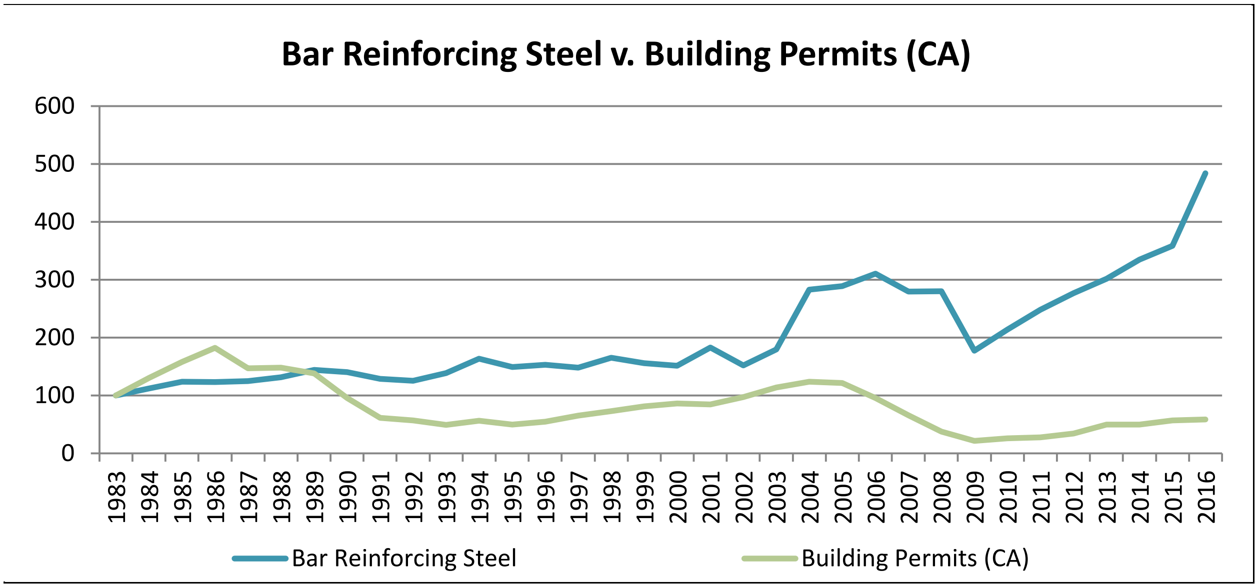
Source: California Department of Transportation, U.S. Census Bureau Building Permit Survey

Appendix Figure A10: Class A PCC Structure Cost versus California Building Permits, Normalized to 1983 = 100



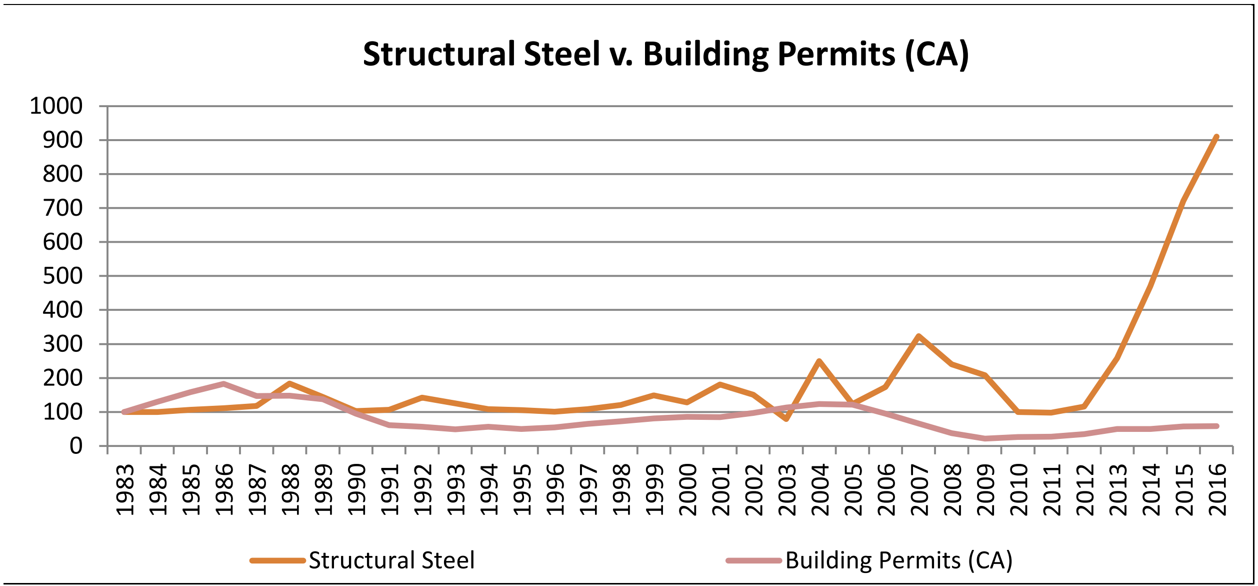
Source: California Department of Transportation, U.S. Census Bureau Building Permit Survey

Appendix Figure A11: Bar Reinforcing Steel Cost versus California Building Permits, Normalized to 1983 = 100



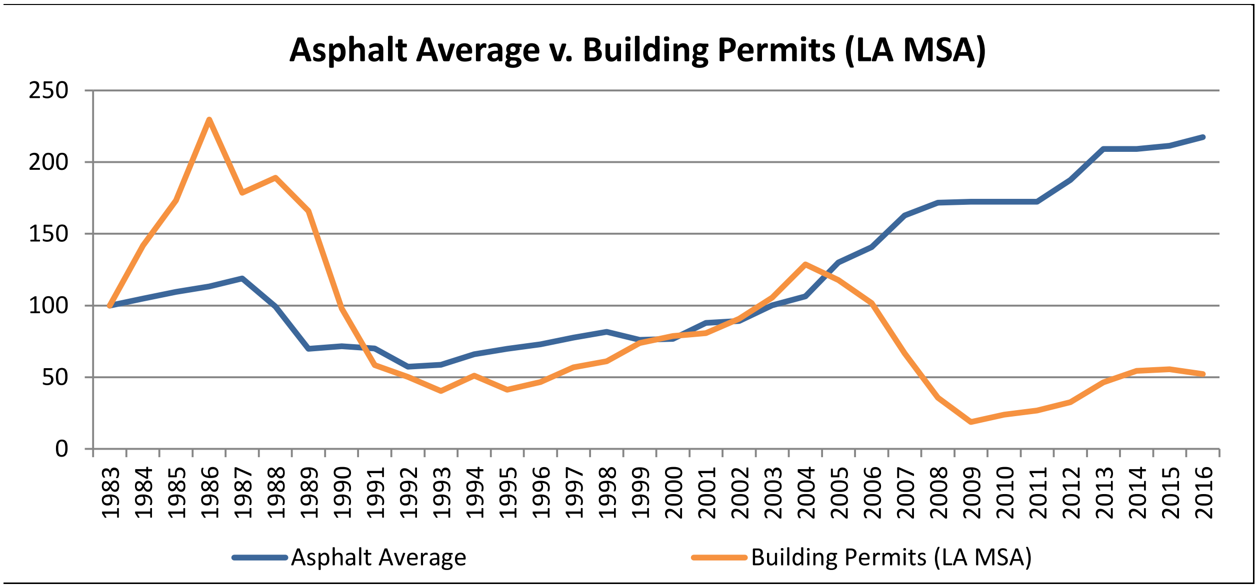
Source: California Department of Transportation, U.S. Census Bureau Building Permit Survey

Appendix Figure A12: Structural Steel Cost versus California Building Permits, Normalized to 1983 = 100



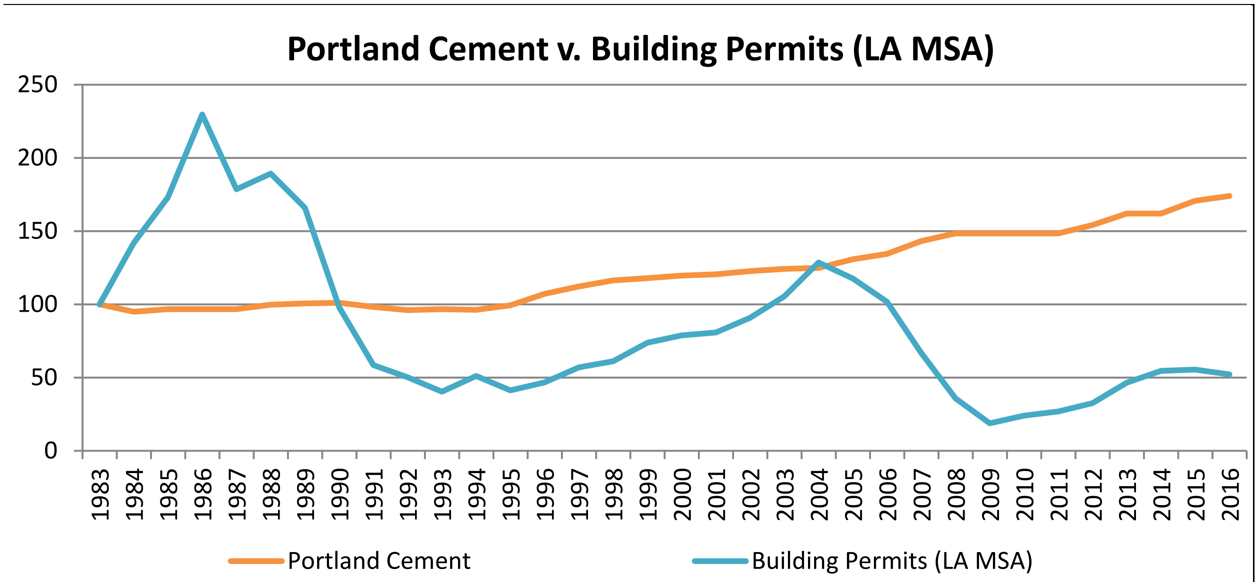
Source: California Department of Transportation, U.S. Census Bureau Building Permit Survey

Appendix Figure A13: Asphalt Cost (average) versus Los Angeles Metropolitan Area Building Permits, Normalized to 1983 = 100



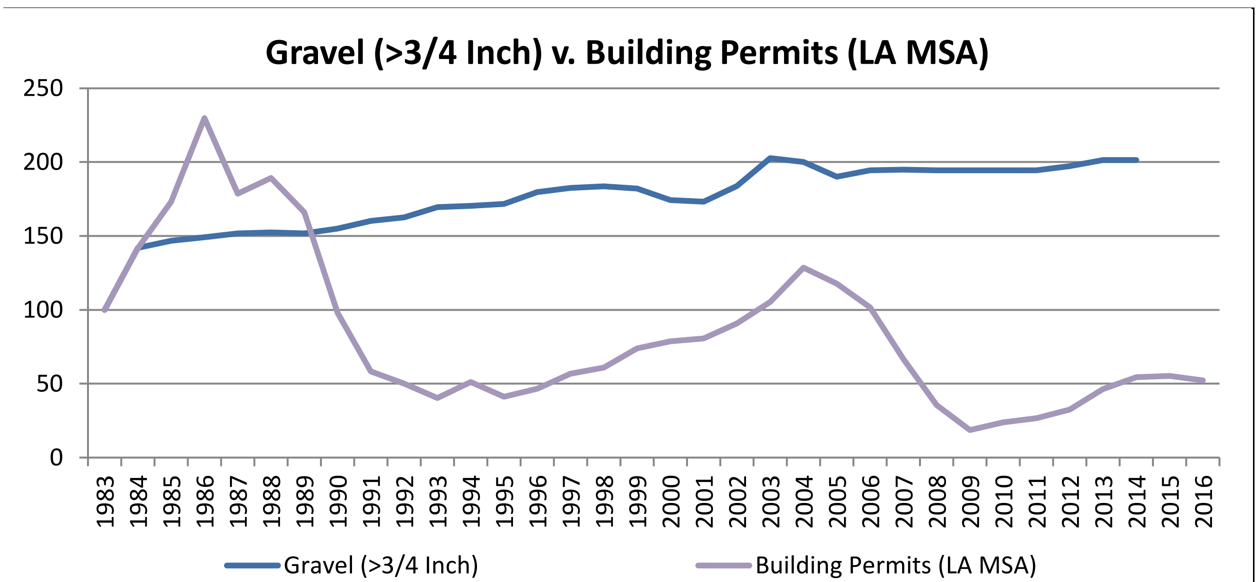
Source: Engineering News Record, U.S. Census Bureau Building Permit Survey

Appendix Figure A14: Portland Cement Cost versus Los Angeles Metropolitan Area Building Permits, Normalized to 1983 = 100



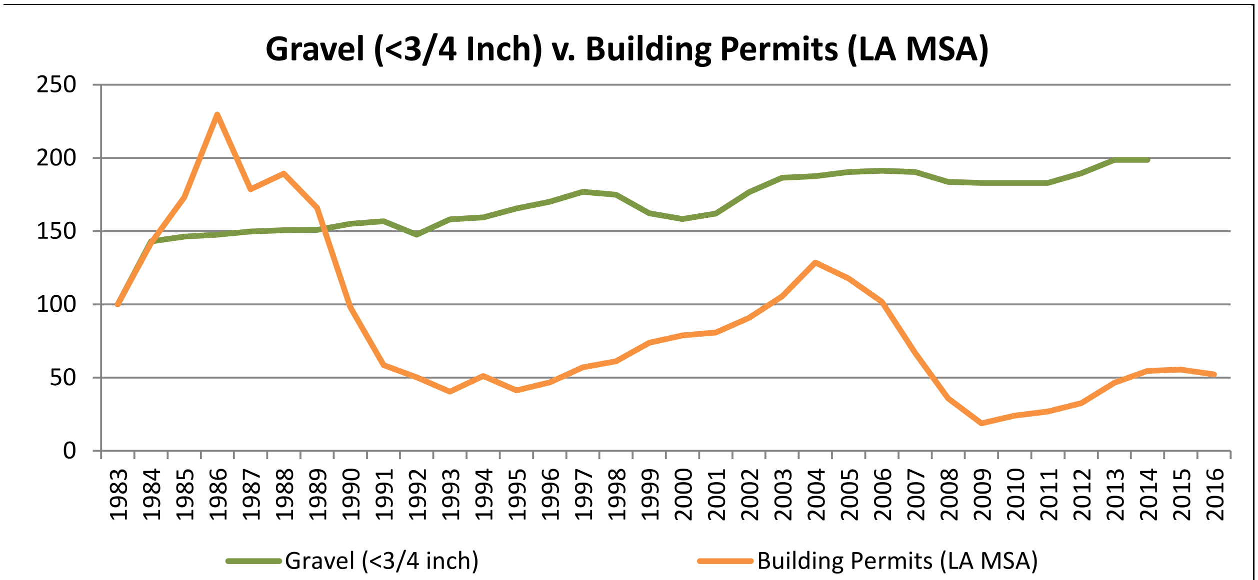
Source: Engineering News Record, U.S. Census Bureau Building Permit Survey

Appendix Figure A15: Gravel (>3/4 inch) Cost versus Los Angeles Metropolitan Area Building Permits, Normalized to 1983 = 100



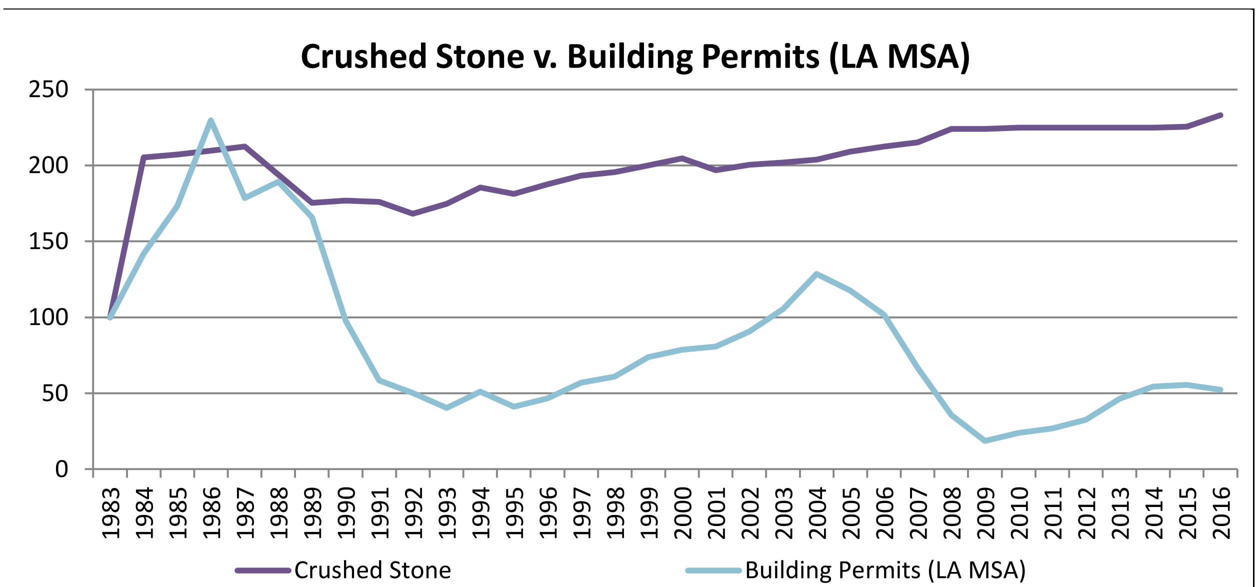
Source: Engineering News Record, U.S. Census Bureau Building Permit Survey

Appendix Figure A16: Gravel (<3/4 inch) Cost versus Los Angeles Metropolitan Area Building Permits, Normalized to 1983 = 100



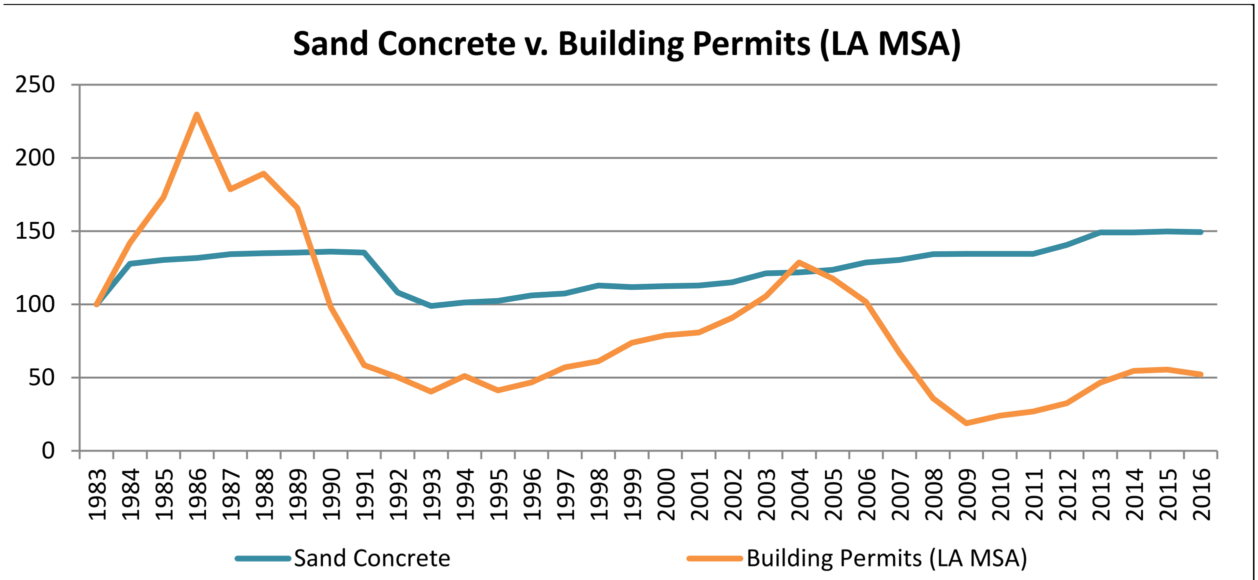
Source: Engineering News Record, U.S. Census Bureau Building Permit Survey

Appendix Figure A17: Crushed Stone Cost versus Los Angeles Metropolitan Area Building Permits, Normalized to 1983 = 100



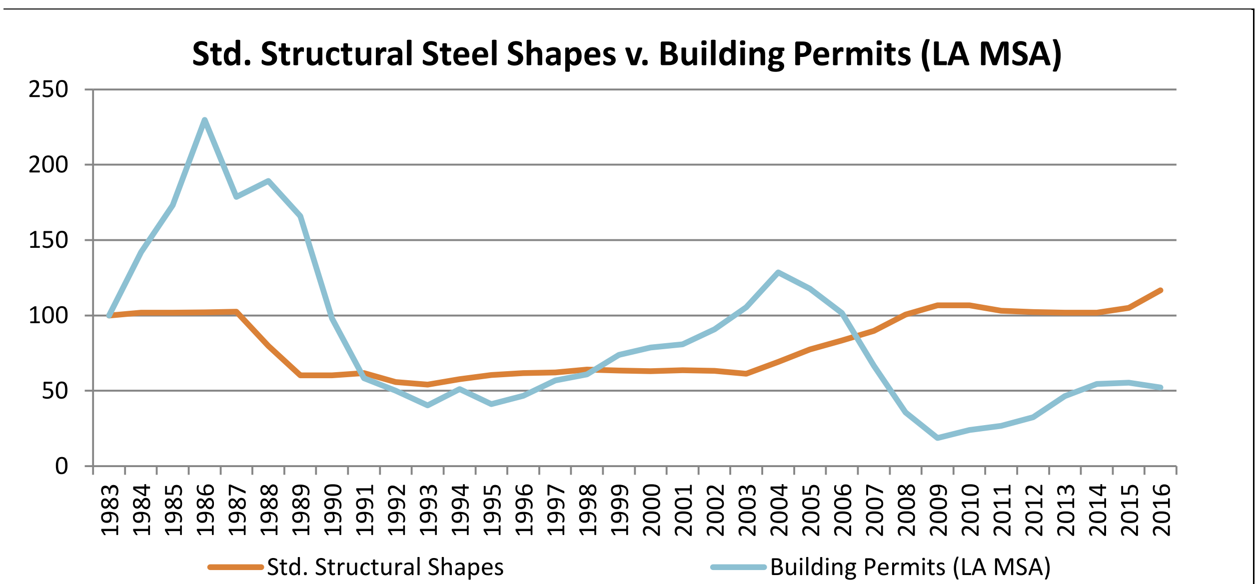
Source: Engineering News Record, U.S. Census Bureau Building Permit Survey

Appendix Figure A18: Sand Concrete Cost versus Los Angeles Metropolitan Area Building Permits, Normalized to 1983 = 100



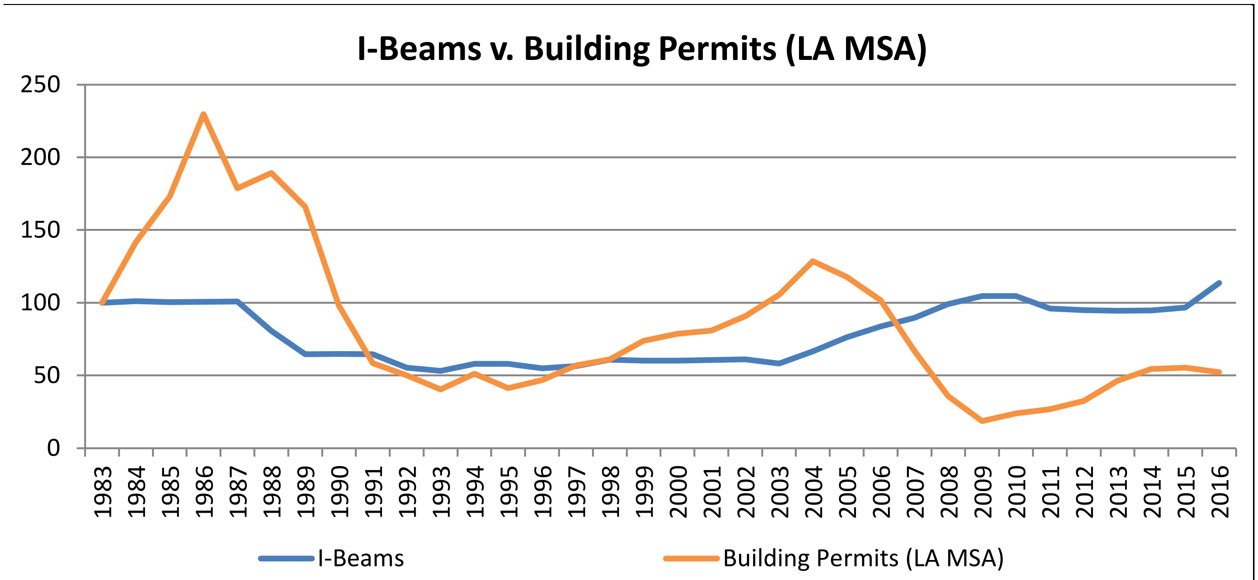
Source: Engineering News Record, U.S. Census Bureau

Appendix Figure A19: Std. Structural Steel Shapes Cost versus Los Angeles Metropolitan Area Building Permits, Normalized to 1983 = 100



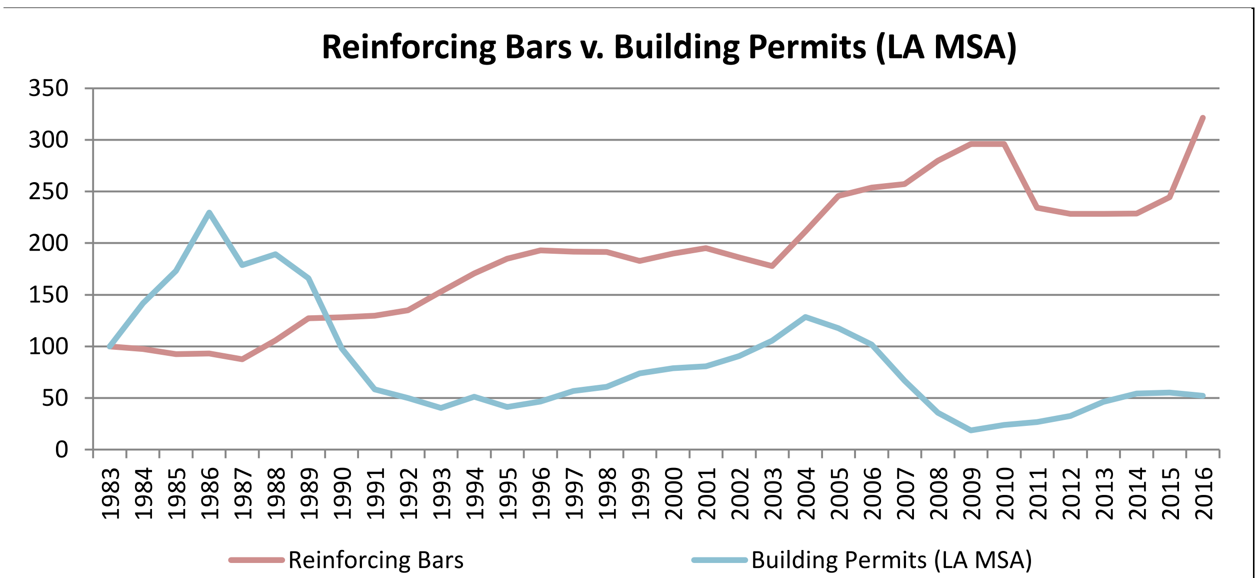
Source: Engineering News Record, U.S. Census Bureau Building Permit Survey

Appendix Figure A20: I-Beam Cost versus Los Angeles Metropolitan Area Building Permits, Normalized to 1983 = 100



Source: Engineering News Record, U.S. Census Bureau Building Permit Survey

Appendix Figure A21: Reinforcing Bars Cost versus Los Angeles Metropolitan Area Building Permits, Normalized to 1983 = 100



Source: Engineering News Record, U.S. Census Bureau Building Permit Survey