ECONOMIC EFFECTS OF INCREASED BROADBAND USE IN CALIFORNIA

RESEARCH REPORT

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Introduction

The Internet has become an indispensable communications tool and information resource for businesses and individuals. The proliferation of broadband Internet access has changed both business practices and consumer behavior. Like the introduction of the telephone and personal computer, high speed Internet access has the potential to significantly influence economic activities and outcomes. Compared to other innovative phenomena, few empirical studies have been completed examining the economic effects of broadband, especially at the regional level.

AT&T commissioned the Sacramento Regional Research Institute (SRRI), a joint venture of the Sacramento Area Commerce and Trade Organization (SACTO) and California State University, Sacramento (Sacramento State), to analyze how increased use of broadband (and the migration from dial-up to broadband) affects economic outcomes in California and selected regions within the state. This report serves as the project's technical Research Report, discussing the research methodology behind the key findings highlighted in the Summary Report.

Overall, SRRI's analysis demonstrates that increased broadband use (and migration from dial-up to broadband access) within California has had a positive effect on employment and payroll growth. Moving forward, further increases in broadband use will incrementally boost the number of jobs retained by businesses in the state and the total amount of industry payroll—all regions could benefit from increased broadband use, but the magnitude depends on the local economic conditions and unique distribution of Internet connections. The empirical evidence related to the effect of broadband use on growth in total business establishments is mixed and sensitive to specification.

This report is arranged in five main sections. The first section summarizes a handful of previous studies that examine the economic effects of broadband, which have generally found that broadband generates a positive impact on the economy overall. The broadband data used in this study, based on Scarborough Research surveys, is discussed and presented in the second section. The third section describes the variables used in SRRI's model of economic growth (economic activity, Internet access, and controls) while the fourth section explains the empirical methodology and the regression results. The final section discusses SRRI's baseline forecast for California and selected regions within the state as well as the three scenarios of broadband growth (moderate, strong, and dramatic). This section presents the employment and payroll forecasts and estimated cumulative effects.

Previous Studies on the Economic Effects of Broadband

Relative to other information technology phenomena, few empirical studies have been completed examining the economic effects of broadband. There are three reasons for this. First, broadband has only been accessible for a relatively short period of time. Widely commercially available broadband has been a reality only since the mid- to late-1990s. Second, there is limited consensus on the definition of broadband. The debate mainly centers on line speed (for example, the Federal Communication Commission's description of "high speed" as 200 kilobits per second versus the forecasted need for faster speeds now and in the future up to 1 gigabit per second) and direction (i.e. upstream and downstream) of an "always on" connection. Third, measures of broadband are not consistent and not widely available. Most metrics focus on availability, penetration, or use—availability indicates whether an individual has access to a broadband provider; penetration, sometimes referred to as adoption, measures the degree to which broadband is available (for instance, broadband lines relative to geographic size); and use captures whether an individual accesses the Internet through a broadband connection. Actual use is the ideal metric for studying the economic effects of broadband since it is a qualification for any resulting impacts. Notwithstanding these issues, studies that have directly analyzed the economic effects of broadband have generally found that it generates a positive impact on the economy overall. This would suggest that increased investment in the deployment and, in turn, the use of broadband would create additional economic benefits.

Jorgenson (2001) discusses the importance of the growth in information technology (IT) for living standards and economic growth. The author focuses mainly on how technological advances in IT have lead to a decrease in the price of capital (and overall production costs) and increase in productivity growth. While this discussion does not address broadband specifically, it does highlight the potential gains associated with capital investment in the IT sector for gross domestic product and income growth in the United States. Varian, Litan, Elder, and Shutter (2002) examine the impact of cost savings associated with IT on productivity growth in the United States, United Kingdom, France, and Germany. The authors find that a wide variety of firms have integrated IT solutions to lower operating costs. In the United States, these cost savings are expected to produce a 0.43 percentage point increase in the annual productivity growth rate, generating revenue increases and a positive impact on living standards. This study also does not focus on broadband access, but looks at how the Internet in general and IT business solutions benefit firms and the economy.

A few recent studies demonstrate the benefits of broadband at the national level. Notably, Crandall and Jackson (2001) estimate the consumer surplus and producer benefits associated with broadband Internet access and highlight the importance of network effects and associated decrease in transportation and production costs. This study estimates that a rapid increase in the availability and eventual use of broadband could generate up to $500 billion per year in additional gross domestic product for the United States. The United States Department of Commerce (2006) estimates the effect of broadband growth on key macroeconomic variables using availability data. The analysis

includes two national datasets—one at the zip code level and the other at the state level. The study finds that the existence of broadband in a given zip code or state has a positive and significant effect on growth in employment, business establishments (especially those in IT-intensive sectors), and housing rents. Specifically, the study demonstrates that broadband added between 1 percent and 1.4 percent to the 1998 to 2002 employment growth rate and 0.5 percent to 1.2 percent to the establishment growth rate in the same period. Crandall, Lehr, and Litan (2007) study state-level broadband penetration data (across most states) to identify the impacts on employment and output. The authors show that broadband penetration has had a meaningful effect on employment and project that a 1 percentage point increase in penetration could create 293,000 more jobs in 2006 while a 3 percentage point increase could generate an additional 880,000 jobs.

Crandall, Lehr, and Litan (2007) also develop 2006 employment projections for California. They estimate that a 1 percentage point increase in broadband penetration could lead to 32,000 more jobs with a 3 percentage point increase possibly generating 97,000 more jobs. Gartner (2003) provides an additional analysis on the impacts of broadband in the state. This study examines the correlation between macroeconomic indicators and broadband penetration and forecasts that over the ten year period from 2000 to 2010 the state could see a total incremental gain of $376 billion in gross state product and 2 million jobs as a result of an initiative to increase broadband penetration.

There has been relatively little work in the academic literature on the economic consequences of broadband. Ford and Koutsky (2005) tie broadband investment to economic growth in a Florida municipality. The authors compare economic growth across counties in Florida to actual outcomes in Lake County, a small county in central Florida that established a municipal fiber-optic network for use by businesses and other institutions. Using this event-study approach, the authors find that Lake County grew at twice the rate of similar control counties.

The findings from SRRI's analysis are similar to those from recent studies examining the effects of broadband on comparable economic variables in California and the United States. In addition to adding another piece of support to the concept that broadband has a positive, measurable impact on the economy, this analysis makes three distinct contributions to the discussion of the economic effects of broadband. First, the measure of broadband is based on actual use, as opposed to availability or penetration. Second, the panel regression approach allows the model to capture the dynamic effects of broadband use and migration from other, slower connection types. Third, regional effects are presented (and forecasted), rather than simply national or statewide estimates. Overall, this analysis paints a clear picture of how increased broadband use (and the migration from dial-up to broadband) affects employment and payroll in California and a select group of its regions—the direction of the effect is always positive and the magnitude depends on the size of the shift in the percentage of the adult population using a broadband Internet connection.

Broadband Data

California County Survey

SRRI measured the use of broadband using a propriety dataset from Scarborough Research, which presents the results of surveys measuring how individuals (in the adult population age 18 and above) access the Internet in their household. The survey was conducted in 39 of California's counties twice each year from 2001 to 2007. The Internet connection types covered for all counties and time periods in the survey include dial-up (DIAL), digital subscriber line (DSL), and cable (CAB). For this project, broadband (BB) is defined as cable or DSL. This data allowed SRRI to capture the extent of broadband use over time (and across counties) along with the migration from dial-up to broadband access. According to 2007 California Department of Finance data, the aggregation of the 39 counties covered in the Scarborough Research data accounts for close to 92 percent of California's population; therefore, it was used as a proxy for behavior of the state overall.

This study is aimed at testing the hypothesis that increased broadband use leads to an increase in economic activity. It is important to note that empirical measures of broadband use (such as those in this report) often rely on personal Internet access and do not account for workplace access. SRRI believes that individual Internet access within the home is a good proxy for overall adoption of broadband in the state for two reasons. First, individuals using the Internet at home are more likely to engage in work-related, productive activities outside of the physical workplace through their Internet connection and the related technological capabilities. Second, individuals who grow accustomed to accessing the Internet in the workplace are more likely to desire and obtain access at home for personal use. Therefore, a rise in personal Internet access is likely correlated with a rise in Internet access for work-related activities—individual household broadband use likely mirrors (and somewhat lags) workplace use. Using this measure as a proxy, however, could ultimately understate the magnitude of the economic effects.

To demonstrate effects at the regional level, these counties were bucketed into economically and socially integrated areas—metropolitan and micropolitan statistical areas and metropolitan divisions. Figure 1 provides a crosswalk between the 39 counties available in the Scarborough Research data and the 24 respective regions.

FIGURE 1
COUNTIES WITHIN SELECTED
CALIFORNIA REGIONS

Region	*Component Counties*
Clearlake	Lake
Fresno	Fresno
Hanford-Corcoran	Kings
Los Angeles-Long Beach-Glendale	Los Angeles
Madera	Madera
Merced	Merced
Modesto	Stanislaus
Napa	Napa
Oakland-Fremont-Hayward	Alameda & Contra Costa
Oxnard-Thousand Oaks-Ventura	Ventura
Phoenix Lake-Cedar Ridge	Tuolumne
Riverside-San Bernardino-Ontario	Riverside & San Bernardino
Sacramento-Arden Arcade-Roseville	El Dorado, Placer, Sacramento, & Yolo
San Diego-Carlsbad-San Marcos	San Diego
San Francisco-San Mateo-Redwood City	Marin, San Francisco, & San Mateo
San Jose-Sunnyvale-Santa Clara	Santa Clara
Santa Ana-Anaheim-Irvine	Orange
Santa Rosa-Petaluma	Sonoma
Stockton	San Joaquin
Truckee-Grass Valley	Nevada
Ukiah	Mendocino
Vallejo-Fairfield	Solano
Visalia-Porterville	Tulare
Yuba City	Sutter & Yuba

Sacramento Regional Research Institute, November 2007
Source: California Employment Development Department, Metropolitan Statistical Areas in California (New 2003 Definitions)
Note: San Benito County was not included in the San Jose-Sunnyvale-Santa Clara region since Scarborough Research data was not available.

Internet Access

The increased availability of broadband Internet access and the demand for faster connections has certainly amplified the use of broadband in California. As illustrated in Figure 2, Scarborough Research data shows that, across the 39 measured counties in California, the proportion of the adult population using broadband has risen steadily over the past few years while dial-up access has seen a constant decline. Between 2001 and 2006, the share of adult population using broadband increased by an average of roughly 4 percentage points each year—if this trend continues, nearly the entire adult population will access the Internet via a broadband connection by the year 2019. Conversely, if the dial-up use trend continues, this type of connection will reach minimal levels in the short-term future. These trends occurred while total Internet access from dial-up and broadband increased from roughly 55 percent of the adult population to close to two-thirds during the measured timeframe. The most recent measures show close to 54 percent of the adult population using broadband versus 11 percent accessing the Internet through a dial-up connection. The remaining adult population answered either “none” (no Internet connection) or “other” (some other access type) in the survey (the data does not distinguish between “none” or “other” at the county level).

FIGURE 2
INTERNET ACCESS TYPE IN CALIFORNIA

	% Adult Population	
Period	*Dial-Up*	*Broadband*
2001-1	41.2%	15.2%
2001-2	39.9%	15.2%
2002-1	39.4%	17.3%
2002-2	38.6%	20.4%
2003-1	33.2%	23.8%
2003-2	32.2%	26.0%
2004-1	29.8%	31.0%
2004-2	22.1%	38.7%
2005-1	21.8%	38.8%
2005-2	16.8%	44.6%
2006-1	14.0%	48.7%
2006-2	10.6%	53.5%

Sacramento Regional Research Institute, November 2007
Data Source: Scarborough Research

It is possible that the larger regions could drive the trends mentioned above as there is evidence that the ability to switch to broadband access exists disproportionately in metropolitan areas (Malecki & Bousch, 2003). Figure 3 shows that the use of broadband varies widely among the selected regions in the state (based on measures for the first half of each year), ranging from about 4 percent of the adult population (Clearlake) to close to 66 percent (Vallejo-Fairfield) in 2006. The larger, more established regions have generally demonstrated higher broadband use than smaller rural and Central Valley areas. Nearly every measured region has seen a notable increase in the use of broadband over the past few years. The greatest percentage point gains in the proportion of adult population using broadband occurred in Northern California regions (including Vallejo-Fairfield, San Jose-Sunnyvale-Santa Clara, and Sacramento-Arden Arcade-Roseville).

FIGURE 3
REGIONAL PERCENTAGE OF ADULT
POPULATION USING BROADBAND
FIRST PERIOD OF EACH YEAR

Region	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*
Clearlake	3.5%	0.0%	30.0%	37.2%	18.7%	4.2%
Fresno	12.0%	13.5%	14.4%	19.0%	23.9%	28.4%
Hanford-Corcoran	3.8%	0.0%	4.7%	17.8%	9.3%	15.4%
Los Angeles-Long Beach-Glendale	14.8%	14.3%	19.0%	26.1%	35.0%	42.6%
Madera	1.1%	14.0%	4.3%	6.1%	19.6%	32.2%
Merced	4.2%	0.0%	1.5%	14.1%	27.8%	33.0%
Modesto	12.6%	17.2%	17.0%	15.2%	29.0%	44.8%
Napa	7.9%	0.0%	5.2%	21.9%	16.7%	35.0%
Oakland-Fremont-Hayward	22.2%	27.8%	35.7%	40.3%	48.9%	60.1%
Oxnard-Thousand Oaks-Ventura	17.8%	22.3%	21.5%	27.8%	37.7%	56.7%
Phoenix Lake-Cedar Ridge	0.0%	0.0%	0.0%	0.0%	23.3%	25.2%
Riverside-San Bernardino-Ontario	7.4%	9.3%	23.1%	26.7%	27.7%	41.3%
Sacramento-Arden Arcade-Roseville	13.5%	18.1%	20.1%	26.7%	39.4%	54.4%
San Diego-Carlsbad-San Marcos	17.2%	25.3%	29.6%	39.6%	49.5%	56.7%
San Francisco-San Mateo-Redwood City	19.5%	23.1%	27.7%	40.8%	53.0%	52.6%
San Jose-Sunnyvale-Santa Clara	14.7%	22.0%	35.2%	45.5%	49.0%	61.2%
Santa Ana-Anaheim-Irvine	20.6%	20.7%	30.3%	39.9%	48.2%	61.4%
Santa Rosa-Petaluma	25.2%	20.1%	15.0%	25.2%	49.0%	52.0%
Stockton	12.9%	10.3%	20.7%	21.4%	28.7%	37.5%
Truckee-Grass Valley	2.1%	0.0%	2.6%	26.8%	9.8%	41.2%
Ukiah	0.0%	0.0%	31.2%	5.7%	12.4%	13.0%
Vallejo-Fairfield	16.9%	2.8%	26.8%	24.6%	31.7%	65.5%
Visalia-Porterville	0.0%	5.3%	12.6%	10.5%	13.7%	24.1%
Yuba City	0.0%	4.8%	5.3%	30.1%	14.6%	30.4%

Sacramento Regional Research Institute, November 2007
Data Source: Scarborough Research

Migration Ratio

A related issue in Internet access is the migration from dial-up to broadband connections. To identify migration, SRRI constructed the following variable for the migration ratio (MIG), which calculates the share of broadband to all measured access types:

$$MIG = BB/(BB + DIAL)$$

This measure accounts for the extent to which individuals have switched from dial-up to broadband, demonstrating the increased use of broadband net the increase in dial-up use. If someone accesses the Internet for the first time using a broadband connection, the value increases, just as if someone switches from dial-up to broadband. It is important to note that this measure and broadband use are not mutually exclusive—broadband use accounts for this connection type alone while the migration ratio focused on broadband net any increase in dial-up.

The aggregate migration ratio for the 39 counties in the sample is shown in Figure 4. Over the past few years, this ratio has dramatically risen as a result of both the general increase in Internet access and individuals switching from dial-up to broadband connections.

FIGURE 4
DIAL-UP TO BROADBAND MIGRATION RATIO IN CALIFORNIA

Period	*Migration Ratio*
2001-1	27.0
2001-2	27.7
2002-1	30.5
2002-2	34.5
2003-1	41.8
2003-2	44.7
2004-1	51.0
2004-2	63.7
2005-1	64.0
2005-2	72.6
2006-1	77.6
2006-2	83.4

Sacramento Regional Research Institute, November 2007
Data Source: Scarborough Research

Figure 5 demonstrates the migration ratio for the selected California regions from 2001 to 2006 (based on the measures for the first half of each year). Like the data for broadband use overall, migration ratios also have a fairly wide range between the regions in the state and have typically increased considerably in the past few years.

FIGURE 5
REGIONAL DIAL-UP TO BROADBAND MIGRATION RATIOS
FIRST PERIOD OF EACH YEAR

Region	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*
Clearlake	6.7	0.0	45.0	56.6	32.8	10.7
Fresno	30.8	28.4	31.6	36.8	51.8	58.6
Hanford-Corcoran	11.5	0.0	11.6	32.1	25.7	38.5
Los Angeles-Long Beach-Glendale	29.8	29.2	37.7	48.4	63.7	77.2
Madera	2.6	22.7	10.1	17.0	47.3	65.6
Merced	13.7	0.0	4.7	27.9	63.1	70.8
Modesto	22.3	35.6	33.1	33.5	56.5	81.5
Napa	13.6	0.0	10.5	28.2	25.6	48.4
Oakland-Fremont-Hayward	32.0	43.7	51.7	57.5	68.1	83.7
Oxnard-Thousand Oaks-Ventura	27.5	36.7	34.0	47.2	63.4	81.0
Phoenix Lake-Cedar Ridge	0.0	0.0	0.0	0.0	30.2	45.7
Riverside-San Bernardino-Ontario	14.2	18.2	45.9	45.3	51.1	74.9
Sacramento-Arden Arcade-Roseville	21.9	28.7	31.8	40.0	56.3	78.7
San Diego-Carlsbad-San Marcos	28.5	39.7	48.2	59.2	75.7	82.7
San Francisco-San Mateo-Redwood City	29.9	34.1	42.6	58.1	78.5	76.4
San Jose-Sunnyvale-Santa Clara	23.3	33.1	48.6	63.5	73.4	80.5
Santa Ana-Anaheim-Irvine	33.2	32.3	47.8	60.5	69.7	82.4
Santa Rosa-Petaluma	30.8	29.6	26.2	36.1	68.7	80.8
Stockton	26.4	22.3	41.0	49.4	55.2	67.3
Truckee-Grass Valley	4.7	0.0	4.7	46.3	15.7	48.5
Ukiah	0.0	0.0	44.7	11.7	17.9	24.0
Vallejo-Fairfield	27.3	3.9	51.5	42.8	47.2	77.0
Visalia-Porterville	0.0	12.4	33.4	25.6	39.8	58.4
Yuba City	0.0	10.4	16.8	50.5	22.0	48.6

Sacramento Regional Research Institute, November 2007
Data Source: Scarborough Research

Overall, there has been a dramatic rise in California's reliance on broadband Internet access between 2001 and 2006. Both the proportion of the adult population using a broadband connection and the migration from dial-up to broadband have demonstrated clear upward trends in the past few years.

Variables

SRRI constructed a panel data set across the 39 California counties (available in the Scarborough Research data) from 2001 to 2006 for the regression analysis. There are three broad categories of variables used for this analysis—economic activity, broadband, and controls.

The project uses three measures of economic activity at the county level: wage and salary employment (EMP—jobs retained by business establishments), business establishments (EST—number of firms), and payroll (PAYRL—total industry payroll of all business establishments). In order to capture potential sectoral shifts in employment across counties and over time, SRRI also examined non-farm employment (EMP_NF), goods-producing sector employment (EMP_GDS), and service-providing sector employment (EMP_SER). The annual growth rates of these variables were obtained using the difference in logs.

The analysis uses two measures of broadband—share of the adult population accessing the Internet through broadband sources and the migration ratio from dial-up to broadband. Broadband data were obtained from the proprietary Scarborough Research household survey of individuals regarding their Internet usage. In order to deal with the semi-annual nature of the broadband data and the inconsistency in the timing across counties (some counties are surveyed between February-July and August-January while other counties have a March-August and September-February survey timeframe), SRRI computed the average broadband use from each semi-annual survey as a proxy for broadband usage in a given year. The survey data reports figures extrapolated from semi-annual adult population estimates. Therefore, to obtain the share of the adult population that uses broadband, SRRI used the population estimate from the Scarborough Research survey dataset.

Finally, SRRI incorporated a handful of control variables designed to capture economic conditions in individual counties over time. SRRI observed that counties with higher levels of personal income tended to have greater broadband use, relative to those in lower-income counties. Similarly, lower-income counties tend to have higher unemployment rates. Therefore, the two primary controls used are personal income and the unemployment rate. The use of these controls permits the isolation of economic effects as a result of broadband use versus other factors that may vary spatially and temporally. Specifically, SRRI used the growth rate of personal income (INC—the log-differenced total personal income) and the unemployment rate (UNR—number of unemployed as a share of the labor force) to account for differences in economic conditions across counties. The choice of control variable depended on the measure of economic activity. For example, the unemployment rate was used as a control variable in the analysis of total establishments and total payroll, but not in the employment regressions because it is based on the loosely-related labor force measures.

As the sample ranges from 2001 to 2006, SRRI was unable to explicitly control for socio-demographic characteristics that vary across counties in the panel sample. Measures of

these characteristics are generally best addressed through variables available from the decennial Census. However, SRRI did construct a cross section dataset that includes two demographic variables available at the county level in the Census, including shift in educational attainment (COL—growth in the percentage of the population with a college degree or higher) and population density (DENS—population per square mile)—this is discussed in greater detail in the next section of this report.

Figure 6 describes the variables used in this analysis.

FIGURE 6
DESCRIPTION OF VARIABLES
FOR REGRESSION ANALYSIS

Type	*Variable*	*Description*	*Frequency*	*Source*
Dependent (Economic Activity)	EMP	Total wage & salary employment	Quarterly	Bureau of Labor Statistics, Quarterly Census of Employment and Wages
Dependent (Economic Activity)	EMP_NF	Total employment in non-farm sectors	Quarterly	Bureau of Labor Statistics, Quarterly Census of Employment and Wages
Dependent (Economic Activity)	EMP_GDS	Total employment in goods-producing sectors	Quarterly	Bureau of Labor Statistics, Quarterly Census of Employment and Wages
Dependent (Economic Activity)	EMP_SER	Total employment in service-providing sectors	Quarterly	Bureau of Labor Statistics, Quarterly Census of Employment and Wages
Dependent (Economic Activity)	EST	Total business establishments	Quarterly	Bureau of Labor Statistics, Quarterly Census of Employment and Wages
Dependent (Economic Activity)	PAYRL	Total industry payroll measured in thousands of dollars	Quarterly	Bureau of Labor Statistics, Quarterly Census of Employment and Wages
Internet Access	CAB	Proportion of population (age 18 and above) reporting use of cable for Internet access	Semi-annual	Scarborough Research
Internet Access	DIAL	Proportion of population (age 18 and above) reporting use of dial-up for Internet access	Semi-annual	Scarborough Research
Internet Access	DSL	Proportion of population (age 18 and above) reporting use of digital subscriber line (DSL) for Internet access	Semi-annual	Scarborough Research
Internet Access	BB	Proportion of population (age 18 and above) reporting use of cable or digital subscriber line (DSL) for Internet access	Semi-annual	Scarborough Research
Control	INC	Growth rate of personal income computed as the log difference in personal income	Annual	Bureau of Economic Analysis, Local Area Personal Income
Control	UNR	Proportion of the labor force that is unemployed	Monthly	California Employment Development Department, Current Employment Statistics
Control	COL	Growth in the number of individuals (age 25 and above) with a college degree or higher between 1990 and 2000	Decennial	Census Bureau, Decennial Census
Control	DENS	Growth in population density in 2000 computed as the (growth in) total population divided by land area (measured in square miles)	Decennial	Census Bureau, Decennial Census

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Empirical Methodology

Model of Economic Growth

Using the panel data set, SRRI used regression analysis to estimate the marginal effect of broadband use on measures of economic activity. The hypothesis was that increased broadband use leads to an increase in economic activity.

SRRI expected that broadband would have a positive effect on growth in employment. This is an empirical finding supported by earlier empirical studies and economic theory. Increased use of a productive input (machinery, tools, or the Internet) will increase overall production, creating new jobs in the labor market. While labor productivity rises in this case, there will still be positive growth in employment as long as other productive inputs increase. There may be sectoral shifts in employment associated with a change in the types of goods and services produced in the economy. To that end, the analysis looks at different measures of employment. The control variable used here was growth in income—the expectation was that this variable would have a positive relationship with growth in employment since as employment increases, more people earn income, leading to an increase in personal income.

The total number of business establishments was used as a measure of total production and production capacity. The relationship between broadband and total establishments could be positive or negative. If increased broadband use leads to an increase in employment and overall output, then an increase in business establishments would be expected. On the other hand, there are two reasons why a positive relationship might not be observed. First, the total number of business establishments masks the dynamics of the number of firms entering and exiting the market. If increased broadband use does lead to a sectoral shift, the result might be no change in total business establishments. Second, a related issue is that increased use of broadband may lead to an increase in self-employment, telecommuting, and/or easier importation of goods and services from outside of a given county. These factors would tend to reduce the number of business establishments.

Similar to employment, SRRI expected to observe a positive relationship between total payroll and broadband. As more people are hired (and productivity rises), total payroll should increase. The control variable used was the unemployment rate. As the unemployment rate rises, growth in total payroll should decline, as fewer people are hired. The benefit of using payroll is that SRRI was able to generate a dollar figure to capture the economic effects of increased broadband use at the regional level. Other studies use aggregate measures of production such as gross domestic or state product. Comparable dollar figures are not readily available at the county level. It is important to note that total payroll figures exclude total income payments (captured in production measures). Therefore, the dollar contributions from broadband will be smaller in magnitude versus measures of total production.

EMPIRICAL METHODOLOGY

The empirical specification is based on the model of economic growth described below.

Assume that economic activity grows exponentially at rate g:

$$Y_{it} = Y_0 e^{git}$$

Where the growth rate of economic activity depends on broadband usage and other variables:

$$g_{it} = g^* + X_{it}\beta + \gamma BB_{it} + e_{it}$$

BB is a measure of broadband usage and X denotes a vector of control variables that explain differences in growth rates across counties. Control variables are important in order to accurately measure broadband's marginal effect on economic activity. The term e_{it} denotes any residual growth not attributed to the other variables in the equation (the interpretation of g* will be discussed further below).

Now, consider economic growth between two periods, period 0 and period 1:

$$Y_{i,1} = Y_{i,0} e^{g}_{i}$$

Or, in log-linear form:

$$\ln(Y_{i,1}) = \ln(Y_{i,0}) + g_i$$

Using the expression for the growth rate given above:

$$\ln(Y_{i,1}) - \ln(Y_{i,0}) = g_{i,1} = g^* + X_{i,1}\beta + \gamma BB_{i,1}$$

Rewriting this expression as a linear regression equation:

$$g_{i,1} = g^* + X_{i,1}\beta + \gamma BB_{i,1} + e_{i,1}$$

Therefore, the growth rate of economic activity depends on the use of broadband and other control variables. In general:

$$g_{i,t} = g^* + X_{i,t}\beta + \gamma BB_{i,t} + e_{i,t}$$

The coefficient γ measures how broadband usage affects growth in economic activity, given a set of control variables (contained in the vector X).

There are several ways to estimate the parameters (g*, β, and γ) from the regression equation above. First, estimating the equation using ordinary least squares (OLS) where the term g* is constant across counties, and therefore the error term does not vary systematically across counties. Second, analysis can allow the estimate of g* to vary

across counties through the introduction of county fixed effects. In this case, the regression specification is:

$$g_{i,t} = \alpha_i + X_{i,t}\beta + \gamma BB_{i,t} + e_{i,t}$$

The estimate α_i is equal to the g* for each individual county. The parameter is estimated by including a dummy variable for each county (excluding one to avoid over-identification). The primary benefit of this approach is that any variation across counties not captured by the vector of control variables, X, is measured in the county fixed effect.

Similarly, one could be concerned that the estimate g* varies over time. This could be because economic activity tends to grow over longer periods of time. In this case, analysis can introduce a time fixed effect (in addition to the county fixed effect above):

$$g_{i,t} = \alpha_i + \delta_t + X_{i,t}\beta + \gamma BB_{i,t} + e_{i,t}$$

δ_t is estimated by including a dummy variable for each time period (excluding one to avoid over-identification). The parameter δ_t is the estimated growth rate in year t (holding other variables constant).

Because these regressions involve the growth rates of economic activity, some observations are lost since the growth rate is computed from one year to the next. Given the availability of data and the limitations on the time dimension of the panel dataset, only county fixed effects are reported here.

Baseline Regression Estimates

Figures 7 through 9 report the regression results for the three measures of economic activity—employment, establishments, and payroll. These results focus on the economic effects of broadband on growth in economic activity. The F-statistic is statistically significant in all specifications, so that the explanatory variables are jointly significant in explaining variation in the growth in economic activity.

In each Figure, there are two sets of regressions reported. Each set reports the regression specifications discussed above—ordinary least squares (OLS) and OLS with county fixed effects.[1] The two sets are distinguished by the inclusion of control variables. The control variables allow for an isolation of the importance of broadband use for growth in economic activity. In these Figures, the notation *, **, and *** indicates the variable is significant at the 90 percent, 95 percent, and 99 percent confidence level, respectively.

[1] Another approach to the model of economic growth is to use a random effects model where the constant terms varies across county and time (in lieu of a time fixed effect): $g_{i,t} = \alpha_{it} + X_{i,t}\beta + \gamma BB_{i,t} + e_{i,t}$. The Hausman test (examining the appropriateness of fixed versus random effects) for the regressions uniformly rejects the use of random effects.

When county fixed effects are included, their statistical significance is indicated with the asterisk notation used on the coefficient estimates. Across the three measures of economic activity, the inclusion of county fixed effects is generally appropriate.

FIGURE 7
ESTIMATED EFFECTS OF
BROADBAND ON
EMPLOYMENT GROWTH

	OLS	*County Fixed Effects*	*OLS with Controls*	*County Fixed Effects with Controls*
BB	-0.015	0.051	0.007	0.05
	(0.016)	(0.020)**	(0.017)	(0.025)**
EMP_{t-1}	-	-	0.182	-0.317
			(0.079)**	(0.098)***
INC	-	-	0.384	0.131
			(0.095)***	(0.098)
C	0.014	-0.001	-0.013	-0.006
	(0.004)***	(0.005)	(0.007)*	(0.007)
County fixed effects	No	Yes***	No	Yes**
Adjusted R^2	0	0.268	0.169	0.346
AIC	-4.2605	-4.3676	-4.5273	-4.5272
Obs.	150	150	113	113

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FIGURE 8
ESTIMATED EFFECTS OF
BROADBAND ON
ESTABLISHMENT GROWTH

	OLS	*County Fixed Effects*	*OLS with Controls*	*County Fixed Effects with Controls*
BB	-0.053	-0.132	-0.001	-0.057
	(0.014)***	(0.015)***	(0.014)	(0.021)***
EST_{t-1}	-	-	0.6	-0.105
			(0.065)***	(0.105)
UNR	-	-	-0.079	1.059
			(0.082)	(0.311)***
C	0.035	0.052	0.003	-0.043
	(0.004)***	(0.004)***	(0.009)	(0.024)*
County fixed effects	No	Yes***	No	Yes***
Adjusted R^2	0.0823	0.513	0.4435	0.599
AIC	-4.4525	-4.9524	-5.2498	-5.3366
Obs.	150	150	113	113

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FIGURE 9
ESTIMATED EFFECTS OF
BROADBAND ON
PAYROLL GROWTH

	OLS	*County Fixed Effects*	*OLS with Controls*	*County Fixed Effects with Controls*
BB	-0.003	0.102	0.037	0.067
	(0.023)	(0.031)***	(0.024)	(0.038)*
$PAYRL_{t-1}$	-	-	0.134	-0.193
			(0.064)**	(0.082)**
UNR	-	-	0.01	-0.823
			(0.143)	(0.566)
C	0.046	0.022	0.032	0.098
	(0.006)***	(0.008)***	(0.016)**	(0.048)**
County fixed effects	No	Yes**	No	Yes*
Adjusted R^2	0	0.149	0.013	0.162
AIC	-3.564	-3.5265	-4.1239	-4.0288
Obs.	150	150	113	113

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In all specifications where the control variables are statistically significant, they have the expected sign. Growth in income is used as a control variable when analyzing the behavior of employment growth. Counties with higher growth in income are expected to have higher growth in employment. Figure 7 shows that this is the case across all specifications.

An increase in the unemployment rate is associated with lower growth in total business establishments and total payroll. When unemployment is statistically significant, it has the correct sign across specifications for payroll, but has a positive and statistically significant sign in the county fixed effects regression for growth in business establishments. This could be a reflection of a lag between the labor and output markets. A related issue is possible endogenous relationship between unemployment and growth in establishments.

The baseline regression results indicate that broadband has a positive and significant effect on growth in employment in the specification with county fixed effects. Broadband has a positive effect on growth in total payroll in most specifications. The analysis in this report relies on the estimates with county fixed effects because they are statistically significant in most specifications. The exclusion of these county fixed effects would bias the estimated effect of broadband on economic activity.

Broadband appears to have a negative and statistically significant effect on the growth in total business establishments. This could reflect an increase in telecommuting, self-employment, and/or an increase in importation of goods and services to the region accompanied by a reduction in the number of physical business establishments in a given county. This is consistent with the positive effect on employment growth discussed above.

Migration from Dial-Up to Broadband

The time series data from Figure 4 indicate a migration from dial-up toward broadband access over time. SRRI's hypothesis is that an increase in migration will have a positive effect on economic activity.

Figures 10 to 12 report regression results analogous to those presented above, replacing the share of broadband usage with the migration ratio variable. The results include the control variables used in the baseline regression estimates. The F-statistic is statistically significant in all specifications, so that the explanatory variables are jointly significant in explaining variation in the growth in economic activity.

FIGURE 10
ESTIMATED EFFECTS OF MIGRATION FROM DIAL-UP TO BROADBAND ON EMPLOYMENT GROWTH

	OLS with Controls	*County Fixed Effects with Controls*
MIG	0.013	0.032
	(0.012)	(0.016)*
EMP_{t-1}	0.189	-0.311
	(0.078)**	(0.098)***
INC	0.379	0.134
	(0.094)***	(0.098)
C	-0.016	-0.007
	(0.007)**	(0.008)
County fixed effects	No	Yes**
Adjusted R^2	0.176	0.344
AIC	-4.536	-4.5235
Obs.	113	

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FIGURE 11
ESTIMATED EFFECTS OF MIGRATION FROM DIAL-UP TO BROADBAND ON ESTABLISHMENT GROWTH

	OLS with Controls	*County Fixed Effects with Controls*
MIG	0.003	-0.038
	(0.009)	(0.015)**
EST_{t-1}	0.607	-0.118
	(0.065)***	(0.109)
UNR	-0.062	1.048
	(0.074)	(0.317)***
C	0	-0.04
	(0.009)	(0.025)
County fixed effects	No	Yes***
Adjusted R^2	0.444	0.594
AIC	-5.251	-5.3249
Obs.	113	

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FIGURE 12
ESTIMATED EFFECTS OF MIGRATION FROM DIAL-UP TO BROADBAND ON PAYROLL GROWTH

	OLS with Controls	*County Fixed Effects with Controls*
MIG	0.029	0.035
	(0.016)*	(0.027)
$PAYRL_{t-1}$	0.132	-0.185
	(0.063)**	(0.083)**
UNR	-0.013	-0.9
	(0.129)	(0.603)
C	0.031	0.106
	(0.014)**	(0.052)**
County fixed effects	No	Yes
Adjusted R^2	0.041	0.146
AIC	-4.1339	-4.0102
Obs.	113	

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These results support the general conclusions from the baseline regressions. Migration from dial-up to broadband Internet access tends to increase growth in employment and total payroll, while reducing growth in the total number of business establishments.

Threshold and Saturation Effects

In order to draw comparisons with earlier work using event studies and binary variables to measure the existence of broadband, SRRI estimated the economic model using thresholds for broadband use.

In this case, the assumption is that the broadband variable in the economic model is measured as a dummy variable (BBD) that takes on the value of 1 if broadband use crosses some threshold, and 0 otherwise. Based on the distribution of the share of the adult population accessing the Internet through broadband,[2] SRRI identified three possible thresholds for the counties included in the sample—10 percent, 15 percent, and 20 percent. For example, if more than 20 percent of the adult population in a given county in 2001 accesses the Internet through broadband, then the BB20 is 1 for the county. The threshold effects are based on the initial year under the assumption that there is some saturation effect associated with broadband use. This is comparable to the approach used in the Department of Commerce (2006) study.

This specification allowed SRRI to identify whether those counties with widespread broadband use tended to experience higher growth rates in subsequent years.[3] Also, this is comparable to the approach used in earlier research relying on event study or dummy variables to identify broadband availability/penetration. The results for these regressions are reported in Figures 13 to 15. The F-statistic is statistically significant in all specifications for employment and total establishments while for the payroll regression it is significant only when a 10 percent threshold value is used.

FIGURE 13
ESTIMATED EFFECTS OF BROADBAND ON EMPLOYMENT GROWTH—DUMMY VARIABLE APPROACH

	Threshold Value		
	10%	*15%*	*20%*
BBD	-0.009	-0.009	-0.008
	(0.006)	(0.006)*	(0.009)
EMP_{t-1}	0.118	0.118	0.147
	(0.083)	(0.083)	(0.081)*
INC	0.379	0.379	0.391
	(0.096)***	(0.096)***	(0.096)***
C	-0.008	-0.008	-0.011
	(0.006)	(0.006)	(0.006)*
R^2	0.212	0.212	0.197
Obs.	111		

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[2] The median share in the sample is 20.8 percent. The 38 counties that reported broadband use from 2001 to 2006 all obtained a share of 10 percent by 2006.

[3] Since the dummy variable takes on a value of 0 or 1 for each county in the first year, this eliminates the ability to estimate the regressions with county fixed effects.

FIGURE 14
ESTIMATED EFFECTS OF BROADBAND ON ESTABLISHMENT GROWTH—DUMMY VARIABLE APPROACH

	Threshold Value		
	10%	*15%*	*20%*
BBD	0.001	-0.004	-0.004
	(0.003)	(0.004)	(0.006)
EST_{t-1}	0.602	0.59	0.594
	(0.064)***	(0.065)***	(0.065)***
UNR	-0.071	-0.095	-0.086
	(0.07)	(0.07)	(0.07)
C	0.002	0.005	0.004
	(0.006)	(0.006)	(0.006)
R^2	0.458	0.463	0.46
Obs.	111		

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FIGURE 15
ESTIMATED EFFECTS OF BROADBAND ON PAYROLL GROWTH—DUMMY VARIABLE APPROACH

	Threshold Value		
	10%	*15%*	*20%*
BBD	-0.016	-0.008	-0.003
	(0.006)**	(0.007)	(0.012)
$PAYRL_{t-1}$	0.073	0.093	0.113
	(0.065)	(0.068)	(0.068)*
UNR	-0.187	-0.157	-0.125
	(0.120)	(0.124)	(0.124)
C	0.067	0.058	0.053
	(0.011)***	(0.011)***	(0.010)***
R^2	0.092	0.05	0.039
Obs.	111		

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The results from Figures 13 to 15 indicate that the dummy variables for broadband use are not statistically significant. These findings are consistent with Department of Commerce (2006) analysis. In that study, once control variables are included in the regression, the dummy variable (which indicates the existence of at least one broadband line in a given state) is not statistically significant.

There are two possible explanations for this finding. One is posited in the Department of Commerce (2006) study—using a large geographic region involves aggregation of data, such that the economic benefits are overlooked. The other is that the sample covers a period over which the most significant benefits from broadband are already realized. That is, increasing the share of the adult population that accesses the Internet from 0

percent to 10 percent is far more significant than the returns of increasing this share from 20 percent to 30 percent or 40 percent to 50 percent. Given the sample in this analysis, it is likely that the historical benefits associated with broadband use are underestimated.

Goods-Producing Versus Service-Providing Employment

Earlier research on IT and broadband seek to estimate the differential effects on specific sectors of the economy. SRRI used total nonfarm, goods-producing, and service-providing employment to study whether changes in broadband use have affected employment in these sectors differently.

Figures 16 through 18 report the regression results for growth in employment in these three categories. The results do not seem sensitive to employment in these broad sectors of the economy. Broadband has a positive and significant effect on growth in total nonfarm and goods-sector employment. In these specifications, the economic impact of broadband on growth in goods-production employment is twice as large in magnitude compared to total nonfarm employment. These findings indicate that increase in broadband use may lead to significant increases in job growth, especially in goods-production industries. A similar finding is evident in the Gartner (2003) study, which shows sectors such as Manufacturing and Construction in the upper half of the distribution of gains in gross state product due to increased broadband infrastructure.

FIGURE 16
ESTIMATED EFFECTS OF BROADBAND ON NONFARM EMPLOYMENT GROWTH

	OLS with Controls	*County Fixed Effects with Controls*
BB	0.012	0.052
	(0.012)	(0.020)***
EMP_NF_{t-1}	0.415	0.105
	(0.063)***	(0.086)
INC	0.362	0.143
	(0.055)***	(0.071)**
C	-0.014	-0.01
	(0.004)***	(0.005)**
County fixed effects	No	Yes
Adjusted R^2	0.423	0.43
AIC	-4.9469	-4.7591
Obs.	150	

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FIGURE 17
ESTIMATED EFFECTS OF BROADBAND ON GOODS-PRODUCING SECTOR EMPLOYMENT GROWTH

	OLS with Controls	*County Fixed Effects with Controls*
BB	-0.015	0.149
	(0.028)	(0.042)***
EST_GDS_{t-1}	0.156	-0.218
	(0.074)**	(0.080)***
INC	0.679	0.166
	(0.137)***	(0.152)
C	-0.023	-0.036
	(0.009)**	(0.009)***
County fixed effects	No	Yes***
Adjusted R^2	0.189	0.386
AIC	-3.1393	-3.2173
Obs.	150	

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FIGURE 18
ESTIMATED EFFECTS OF BROADBAND ON SERVICE-PROVIDING SECTOR EMPLOYMENT GROWTH

	OLS with Controls	*County Fixed Effects with Controls*
BB	0.011	0.034
	(0.013)	(0.021)
EMP_SER_{t-1}	0.414	0.153
	(0.066)***	(0.089)*
INC	0.312	0.133
	(0.057)***	(0.077)*
C	-0.012	-0.005
	(0.004)***	(0.005)
County fixed effects	No	Yes
Adjusted R^2	0.348	0.318
AIC	-4.8394	-4.5933
Obs.	150	

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Marginal Effects of Broadband

The empirical analysis indicates that growth in broadband has a positive effect on growth in employment and payroll and a negative effect on growth in establishments. Figure 19 shows the hypothesized relationships and those estimated from the regression for each measure of economic activity. The estimates in this table are based on regressions including county fixed effects and control variables.

FIGURE 19
ESTIMATED MARGINAL EFFECTS OF BROADBAND
ON 2002-2005 ECONOMIC GROWTH IN CALIFORNIA

	Percentage Point Increase/Decrease					
	Employment		Establishments		Payroll	
Measure	*Estimate*	*Hypothesis*	*Estimate*	*Hypothesis*	*Estimate*	*Hypothesis*
Broadband Use	0.025 to 0.075	+	-0.104 to -0.062	+/-	0.029 to 0.088	+
Migration Ratio	0.016 to 0.048	+	-0.053 to -0.023	+/-	0.008 to 0.061	+

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Note: Ranges based on 90 percent confidence intervals.

Based on the estimated effect of broadband share on the growth in employment shown in Figure 19, a 1 percentage point increase in the share of the adult population accessing the Internet through a broadband connection increases the growth rate in employment by as much as 0.075 percentage points. These estimates are slightly smaller than those from the Department of Commerce (2006) study, which finds that broadband added between 1 and 1.4 percent to the nation's employment growth rate between 1998 and 2002. Considering that the measure of broadband is different (availability instead of actual use) and estimated over the U.S. (versus California alone), the results for employment are remarkably similar.

SRRI's findings deviate from the Department of Commerce (2006) study for business establishments.[4] This analysis shows a negative relationship between broadband use and the migration ratio and establishments. The difference in the findings could be attributed to how the establishments variable is constructed, or it could reflect a difference in California counties relative to the rest of the country. These differences could arise from a preference for telecommuting or self-employment. Longer commute times in larger counties may similarly affect individuals' preferences. Alternatively, the difference could reflect the relatively high cost of renting (for the purposes of creating a physical business establishment) in California. These factors suggest that the increased use of broadband may induce individuals to shift away from working in a centralized location in California more so than in other states. It is important to note that the robustness checks discussed later in this section show both positive and negative effects on establishments and indicate that findings for this variable are suspect and subject to specifications.

[4] In the Department of Commerce (2006) study, the measure of business establishments is the ratio of establishments in one year divided by the previous period. For the purposes of consistency with the economic model and regression specifications use for employment and payroll, SRRI opted to analyze the growth in business establishments.

The estimates demonstrate that both increased broadband use and migration from dial-up to broadband are associated with higher payroll growth. SRRI's model estimates that a 1 percentage point increase in the share of adult population using broadband increases the payroll growth rate by as much as 0.088 percentage points. This is consistent with the findings for employment above and the economic model altogether. With increased use of broadband, new jobs are created and productivity rises. Both of these changes will have a positive effect on total payroll growth.

The results for the migration ratio have the same sign, although are smaller in magnitude. This is because the migration ratio only measures broadband compared to the combination of DSL, cable, and dial-up. When individuals access the Internet through some other medium (e.g. wireless local area networks provided by a municipality or employer), the migration ratio will not measure the economic effects of switching from DSL or cable to some other access type. Considering this, the economic effects of switching from dial-up to DSL or cable are not trivial.

Historical Contribution of Broadband

To put these figures into context, SRRI used point estimates from the regression equations to quantify the marginal effects of increased broadband and migration from dial-up to broadband on historical economic activity. These figures are reported in Figure 20.

While the marginal effects reported in Figure 19 appear relatively small, the historical estimates reported in Figure 20 illustrate that small differences in growth have significant implications for California's employment, establishments, and payroll. In 2005, increased broadband use contributed about 52,000 of the 281,000 net new jobs created in California. Migration from dial-up to broadband contributed roughly the same amount of jobs, demonstrating the economic effects of broadband net any new increases in dial-up use. Similarly, in 2005 increased broadband use contributed approximately $3.2 billion of the $36 billion in net new payroll. Estimates for the migration of access show a contribution of close to $2.7 billion of payroll to the state's economy. Over the entire 2002 to 2005 period, broadband use or the migration from dial-up to broadband generated between roughly 195,000 and 198,000 jobs and approximately $9.3 billion and $11.6 billion of payroll in California. The point estimates of the effects on establishments show negative impacts from broadband use and the migration from dial-up to broadband.

FIGURE 20
HISTORICAL ECONOMIC EFFECTS OF BROADBAND ON ECONOMIC ACTIVITY IN CALIFORNIA

Measure	Year	Total	Change from Previous Year	Contribution: Increased Broadband Use	Contribution: Migration from Dial-Up to Broadband
Employment	2002	14,837,334	-144,423	26,808	24,556
Employment	2003	14,807,656	-29,678	44,565	50,260
Employment	2004	14,953,022	145,366	74,181	67,031
Employment	2005	15,234,188	281,166	52,332	53,125
Employment	Cum.	-	252,431	197,886	194,971
Establishments	2002	1,112,094	46,395	-3,319	-2,195
Establishments	2003	1,159,321	47,227	-5,773	-4,702
Establishments	2004	1,193,718	34,397	-9,823	-6,402
Establishments	2005	1,221,898	28,180	-6,948	-5,092
Establishments	Cum.	-	156,199	-25,863	-18,391
Payroll ($ millions)	2002	$614,542	-$4,604	$1,478	$1,105
Payroll ($ millions)	2003	$630,692	$16,150	$2,527	$2,325
Payroll ($ millions)	2004	$667,522	$36,829	$4,407	$3,250
Payroll ($ millions)	2005	$703,993	$36,471	$3,219	$2,667
Payroll ($ millions)	Cum.	-	$84,846	$11,630	$9,347

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Note: Ranges based on 90 percent confidence intervals.

Estimation Issues and Robustness

It is possible that there is an endogenous relationship between the use of broadband and economic activity in the model presented above. Therefore, the regression estimates indicate only that there is a positive relationship between broadband use and growth in economic activity.

To check the robustness of the results, SRRI estimated the growth in economic activity as a function of broadband use from the previous year. The estimates from these regressions are presented in Figures 21 to 23. These Figures demonstrate that the general conclusions from the preliminary regressions are robust to this specification. The F-statistic is statistically significant in all specifications.

FIGURE 21
ESTIMATED EFFECTS OF LAGGED BROADBAND ON EMPLOYMENT GROWTH

	OLS with Controls	*County Fixed Effects with Controls*
BB_{t-1}	0.023	0.092
	(0.019)	(0.027)***
EMP_{t-1}	0.181	-0.377
	(0.077)**	(0.096)***
INC	0.409	0.2
	(0.095)***	(0.090)**
C	-0.017	-0.014
	(0.007)**	(0.007)*
County fixed effects	No	Yes***
Adjusted R^2	0.18	0.406
AIC	-4.5346	-4.6152
Obs.	112	

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FIGURE 22
ESTIMATED EFFECTS OF LAGGED BROADBAND ON ESTABLISHMENT GROWTH

	OLS with Controls	*County Fixed Effects with Controls*
BB_{t-1}	-0.012	-0.058
	(0.015)	(0.026)**
EST_{t-1}	0.591	-0.013
	(0.065)***	(0.1)
UNR	-0.108	0.881
	(0.08)	(0.374)**
C	0.007	-0.036
	(0.008)	(0.029)
County fixed effects	No	Yes***
Adjusted R^2	0.445	0.586
AIC	-5.2457	-5.2956
Obs.	112	

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FIGURE 23
ESTIMATED EFFECTS OF LAGGED BROADBAND ON PAYROLL GROWTH

	OLS with Controls	*County Fixed Effects with Controls*
BB_{t-1}	0.012	0.01
	(0.027)	(0.051)
$PAYRL_{t-1}$	0.121	-0.204
	(0.064)*	(0.085)**
UNR	-0.084	-1.401
	(0.141)	(0.638)**
C	0.047	0.155
	(0.014)***	(0.053)***
County fixed effects	No	Yes
Adjusted R^2	0.013	0.134
AIC	-4.0976	-3.9867
Obs.	112	

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In the preferred regression specifications (with county fixed effects), broadband has a positive effect on growth in employment and a negative effect on growth in establishments. When using the lagged value of the broadband variable, broadband does not have a statistically significant effect on growth in payroll in the specifications reported in Figure 23.

The county fixed effects included in the regressions above are meant to capture unobserved cross-county variation that is not explained by the explanatory variables. In order to test the robustness of the findings, SRRI also estimated cross section regressions similar to those in the Department of Commerce (2006) study, inclusive of demographic variables from the decennial Census. SRRI considered two demographic variables—college education (COL) and population density (DENS). The results from these regressions are reported in Figure 24. The F-statistics indicate this specification is unable to explain variation in growth in payroll.

FIGURE 24
ESTIMATED EFFECTS OF BROADBAND ON ECONOMIC GROWTH—CROSS-SECTION

	Dependent Variable (Y_t)		
	EMP	*ESTAB*	*PAYRL*
BB	0.058	0.074	0.039
	(0.053)	(0.035)**	(0.095)
Y_{t-1}	-0.01	0.699	-0.004
	(0.182)	(0.178)***	(0.184)
X_t (INC or UNR)	0.607	-0.143	-0.055
	(0.235)**	(0.191)	(0.436)
COL	0.005	-0.007	-0.113
	(0.056)	(0.050)	(0.121)
DENS	0.137	0.12	0.329
	(0.103)	(0.070)*	(0.169)
C	-0.062	-0.026	0.004
	(0.019)***	(0.027)	(0.060)*
R^2	0.49	0.525	0.201
F-statistic	5.19***	5.97***	1.36
Obs.	38	38	38

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The inclusion of cross-section decennial Census data severely limits the sample in that SRRI was unable to analyze how changes in broadband affect economic outcomes over time. This could explain the statistical insignificance of college education and population density. Compared with the Department of Commerce (2006) study, these results are roughly similar. In that study, growth in college education and the urban population are not statistically significant in cross-section salary regressions.

The general conclusions for the economic effects of broadband are similar to those presented above for growth in employment and payroll. The results for growth in establishments are statistically significant and indicate a positive effect (compared with the negative effect shown in Figure 8).

Overall, SRRI's analysis shows that this migration and the growth in broadband use appears to have had a positive and significant effect on employment and payroll in the state. Economic theory would suggest that increased investment in the deployment and, sequentially, the use of broadband has the potential to generate incremental benefits to many of the state's regions and California overall.

Forecasts of Economic Activity

Forecasting Approach

Looking forward, broadband use, and the migration from dial-up to broadband connections, will likely continue to have a significant effect on economic growth throughout the state. Any incremental gains in broadband use have the potential to marginally impact economic outcomes.

SRRI used the estimated regression equations to create four separate forecasts of how increased broadband use could affect economic outcomes in the state and the sample regions.[5] One forecast establishes a baseline of economic growth following typical historical trends or "business as usual." This forecast is estimated by taking the unconditional mean of growth for the economic outcomes between 2004 and 2005.[6] The other three forecasts are based on scenarios of how broadband use and migration from dial-up to broadband change over time—the "moderate" scenario assumes a 0.2 annual percentage point increase in the adult population using broadband (the sample data minimum value), "strong" is based on a 3.8 percentage point increase (the average of the sample data), and "dramatic" uses a 7.6 percentage point increase (the sample data maximum value). In cases where the broadband growth scenario pushes the percentage of the adult population to extraordinarily high levels, SRRI applied an upper threshold of 94 percent, reflecting the penetration level of common telephone service.[7]

In order to forecast the economic outcomes in these scenarios, SRRI used the marginal effect of broadband on the measure of economic activity:

$$\Delta g_{i,t} = \gamma \Delta BB_{i,t}$$

The estimate of g is obtained from the regression analysis described in the preceding section. SRRI used the estimates from the specifications with county fixed effects. For example, consider the forecast for employment. This is obtained by computing the growth rate in employment from the regression equation. In the employment regression estimates with county fixed effects, the estimated value of γ is 0.0502. Under the strong scenario, $\Delta BB_{i,t}$ is 3.8 percentage points, or 0.038:

$$\Delta g_{i,t} = 0.0502(0.038) = 0.001909$$

[5] This forecasting exercise relies on a fairly straightforward approach, which focuses on how much one variable, broadband use, increases over time. Internet access trends suggest that dial-up connections will be of minimal importance moving forward, making the more complex examination of all Internet connection types less useful.

[6] The average growth rate over the entire sample was not used because 2001 is a recession year—calculations over the period 2001-2005 yields exceptionally low (and in some cases negative) growth rates. For counties that experienced negative growth in economic activity 2004-2005, a value of zero growth was assigned to generate forecasts in the baseline case. Use of a negative growth rate would inflate the economic effects of broadband on economic growth and it is unlikely that these counties would experience negative growth in employment and payroll over the next ten years.

[7] Crandall and Jackson (2001) cite 94 percent as the proportion of households that subscribe to ordinary telephone service based on the Current Population Survey for August 2000 (p. 19).

Therefore, the growth rate will be 0.001909 higher in this scenario (compared to a situation with zero broadband growth). This is added to the unconditional growth rate observed between 2004 and 2005.

Using the implied growth rate for each scenario, the predicted level of economic activity (employment or payroll) can be computed:

$$g_{it} = \ln(Y_t) - \ln(Y_{t-1})$$

$$\ln(Y_t) = g_{it} + \ln(Y_{t-1})$$

The forecasting exercises only consider employment and total payroll since the robustness of the estimated models for establishments is suspect—the economic effects are mixed and depend on the specification used.

Forecasts for California are based on employment and payroll figures at the state level. Since broadband usage data were only available for the 39 counties in the original sample, SRRI assumed that broadband usage in these counties was representative of the entire state (since 92 percent of the state's population resides in the sample counties). Looking at the distribution of variables and the characteristics of the counties included in the sample, it seems reasonable to conclude that the estimated model can be applied to all counties. The regional forecasts are generated based on the economic situation in the California counties included in the panel data set.

Exponentiation of the forecasted value of $\ln(Y_t)$ yields the values discussed below.[8] This forecasting method assumes that the marginal effect of broadband on economic activity is the same across California regions. The regional forecasts are based on the county-level forecasts of economic activity, aggregated across the regions.

Employment and Payroll Forecasts

Figures 25 and 26 present the results of the three broadband scenarios, along with the baseline forecast, on employment and payroll for California. The cumulative 10-year gains over the baseline forecast are also shown in these Figures. Even a moderate increase in broadband use could make a notable contribution to the state's economy—a 10-year cumulative gain of 57,000 jobs and $7 billion of payroll compared to the business as usual forecast. Over the next ten years, the strong level of broadband growth could generate a cumulative gain of 1.8 million jobs and $132 billion of payroll in California relative to the baseline forecast of economic growth. The dramatic broadband growth scenario would push the state to the threshold use level toward the middle of the 10-year timeframe. All in all, this scenario could lead to a statewide cumulative gain

[8] There are three issues to consider when generating forecasts over long horizons. First, the longer-term the forecast, the less accuracy and certainty regarding the estimates. Second, extrapolating data over longer horizons would imply that the share of the adult population using broadband approaches (or exceeds) 100 percent in the strong and dramatic broadband scenarios. Third, employment forecasts (and related measures) are subject to limits on the ability to generate new jobs and generally assume that the economy is not at (and does not reach) "full employment" (a long-term low unemployment rate).

over the 10 years of about 2.2 million jobs and $267 billion of payroll weighed against the baseline forecast.

FIGURE 25
CALIFORNIA EMPLOYMENT
FORECASTS
THOUSANDS OF JOBS

	Business	*Broadband Growth Scenario*		
Year	*As Usual*	*Moderate*	*Strong*	*Dramatic*
2005	15,234	15,234	15,234	15,234
2006	15,452	15,454	15,482	15,511
2007	15,673	15,676	15,733	15,793
2008	15,897	15,902	15,988	16,080
2009	16,124	16,131	16,248	16,373
2010	16,355	16,362	16,512	16,607
2011	16,589	16,596	16,780	16,844
2012	16,826	16,833	17,052	17,085
2013	17,067	17,074	17,329	17,329
2014	17,311	17,318	17,611	17,577
2015	17,558	17,565	17,897	17,829
10-Yr. Cum. Gains	-	57	1,780	2,176

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While not directly comparable, the results of the strong broadband growth scenario are consistent (although somewhat smaller) with the Gartner (2003) study, which projects an incremental addition of 2 million jobs between 2000 and 2010 with increased broadband utilization.

FIGURE 26
CALIFORNIA PAYROLL
FORECASTS
BILLIONS OF DOLLARS

	Business	*Broadband Growth Scenario*		
Year	*As Usual*	*Moderate*	*Strong*	*Dramatic*
2005	$704	$704	$704	$704
2006	$733	$733	$735	$737
2007	$763	$763	$767	$771
2008	$794	$794	$800	$806
2009	$826	$827	$835	$843
2010	$860	$861	$871	$882
2011	$895	$896	$909	$923
2012	$932	$933	$949	$966
2013	$970	$971	$990	$1,010
2014	$1,010	$1,011	$1,033	$1,057
2015	$1,051	$1,052	$1,078	$1,106
10-Yr. Cum. Gains	-	$7	$132	$267

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Regional employment and payroll forecasts for the business as usual and three broadband growth scenarios are reported in Figures 27 through 34. The broadband growth scenario Figures also show the cumulative 10-year gains. In both the strong and dramatic broadband growth scenarios, some regions reach the threshold broadband use proportion in the forecast period. The regional analysis allows each affected area to reach the threshold point at different times in the strong and dramatic scenarios, which differs from

the statewide model that essentially caps the entire state at the same time under the dramatic scenario.[9] As a result of varying economic conditions and dissimilar levels of Internet access, each region is impacted differently by an increase in the proportion of the adult population using broadband. In all cases, every selected region could benefit from an incremental boost in broadband use over what is expected in the baseline forecasts.

The large, metropolitan Los Angeles-Long Beach-Glendale region could see the greatest marginal employment gains from increased broadband use with cumulative expansion of between approximately 15,000 and 814,000 jobs and $1 and $63 billion of payroll compared to business as usual job growth. At the other end of the spectrum, the small, more rural Clearlake region could expect a 10-year cumulative gain of between about 55 and 3,400 jobs and $3 and $194 million of payroll under the broadband growth scenarios relative to the baseline forecast. These estimates highlight the important impact increased broadband use could generate throughout the state—compounded over time, even the smaller regions of the state could benefit from notable economic gains, including more jobs and additional money to ripple through the economy.

FIGURE 27
REGIONAL BUSINESS AS USUAL EMPLOYMENT FORECASTS

Region	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
Clearlake	15,619	15,692	15,764	15,838	15,911	15,985	16,059	16,134	16,209	16,284	16,359
Fresno	340,775	347,279	353,906	360,660	367,543	374,558	381,706	388,991	396,415	403,980	411,690
Hanford-Corcoran	39,918	40,853	41,810	42,789	43,791	44,816	45,866	46,940	48,039	49,164	50,316
Los Angeles-Long Beach-Glendale	4,082,533	4,114,407	4,146,530	4,178,903	4,211,530	4,244,411	4,277,548	4,310,945	4,344,602	4,378,522	4,412,707
Madera	44,071	45,993	47,998	50,091	52,276	54,555	56,934	59,417	62,008	64,712	67,534
Merced	68,625	69,844	71,085	72,348	73,633	74,942	76,273	77,628	79,007	80,411	81,840
Modesto	173,937	177,519	181,175	184,906	188,715	192,601	196,568	200,616	204,748	208,964	213,268
Napa	65,201	65,705	66,212	66,724	67,240	67,759	68,283	68,810	69,342	69,878	70,418
Oakland-Fremont-Hayward	1,015,218	1,017,509	1,019,816	1,022,139	1,024,477	1,026,831	1,029,201	1,031,587	1,033,988	1,036,407	1,038,841
Oxnard-Thousand Oaks-Ventura	312,638	319,038	325,569	332,233	339,034	345,974	353,056	360,283	367,658	375,185	382,865
Phoenix Lake-Cedar Ridge	18,170	18,509	18,855	19,207	19,566	19,931	20,303	20,682	21,068	21,462	21,862
Riverside-San Bernardino-Ontario	1,238,361	1,310,586	1,387,044	1,467,985	1,553,673	1,644,387	1,740,423	1,842,097	1,949,738	2,063,701	2,184,358
Sacramento-Arden Arcade-Roseville	906,812	928,983	951,721	975,041	998,958	1,023,489	1,048,650	1,074,459	1,100,932	1,128,087	1,155,943
San Diego-Carlsbad-San Marcos	1,291,900	1,311,783	1,331,972	1,352,471	1,373,286	1,394,421	1,415,882	1,437,673	1,459,799	1,482,266	1,505,078
San Francisco-San Mateo-Redwood City	960,379	960,379	960,379	960,379	960,379	960,379	960,379	960,379	960,379	960,379	960,379
San Jose-Sunnyvale-Santa Clara	871,239	872,780	874,329	875,887	877,454	879,029	880,614	882,207	883,810	885,423	887,045
Santa Ana-Anaheim-Irvine	1,489,269	1,525,361	1,562,328	1,600,191	1,638,972	1,678,693	1,719,376	1,761,045	1,803,724	1,847,437	1,892,209
Santa Rosa-Petaluma	189,073	189,916	190,762	191,612	192,466	193,324	194,185	195,051	195,920	196,793	197,670
Stockton	218,216	221,611	225,058	228,559	232,115	235,725	239,392	243,116	246,898	250,739	254,640
Truckee-Grass Valley	29,776	30,294	30,821	31,358	31,904	32,459	33,024	33,599	34,183	34,778	35,383
Ukiah	32,500	32,500	32,500	32,500	32,500	32,500	32,500	32,500	32,500	32,500	32,500
Vallejo-Fairfield	129,185	130,739	132,311	133,902	135,512	137,142	138,791	140,460	142,150	143,859	145,589
Visalia-Porterville	140,360	142,830	145,344	147,902	150,505	153,154	155,849	158,592	161,383	164,223	167,113
Yuba City	44,042	44,479	44,923	45,375	45,834	46,301	46,776	47,259	47,751	48,251	48,760

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[9] The differences in threshold behavior generate varying growth assumptions between the statewide model and the aggregate of all regions in the individual regional models.

FIGURE 28
REGIONAL MODERATE BROADBAND GROWTH
SCENARIO EMPLOYMENT FORECASTS

Region	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*10-Year Cum. Gains*
Clearlake	15,619	15,693	15,768	15,842	15,917	15,991	16,066	16,140	16,215	16,290	16,366	55
Fresno	340,775	347,313	353,977	360,769	367,691	374,708	381,860	389,147	396,574	404,142	411,855	1,310
Hanford-Corcoran	39,918	40,857	41,818	42,802	43,808	44,834	45,884	46,959	48,059	49,184	50,336	158
Los Angeles-Long Beach-Glendale	4,082,533	4,114,820	4,147,363	4,180,163	4,213,222	4,246,117	4,279,268	4,312,678	4,346,349	4,380,282	4,414,481	14,638
Madera	44,071	45,997	48,008	50,106	52,297	54,577	56,957	59,441	62,033	64,738	67,561	197
Merced	68,625	69,851	71,099	72,370	73,663	74,972	76,304	77,659	79,039	80,444	81,873	262
Modesto	173,937	177,537	181,212	184,962	188,790	192,679	196,647	200,697	204,830	209,048	213,354	675
Napa	65,201	65,711	66,226	66,744	67,267	67,786	68,310	68,838	69,370	69,906	70,446	234
Oakland-Fremont-Hayward	1,015,218	1,017,612	1,020,021	1,022,447	1,024,889	1,027,244	1,029,614	1,032,001	1,034,404	1,036,823	1,039,259	3,518
Oxnard-Thousand Oaks-Ventura	312,638	319,070	325,634	332,333	339,170	346,113	353,198	360,428	367,806	375,335	383,019	1,212
Phoenix Lake-Cedar Ridge	18,170	18,511	18,859	19,213	19,573	19,939	20,311	20,690	21,077	21,470	21,871	70
Riverside-San Bernardino-Ontario	1,238,361	1,310,718	1,387,323	1,468,428	1,554,297	1,645,048	1,741,123	1,842,837	1,950,522	2,064,531	2,185,236	6,070
Sacramento-Arden Arcade-Roseville	906,812	929,076	951,912	975,335	999,360	1,023,901	1,049,072	1,074,891	1,101,374	1,128,540	1,156,408	3,606
San Diego-Carlsbad-San Marcos	1,291,900	1,311,915	1,332,239	1,352,879	1,373,838	1,394,982	1,416,451	1,438,251	1,460,386	1,482,862	1,505,683	4,854
San Francisco-San Mateo-Redwood City	960,379	960,475	960,572	960,669	960,765	960,765	960,765	960,765	960,765	960,765	960,765	3,281
San Jose-Sunnyvale-Santa Clara	871,239	872,868	874,505	876,151	877,806	879,383	880,968	882,562	884,166	885,779	887,402	3,010
Santa Ana-Anaheim-Irvine	1,489,269	1,525,515	1,562,642	1,600,674	1,639,631	1,679,367	1,720,067	1,761,753	1,804,449	1,848,179	1,892,970	5,910
Santa Rosa-Petaluma	189,073	189,935	190,800	191,670	192,543	193,401	194,263	195,129	195,999	196,872	197,749	664
Stockton	218,216	221,633	225,103	228,628	232,208	235,820	239,489	243,214	246,998	250,840	254,742	821
Truckee-Grass Valley	29,776	30,297	30,828	31,367	31,916	32,472	33,037	33,612	34,197	34,792	35,398	113
Ukiah	32,500	32,503	32,507	32,510	32,513	32,513	32,513	32,513	32,513	32,513	32,513	111
Vallejo-Fairfield	129,185	130,752	132,337	133,942	135,567	137,197	138,847	140,517	142,207	143,917	145,648	475
Visalia-Porterville	140,360	142,845	145,373	147,946	150,565	153,215	155,912	158,655	161,448	164,289	167,180	535
Yuba City	44,042	44,483	44,932	45,388	45,852	46,320	46,795	47,278	47,770	48,270	48,779	160

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FIGURE 29
REGIONAL STRONG BROADBAND GROWTH
SCENARIO EMPLOYMENT FORECASTS

Region	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*10-Year Cum. Gains*
Clearlake	15,619	15,721	15,825	15,928	16,033	16,138	16,244	16,351	16,458	16,566	16,675	1,705
Fresno	340,775	347,942	355,260	362,732	370,361	378,150	386,103	394,224	402,515	410,980	419,624	41,163
Hanford-Corcoran	39,918	40,931	41,970	43,034	44,126	45,246	46,394	47,571	48,779	50,016	51,285	4,970
Los Angeles-Long Beach-Glendale	4,082,533	4,122,269	4,162,391	4,202,904	4,243,811	4,285,116	4,326,823	4,368,937	4,411,460	4,454,397	4,497,752	455,753
Madera	44,071	46,081	48,182	50,379	52,676	55,078	57,590	60,216	62,962	65,833	68,835	6,315
Merced	68,625	69,978	71,357	72,764	74,198	75,660	77,152	78,673	80,223	81,805	83,417	8,213
Modesto	173,937	177,858	181,868	185,968	190,161	194,448	198,832	203,315	207,898	212,585	217,378	21,233
Napa	65,201	65,830	66,466	67,107	67,755	68,409	69,069	69,736	70,409	71,089	71,775	7,275
Oakland-Fremont-Hayward	1,015,218	1,019,454	1,023,717	1,028,009	1,032,330	1,036,679	1,041,057	1,045,464	1,049,900	1,054,366	1,058,862	109,041
Oxnard-Thousand Oaks-Ventura	312,638	319,647	326,814	334,141	341,633	349,292	357,123	365,130	373,316	381,686	390,243	38,131
Phoenix Lake-Cedar Ridge	18,170	18,545	18,927	19,317	19,716	20,122	20,537	20,960	21,393	21,834	22,284	2,188
Riverside-San Bernardino-Ontario	1,238,361	1,313,090	1,392,350	1,476,416	1,565,582	1,660,157	1,760,472	1,866,877	1,979,742	2,099,463	2,226,457	196,613
Sacramento-Arden Arcade-Roseville	906,812	930,758	955,361	980,640	1,006,615	1,033,305	1,060,730	1,088,913	1,117,873	1,147,635	1,178,221	113,790
San Diego-Carlsbad-San Marcos	1,291,900	1,314,289	1,337,067	1,360,239	1,383,812	1,407,794	1,432,192	1,457,013	1,482,263	1,507,952	1,534,085	152,075
San Francisco-San Mateo-Redwood City	960,379	962,214	964,053	965,895	967,740	969,589	971,442	973,298	975,158	977,021	978,676	101,297
San Jose-Sunnyvale-Santa Clara	871,239	874,448	877,674	880,918	884,179	887,459	890,758	894,075	897,411	900,766	904,141	93,250
Santa Ana-Anaheim-Irvine	1,489,269	1,528,276	1,568,305	1,609,382	1,651,535	1,694,792	1,739,182	1,784,735	1,831,480	1,879,451	1,928,677	186,478
Santa Rosa-Petaluma	189,073	190,278	191,492	192,713	193,941	195,178	196,422	197,674	198,935	200,203	201,480	20,618
Stockton	218,216	222,034	225,919	229,872	233,894	237,986	242,150	246,387	250,698	255,084	259,547	25,717
Truckee-Grass Valley	29,776	30,352	30,939	31,538	32,148	32,770	33,404	34,051	34,709	35,381	36,065	3,555
Ukiah	32,500	32,562	32,624	32,687	32,749	32,812	32,874	32,937	33,000	33,063	33,126	3,435
Vallejo-Fairfield	129,185	130,988	132,817	134,671	136,551	138,457	140,390	142,350	144,337	146,352	148,395	14,853
Visalia-Porterville	140,360	143,103	145,900	148,751	151,658	154,622	157,644	160,725	163,866	167,069	170,334	16,779
Yuba City	44,042	44,564	45,095	45,635	46,185	46,745	47,315	47,895	48,486	49,087	49,699	4,998

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FIGURE 30
REGIONAL DRAMATIC BROADBAND GROWTH
SCENARIO EMPLOYMENT FORECASTS

Region	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*10-Year Cum. Gains*
Clearlake	15,619	15,752	15,885	16,020	16,156	16,293	16,431	16,571	16,711	16,853	16,931	3,369
Fresno	340,775	348,607	356,619	364,815	373,199	381,777	390,551	399,527	408,709	416,509	424,458	78,043
Hanford-Corcoran	39,918	41,009	42,130	43,282	44,465	45,680	46,929	48,211	49,529	50,883	52,274	10,008
Los Angeles-Long Beach-Glendale	4,082,533	4,130,145	4,178,313	4,227,042	4,276,339	4,326,212	4,376,666	4,427,708	4,462,277	4,497,116	4,532,227	813,940
Madera	44,071	46,169	48,366	50,668	53,080	55,607	58,253	61,026	63,931	66,974	69,894	12,451
Merced	68,625	70,111	71,630	73,181	74,767	76,386	78,041	79,731	81,458	82,905	84,378	15,575
Modesto	173,937	178,198	182,564	187,036	191,619	196,313	201,122	206,050	210,293	214,624	219,044	37,784
Napa	65,201	65,956	66,720	67,493	68,274	69,065	69,865	70,674	71,493	72,320	72,879	14,369
Oakland-Fremont-Hayward	1,015,218	1,021,402	1,027,633	1,033,913	1,040,242	1,046,621	1,049,036	1,051,468	1,053,916	1,056,381	1,058,862	158,679
Oxnard-Thousand Oaks-Ventura	312,638	320,258	328,064	336,060	344,251	352,642	361,237	368,632	376,178	383,878	391,736	62,042
Phoenix Lake-Cedar Ridge	18,170	18,580	18,999	19,428	19,867	20,315	20,774	21,161	21,557	21,959	22,369	3,564
Riverside-San Bernardino-Ontario	1,238,361	1,315,599	1,397,676	1,484,896	1,577,582	1,676,079	1,780,752	1,891,990	2,006,349	2,123,605	2,247,748	358,281
Sacramento-Arden Arcade-Roseville	906,812	932,536	959,016	986,272	1,014,331	1,043,214	1,072,949	1,100,697	1,128,506	1,156,354	1,184,920	192,534
San Diego-Carlsbad-San Marcos	1,291,900	1,316,801	1,342,181	1,368,051	1,394,419	1,421,296	1,443,170	1,465,381	1,487,933	1,510,833	1,534,085	219,518
San Francisco-San Mateo-Redwood City	960,379	964,053	967,740	971,442	975,158	978,465	978,465	978,465	978,465	978,465	978,465	145,393
San Jose-Sunnyvale-Santa Clara	871,239	876,118	881,031	885,977	890,957	895,971	897,657	899,357	901,069	902,717	904,375	136,649
Santa Ana-Anaheim-Irvine	1,489,269	1,531,196	1,574,304	1,618,625	1,664,194	1,711,045	1,752,513	1,794,985	1,838,486	1,883,042	1,928,677	267,730
Santa Rosa-Petaluma	189,073	190,642	192,224	193,819	195,428	197,050	197,928	198,810	199,696	200,586	201,480	29,963
Stockton	218,216	222,458	226,783	231,192	235,686	240,268	244,939	249,701	254,556	258,516	262,537	48,784
Truckee-Grass Valley	29,776	30,410	31,058	31,719	32,395	33,084	33,789	34,509	35,243	35,994	36,620	7,018
Ukiah	32,500	32,624	32,749	32,874	33,000	33,126	33,253	33,380	33,508	33,636	33,765	6,917
Vallejo-Fairfield	129,185	131,239	133,325	135,444	137,598	139,785	142,007	144,265	146,000	147,756	149,532	26,496
Visalia-Porterville	140,360	143,377	146,458	149,606	152,821	156,105	159,460	162,887	166,388	169,964	172,955	33,127
Yuba City	44,042	44,649	45,267	45,897	46,539	47,193	47,860	48,540	49,232	49,938	50,573	9,980

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FIGURE 31
REGIONAL BUSINESS AS USUAL PAYROLL FORECASTS
MILLIONS OF DOLLARS

Region	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
Clearlake	$455	$481	$509	$538	$570	$602	$637	$674	$713	$754	$797
Fresno	$10,995	$11,567	$12,167	$12,800	$13,465	$14,164	$14,900	$15,674	$16,488	$17,345	$18,246
Hanford-Corcoran	$1,197	$1,261	$1,328	$1,399	$1,474	$1,553	$1,636	$1,724	$1,816	$1,913	$2,015
Los Angeles-Long Beach-Glendale	$189,303	$195,099	$201,072	$207,228	$213,572	$220,110	$226,849	$233,794	$240,952	$248,329	$255,931
Madera	$1,294	$1,386	$1,484	$1,590	$1,702	$1,823	$1,953	$2,092	$2,240	$2,399	$2,570
Merced	$2,073	$2,200	$2,334	$2,477	$2,629	$2,789	$2,960	$3,141	$3,333	$3,537	$3,753
Modesto	$5,970	$6,283	$6,613	$6,959	$7,324	$7,708	$8,112	$8,537	$8,984	$9,455	$9,951
Napa	$2,620	$2,738	$2,861	$2,990	$3,124	$3,265	$3,412	$3,566	$3,726	$3,894	$4,069
Oakland-Fremont-Hayward	$53,405	$54,993	$56,630	$58,318	$60,058	$61,851	$63,700	$65,606	$67,571	$69,597	$71,685
Oxnard-Thousand Oaks-Ventura	$13,943	$14,768	$15,642	$16,567	$17,548	$18,586	$19,686	$20,851	$22,085	$23,392	$24,776
Phoenix Lake-Cedar Ridge	$587	$631	$679	$730	$786	$845	$909	$978	$1,052	$1,131	$1,217
Riverside-San Bernardino-Ontario	$43,592	$47,240	$51,196	$55,488	$60,143	$65,193	$70,671	$76,615	$83,064	$90,061	$97,655
Sacramento-Arden Arcade-Roseville	$38,811	$40,862	$43,024	$45,302	$47,704	$50,237	$52,907	$55,722	$58,691	$61,822	$65,124
San Diego-Carlsbad-San Marcos	$56,616	$59,366	$62,250	$65,275	$68,446	$71,771	$75,258	$78,914	$82,747	$86,767	$90,983
San Francisco-San Mateo-Redwood City	$62,431	$62,670	$62,918	$63,177	$63,446	$63,727	$64,019	$64,323	$64,640	$64,971	$65,314
San Jose-Sunnyvale-Santa Clara	$62,703	$62,730	$62,759	$62,789	$62,820	$62,854	$62,888	$62,925	$62,963	$63,003	$63,045
Santa Ana-Anaheim-Irvine	$70,296	$74,134	$78,180	$82,448	$86,948	$91,694	$96,700	$101,978	$107,545	$113,415	$119,606
Santa Rosa-Petaluma	$7,566	$7,702	$7,841	$7,982	$8,125	$8,271	$8,420	$8,572	$8,726	$8,883	$9,042
Stockton	$7,644	$8,022	$8,419	$8,835	$9,271	$9,730	$10,211	$10,715	$11,245	$11,801	$12,384
Truckee-Grass Valley	$1,012	$1,061	$1,111	$1,165	$1,221	$1,279	$1,340	$1,405	$1,472	$1,542	$1,616
Ukiah	$933	$953	$974	$995	$1,017	$1,038	$1,061	$1,084	$1,107	$1,131	$1,156
Vallejo-Fairfield	$4,965	$5,219	$5,486	$5,766	$6,061	$6,371	$6,697	$7,040	$7,400	$7,779	$8,177
Visalia-Porterville	$4,012	$4,217	$4,432	$4,659	$4,897	$5,148	$5,411	$5,687	$5,978	$6,284	$6,605
Yuba City	$1,415	$1,476	$1,540	$1,607	$1,677	$1,749	$1,825	$1,904	$1,986	$2,072	$2,162

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FIGURE 32
REGIONAL MODERATE BROADBAND GROWTH
SCENARIO PAYROLL FORECASTS
MILLIONS OF DOLLARS

Region	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*10-Year Cum. Gains*
Clearlake	$455	$481	$509	$539	$570	$603	$638	$674	$713	$754	$798	$3
Fresno	$10,995	$11,568	$12,171	$12,805	$13,472	$14,172	$14,908	$15,682	$16,497	$17,354	$18,256	$69
Hanford-Corcoran	$1,197	$1,261	$1,329	$1,400	$1,475	$1,554	$1,637	$1,724	$1,817	$1,914	$2,016	$8
Los Angeles-Long Beach-Glendale	$189,303	$195,125	$201,126	$207,311	$213,686	$220,228	$226,971	$233,919	$241,081	$248,462	$256,068	$1,041
Madera	$1,294	$1,386	$1,485	$1,590	$1,703	$1,824	$1,954	$2,093	$2,242	$2,401	$2,571	$9
Merced	$2,073	$2,200	$2,335	$2,478	$2,630	$2,791	$2,961	$3,142	$3,335	$3,539	$3,755	$14
Modesto	$5,970	$6,284	$6,614	$6,962	$7,328	$7,712	$8,116	$8,542	$8,989	$9,460	$9,956	$38
Napa	$2,620	$2,738	$2,862	$2,991	$3,126	$3,267	$3,414	$3,568	$3,728	$3,896	$4,072	$16
Oakland-Fremont-Hayward	$53,405	$55,001	$56,646	$58,342	$60,090	$61,884	$63,734	$65,641	$67,607	$69,634	$71,724	$292
Oxnard-Thousand Oaks-Ventura	$13,943	$14,770	$15,646	$16,574	$17,557	$18,596	$19,696	$20,862	$22,096	$23,404	$24,789	$91
Phoenix Lake-Cedar Ridge	$587	$631	$679	$731	$786	$845	$909	$978	$1,052	$1,132	$1,217	$4
Riverside-San Bernardino-Ontario	$43,592	$47,246	$51,210	$55,510	$60,175	$65,228	$70,709	$76,656	$83,108	$90,110	$97,707	$333
Sacramento-Arden Arcade-Roseville	$38,811	$40,867	$43,035	$45,321	$47,730	$50,264	$52,935	$55,752	$58,723	$61,855	$65,159	$245
San Diego-Carlsbad-San Marcos	$56,616	$59,374	$62,267	$65,301	$68,482	$71,809	$75,298	$78,956	$82,792	$86,814	$91,031	$348
San Francisco-San Mateo-Redwood City	$62,431	$62,678	$62,935	$63,202	$63,480	$63,761	$64,053	$64,358	$64,675	$65,005	$65,349	$292
San Jose-Sunnyvale-Santa Clara	$62,703	$62,739	$62,776	$62,814	$62,854	$62,887	$62,922	$62,958	$62,997	$63,037	$63,079	$286
Santa Ana-Anaheim-Irvine	$70,296	$74,144	$78,201	$82,481	$86,995	$91,743	$96,751	$102,033	$107,602	$113,476	$119,670	$448
Santa Rosa-Petaluma	$7,566	$7,703	$7,843	$7,985	$8,130	$8,276	$8,425	$8,576	$8,730	$8,887	$9,047	$38
Stockton	$7,644	$8,023	$8,421	$8,838	$9,276	$9,735	$10,216	$10,721	$11,251	$11,807	$12,391	$47
Truckee-Grass Valley	$1,012	$1,061	$1,112	$1,165	$1,221	$1,280	$1,341	$1,405	$1,473	$1,543	$1,617	$6
Ukiah	$933	$953	$974	$995	$1,017	$1,039	$1,062	$1,084	$1,108	$1,132	$1,156	$5
Vallejo-Fairfield	$4,965	$5,219	$5,487	$5,769	$6,065	$6,375	$6,701	$7,044	$7,404	$7,783	$8,181	$31
Visalia-Porterville	$4,012	$4,217	$4,434	$4,661	$4,900	$5,150	$5,414	$5,690	$5,981	$6,287	$6,608	$25
Yuba City	$1,415	$1,477	$1,541	$1,608	$1,677	$1,750	$1,826	$1,905	$1,987	$2,073	$2,163	$8

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FIGURE 33
REGIONAL STRONG BROADBAND GROWTH
SCENARIO PAYROLL FORECASTS
MILLIONS OF DOLLARS

Region	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*10-Year Cum. Gains*
Clearlake	$455	$483	$512	$543	$575	$610	$647	$686	$727	$771	$818	$96
Fresno	$10,995	$11,596	$12,230	$12,898	$13,602	$14,345	$15,129	$15,955	$16,827	$17,746	$18,716	$2,229
Hanford-Corcoran	$1,197	$1,264	$1,335	$1,410	$1,489	$1,573	$1,661	$1,754	$1,853	$1,957	$2,067	$245
Los Angeles-Long Beach-Glendale	$189,303	$195,595	$202,097	$208,814	$215,755	$222,926	$230,336	$237,992	$245,903	$254,076	$262,521	$33,079
Madera	$1,294	$1,389	$1,492	$1,602	$1,720	$1,847	$1,983	$2,129	$2,286	$2,455	$2,636	$299
Merced	$2,073	$2,205	$2,346	$2,496	$2,655	$2,825	$3,005	$3,197	$3,401	$3,618	$3,849	$448
Modesto	$5,970	$6,299	$6,646	$7,013	$7,399	$7,806	$8,237	$8,690	$9,169	$9,674	$10,207	$1,214
Napa	$2,620	$2,745	$2,876	$3,013	$3,156	$3,307	$3,465	$3,630	$3,803	$3,984	$4,174	$506
Oakland-Fremont-Hayward	$53,405	$55,133	$56,919	$58,765	$60,672	$62,642	$64,679	$66,784	$68,959	$71,207	$73,531	$9,282
Oxnard-Thousand Oaks-Ventura	$13,943	$14,805	$15,721	$16,694	$17,727	$18,824	$19,988	$21,225	$22,538	$23,933	$25,414	$2,971
Phoenix Lake-Cedar Ridge	$587	$633	$683	$736	$794	$856	$923	$995	$1,073	$1,157	$1,248	$140
Riverside-San Bernardino-Ontario	$43,592	$47,360	$51,457	$55,913	$60,758	$66,027	$71,758	$77,991	$84,771	$92,146	$100,169	$11,022
Sacramento-Arden Arcade-Roseville	$38,811	$40,966	$43,243	$45,649	$48,192	$50,880	$53,720	$56,723	$59,897	$63,253	$66,801	$7,928
San Diego-Carlsbad-San Marcos	$56,616	$59,517	$62,568	$65,774	$69,145	$72,689	$76,414	$80,331	$84,447	$88,775	$93,325	$11,211
San Francisco-San Mateo-Redwood City	$62,431	$62,829	$63,239	$63,660	$64,095	$64,542	$65,003	$65,478	$65,968	$66,474	$66,996	$9,080
San Jose-Sunnyvale-Santa Clara	$62,703	$62,890	$63,079	$63,270	$63,463	$63,658	$63,855	$64,055	$64,257	$64,461	$64,669	$8,878
Santa Ana-Anaheim-Irvine	$70,296	$74,322	$78,579	$83,079	$87,837	$92,867	$98,186	$103,809	$109,754	$116,040	$122,685	$14,512
Santa Rosa-Petaluma	$7,566	$7,722	$7,881	$8,043	$8,208	$8,377	$8,550	$8,726	$8,905	$9,088	$9,275	$1,211
Stockton	$7,644	$8,042	$8,461	$8,902	$9,366	$9,854	$10,368	$10,908	$11,476	$12,074	$12,703	$1,523
Truckee-Grass Valley	$1,012	$1,063	$1,117	$1,174	$1,233	$1,295	$1,361	$1,430	$1,502	$1,578	$1,658	$200
Ukiah	$933	$956	$979	$1,003	$1,027	$1,052	$1,077	$1,103	$1,130	$1,157	$1,185	$153
Vallejo-Fairfield	$4,965	$5,232	$5,514	$5,810	$6,123	$6,453	$6,800	$7,166	$7,552	$7,959	$8,387	$1,001
Visalia-Porterville	$4,012	$4,228	$4,455	$4,695	$4,947	$5,213	$5,494	$5,789	$6,101	$6,429	$6,775	$809
Yuba City	$1,415	$1,480	$1,548	$1,619	$1,694	$1,771	$1,853	$1,938	$2,027	$2,120	$2,218	$270

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FIGURE 34
REGIONAL DRAMATIC BROADBAND GROWTH
SCENARIO PAYROLL FORECASTS
MILLIONS OF DOLLARS

Region	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*10-Year Cum. Gains*
Clearlake	$455	$484	$514	$547	$581	$618	$657	$698	$742	$789	$839	$194
Fresno	$10,995	$11,626	$12,292	$12,996	$13,741	$14,529	$15,361	$16,242	$17,173	$18,157	$19,100	$4,402
Hanford-Corcoran	$1,197	$1,268	$1,342	$1,421	$1,505	$1,593	$1,687	$1,786	$1,891	$2,002	$2,120	$495
Los Angeles-Long Beach-Glendale	$189,303	$196,093	$203,127	$210,413	$217,960	$225,778	$233,876	$242,265	$250,955	$258,638	$266,556	$62,726
Madera	$1,294	$1,393	$1,499	$1,614	$1,737	$1,870	$2,013	$2,168	$2,333	$2,512	$2,704	$604
Merced	$2,073	$2,211	$2,358	$2,515	$2,683	$2,861	$3,052	$3,255	$3,471	$3,702	$3,929	$884
Modesto	$5,970	$6,315	$6,680	$7,066	$7,475	$7,906	$8,363	$8,846	$9,357	$9,848	$10,364	$2,295
Napa	$2,620	$2,752	$2,890	$3,036	$3,189	$3,349	$3,518	$3,695	$3,881	$4,076	$4,282	$1,022
Oakland-Fremont-Hayward	$53,405	$55,273	$57,209	$59,214	$61,292	$63,444	$65,673	$67,638	$69,664	$71,753	$73,906	$15,057
Oxnard-Thousand Oaks-Ventura	$13,943	$14,843	$15,801	$16,822	$17,908	$19,065	$20,296	$21,606	$22,885	$24,239	$25,674	$5,240
Phoenix Lake-Cedar Ridge	$587	$635	$686	$742	$802	$867	$937	$1,013	$1,090	$1,172	$1,261	$246
Riverside-San Bernardino-Ontario	$43,592	$47,481	$51,720	$56,341	$61,379	$66,872	$72,861	$79,391	$86,512	$93,800	$101,709	$20,738
Sacramento-Arden Arcade-Roseville	$38,811	$41,070	$43,463	$45,999	$48,685	$51,531	$54,546	$57,741	$60,882	$64,131	$67,557	$14,209
San Diego-Carlsbad-San Marcos	$56,616	$59,669	$62,887	$66,278	$69,852	$73,619	$77,589	$81,358	$85,311	$89,455	$93,801	$18,042
San Francisco-San Mateo-Redwood City	$62,431	$62,989	$63,561	$64,148	$64,750	$65,368	$65,850	$66,162	$66,488	$66,826	$67,179	$14,116
San Jose-Sunnyvale-Santa Clara	$62,703	$63,050	$63,400	$63,754	$64,111	$64,472	$64,836	$64,878	$64,922	$64,964	$65,008	$14,619
Santa Ana-Anaheim-Irvine	$70,296	$74,512	$78,979	$83,715	$88,735	$94,055	$99,695	$105,137	$110,876	$116,928	$123,311	$23,296
Santa Rosa-Petaluma	$7,566	$7,742	$7,921	$8,104	$8,292	$8,484	$8,681	$8,837	$8,996	$9,158	$9,323	$1,974
Stockton	$7,644	$8,063	$8,505	$8,970	$9,462	$9,980	$10,527	$11,104	$11,712	$12,291	$12,898	$2,879
Truckee-Grass Valley	$1,012	$1,066	$1,123	$1,183	$1,246	$1,312	$1,382	$1,455	$1,533	$1,615	$1,701	$403
Ukiah	$933	$958	$984	$1,010	$1,037	$1,065	$1,094	$1,123	$1,153	$1,184	$1,216	$309
Vallejo-Fairfield	$4,965	$5,245	$5,542	$5,855	$6,186	$6,535	$6,905	$7,295	$7,707	$8,102	$8,516	$1,892
Visalia-Porterville	$4,012	$4,238	$4,478	$4,731	$4,998	$5,280	$5,578	$5,893	$6,226	$6,578	$6,949	$1,632
Yuba City	$1,415	$1,484	$1,556	$1,632	$1,711	$1,794	$1,881	$1,973	$2,069	$2,169	$2,275	$545

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Overall, this analysis paints a clear picture of how increased broadband use (and the migration from dial-up to broadband) affects employment and payroll in California and a select group of its regions—the direction of the effect is always positive and the magnitude depends on the size of the shift in the percentage of the adult population using a broadband Internet connection. Even a small increase in broadband use could generate a substantial cumulative gain over the next 10 years compared to what could be expected under business as usual conditions.

References

Crandall, R.W. & Jackson, C.J. (2001). The $500 Billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access. Available at http://www.criterioneconomics.com/docs/Crandall_Jackson_500_Billion_Opportunity_July_2001.pdf.

Crandall, R., Lehr, W., & Litan, R. (2007). The Effects of Broadband Deployment on Output and Employment: A Cross-Sectional Analysis of U.S. Data. Available at http://www3.brookings.edu/views/papers/crandall/200706litan.pdf.

Ford, G. & Koutsky, T. (2005). Broadband and Economic Development: A Municipal Case Study From Florida. *Review of Urban Regional & Development Studies, 17*(3), 216-229.

Gartner, Inc. (2003). One Gigabit or Bust Initiative: A Broadband Vision for California. Available at http://www.cenic.org/publications/archives/glossies/Gartner_Full.pdf.

Jorgenson, D. (2001). Information Technology and the U.S. Economy. *American Economic Review, 91*(1), 1-32.

Malecki, E. & Bousch, C. (2003). Telecommunications Infrastructure in the Southeastern United States: Urban and Rural Variation. *Growth and Change, 34*(1), 109-29.

United States Department of Commerce (2006). Measuring the Economic Impact of Broadband Deployment. Available at http://www.eda.gov/PDF/MITCMUBBImpactReport.pdf.

Varin, H., Litan, R. E., Elder, A., & Shutter, J. (2002). The Net Impact Study: The Projected Economic Benefits of the Internet in the United States, United Kingdom, France, and Germany. Available at http://www.netimpactstudy.com/NetImpact_Study_Report.pdf.

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The Sacramento Regional Research Institute (SRRI) was established in 2001 as a joint venture of the Sacramento Area Commerce and Trade Organization (SACTO) and California State University, Sacramento (Sacramento State). The Institute acquires, analyzes and distributes economic information for the purpose of providing a greater understanding of the regional and statewide economies.

SRRI provides a full range of objective economic and demographic research services to businesses, government entities, educational institutions, and non-profit organizations. The Institute's primary services include:

- Economic Development Strategies
- Industry Studies
- Economic and Tax Impact Studies
- Market and Feasibility Analyses
- Workforce Studies
- Economic and Demographic Profiles
- Policy Analysis and Program Evaluation Support
- Site Selection Information and Research

The experienced staff at SRRI possesses extensive knowledge of economic and demographic research, economic development practices, and urban planning. Every project is successfully completed on time, within budget, and in accordance with the highest quality standards.

Public and private clients from inside and outside the Sacramento Region look to SRRI's unique economic and demographic research expertise to help them work smarter and more competitively in realizing their objectives.