California and the Innovation Economy

Jerry Nickelsburg
Senior Economist, UCLA Anderson Forecast
Adjunct Professor of Economics, UCLA Anderson School
April 2016

In March, the State Employment Development Department (EDD) released the benchmark revision for non-farm payroll employment statistics. This is a once-a-year event that updates the estimates of payroll employment using the latest employer information. The updated statistics show a 2015 payroll employment growth rate of 3.1%. Were this rate of growth to continue into the indefinite future every man, woman, child, cat and dog in California would be employed. It is for this reason that we have had a sharply reduced growth in employment in the State for our 2016 to 2018 forecasts. Reduced employment growth does not necessarily mean reduced income growth as increased productivity can generate more income with the same number of workers. In this California report, we explore State GDP growth by looking at innovation and technology as potential drivers of GDP growth. To accomplish this, we examine 2012 to 2014 GDP growth rates for all 50 states and look for determinates of growth that will inform the forecast. The bottom line is that if the U.S. continues to grow through 2018 as we are forecasting it will, then California's GDP ought to grow faster than the U.S.

The recovery from the 2008-09 recession has been described as a non-recovery, a bifurcated recovery and an innovation or information recovery.[1] Within California, we were the first to describe this as a bifurcated recovery with the coastal regions gaining traction while the inland regions stagnated, or in some cases contracted.[2] The difference between the two rested solely on the type of work that was performed in the eastern vs. western parts of California prior to the 2008 crash. In the eastern part the State was predominately driven by construction, traditional manufacturing, government and agriculture. In the western part, the economy was predominately one based on services, particularly technology-laden services.

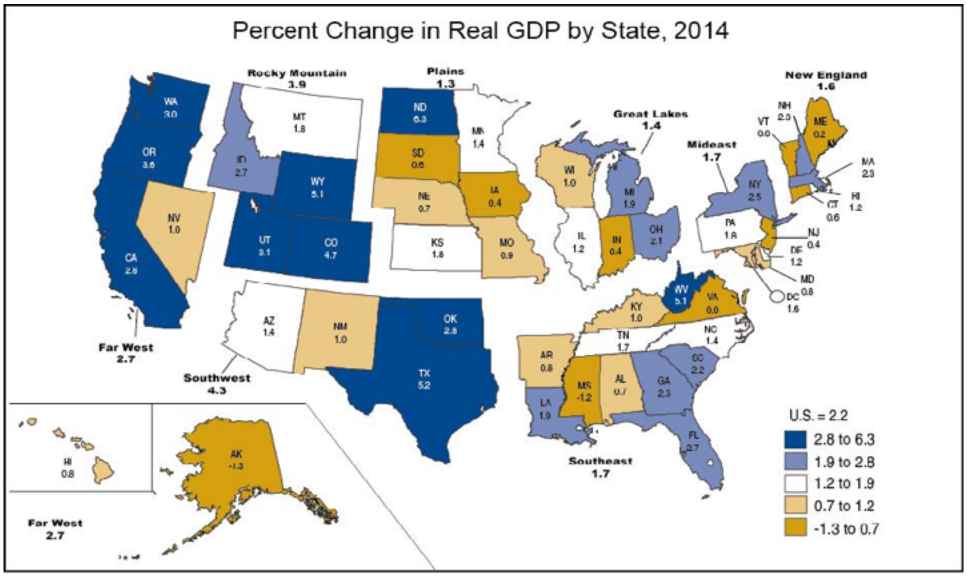
This is true as well for the nation. A map of economic growth by state created by the U.S. Bureau of Economic Analysis shows a pattern of growth not explained by the presence of Republican or Democratic Party policies, not by the "business-friendly" environment or lack thereof, but by the presence of a vibrant tech oriented sector(s) or by the presence of extractive energy resources.[3] Granting that tech

1 *Barry Ritholtz. "Are you not feeling the economic recovery? This could be why." Washington Post, May 15, 2015. https://www.washingtonpost.com/business/get-there/whether-youre-feeling-the-economic-recovery-relies-heavily-on-these-factors/2015/05/15/fc8d70fe-f8e0-11e4-9030-b4732caefe81_story.html*
Craig S. Hakkio, "Economic Policy For The Information Economy, A Summary of The Bank's 2001 Symposium," Federal Reserve Bank of Kansas City Economic Review, Fourth Quarter 2001. https://www.kansascityfed.org/publicat/econrev/Pdf/4q01hakk.pdf
The discussion in this article presages the slow recovery of 2009-2016

2 *Jerry Nickelsburg, "California: A Bifurcated Economy" UCLA Anderson Forecast, June 2010.*

3 *http://bea.gov/newsreleases/regional/gdp_state/qgsp_newsrelease.htm*
The maps for previous years beginning in 2010 have roughly the same pattern of successful states and less successful states. The 2015 map ought to show a different pattern for energy intensive states.

Chart 1



Sources: U.S. Bureau of Economic Analysis

leads the way in this economy the question then arises, does tech just happen or are the determinants of success in tech/information/innovation that may be influenced by policy? In this essay we examine this question by looking across the U.S. at indicators that provide insight as to why California, with its reputation as the worst place to do business in the U.S., does very well in that regard.[4]

How Innovation Affects Economic Growth

In the macroeconomic literature on economic growth, the model proposed by Solow stands out as the kernel of much of the research that follows.[5] In this model, admittedly an abstraction, there is one good economic activity. The amount of that good is generated through a combination of labor and capital in a process determined by technology. Growth occurs through the growth of any of the three components: labor, capital, and technology.

In previous California reports, we have argued that the rate of growth in California is constrained by growth in the population and we argued that population growth rates are somewhat muted by the deterrence of California's high cost of living.[6] That would leave the accumulation of capital and the improvement in productivity through innovation as explanations for California's more rapid growth.

Technology changes through innovation. The more innovation, the more efficient is the process of generating economic activity. For example, when Tesla took over the GM/Toyota factory in Fremont they used modern technology to automate the production line. The robots that are now used for tasks such as seat installation, speeds the process of automobile assembly. The workers using the robots are now more productive and thus the workers' productivity has gone up. To be sure, there are fewer workers and they may not be the same people as before, but the individuals doing the work are producing more per hour than their predecessors.

4 *California's growth rate for the first two quarters of 2015, the latest data available, slows to average due in large part to the labor dispute at West Coast ports.*

5 *Robert M. Solow. 1956. "A Contribution to the Theory of Economic Growth". The Quarterly Journal of Economics 70 (1). Oxford University Press: 65–94. http://www.jstor.org/stable/1884513.*

6 *Jerry Nickelsburg. "Will California's Expansion Stall As It Zeros in On Full Employment?" UCLA Anderson Forecast, December 2015. Jerry Nickelsburg. "Will California's Housing Ever Be Affordable?" UCLA Anderson Forecast. September 2015.*

Empirically, there is a bit of disentangling that is required as new technologies require investment in new capital and some of the improvement in labor productivity is due to the increase in capital and some to the innovation that gave rise to the more efficient capital.

For our purposes here, we are interested in two aspects of this process. First, are there factors associated with innovation that historically have generated the increase in investment which has engendered California's more rapid economic growth? Second, does economic growth typically occur more rapidly close to where innovation happens, and does the process of geographical diffusion spread the love to the rest of the U.S. quite rapidly?

Measuring the impact of innovation on Economic Growth

Measuring innovation is not a straightforward task. How does one add innovations in social media with innovations in aerospace and with innovations in computer processors? To get at this problem researchers have used proxies for innovation. Patents, research and development expenditure, scientific and engineering employment, investment in new ventures, and university impacts are but a few of the variables that describe either the result of innovating or the conditions that give rise to innovation.[7]

For the purposes of this essay we focus on three factors that might influence the differential rates of growth between 2012 and 2015 in states across the U.S. These are measures of university impacts, research and development in technology related sectors, and patents issued. The first two are inputs to the development of innovation while the third, patents, is an output. To distinguish between them, we estimated the predicted number of patents based on university impacts and R&D spending and took that which was not predicted as an indicator of other factors driving innovations.

There are a number of ways to measure university impacts. The one with the best explanatory power relative to differential state GDP growth was a ratio of the number of PhD degrees in science and technology issued to the total number of degrees in science and technology (BS, MS and PhD) issued.[8] The explanation for the power of this statistic is that a larger number of PhD's relative to the total indicates a larger presence of research institutions and by implication more innovation.

The following three charts show the partial correlation between R&D, PhD Degrees/Total Degrees, and the number of patents per capita not explained by the first two variables. The patents can be negative if R&D and Degrees predict more patents would be issued than actually were. There are two things to notice in these charts. The first is that there are some outliers. In particular, Texas and North Dakota, two states that have benefited from the energy boom, are at the top of each chart. A more complete analysis will take into account this factor. Second, only the "degrees" variable has much explanatory power.

We estimated a multiple regression equation, one that takes account of all of these factors at the same time. The equation explains 69% of the variation in GDP growth rates across states. The two most important variables were the value of petroleum production as a percent of GDP and PhDs in science and technology as a percent of total degrees awarded in science and technology. The latter variable is an indicator of the intensity of research universities in a state. Since research institutions spin off innovations and patents and attract R&D grants, it is not surprising that they stand out as the most important variable in explaining the innovation/technology portion of state growth in the current economy.

Estimated Equation:

Average Change in State GDP =

-0.025 + 0.016 x (PhD's / Total Degrees) - 0.002 x (PhD's / Total Degrees)^2
(1.96) (2.62) (2.40)

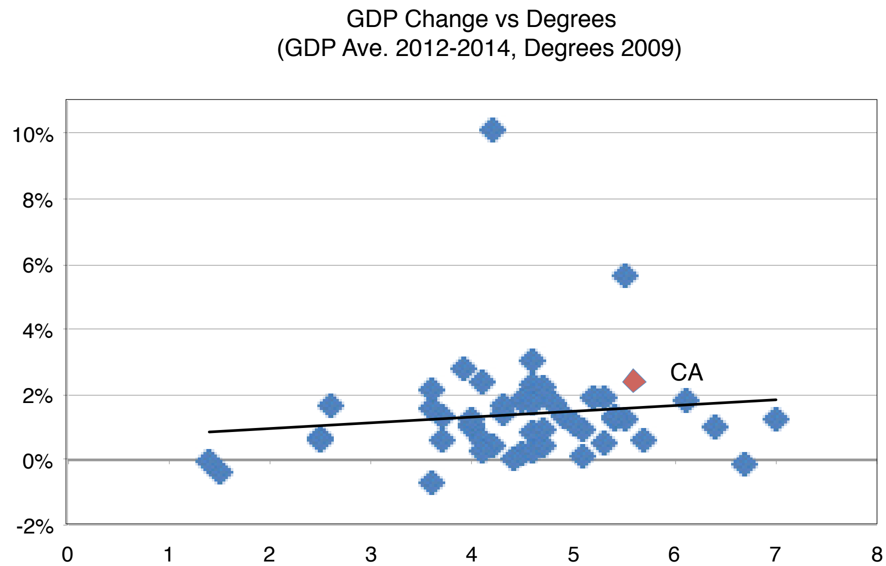
+ 1.92 x (Petroleum Ouput / GDP) + 0.191 x (R&D / GDP)
(9.31) (0.54)

+ 0 x (Unpredicted Patents)
(0.19)

7 Pierre Perrolle and Francisco Moris, *"Advancing Measures of Innovation: Knowledge Flows, Business Metrics and Measurement Strategies," National Science Foundation, June 6, 2006. http://www.nsf.gov/sbe/scisip/srs_innov_metrics_wkshp.pdf.*
Mark Rogers. "The definition and measurement of innovation." Parkville, VIC: Melbourne Institute of Applied Economic and Social Research, 1998. https://www.melbourneinstitute.com/downloads/working_paper_series/wp1998n10.pdf.

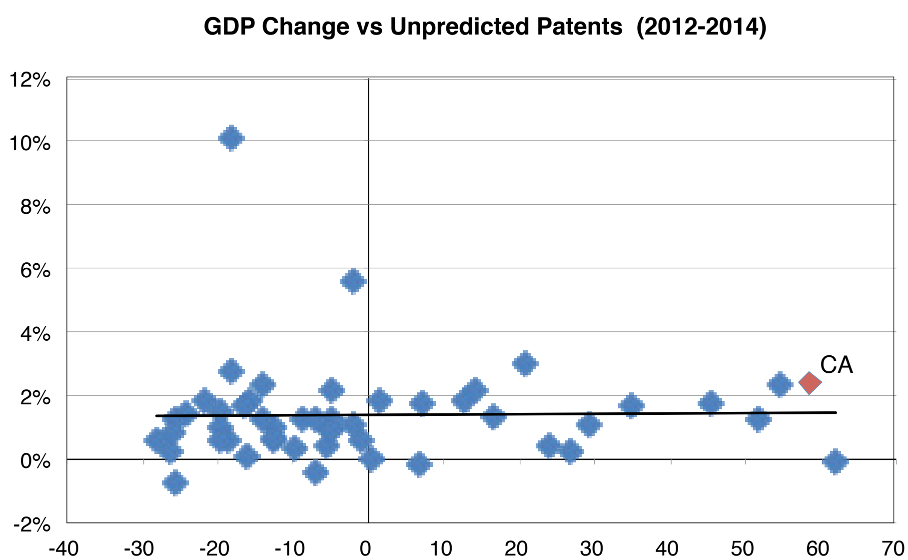
8 *The data maybe found at: http://www.nsf.gov/statistics/seind12/pdf/c08.pdf, http://www.nsf.gov/statistics/2016/nsf16301/#chp2, http://www.uspto.gov/web/offices/ac/ido/oeip/taf/cst_utl.htm.*

Chart 2



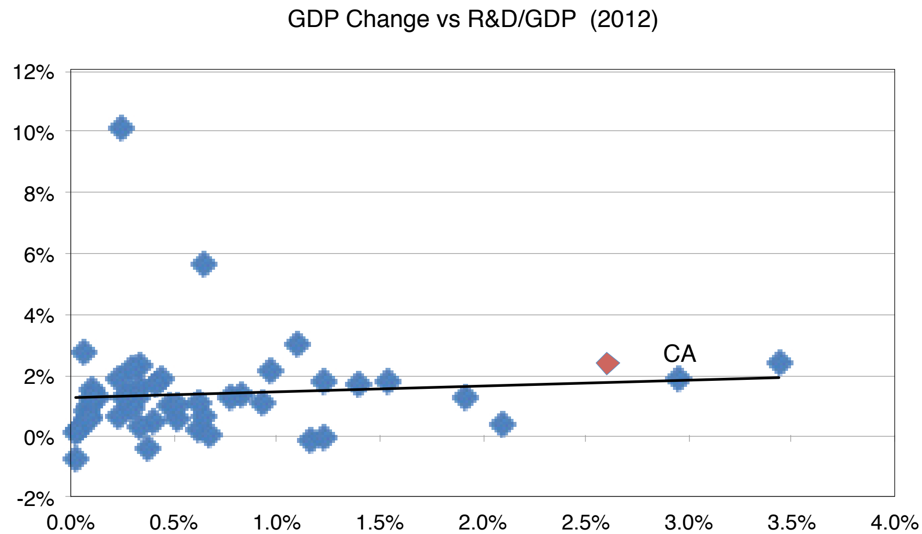
Sources: Bureau of Eocnomic Research, National Science Foundation, UCLA Anderson Forecast

Chart 3



Sources: Bureau of Economic Research, National Science Foundation, UCLA Anderson Forecast

Chart 4



Sources: Bureau od Economic Research, National Science Foundation, UCLA Anderosn Forecast

The numbers in parentheses are t-statistics corresponding to the coefficient estimate immediately above. The larger the t-statistic the more important the variable is in explaining changes in GDP. The two variables with coefficient t-statistics less than 1, (R&D / GDP) and (Unpredicted Patents) had an insignificant impact on differentials in GDP growth rates.

Implications for the Forecast

While innovation is not the entire story of the economic recovery, it is certainly an important part of it. The very rapid growth in Silicon Valley and San Francisco attests to this fact. The results presented here suggest that in the near term, the critical mass developed with California's research institutions will continue to provide the state with a disproportionate amount of innovation and therefore a faster growth in GDP than the average for the U.S. The fly in the ointment stems from the fact that innovation in productivity improvements is not like assembling aircraft. It comes in fits and starts and is inherently unpredictable. Nevertheless, we expect California's GDP growth rate to exceed that of the U.S. through our forecast period.

With U.S. growth coming in slower than we originally expected for 2016, the California forecast has been revised downward slightly. The current forecast is for continued steady gains in employment through 2018. What this means is a steady decrease in the unemployment rate in California over the next two years. We expect California's unemployment rate to be insignificantly different from the U.S. rate at 5.0% by the end of the forecast period.

Our estimate for the 2016 total employment growth is 1.9%, and for 2017 and 2018 the forecast is for 1.6% and 1.0%. Payrolls will grow more at about the same rate over the forecast horizon. Real personal income growth is estimated to be 3.6% in 2016 and forecast to be 3.2% and 3.0% in 2017 and 2018, respectively.