Summary of Technical Approach Underlying ABAG Final Regional Forecast 2010-2040

Attachment A to "Final Regional Forecast 2010-2040" Memo to the Executive Board

This attachment to the memo "Final Regional Forecast 2010-2040" summarizes the methods used to calculate the regional forecast and the changes in measures or assumptions that led to shifts from the memo on "Preliminary Regional Forecast Numbers" released in October 2015.

The memo describes the methods underlying:

- Employment projections
- Population projections
- Household projections (number and income distribution)
- In-commute projection
- Regional Housing Control Total projection

Employment

ABAG built the employment projection using the Bay Area REMI PI+ model[1], version 1.7.8, with the adjustments described here. Regional Economic Modeling, Inc. (REMI) for more than 25 years has produced custom regional models for use in making projections and for impact analysis. We made several adjustments to the "out of the box" model at both the national and local level. These adjustments were somewhat different than those made for the preliminary forecast.

Adjustments include:

1) Modifying the rate of employment growth at the *national* level for construction, information, retail, wholesale and transportation and warehousing sectors.
2) At the *regional* level modifying residential and nonresidential investment and the relative housing price, and replacing the first two years of forecast employment with estimates based on reported Bureau of Labor Statistics employment growth rates.
3) At the *regional* level, translating employment results from the US Bureau of Economic Analysis (BEA) employment definition to a measure equivalent to the US Bureau of Labor Statistics (BLS) measure of jobs by place of work plus the US Bureau of the Census measure of self-employed workers.

Table A-1 compares the National Standard Control employment results with the modified national control (we have identified this version by the code NC3). Sector adjustments for NC3 were as follows:

a) Construction: REMI shows construction investment and jobs expanding far faster than historic trends. The high jobs come from an overestimate of growth from 2013 to 2015, while the investment issue appears to be a weakness of the model. We applied actual BLS rates of growth for 2014 and 2015 to the 2013 BEA employment number given in REMI (this rate of growth is lower than the REMI projected rate of growth). From 2016 to 2019, the 2015 rate of growth is interpolated to reach the REMI estimated rate of growth by 2020. After 2020, employment grows at the REMI calculated rate, but from the new (lower) 2020 employment level. It is not possible to adjust residential and nonresidential investment in the model at the national level. ABAG's regional level adjustment is explained below.

[1] See Regional Economic Models, Inc., *Bay Area Economic Forecasting: PI+/HD and County Control Forecasting,* March 2014. Further documentation available on model updates at http://www.remi.com/resources/documentation.

Table A-1: REMI National Standard Control compared to National Control version 3 (NC3)				
Category	**2010**	**2040**	**2040**	**Difference**
Forestry, Fishing, and Related Activities	855.4	699.3	699.3	0
Mining	1268	2126.9	2126.9	0
Utilities	582.2	350.1	350.1	0
Construction	8793.7	18206.6	17397.6	-809.0
Manufacturing	12102.9	10382.5	10382.5	0
Wholesale Trade	6024	6343.7	7032.2	688.5
Retail Trade	17591.6	18428.9	20619.1	2190.2
Transportation and Warehousing	5474.2	5955.8	6410.2	454.4
Information	3222.6	2450.0	3200.3	750.3
Finance and Insurance	9202.4	10328.4	10328.4	0
Real Estate and Rental and Leasing	7697	9107.2	9107.2	0
Professional, Scientific, and Technical Services	11755.8	18847.4	18847.4	0
Management of Companies and Enterprises	2019.4	1835.0	1835.0	0
Administrative and Waste Management Services	10402.2	15367.1	15367.1	0
Educational Services	4089.9	5027.7	5027.7	0
Health Care and Social Assistance	19089.9	31162.8	31162.8	0
Arts, Entertainment, and Recreation	3788.4	4569.8	4569.8	0
Accommodation and Food Services	11986.3	14608.8	14608.8	0
Other Services, except Public Administration	9780.8	10396.8	10396.8	0
Government	24672	23164.1	23164.1	0
Farm	2646	1502.1	1502.1	0
Total	173044.7	210860.9	214135.3	3274.4
Source: ABAG analysis using Bay Area REMI 1.7.8				

b) Information: REMI's national forecast for information is far less optimistic than most other forecasts and also underestimates recent growth. We built our adjustment on BLS 2012 to 2022 projections.[2] Specifically, we used measured BLS growth rates to adjust 2013, 2014 and 2015 numbers for subsectors publishing, internet, motion pictures and telecommunications (only 2014 and 2015). For subsequent years we used BLS 2012-2022 projected rates of growth (publishing, telecommunications), adjusted BLS 2012-2022 projected rates of growth (internet and other—decreased by 2/3 from 2021 to 2030, decreased forecast rates of growth by half from 2031 to 2040), or reverted back to the REMI rate (motion pictures). The relevant BLS projections are shown in Table A-2.

c) Retail, Wholesale, Transportation and Warehousing: These sectors all dropped sharply over the 30 year period in REMI's National Standard Control (NSC). We compared this to historic relations to factors such as population and manufacturing and adjusted the levels over time. To make these adjustments, we calculated log/log relationships with relevant factors (retail—population; wholesale—manufacturing and population; transportation and warehousing—population,

[2] Bureau of Labor Statistics, Economic Forecast 2012 to 2022, BLS Detailed Industry, Table 2.7 Employment and Output by industry; http://www.bls.gov/opub/mlr/2013/article/industry-employment-and-output-projections-to-2022.htm.

manufacturing, and professional and scientific). We used these relationships to adjust growth rate either directly or in a tapered way (retail, wholesale) assuming effects of technological change. (See Table A-3 for regression results).

This adjustment to the national control raised the employment forecast at the national level by about 1.6 percent compared to the REMI NSC. In contrast, in the preliminary forecast, we had created a new national control that adjusted a larger number of sectors, raised the 2040 employment level by about 3 percent, but did not adequately account for the 2010 to 2015 surge in employment.

Table A-2: Bureau of Labor Statistics 2012-2022 Employment Projections for Information Sectors (Thousands)

	Actual	Forecast	Percent Change
Industry	**2012**	**2022**	**2012 - 2022**
Publishing industries	737.8	705.9	-0.4%
Motion picture, video, and sound recording industries	372.3	350	-0.6%
Broadcasting (except internet)	285.4	296.7	0.4%
Telecommunications	858	807	-0.6%
Data processing, hosting, related services, and other information services	424.1	452.8	0.7%

Source: ABAG from US Bureau of Labor Statistics Economic Forecast , Detailed Industry, Table 2.7.

Table A-3: Regression Results Used in Calculating Alternative Sector Projections

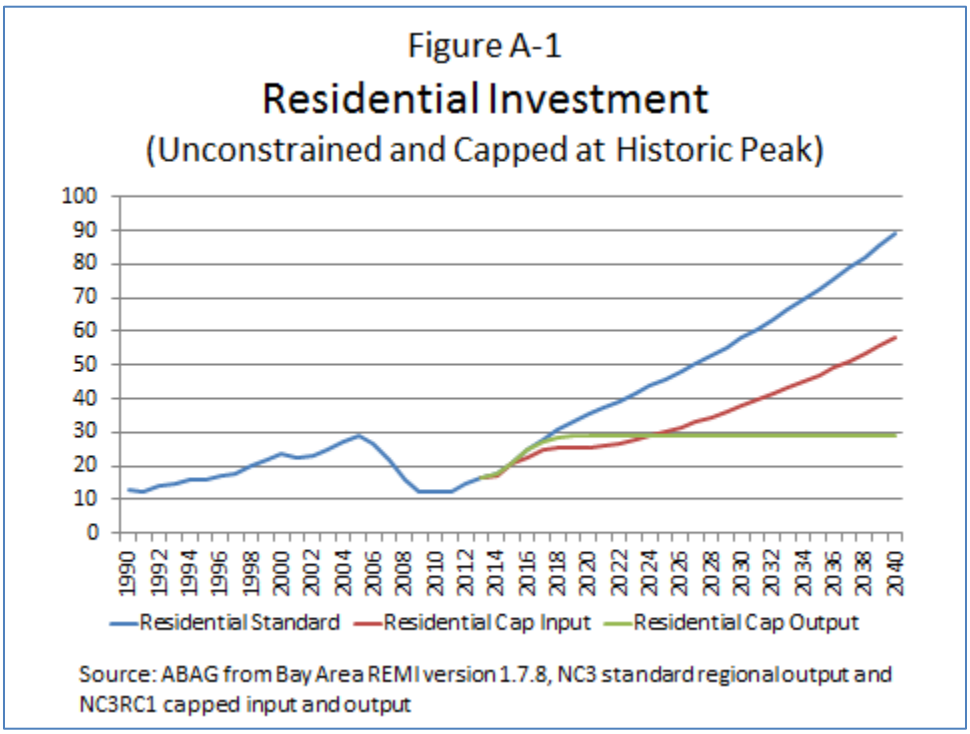
	Dependent variables (log form)				
	retail employment	**wholesale employment**	**air transportation**	**transit**	**warehousing**
Independent variables (log form; t value in parentheses)					
Population	0 .6180171 (6.19)	1.147926 (8.79)		1.949733 (21.44)	3.351744 (35.02)
manufacturing employment		0.3184065 (4.77)	0.9150349 (8.72)		
professional, technical and scientific emp.			0.5055651 (6.34)		
Adjusted R-Squared	0.6185	0.8358	0.7713	0.9523	0.9816

Source: ABAG Analysis

We created a new *regional* control based on our REMI NC3 national control with three additional adjustments. These include:

1) *A reduction of levels of residential and nonresidential investment* to temper the degree to which this expands. For those familiar with REMI, this is done by entering new investment numbers by

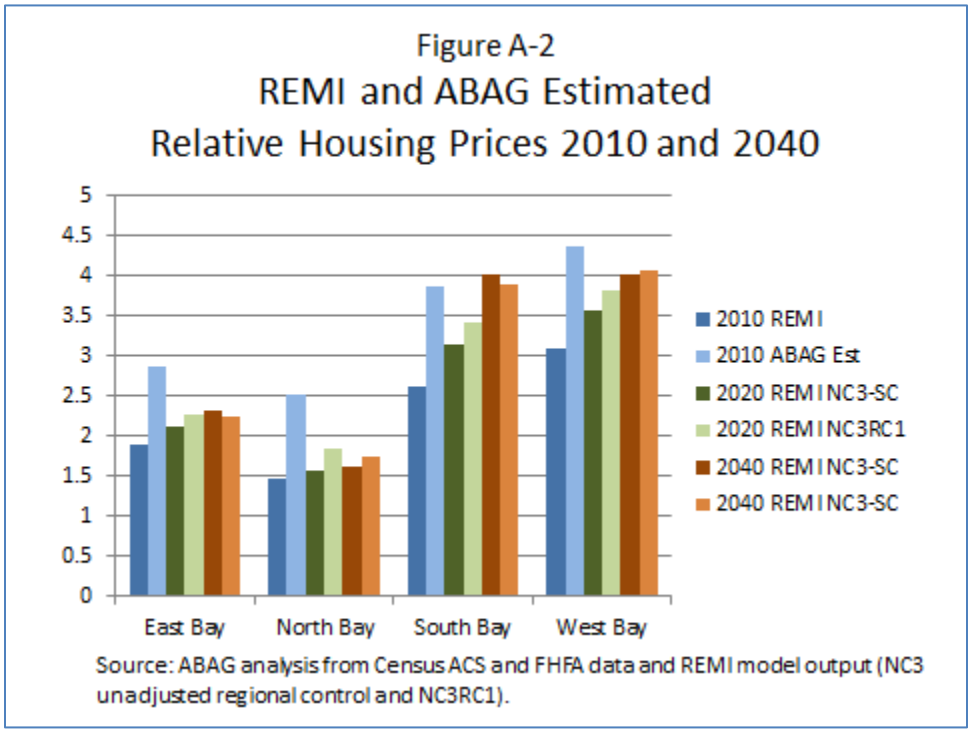
subregion in the policy section of the regional control.[3] The new investment numbers were calculated to be no larger than the previous peak. Once entered into REMI, this does not actually cap investment to the previous level, but it does reduce the rate at which investment expands to a level more consistent with actual growth. Figure A-1 illustrates the relationship between the residential investment level in the standard regional control based on national control NC3, the input to the revised regional control for the final forecast (NC3RC1) and the output of the model for residential investment in NC3RC1. The relative positions of the lines also indicate the reason for the adjustment. Construction investment is generally a flow rather than a stock variable, and thus grows with the level of change, not the absolute level. Thus, the pace of growth in the standard control is much higher than would be expected from the economic growth observed.



2) *An adjustment to the ratio of Bay Area relative to national housing prices*. This policy variable has a bearing on economic migration levels as these are a function of the attractiveness of the Bay Area amenities and job opportunities, but tempered by the cost of housing. We found that REMI's account of the cost of housing relative to the US as a whole is substantially lower than what we calculate from other sources, leading to overly optimistic economic migration flows. Our adjustment was created using 2013 5-year ACS data for the US and the MSAs relative to our analysis and the FHFA index adjusted to a 2011 base (to be consistent with the 5 year ACS data). We used this data to create a series for price by MSA relative to the US. In looking back to 1975, it leaves only a small advantage for the Bay Area relative to the US, consistent with historic estimates. We then averaged the relative price from 2005 to 2014. We applied 50 percent of the difference between our calculations and the REMI levels to the forecast. As with construction

[3] ABAG's version of the REMI model has 4 subregions within the Bay Area—the East Bay (Alameda and Contra Costa counties), North Bay (Napa, Solano and Sonoma counties), South Bay (Santa Clara County) and West Bay (Marin, San Francisco, and San Mateo counties).

investment, REMI still recalculates the relative price. The effect is insignificant by 2040 but raises prices midway through the forecast, relative to REMI's unadjusted relative prices, as shown in Figure A-2.



3) *An adjustment of employment levels in 2014 and 2015* to actual measured rate of growth by sector from BLS. For those familiar with REMI, we made this adjustment in the Policy section rather than in the Update section. This treats the higher employment levels as a short term exogenous shock which the model can then respond to, and adjust to (e.g. short term labor scarcity drives up costs and reduces demand). This is distinct from other possible treatments. We could also have treated the high recent growth as an accounting change through the update function, setting the baseline higher, which would have more long term effects in an upwards direction (the companion memo puts magnitude to the long term effect of this sort of adjustment of between 150,000 and 300,000 additional jobs by 2040). We chose this approach (exogenous rather than baseline accounting adjustment) because it is consistent with the region's historic experience with the sectors that have driven the current surge, marked by not insignificant volatility.

After running the model, we then present the results in Bureau of Labor Statistics measures of employment rather than Bureau of Economic Analysis measures of employment.[4] These result in an average annual figure, rather than a count of all jobs that are offered at some time during the year.

[4] The BEA measure accounts all jobs held at all firms by all individuals during a year (as well as self-employment), and thus is likely to double count individuals and even positions in a company (where there has been turnover in a position during the year). In contrast BLS reports monthly employment which is then averaged for an annual count. The latter is more useful for planning purposes, because it is closer to identifying likely housing and travel demand. BLS does not report self employment, so ABAG adds this estimate to the employment count. The BEA count is related to the agency's major responsibility of tracking income and output.

(Note that both definitions are different from the ABAG definition used prior to Projections 2013. Prior definitions were based on a count of one job per person, rather than jobs per workplace).

Table A-4 compares the 1.7.8 REMI control with the preliminary forecast and the final forecast, using the Bureau of Labor Statistics plus self-employment definition of employment. Table A-5 shows the ratios used to adjust BEA to BLS plus self-employment counts, estimated from an average of 2007, 2010 and 2013.

Table A-4: Bay Area Employment Projections from Regional Standard Control, Preliminary October 2015 Forecast, and Final January 2016 Forecast

	2010	2040	2040	2040	Percent Change 2010-2040		
(Employment in Thousands)	EDD+SE	REMI SC	Prelim Forecast	Final Forecast	REMI SC	Prelim Forecast	Final Forecast
Agriculture & Natural Resources	25.1	24.8	27.7	24.4	-1.3%	10.2%	-2.9%
Construction	165.7	411.0	246.5	313.4	148.0%	48.7%	89.1%
Manufacturing & Wholesale	428.5	395.7	435.8	408.3	-7.7%	1.7%	-4.7%
Retail	324.8	353.4	385.8	398.2	8.8%	18.8%	22.6%
Transportation & Utilities	97.1	97.1	112.3	110.5	-0.1%	15.7%	13.7%
Information	118.0	114.5	158.5	165.0	-2.9%	34.3%	39.8%
Financial & Leasing	194.9	234.1	252.0	234.5	20.1%	29.3%	20.3%
Professional & Managerial Services	625.2	1062.4	1023.1	1093.4	69.9%	63.6%	74.9%
Health & Educational Services	502.7	883.3	838.4	887.6	75.7%	66.8%	76.6%
Arts, Recreation & Other Services	476.5	577.9	633.1	591.8	21.3%	32.9%	24.2%
Government	452.2	474.9	488.3	471.3	5.0%	8.0%	4.2%
Total Jobs	3410.9	4629.0	4601.5	4698.4	35.7%	34.9%	37.7%

Source: ABAG from Bay Area REMI 1.7.8 (Standard Control and NC3RC1) and 1.7.2 (k3-v2).

BEA employment numbers are divided by the factors in Table A-5 to give estimates of the Bureau of Labor Statistics (employment by place of work) plus self-employment equivalent.

Table A-5: Adjustment Ratios to Convert BEA Employment Measures to BLS plus Self Employment

Employment Sector	Adjustment Factor
Agriculture & Natural Resources	1.402484
Construction	1.158725
Manufacturing & Wholesale	1.084723
Retail	1.168494
Transportation & Utilities	1.239593
Information	1.12953

Table A-5: Adjustment Ratios to Convert BEA Employment Measures to BLS plus Self Employment	
Employment Sector	**Adjustment Factor**
Financial & Leasing	2.377468
Professional & Managerial Services	1.342899
Health & Educational Services	1.091576
Arts, Recreation & Other Services	1.374565
Government	1.035506
Source: ABAG analysis using BEA, BLS and American Community Survey data.	

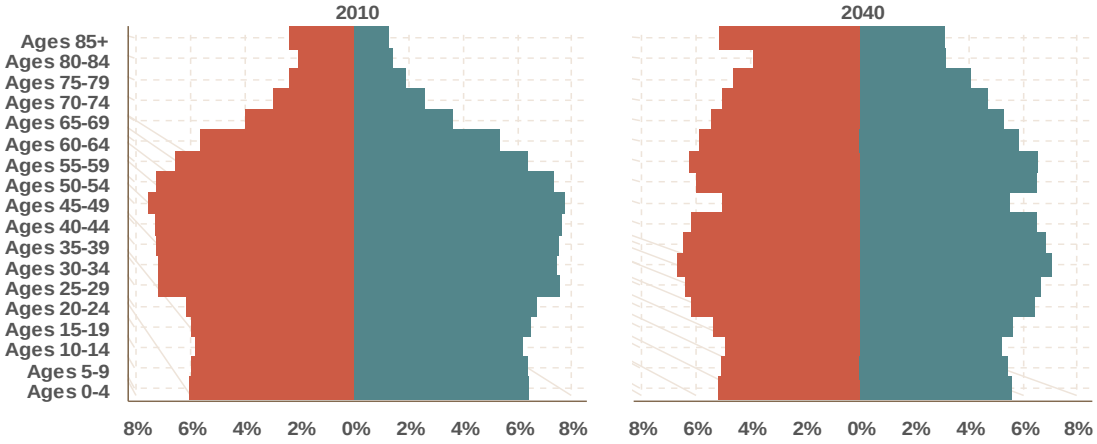
Population

In developing the preliminary forecast, staff used two separate but similar population modeling approaches. The Pitkin-Myers population model for the Bay Area uses a cohort survival model, with careful attention to immigrant status, including generation since immigrating.[5] The REMI model uses a simpler cohort survival model, which also recognizes differences by ethnic group, but assumes once immigration has happened, the immigrant takes on the characteristics of the ethnic group. We compared the results of the different models in terms of age and ethnicity and found, especially for age categories, results were very similar. For consistency with the employment data, we used the REMI population forecast in both the preliminary and final forecast. Table A-6 compares results from four population projections, the REMI standard regional control, ABAG's preliminary and final population projections, and the output of the Pitkin-Myers higher migration scenario. Figure A-3 shows population pyramids for 2010 and the 2040 population in the final forecast.

Table A-6: Population Projections for Final Forecast and Alternative Forecasts					
		2040 Projections			
Age Category	2010	Standard Control	Final Forecast	Preliminary Forecast	Pitkin-Myers In-Migration up 15%
Ages 0-14	1,320,200	1,532,900	1,499,300	1,470,100	1,524,500
Ages 15-24	909,800	1,160,900	1,126,200	1,118,100	1,054,900
Ages 25-64	4,051,500	4,908,200	4,779,000	4,739,200	4,786,500
Ages 65+	885,100	2,149,500	2,117,700	2,115,400	2,127,300
Total	7,166,700	9,751,400	9,522,300	9,442,800	9,493,100
Share of Total					
Ages 0-14	18.4%	15.7%	15.7%	15.6%	16.1%
Ages 15-24	12.7%	11.9%	11.8%	11.8%	11.1%
Ages 25-64	56.5%	50.3%	50.2%	50.2%	50.4%
Ages 65+	12.4%	22.0%	22.2%	22.4%	22.4%
Source: ABAG from REMI and Pitkin-Myers projections.					

[5] See John Pitkin, *Summary and Analysis of Pitkin-Myers Generational Projections of the Population of the Bay Area to 2040*, Cambridge: June 30, 2015.

Figure A-3: Final Forecast Population Age Distributions, 2010 and 2040



Household Estimates

Household estimates are computed by applying headship rates, or the number of householders relative to the population calculated from the American Community Survey to the REMI population output by age and ethnicity. The headship rate is applied to age/race/gender bins: Two genders, four race / ethnic groups and 15 age groups, or a total of 120 distinct groups. Rates are pooled from ACS 1-year PUMS samples 2006-2014, with an exponentially weighted smoothing average applied to avoid spikes in particular in the thinner slices of the PUMS sample.

While not adjusting headship rates secularly across the board, we did two specific rate adjustments:

1) We marginally reduced headship rates for Black and White, non-Hispanic households, age groups 25-34 and 65-74 by 5 percentage points to reflect expected changes in household sizes for those groups, due to changing cultural and financial conditions.
2) We reduced headship rates for Black and White, non-Hispanic households age groups 75+ by 10 percentage points to reflect expected increases in male survival rates.

We did not adjust headship rates for other ethnic groups related to increased "survival" of older age groups because headship rates were already so low for those ethnicities.

There is a small difference in the rate of household formation between our preliminary and final forecasts due to the addition of 2014 to the smoothing process in calculating rates for the final forecast. Headship rates are summarized for the final forecast in Table A-7.

Table A-7: Headship Rates by Age, Gender and Ethnicity								
gender	**Females**				**Males**			
Race/ ethnicity	**Black-NonHisp**	**Hispanic**	**Other-NonHisp**	**White-NonHisp**	**Black-NonHisp**	**Hispanic**	**Other-NonHisp**	**White-NonHisp**
Final Forecast Rates								
Age								
5-19	0.0079	0.0041	0.0032	0.0063	0.0027	0.0038	0.0038	0.0040
20-24	0.2145	0.1410	0.1333	0.1854	0.1250	0.1051	0.1300	0.1652
25-29	0.4264	0.2917	0.2526	0.3297	0.1976	0.2525	0.3072	0.3195
30-34	0.4996	0.3938	0.3227	0.4241	0.3377	0.3705	0.5099	0.4652
35-39	0.6182	0.4092	0.3304	0.4864	0.4361	0.4514	0.5973	0.5432
40-44	0.6583	0.4296	0.3730	0.5316	0.4815	0.5020	0.6176	0.5557
45-49	0.6676	0.4290	0.3765	0.5238	0.5152	0.5207	0.6094	0.5897
50-54	0.6335	0.4319	0.3626	0.5296	0.5969	0.5389	0.6401	0.6182
55-59	0.6230	0.4450	0.3517	0.5317	0.5985	0.5511	0.6068	0.6427
60-64	0.6590	0.4260	0.3202	0.5450	0.6333	0.5852	0.6062	0.6817
65-69	0.6345	0.3922	0.3161	0.4986	0.6408	0.6314	0.5732	0.6829
70-74	0.6592	0.4589	0.2982	0.5161	0.6724	0.5735	0.5436	0.6862
75-79	0.6206	0.4298	0.3448	0.5016	0.6361	0.6103	0.5636	0.6629
80-84	0.6313	0.5203	0.4176	0.5485	0.6558	0.5400	0.5557	0.6491
85+	0.6118	0.4394	0.4458	0.6338	0.5327	0.5425	0.5632	0.6622
Preliminary Forecast								
5-19	0.0085	0.0040	0.0028	0.0057	0.0041	0.0042	0.0033	0.0046
20-24	0.2098	0.1485	0.1439	0.1982	0.1320	0.1104	0.1305	0.1673
25-29	0.4466	0.2866	0.2509	0.3345	0.2060	0.2693	0.3197	0.3351
30-34	0.5166	0.3703	0.3291	0.4293	0.3878	0.3876	0.5216	0.4676
35-39	0.6297	0.4098	0.3393	0.4878	0.4624	0.4743	0.5902	0.5628
40-44	0.6823	0.4230	0.3606	0.5189	0.4935	0.5027	0.6208	0.5712
45-49	0.6811	0.4190	0.3643	0.5148	0.5411	0.5220	0.6256	0.6084
50-54	0.6447	0.4217	0.3541	0.5181	0.5790	0.5379	0.6384	0.6378
55-59	0.6596	0.4488	0.3386	0.5363	0.6083	0.5702	0.6153	0.6531
60-64	0.6471	0.4339	0.3191	0.5399	0.6308	0.5664	0.6037	0.6893
65-69	0.6465	0.4039	0.2942	0.5029	0.6394	0.6472	0.5824	0.6949
70-74	0.6563	0.4117	0.2778	0.5052	0.6495	0.5572	0.5474	0.6962
75-79	0.6056	0.4444	0.3481	0.5024	0.6663	0.6138	0.5825	0.6693
80-84	0.6329	0.5167	0.4235	0.5417	0.6280	0.5382	0.5768	0.6542
85+	0.5781	0.4068	0.4343	0.6186	0.5425	0.5527	0.5508	0.6717

Income Distribution

The income distribution analysis is designed to take into account structural characteristics of the region including demographic factors such as the age profile and ethnic mix, and economic factors such as the predominant industries and occupations in which people work, as well as the various sources of income (retirement income, public assistance income, wage and salary income). An earlier methodology used for Projections 2013, considered the effects of industry and occupational structure on income mix. The methodology created for this analysis includes additional factors, such as all income (including non-wage income).

Other aspects of Bay Area regional forecasting rely on estimates of the distribution of income among four income bins originally defined using 1989 incomes and later updated using 1999 incomes. The categories, originally, were:

1) Below $25,000 (1989 dollars, updated to $30,000 for 1999 dollars)
2) Between $25,000 and $45,000 (1989 dollars, upper break point updated to $60,000 for 1999)
3) Between $45,000 and $75,000 (1989 dollars, upper break point updated to $100,000 for 1999), and
4) Above $75,000 (1989 dollars, updated to $100,000 for 1999.

ABAG specified four regression models (using American Community Survey, Census 2000 data) on the relationship between demographic and economic variables and share of households in each of the four income quartiles defined above.

The results of these regressions are shown in Tables A-7 to A-10.

Table A-7: Regression Results for Income Category 1 (Households below $30,000, 1999 dollars)				
	params	**pvals**	**std**	**test_stats**
Adjusted R-Squared	0	0	0	0.669211
R-Squared	0	0	0	0.672062
Intercept	0.741601	4.37E-41	0.052547	
Share of population, White (not Hispanic)	-0.17261	3.65E-39	0.012572	
Wharton Residential Land Use Regulation Index	-0.01799	1.35E-10	0.00277	
Share of population, 65 and over	0.997485	6.22E-50	0.063133	
county housing price median relative to US	-0.05317	1.32E-56	0.003127	
more than 1 million people in MSA	-0.04618	5.23E-27	0.004156	
public assistance income, log	0.040692	5.37E-38	0.003015	
retirement income, log	-0.04888	1.25E-33	0.003884	
Share employed in nat resources, const, and maintenance occ	0.427559	1.18E-22	0.042505	
F Test	235.6765	9.2E-217	0	

Table A-8: Regression Results for Income Category 2 (Households $30,000-$59,999, 1999 dollars)				
	params	pvals	std	test_stats
Adjusted R-Squared	0	0	0	0.414723
R-Squared	0	0	0	0.419768
Intercept	0.530093	4.16E-89	0.023653	
Share of population 16 and over in labor force	0.090489	4.74E-05	0.022137	
Share of population, Hispanic	-0.05252	1E-13	0.00695	
Wharton Residential Land Use Regulation Index	-0.00256	0.055326	0.001336	
Share of population, 25-64	-0.35542	1.14E-14	0.045264	
county housing price median relative to US	-0.02176	9.58E-35	0.001697	
County falls in Census Region 9	0.013903	3.67E-06	0.002985	
Share employed in education services	-0.32121	1.62E-20	0.033779	
Share employed in health care services	-0.23159	2.98E-10	0.036355	
F Test	83.19669	2.2E-103	0	

Table A-9: Regression Results for Income Category 3 (Households $60,000-$99,999, 1999 dollars)				
	params	pvals	std	test_stats
Adjusted R-Squared	0	0	0	0.647393
R-Squared	0	0	0	0.650053
Intercept	-1.08725	1.94E-61	0.060906	
Share of population 16 and over in labor force	0.290893	2.05E-35	0.022443	
Share of population, Black (Not Hispanic)	-0.03842	7.73E-06	0.008541	
Wharton Residential Land Use Regulation Index	0.007572	7.76E-08	0.001398	
Share employed in health care services	-0.32454	1.88E-17	0.037421	
Share employed in professional and scientific services	-0.49631	4.73E-26	0.045586	
more than 1 million people in MSA	0.019135	2.35E-18	0.002144	
per capita income, log	0.115644	3.85E-60	0.006561	
F Test	244.4039	4.9E-205	0	

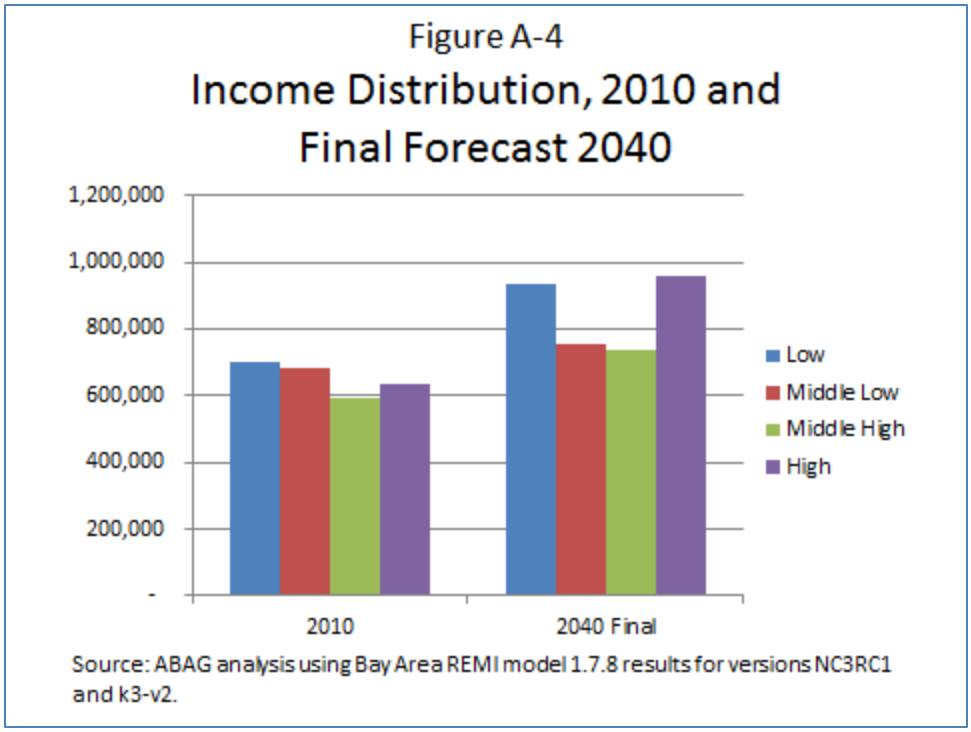
Table A-10: Regression Results for Income Category 4 ($100,000 and over, 1999 dollars)				
	params	pvals	std	test_stats
Adjusted R-Squared	0	0	0	0.798193
r2	0	0	0	0.799035
Intercept	-1.2822	8.17E-55	0.078061	0
county housing price median relative to US	0.028745	1.37E-45	0.001943	0
more than 1 million people in MSA	0.016216	1.72E-16	0.00194	0
per capita income, log	0.134153	1.56E-58	0.007866	0
Share employed in management occupations	0.112038	1.4E-08	0.019613	0
Share employed in services occupations	-0.26406	1.23E-13	0.035204	0
F Test	948.6722	0	0	0

The parameters estimated in these regressions are applied to the subregional results of the REMI-based forecast to estimate future shares of households in each income group. (REMI results are estimated for four subregions within the Bay Area, including the East Bay—Alameda and Contra Costa counties, North Bay—Napa, Solano and Sonoma counties, South Bay—Santa Clara County, and West Bay—Marin, San Francisco and San Mateo Counties.)

Applying regression model coefficients to the projected REMI data for each subregion, we estimate a time series of future shares in each bin. In reaching these shares, we make a number of normalizing adjustments:

1) Predicted shares come from four separate regressions that are not constrained to fall in any particular range. The sum of the shares predicted by the four regressions is then normalized to 1.
2) These shares are indexed to the base year, with regression results expressed as changes over time according to the future state of the region as provided by REMI.
3) The indexed amounts are then applied to the base 2010 numbers to reach a growth in households in each income bin over time.

Figure A-4 compares the 2010 income distribution with the distribution in 2040 in the final forecast. The final forecast has somewhat higher growth in the highest income category, at the expense of growth in the two middle categories. The lowest income group grows more quickly than either of the two middle groups, while the slowest growth is in the lower middle group.



In-Commute and Employed Residents

To calculate the change in in-commute, ABAG estimates the change in employed residents and compares this to the projected growth of employment by place of work. REMI reports "residence adjusted employment" (RAE), which is the number of BEA defined jobs held by residents. This number is not a count of people holding jobs. To adjust this number to something closer to persons holding jobs, we divide the REMI projected RAE by the overall ratio of BEA to BLS plus self-employment jobs (BLS+SE) in the year. Our net commute estimate for one year is the difference between BLS+SE and RAE. The change in commute, then, is the change in this estimate. Between 2010 and 2040, in our REMI based forecast, this difference increases by 53,000. (We also used an alternate calculation method, where we compared the projected labor force growth to employment growth, assuming a steady level of unemployment of around 5 to 5.5 percent during the forecast period. This method gave more representative net commute numbers in the early years, but showed a decrease in net commuting over the 30 year period. We have chosen to include the higher number that comes from the RAE approach in estimating the Regional Housing Control Total, to ensure that the concern about considering the in-commute is met).

Compared to the preliminary forecast, higher employment in the region led to a slightly higher increase in the net in-commute, from 33,000 in the preliminary forecast.

Regional Housing Control Total

To compute the regional housing control total, we make a fairly simple calculation of housing associated with the projected number of households, and add to that the housing that would be associated with the net increase in the in-commute. The number of households projected is almost identical in the two forecasts, preliminary and final. We use a vacancy rate of 5 percent to translate the 3,389,000

households in 2040 (final forecast) to 3,567,000 housing units. We then translate the change in commute number first into households and then into units. We use the ratio of 1.41 workers per household to translate commuters into households. This is the ratio of workers in Bay Area households that i) have workers and ii) have household incomes below the region's median. This is a slightly higher ratio than we used in the preliminary forecast, which was based on employees by place of work per household and included households with no workers and jobs whose workers may have commuted from outside. In the final forecast, this revised approach gives 37,600 households. Applying the same 5 percent vacancy rate, we then estimate a need for 39,600 housing units to satisfy the requirement that the Regional Housing Control Total include housing for the net increase in in-commuting. The Regional Housing Control Total becomes 3,606,600 housing units (the sum of 3,567,000 and 39,600), an increase of 822,600 units from 2010, or 767,000 from 2015. In comparison, the preliminary forecast projected 808,000 additional units compared to 2010, and Plan Bay Area 2013 estimated an addition of 660,000 units.