APPENDIX 1 – 2018 REGIONAL ECONOMIC FORECAST

Executive Summary

This appendix describes the Metro 2018-2038 Regional Economic Forecast (REF). The forecast estimates future total population, employment, and employment by sector for the seven-county Metropolitan Statistical Area (MSA).

Key Findings

- A panel of experts, economists, and demographers found the forecast to be reasonably sound.
- The Metro region has rebounded from the Great Recession.
- The region added 45,000 new residents last year (2016), equal to 1.9% APR. This is the fastest annual growth since the Great Recession.
- The tight labor market is leading to a Portland area unemployment rate below 4 percent (December 2017). Job growth has been robust since 2014.
- Strong regional growth has lifted employment back above the pre-recession employment peak.
- Going forward, both population and job growth are expected to continue at a moderated pace because the region is approaching its full potential and full employment.
- Longer-term, the region will continue to see relatively stronger population growth (than U.S. trends) as net in-migration is expected to add to regional population – averaging 1.0% APR, (784,000 more residents in MSA between 2015 and 2045)
- Job growth in the long-term is expected to trend with population, – averaging roughly the same 1.0% APR, (406,000 more jobs in MSA between 2015 and 2045)

State of the Region

- The Great Recession is now well past. Job and population growth (see table below) have returned to pre-recession rates in recent years.
- National, state and regional unemployment rates are approaching near-full employment – meaning that anyone looking for a job is likely able to find a job, but may mean a shortage for businesses looking to hire.
- Strong real estate prices (charts below) indicate a growing economy with room to expand in a key blue-collar employment sector – construction. Surveys of local apartments show low vacancy rates and higher year-over-year rents.

Annual MSA Population and MSA Employment

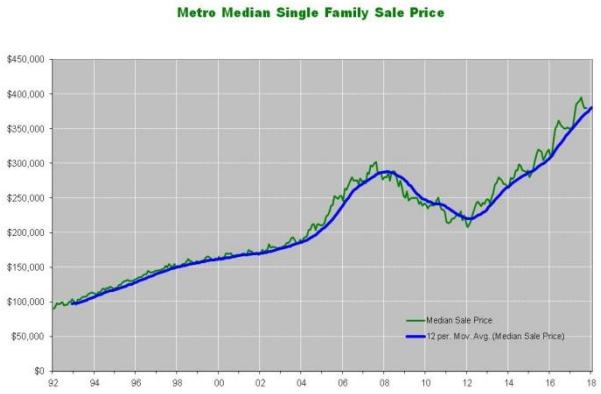
	2012	2013	2014	2015	2016
Population	2,265,725	2,291,650	2,324,535	2,362,655	2,407,540
	(0.7%)	(1.1%)	(1.4%)	(1.6%)	(1.9%)
Employment	1,020,400	1,044,800	1,076,000	1,111,900	1,144,500
	(2.2%)	(2.4%)	(3.0%)	(3.3%)	(2.9%)

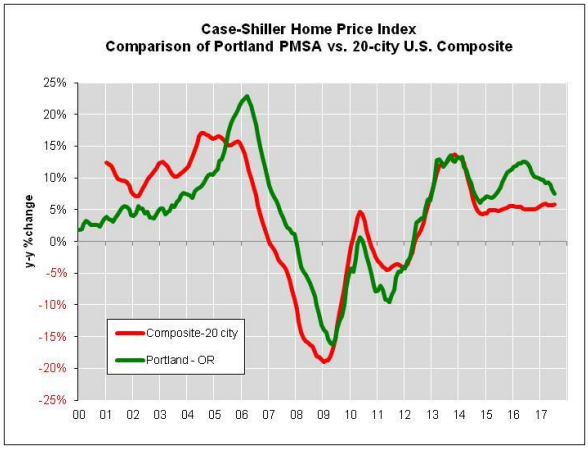
Source: PSU and BLS (annual growth rate in parenthesis)

Housing Price Performance

- Prices for homes are similarly showing strong appreciation – another indicator of a robust and healthy economy.

Median Single-Family Price Indices: Regional and Compared to 20-City U.S. Composite



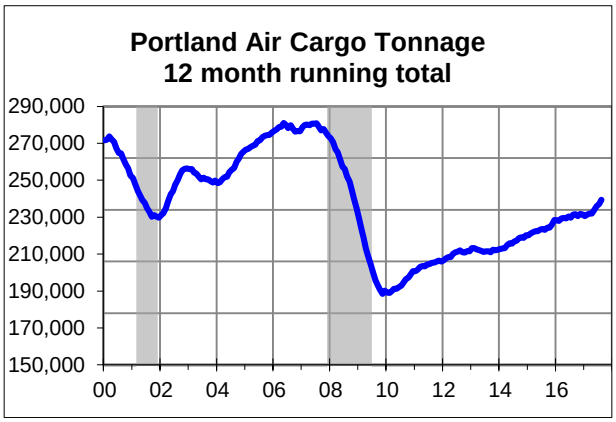


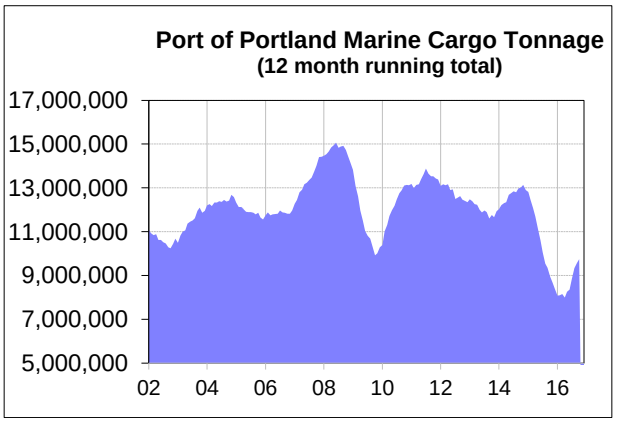
Sources: Regional Multiple Listing Service, Case-Schiller

Economic Performance

- Cargo shipments (charts below) through the Port of Portland indicate a prosperous, growing region. Air cargo is ramping up to activity levels before the recession. Marine cargo (especially through Terminal 6) has not performed to expectations due to labor issues although it shows a capacity to rebound and contribute to regional job growth.

Key Economic Indicators: Yearly Cargo Tonnages

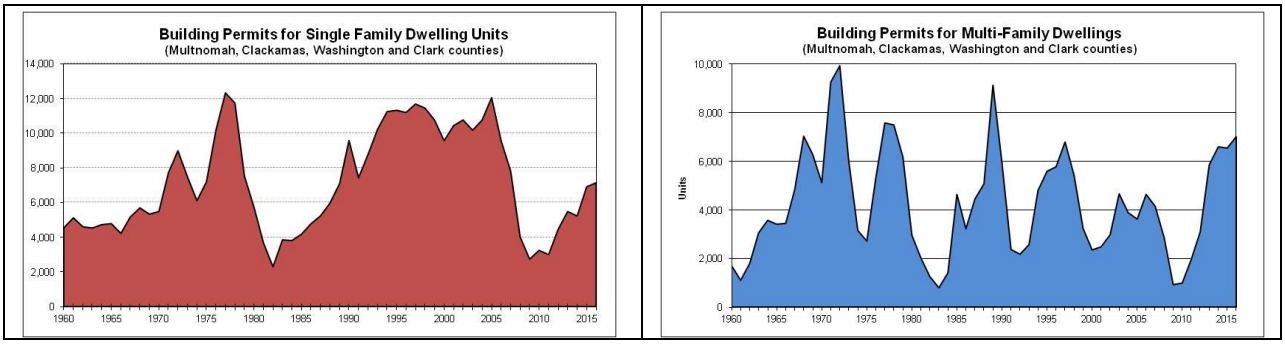




Source: Port of Portland

- Housing construction has rebounded since the Great Recession, very strongly for Multi-Family (charts below)
- Average Single-Family permits issued in last 3 years = 6,400 units/yr; 20 year avg. = 8,050 units/yr
- Average Multi-Family permits issued in last 3 years = 6,700 units/yr; 20 year avg. = 4,100 units/yr

Key Economic Indicators: Housing Permits by Type (Single Family and Multi-Family)



Source: U.S. Census (Permits include Clackamas, Multnomah, Washington and Clark) Regional Economic

Forecast Notes

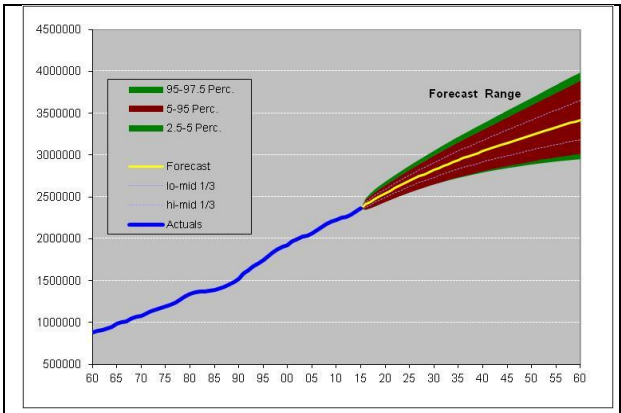
- Forecast prepared using up-to-date Census and Portland State University Population Research Center data
- Forecast data sources include U.S. Bureau of Labor Statistics, Bureau of Economics, Federal Reserve Board, and Census
- U.S. growth projections derived from IHS Markit (August 2017 edition) and U.S. Census
- Forecast contains uncertainty (see charts below).

2018-38 Regional Baseline

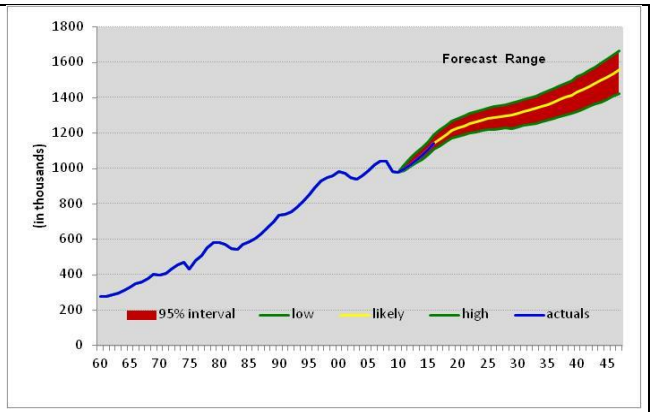
Forecast, Portland-Vancouver-Hillsboro Metropolitan Statistical Area

Year	Population	APR%	Employment	APR%
2015	2,362,655	1.6	1,111,900	3.3
2016	2,407,540	1.9	1,144,450	2.9
2017	2,443,900	1.5	1,169,300	2.2
2018	2,480,800	1.5	1,193,500	2.1
2019	2,513,500	1.3	1,214,250	1.7
2020	2,545,400	1.3	1,230,200	1.3

2018-38 Regional MSA Population and Employment Histories and Forecasts



MSA Population



MSA Employment

Source: history = {Census/ PSU and BLS; forecast = Metro, Research Center, November 2017)

Forecast Comparisons

How does this 2018 forecast change relative to the prior 2015 forecast?

- This 2018 population forecast differs little from the previous Metro 2015 forecast.
- The 2018 employment forecast projects roughly 8% less employment growth by 2038 than the previous 2015 forecast due to changes in the national economic forecast used as an input to the regional forecast.

Forecast Comparison (Metro November 2017 Forecast v. Metro November 2014 Forecast)

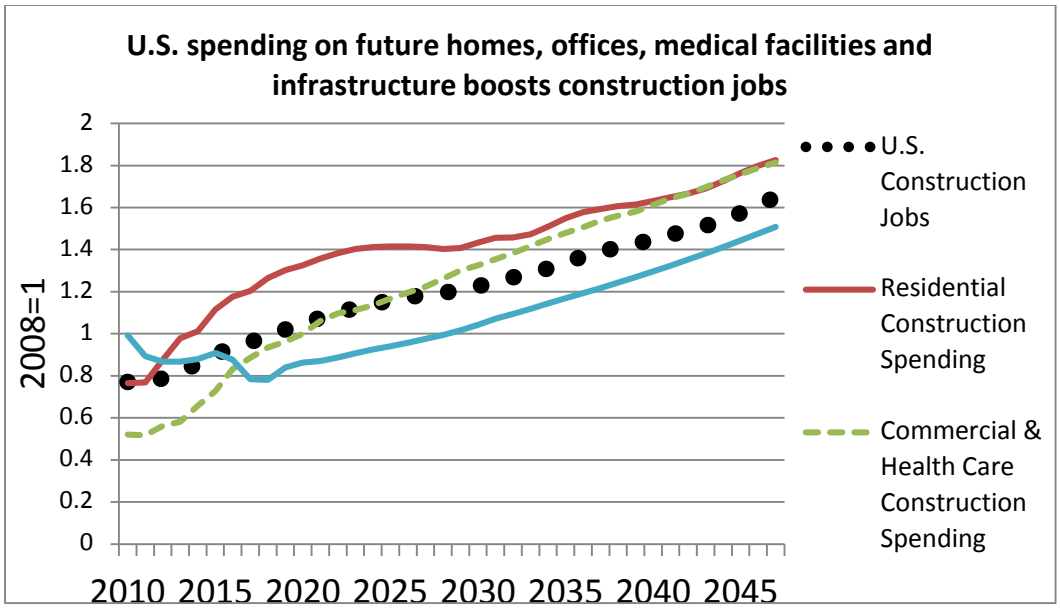
Total Population (in 1,000's)	2015	2020	2025	2030	2035	2040
Metro (2018 vintage)	2,362.7	2,545.4	2,691.5	2,822.5	2,940.4	3,046.7
Metro (2015 vintage)	2,342.5	2,519.2	2,671.8	2,814.1	2,937.9	3,052.1
% diff	0.9%	1.0%	0.7%	0.3%	0.1%	-0.2%
Total Employment (in 1,000's)	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Metro (2018 vintage)	1,111.9	1,230.2	1,281.4	1,313.2	1,363.1	1,432.3
Metro (2015 vintage)	1,100.0	1,228.1	1,311.6	1,399.8	1,484.5	1,571.3
% diff	1.1%	0.2%	-2.3%	-6.2%	-8.2%	-8.8%

How does Metro's 2018 Regional Forecast compare to NERC's November 2017 Forecast?

- Both Metro and NERC economists agree that the differences between the two respective forecasts are not significant.
- Both concur that sector level employment differences are also not large

Total Population (in 1,000's)	2015	2020	2025	2030	2035	2040
Metro	2,362.7	2,545.4	2,691.5	2,822.5	2,940.4	3,046.7
NERC	2,365.1	2,556.3	2,729.8	2,881.6	3,009.3	3,125.3
% diff	0.1%	0.4%	1.4%	2.1%	2.3%	2.5%
Total Employment (in 1,000's)	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**
Metro	1,111.9	1,230.2	1,281.4	1,313.2	1,363.1	1,432.3
NERC	1,111.9	1,223.6	1,272.1	1,319.3	1,367.8	1,417.3
% diff	0.0%	-0.7%	-0.9%	0.6%	0.5%	-1.5%

- Both forecasts project construction to be the fastest industry growth sector. Both cite infrastructure development from state and federal sources along with non-residential construction as key drivers of construction in future years.



Why does the Construction sector grow strongly in Metro's (and others') forecasts?

Construction exhibits greater volatility over its history

The construction industry has a history of extreme volatility as compared to other industry sectors of the Portland economic region. Frequently, construction is a leading indicator. For example, during this last Great Recession, regional construction employment fell into negative growth 9 months before the broader regional economy showed any signs of negative growth. In the 1980-82 Recession, the region also experienced a sharper negative decline in construction employment 3 months before the wider economy began losing jobs again. Swings in regional construction tend to be wider and deeper. This also often leads to recoveries that are sharply faster in the construction industry.

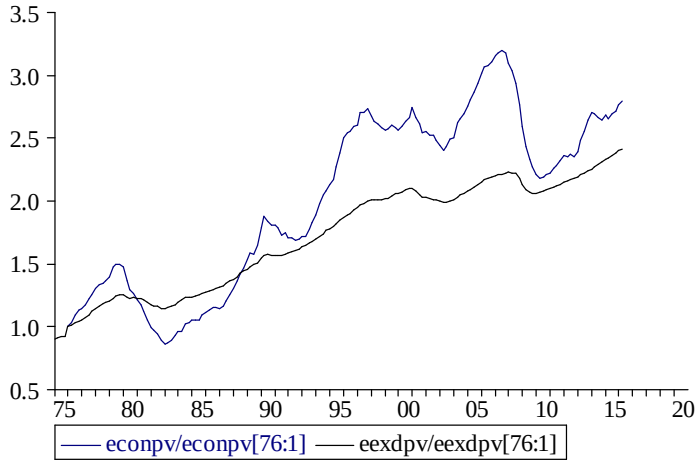


Figure 1: Index of construction (blue) and total nonfarm employment (black), 1976=1, Portland MSA (source: BLS)

The accompanying table shows the greater volatility in regional construction employment over total nonfarm payroll employment.

Table 1: Portland MSA construction and nonfarm employment trends and cycles, percent change

Period of contraction (or expansion)	1976-79	1979-83	1983-90	1990-93	1993-97	1997-2003	2003-07	2007-10	2010-now
Construction employment	+57.7%	-46.6%	+149.7%	-48.8%	+84.4%	-19.3%	+140.4%	-36.2%	+53.7%
Total nonfarm payroll jobs	+27.6%	-11.0%	+41.3%	-2.4%	+30.7%	-3.2%	+114.4%	-9.6%	+21.9%

Upturns and downturns in table 1 may not coincide exactly with official recession periods as described by the National Bureau of Economic Research, the official arbiter of U.S. recessions. The swings reflect the troughs and peaks of construction employment in the Portland MSA along with similar cycles for total nonfarm payroll employment.

Construction has seen faster growth over history

Regional construction has added 44,700 jobs to the Portland MSA between 1976 and 2017. This is a 202% increase for an average annual percent rate (APR) equal to 2.7% per year. At the national level, the increase has been 188% since 1976 or 1.5% APR.

Projections of population growth rates between Metro, NERC and IHS Markit are very close

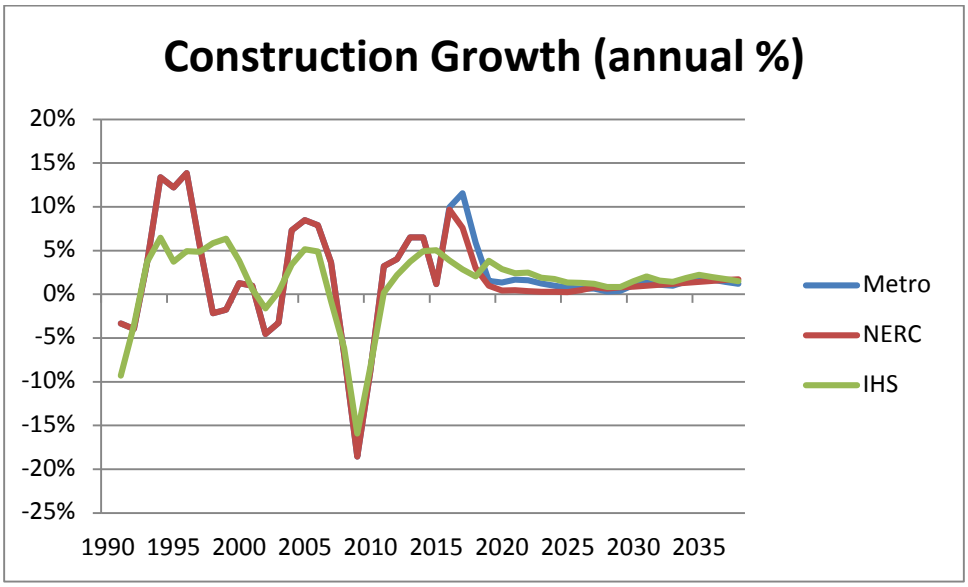


Figure 2: Metro 2018 UGR Regional Forecast (November 2017 vintage), NERC MSA forecast (October 2017 vintage), IHS US Macroeconomic Outlook (August 2017)

A few differences in construction job outlooks:

- Metro forecast carries out a more optimistic regional outlook for construction growth in the short-run through about 2022 as compared to the NERC projection.

- The IHS national forecast (an input to Metro's regional forecast) causes the Metro construction forecast to be more robust than the NERC forecast. The IHS U.S. forecast calls for very strong growth through 2024 before tapering off. In comparison, Metro is faster to 2018-19, but regional growth becomes slower compared to the IHS outlook.
- The NERC forecast relies on a Moody's U.S. outlook as a key input.
- Metro is more optimistic of the current real estate expansion than NERC. The Metro forecast plays out the current construction expansion for a couple more years longer than the NERC forecast assumes.
- NERC assumes a growth recession in between 2020 and 2026 before subsequently rebounding up and past population trend rates.
- Metro assumes slower growth in between but not until 2027 and 2029 – three years shorter and later than NERC. The Metro assumption reflects the IHS national trend in timing.
- In the long-run forecast phase 2030 to 2038, IHS projects a fairly strong employment rebound up to 2.2 percent APR. Both NERC and Metro follow, but the Metro forecast is about 20 to 30 basis points[1] higher. Metro forecast APR growth rates are not predicted to be as strong as the IHS projections, however.

Construction employment history and projections are re-arrayed so that they have a common starting point among the Metro, NERC and IHS Markit forecast series. Year 2015 is selected as the base year.

Metro Construction Employment Forecast in total is close to IHS and NERC

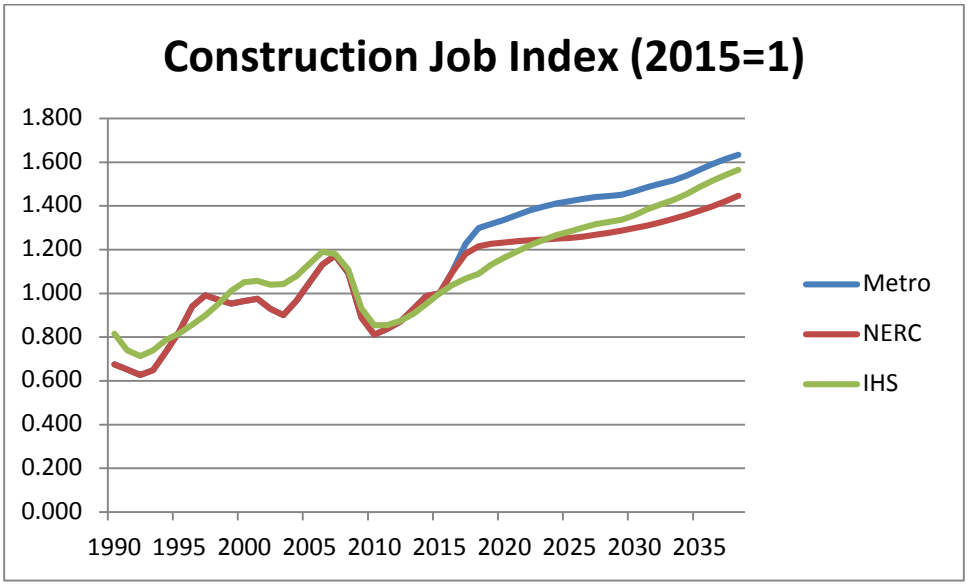


Figure 3: A comparison of regional construction employment trends

[1] The relationship between percentage changes and basis points can be summarized as follows: 1% change = 100 basis points, and 0.01% = 1 basis point.

- The NERC forecast is statistically no different than the Metro baseline (medium) growth scenario.

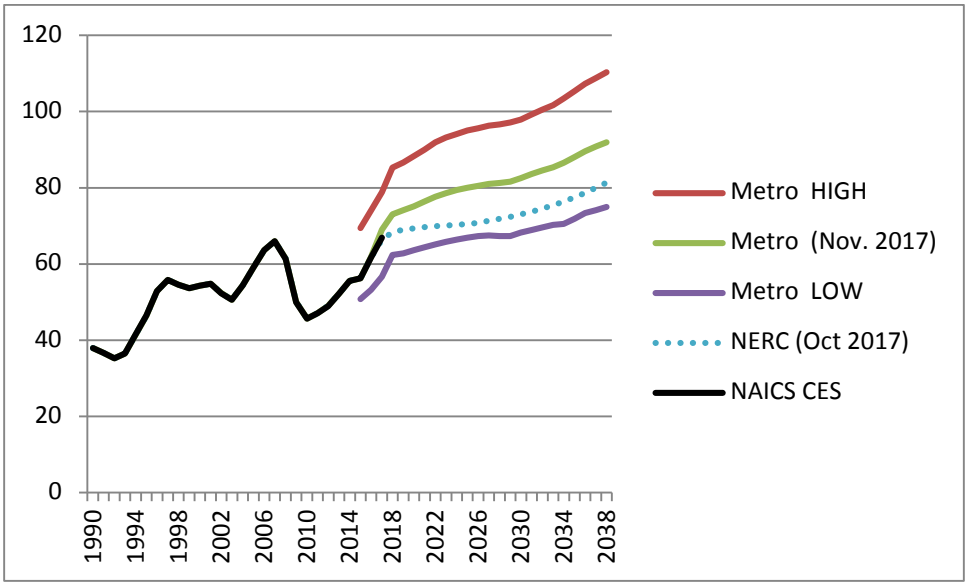


Figure 4: Metro 2018 Employment High Growth, Metro 2018 Baseline, and Metro Low Growth Scenarios – comparing these to the NERC employment forecast (dotted line)

- Metro constructs high and low growth series with its baseline forecast. The baseline forecast represents a most likely medium case trends scenario. The high and low series growth bands approximate a 95 percent confidence interval. (95 times out of 100, we would expect future development trends to fall between these two bands.)
- The NERC forecast falls within Metro's confidence interval. (This means that the Metro baseline and NERC forecast are not statistically different.)

The 2017 Regional Economic Forecast for Years 2018-2038 in Detail

Overview

As mandated by ORS 197.033 (Area population forecasts) and ORS 197.296 (Factors to establish sufficiency of buildable lands within urban growth boundary), Metro produces a regional forecast to satisfy the requirements of state periodic review and Metro's urban growth management role. The regional forecast includes demographic, economic and employment details which Metro uses as part of the data for determining need for housing and employment.

What's new in the 2018 regional forecast?

- The August 2017 IHS Markit U.S. macroeconomic outlook provides the national economic perspective underlying a detailed regional forecast through year 2047. The Metro forecast includes an arithmetic extrapolation of total population, households and employment to year 2060.
- Economic equations in the regional econometric model underlie the detailed regional forecast. Each equation was re-estimated and the overall model re-calibrated to reflect the latest historical data available as of September 2017 for employment (source: U.S. BLS), income and wages (U.S. BEA), input-output coefficients (U.S. BEA), and population (U.S. Census, Oregon and Washington).

Regional Forecast Highlights

- A panel of experts, economists, and demographers found the forecast to be reasonably sound.
- The Metro region has rebounded sharply from the Great Recession and with regional job expansion at 91 consecutive months (as of Jan. 2018) and counting.
- The region added 45,000 new residents last year (2016), equal to 1.9 percent. This is the fastest annual population growth since the Great Recession ended.
- A tight labor market is leading to a Portland area unemployment rate below 4 percent (seasonally adjusted 3.7 percent in Jan. 2018).
- Job growth has been robust since 2014. The MSA has added an average 32,000 jobs a year, peaking at 35,900 jobs added in 2015 alone.
- Labor force participation is wide spread across the nation – U.S. black unemployment rate as of Feb. 2018 stands at 7 percent, Latino at 5.3 percent.
- Strong regional growth has lifted employment back above the pre-recession employment peak. Current employment now stands at 1,168,400 jobs (Jan. 2018). Employment rose 2.4 percent in 2017.
- Going forward, both population and job growth are expected to continue at a moderated pace because the region is approaching its full potential and full employment.
- Longer-term, the region will continue to see relatively stronger population growth (than U.S. trends) as net in-migration is expected to fuel regional population growth– averaging 1.0 percent APR, (784,000 more residents in MSA between 2015 and 2045)

- Job growth in the long-term is expected to trend with population, – averaging roughly the same 1.0 percent APR, (406,000 more jobs in the MSA between 2015 and 2045)
- Inflation remains mild, despite robust national growth. This boosts the likelihood that the Federal Reserve will stay the course and continue with its current policy of slowly raising interest rates.

State of the Region

Nationally, the Great Recession ended in the summer of 2009. At the regional level, the recession – measured in terms of regional payroll employment growth – lingered for another year or so. The Portland MSA did not experience significant year-over-year job growth until the fall of 2010. Since then, the region has been adding jobs at a very high rate. Annual job growth peaked at 3.3 percent in year 2015. The MSA registered a growth rate of 2.4 percent in 2017. The regional recovery continues apace with 91 months in a row of year-over-year job growth – becoming one of the longest expansion periods in the region's history.

Employment growth in the region has been wide spread, benefiting virtually all private industry sectors. The public sector has seen very little job growth since the end of the Great Recession, however. In the private sector, health care leads in absolute employment gains at over 30,000 additional jobs since the recession ended. This was followed by leisure and accommodation services (+25,000) and the construction industry (+20,000). On a percentage change basis, construction led all sectors at +45 percent growth since the recession. Business services had a reading of +30 percent between the recession bottom and today (January 2018).

Total payroll employment in the region should continue to see robust growth for the foreseeable future so long as economic conditions stay the course. Short-term economic indicators do not suggest a downturn or economic correction at this time.

The following set of indicators strongly suggests steady growth in the near term. Even if these indicators take a sharp turn for the worse, there would still be a delay of at least a year before the onset of full recession for the broader regional economy.

Metro Region Core Solid Waste Disposal
(12 month running tonnage total)

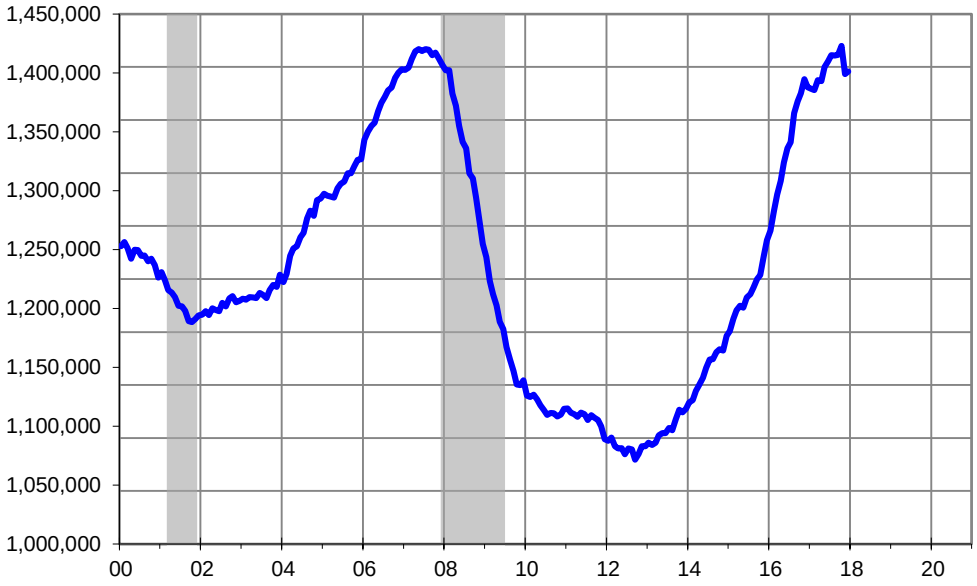


Figure 5. (source: Metro)

Chart shows regional tonnage now reaching pre-Great Recession waste disposal figures. Since bottoming out in 2012, the region has seen over 5 years of steady growth.

Garbage volumes are a reflection of current economic activity.

Portland International Airport (PDX) Passenger Boardings
(12 month running passengers total)

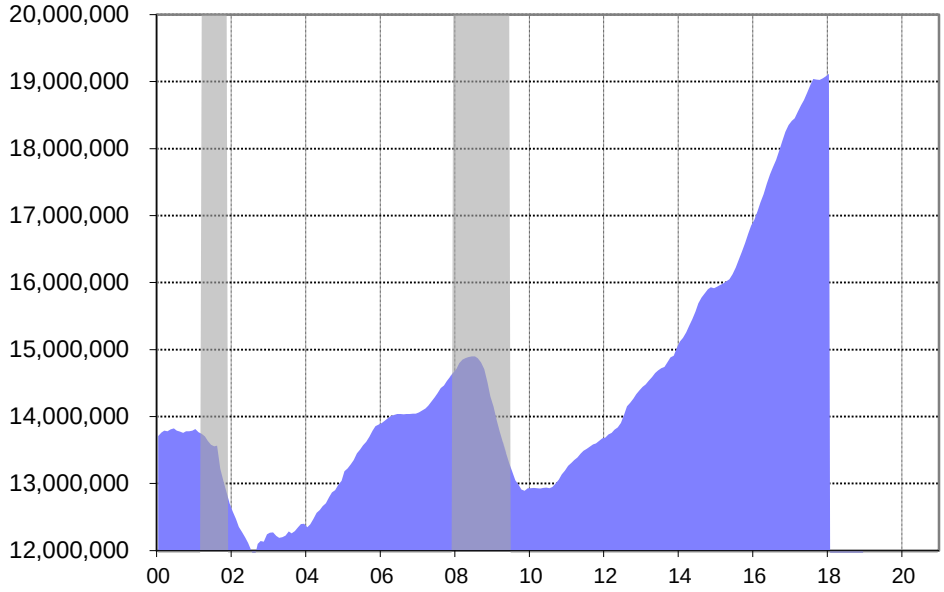


Figure 6. (source: Port of Portland)

Chart shows PDX commercial aviation passenger counts.

Record boarding levels have continued since the end of the Great Recession.

An indicator of positive tourism, business travel and a vibrant regional economy.

Air Cargo (PDX)
(12 month running tonnage total)

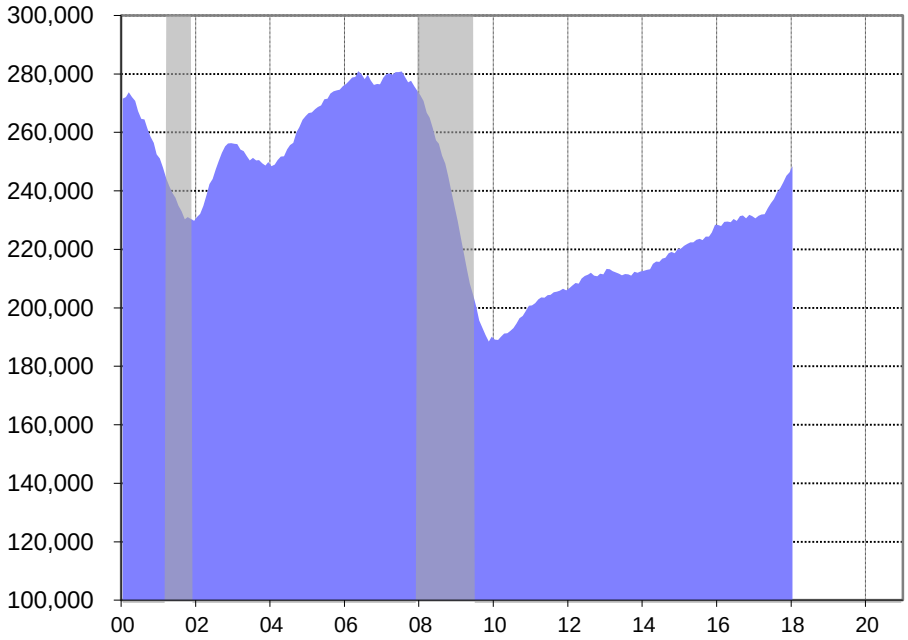


Figure 7. (source: Port of Portland)

Chart shows PDX aviation cargo (in tons). Volume levels are still below the pre-recession peak, but continue to grow steadily.

An indicator of high value goods being shipped by air. Steady growth reflects a vibrancy in regional goods production, particularly in the high-tech sector.

Marine Cargo Shipments (Port of Portland)
(12 month running tonnage total)

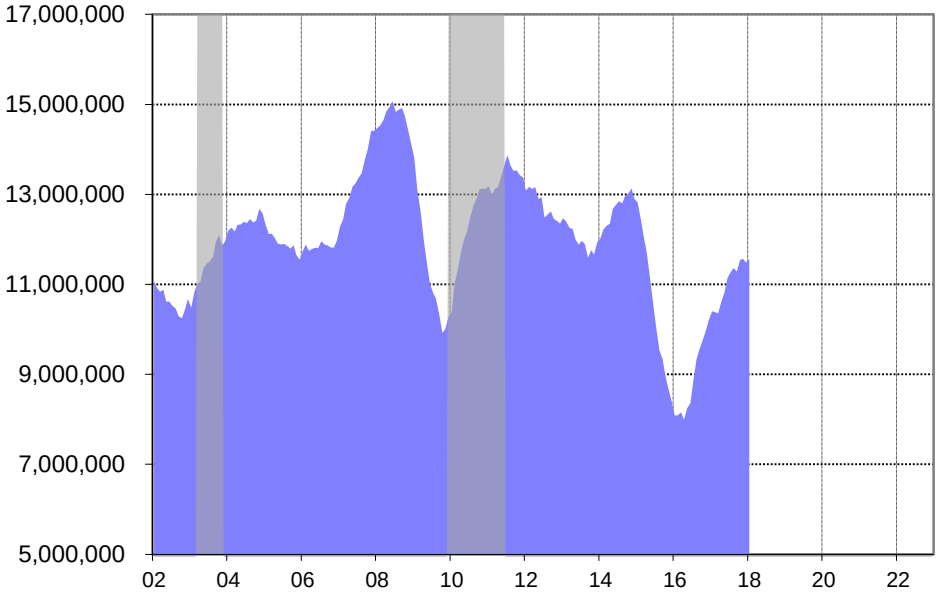
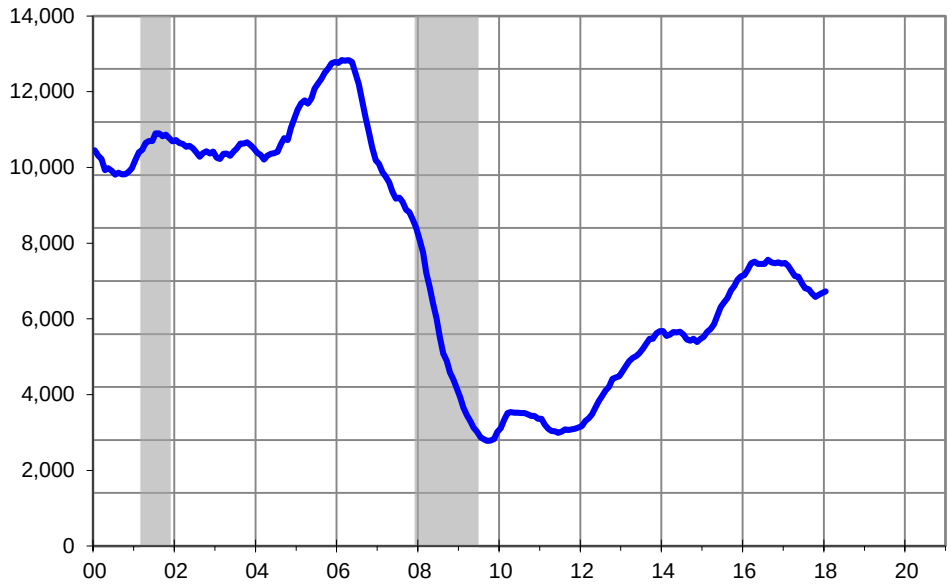


Figure 8. (source: Port of Portland)

Chart shows total tonnage of goods passing through the Port of Portland.

With local labor issues resolved post-recession, goods moving through the Port are bouncing back sharply, more than half-way back to pre-recession peak.

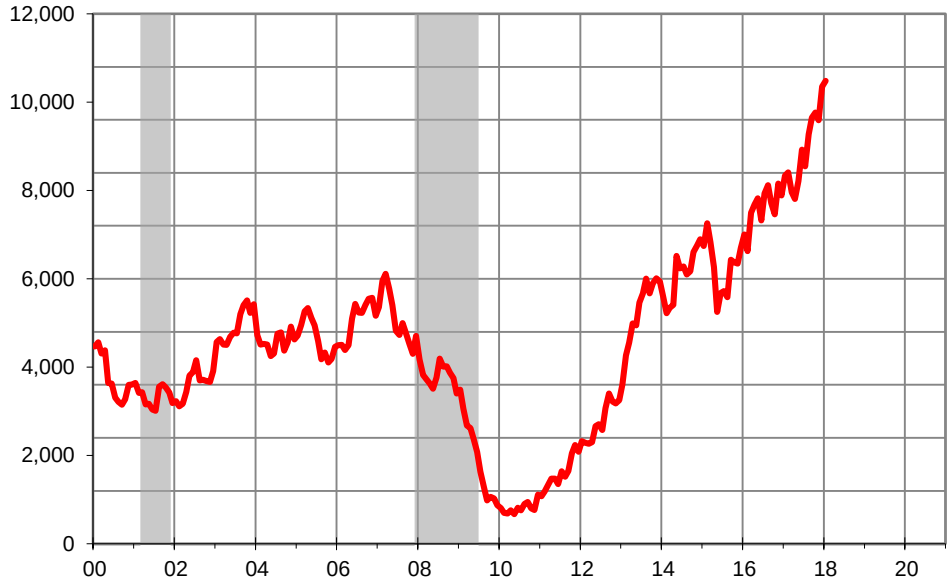
Single Family Permits Issued (7-county MSA)



Permits for single family housing have steadily risen since the end of the recession, but new construction has been constrained by a limited inventory of immediately developable tax lots.

Figure 9. (source: U.S. Census and Real Estate Center at Texas A&M)

Multi- Family Permits Issued (7-county MSA)



Permits for new multi-family units (apartments) have risen sharply since the recession. A surge in 2015 was due to developers applying to build before the city of Portland put into effect its inclusionary zoning ordinance.

Figure 10. (source: U.S. Census and Real Estate Center at Texas A&M)

Residential home prices
(median sales price – nominal dollars and not seasonally adjusted)

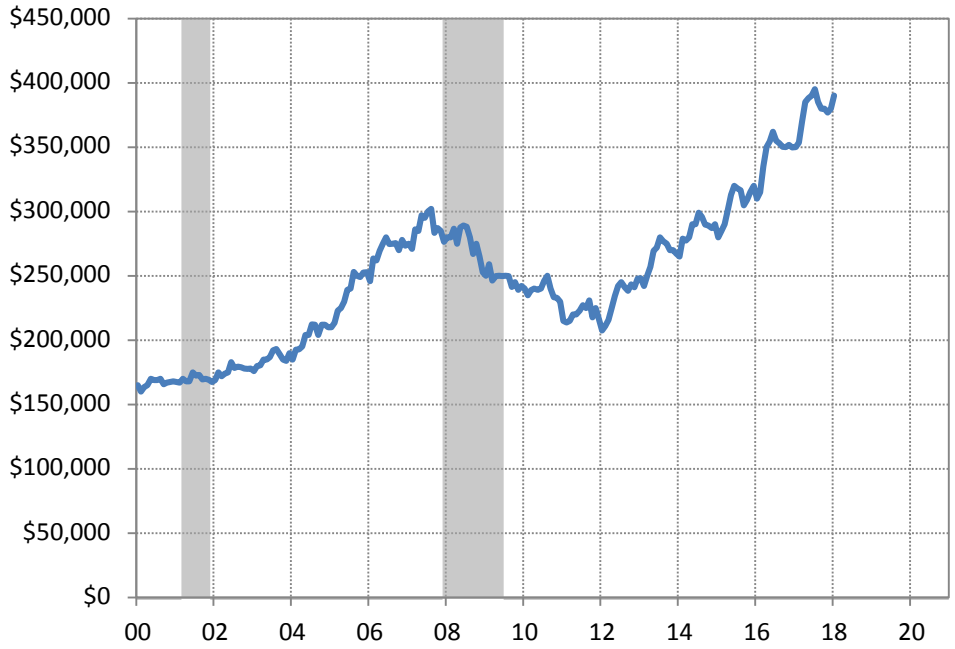


Chart shows the strong bounce back in regional median home prices after the housing market collapse which triggered the Great Recession.

Prices are indicative of the return to robust housing demand and a post-recovery of the regional economy.

Figure 11. (source: RMLS, Multnomah, Clackamas and Washington counties)

State of the U.S. Economy

The U.S. economy is exhibiting little sign of overheating despite tight labor market conditions. Labor force participation rates across the board are trending back up. In another indication of tight labor market conditions, the overall unemployment rate for all adults has steadily shifted lower to the point in which many economists consider the country to be at full employment. As it stands, the U.S. unemployment rate is at 4.1 percent (Feb. 2018, seasonally adjusted). Unemployment had peaked at 10 percent during the Great Recession. The youth and young adult (16 to 24 years of age) unemployment rate (seasonally adjusted) has fallen to 9 percent from a peak of 19.5 percent during the recession. Black and Latino youth unemployment rose to a peak of 33.4 and 24.2 percent, respectively, during the recession. Both unemployment rates have fallen sharply to readings now of 14.1 and 9.9 percent, respectively (Feb. 2018).

U.S. gross domestic product (GDP in real dollar terms) readings edged up in 2017Q2 and 2017Q3. US GDP rose to 3.1 and 3.2 percent in the 2nd and 3rd quarters of 2017, respectively. Otherwise, U.S. GDP has been tepid for much of the current expansion. In contrast, it was not uncommon to see GDP gains after a recession to top 5 percent or more.

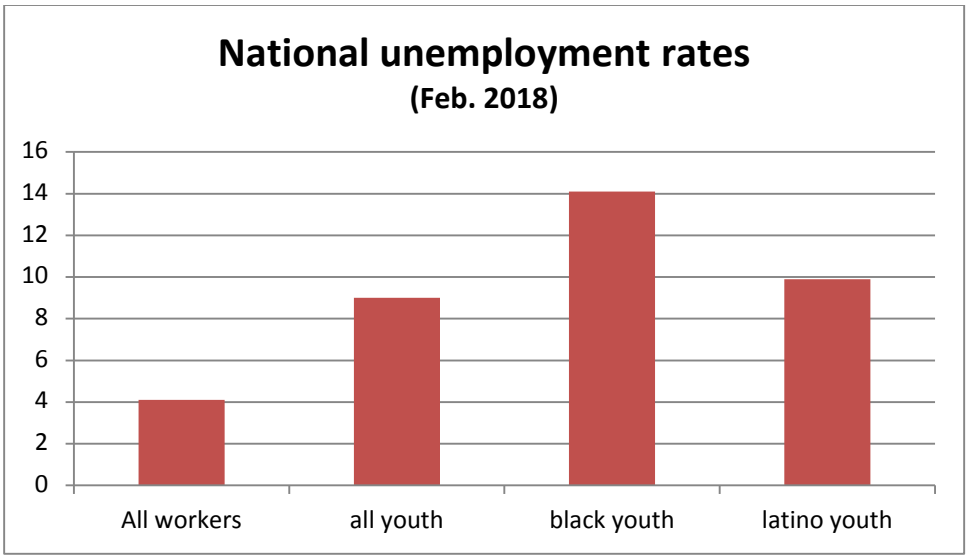


Figure 12. (source: U.S. Census)

The U.S. economy is registering a stable boost in GDP growth resulting from the recent federal income tax cut and continued deregulation. However, a brewing trade war between the U.S. and its major trading partners could erupt and erase the gains from deregulation and tax cuts. Most indicators show an increase in economic sentiment. The Institute of Supply Management reports optimism from aggregate production indexes for the manufacturing (PMI) and non-manufacturing (NMI) sectors. Both indexes indicate the two sectors are expected to continue growing. The Federal Reserve's statistics on productivity and output reinforce expectations of GDP growth for the near term. Both capacity utilization and industrial output measures show the U.S. still expanding.

U.S. Gross Domestic Product (inflation adjusted)
Seasonalized annual average rate (SAAR)

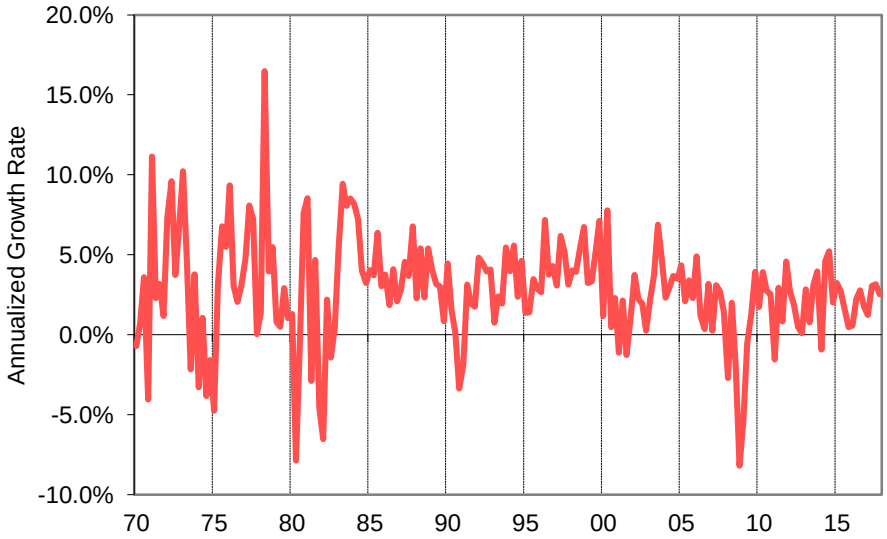
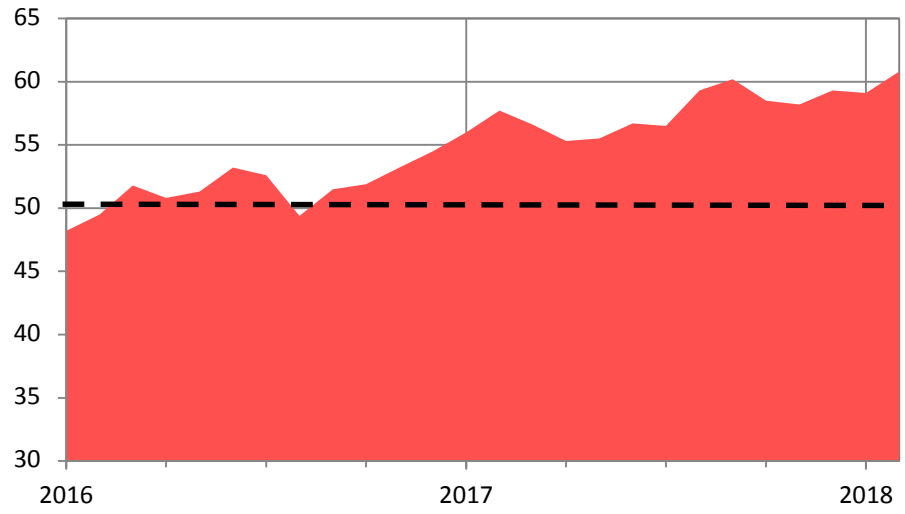


Chart shows U.S. GDP trending ahead since mid-2016. GDP topped 3.1% and 3.2% as recently as 2017Q2 and 2017Q3, respectively. Growth slowed to 2.5% in 2017Q4.

Figure 13. (source: U.S. BEA)

National Association of Purchasing Managers Index (PMI)



A reading greater than 50 indicates the sector poised for growth to continue. The Feb. 2018 PMI is 60.8. The non-manufacturing index (NMI) for Feb. 2018 has a reading of 62.8. Both indicate an economy expanding.

Figure 14. (source: Institute of Supply Management)

U.S. Capacity Utilization and Industrial Production

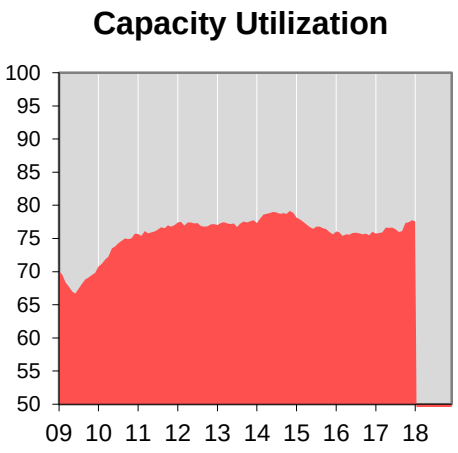


Figure 15. (source: U.S. Federal Reserve)

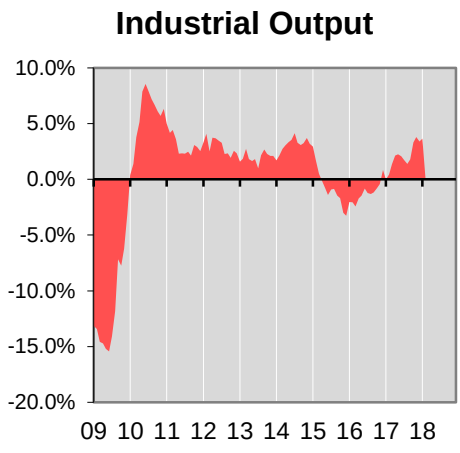


Figure 16. (source: U.S. Federal Reserve)

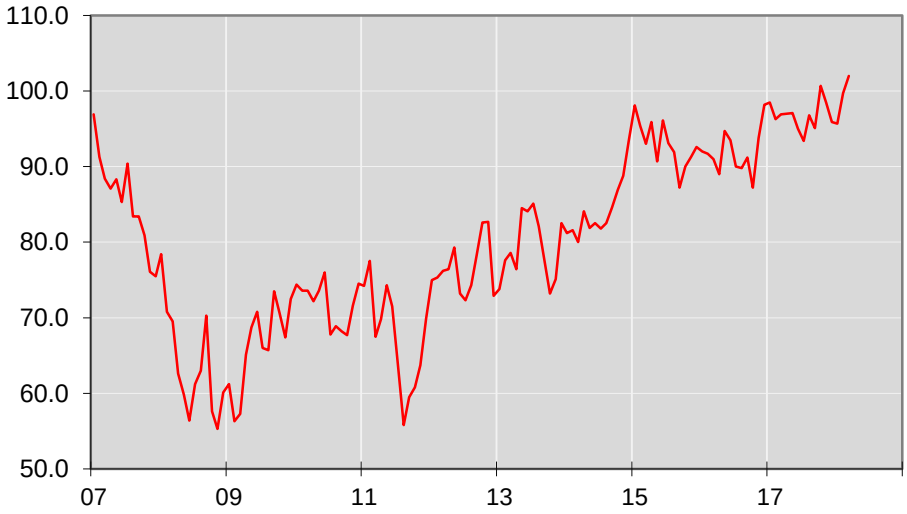
U.S. capacity utilization* averages about 80%. A reading above 75% is normally indicative of an expanding economy. U.S. production output rose 3.7% in Jan. 2018 also indicating growth.

* The capacity utilization rate measures the proportion of potential economic output that is actually produced. Displayed as a percentage, capacity utilization levels give insight into the overall slack that is in the economy at a given point in time. The greater the slack, the more economic "headroom" there exists for the economy to grow.

Finally, consumer sentiment – a qualitative measure of how U.S. consumers are feeling about the economy's prospects – indicates a favorable assessment of current economic conditions. The University of Michigan sentiment index rose to its highest reading since 2004, "a new all-time favorable assessment of current economic conditions", according to a statement released by the study's author. According to the news release, "the gain in the Sentiment index was among households with income in the bottom third". This suggests that the recovery is not just benefitting the rich and wealthy but hitting

consumers in lower income brackets and may provide longer term benefits to the economy if indeed the benefits of growth are more widely distributed in the economy.

Consumer Sentiment Index (1966=100)
(not seasonally adjusted)



The index shows the degree of optimism on the conditions of spending in the U.S. economy. The readings have been generally trending upwards, meaning consumers are expressing confidence in the general direction of U.S. GDP.

Figure 17. (source: University of Michigan)

Regional Forecast Details

The regional forecast in the near term is an extension of current national and regional economic conditions. Over the long-run, the regional economic forecast adopts a growth profile that is closely tied to characteristics incorporated to the regional population projection. This is not to say that national factors don't play into the regional growth forecast, but divergences in population growth make the regional economic forecast grow a bit faster than its national counterpart.

Near term, the regional forecast hews closely to national economic trends and the growth factors incorporated into the national forecast. The national forecast is provided by IHS Markit – an independent private forecast vendor. The national forecast drives near term trends in both population and employment projections for the region. The IHS Markit U.S. forecast is a trend projection, meaning business cycles are not modeled in the long-run trend projections except to play out the current business cycle. The national forecast assumes the current business cycle will taper down to its long-run growth rate and assumes the Federal Reserve will successfully balance near term growth against holding inflation in check. As conditions play out over the long-haul, demographic factors play a more central role in guiding the long-term U.S. economic and employment projections. Demand can exceed or outpace growth in capacity in the short run, but in the long-run demand is controlled by how much supply or in the case of labor force how much population growth is expected. The regional forecast follows the business cycle assumptions contained in the IHS Markit short-run phase of the forecast, but

over the long-run the regional forecast is more closely tied to regional long-term population assumptions.

Population Forecast

A key difference between long run growth expectations between regional and national growth projections are the assumptions for domestic migration vs. immigration. Immigration has historically been a small factor in regional population growth, whereas immigration is a key driver in population expectations nationally. On the other hand, domestic migration assumptions are significant to the region. In the national outlook, immigration is held to the maximum allowed under federal regulations. This assumption and the assumption of lower fertility of existing Americans leads to population rates that are expected to drift lower. U.S. population growth before the Great Recession was about 0.9 percent per year and fell to about 0.7 percent during the downturn and has yet to bounce back up. The Census and IHS Markit project U.S. population growth to rebound to 0.8 percent annually through 2020, but afterwards the demographic forces at play are expected to drive population growth in the country to below 0.5 percent per year by 2047.

By 2038, the end year for the analysis period for this UGM cycle, U.S. population is expected to grow about 0.5 percent annually. The regional forecast calls for mildly faster population growth due to domestic net in-migration that is expected to bolster population. Regional population in 2017 rose 1.5 percent. Over the long-run, population growth in the region is expected to taper off to about 0.7 percent in 2038 and 0.6 percent per year by 2047. Fertility in the region is expected to be slightly higher because the population is a bit younger than at the national level due to a greater degree of migrants (who tend to be younger) making up the resident population.

The following summary figures illustrate characteristics and trends belonging to the regional population forecast. Projections at the regional level are summarized at the 7-county metropolitan statistical area (Portland MSA).

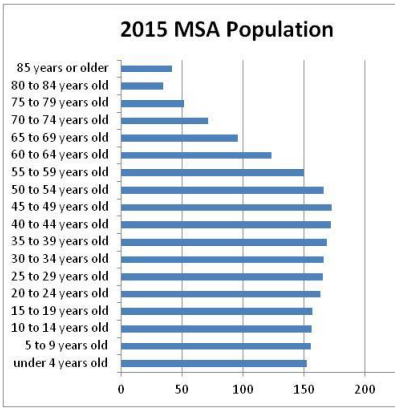


Figure 18

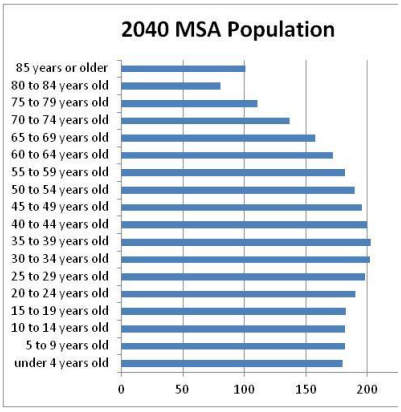


Figure 19

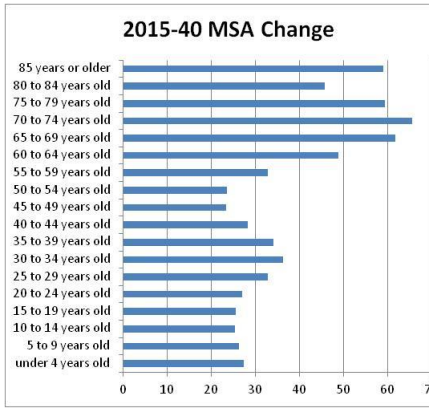


Figure 20

(source: Metro Research Center – Baseline forecast scenario)

These charts are not traditional population pyramids, but rather population histograms which only show population by age without the gender breakdown. They indicate a population pyramid for the Portland MSA that displays near stationary growth. If not for relatively strong net in-migration, the region's population going forward would show little growth. A stationary population is one that displays a near "rectangular" shape at the pyramid's bottom. The bottom age brackets exhibit roughly equal percentages across its age cohorts and tapering off toward the top age brackets. These pyramids are often characterized in developed nations or regions, in which birth rates are low and overall quality of life is high.

Portland area natural increase in population, which is the difference between births minus deaths, is predicted in the long-run to be below replacement. Annual population growth is almost evenly split between migration and natural increase in the near term, but as fertility rates steadily decline through the forecast and the number of total deaths rise (due to an aging population), the natural increase from the resident population is expected to fall. Thus, regional population growth will become increasingly more dependent on domestic net in-migration to fuel growth.

The population forecast encapsulates assumptions for slower annual population growth. This is evident in lower fertility rate projections from U.S. Census Bureau; higher mortality figures as a result of a population incrementally growing older each year (e.g., rising of median age), and proportionally lower regional net in-migration rates (i.e., relative to total population) projected for the future. Migration, population and employment trends are linked together in the regional forecast. These trends are consistent and reinforce themselves over time.

For example, a slower migration rate relative to total population means that migration will provide a smaller impact on population growth. Slower population growth means relatively fewer individuals in the labor force and fewer consumers to drive demand for goods and services. A lower labor force count also means fewer workers earnings and on a relative basis a smaller economic footprint than otherwise. Lower personal income means the likelihood of less consumer spending. Less spending turns out to be less demand as well and so on. The cycle completes itself by reinforcing back on itself until the economic system settles to slower regional economic GDP growth.

Population by Age Group – Baseline Forecast Scenario
Portland-Vancouver-Hillsboro, OR-WA MSA (Portland MSA)

(in 1,000's)	2015	2020	2025	2030	2035	2040	2045
under 4 years old	152.4	161.7	168.4	173.2	176.9	179.8	182.5
5 to 9 years old	155.3	162.1	168.2	173.6	178.1	181.6	184.6
10 to 14 years old	156.3	162.4	167.4	172.7	177.6	181.7	185.3
15 to 19 years old	157	164.2	168.7	173.3	178.1	182.5	186.6
20 to 24 years old	163.6	174.9	179.1	182.8	186.7	190.7	194.9
25 to 29 years old	165.3	180.5	187.1	191.2	194.7	198.2	202.1
30 to 34 years old	165.7	179.4	188.4	194.3	198.6	202.1	205.8
35 to 39 years old	168.7	176.9	185.5	192.8	198.5	202.8	206.7
40 to 44 years old	172.2	175.8	181.5	188.6	195.1	200.5	205.1
45 to 49 years old	172.5	174.8	178.1	183.5	189.8	195.8	201.2
50 to 54 years old	166.1	171.3	174.4	178.4	183.7	189.7	195.5
55 to 59 years old	149.3	161.2	167.4	171.9	176.7	182.2	188
60 to 64 years old	123.4	142.1	153.7	161.1	166.7	172.2	178
65 to 69 years old	95.6	116.1	131.9	143.1	151	157.5	163.6
70 to 74 years old	71.2	88.5	105	118.6	128.9	136.9	143.8
75 to 79 years old	51.4	63.4	77.2	90.5	101.8	110.9	118.5
80 to 84 years old	34.7	41.8	51.3	61.8	71.7	80.4	87.8
85 years or older	42	48.4	58.1	71	85.7	101.1	116.5
TOTAL MSA POP.	2362.7	2545.5	2691.4	2822.4	2940.3	3046.6	3146.5

Figure 21. (source: Metro Research Center) – figures may not add due to rounding

Population Forecast Comparison: (2018 vintage v. 2015 vintage)
Portland-Vancouver-Hillsboro, OR-WA MSA (Portland MSA)
Baseline Scenarios

(in 1,000's)	2015	2020	2025	2030	2035	2040	2045
Actual est. (PSU)	2362.7						
2015 vintage	2342.5	2519.2	2671.8	2814.1	2937.9	3052.1	n/a
2018 vintage	2362.7	2545.5	2691.4	2822.4	2940.3	3046.6	3146.5

(source: Portland State Univ., Metro Research Center – Baseline forecast scenarios)
Figure 22

The regional (MSA) forecast maintains growth rates slightly greater than the U.S. This is due in part to the region's slightly higher fertility levels. The MSA has a somewhat younger median age and therefore proportionally more of its population still in its root setting years, which is to say that they are more likely to start a family and have more kids. Adding to this is the region's continued ability to draw in more migrants than it loses to other states. These trends carry forward from an historical perspective. Due to the quality of life of this region, it has had a track record of attracting young and well educated migrants that have added to growth and resiliency of the Metro area. In the long run, these difference

start to narrow and as a result the forecast foresees that the difference in annual growth rates converging between the region and the nation.

Population Forecast Growth Rates: (U.S. vs. MSA)
Portland-Vancouver-Hillsboro, OR-WA MSA (Portland MSA)
MSA Baseline Scenario and U.S. Baseline Trend

(Annualized pct.)	2015	2020	2025	2030	2035	2040	2045
U.S. (IHS Markit)	0.7	0.8	0.8	0.7	0.6	0.5	0.5
Region (Metro)	1.2	1.5	1.1	1.0	0.8	0.7	0.6

(source: IHS Markit, Metro Research Center – Baseline forecast scenarios)
Figure 23

Population Net In-Migration Trend
Portland-Vancouver-Hillsboro, OR-WA MSA (Portland MSA)

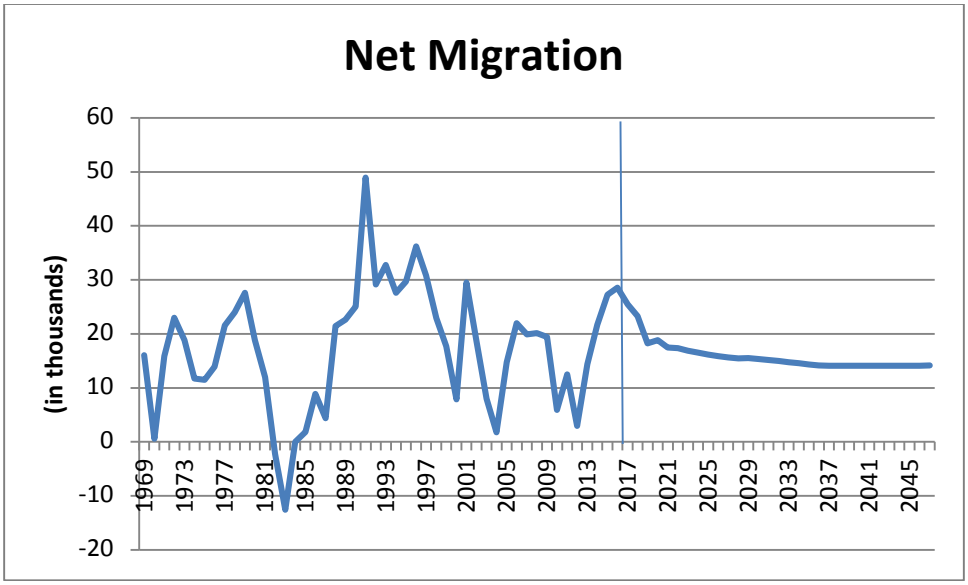


Figure 24. (Portland MSA baseline forecast, source: Metro Research Center)

Migration is forecasted to peak and moderate through the current regional business cycle. The projected trend in the long-run is expected to taper down to near the historical average net migration level.

Population Forecast Scenarios (High, Medium or "Baseline" Low)
Portland-Vancouver-Hillsboro, OR-WA MSA (Portland MSA)
Total Nonfarm Civilian Employment

(in 1,000's)	2015	2020	2025	2030	2035	2040	2045
High		2600.6	2775.1	2938.5	2090.1	3229.7	3369.1
Medium (Baseline)	2362.7	2545.5	2691.4	2822.4	2940.3	3046.6	3146.5
Low		2441.5	2554.8	2652.7	2737.9	2806.2	2869.6

(source: Metro Research Center – Baseline forecast scenarios)
Figure 25

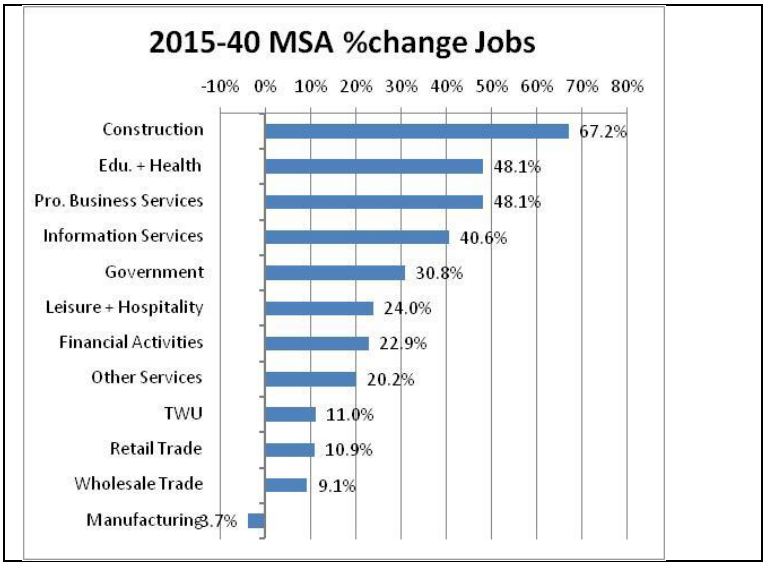
As there is always uncertainty in growth projections, Metro has prepared a "range forecast" that sets out high and low growth scenarios in addition to the likely baseline. These scenarios represent a 95 percent confidence interval. The interval means that 95 percent of the time, the region can expect growth to fall between the high and low growth bands.

Employment Forecast

Overall employment growth is expected to trend with population, but individual growth rates among industries are expected to differ. Some of this difference is driven by economic/employment trends at the national level. This is incorporated through the IHS Markit U.S. forecast. Other regional trends owe to the region's inherent advantages and concentration in certain industry categories, such as electronics (i.e., consumer and business electronics), advanced manufacturing (i.e., sportswear and apparel) and medical research. Baseline industrial job growth is projected to decline in the long-run, but demand for industrial real estate may not depending on future regional output and productivity. In summary, the regional economy will see growth but at a more moderate pace that reflects demographic factors.

Employment Projections by Industry Supersectors

Portland-Vancouver-Hillsboro, OR-WA MSA (Portland MSA) Baseline Scenarios



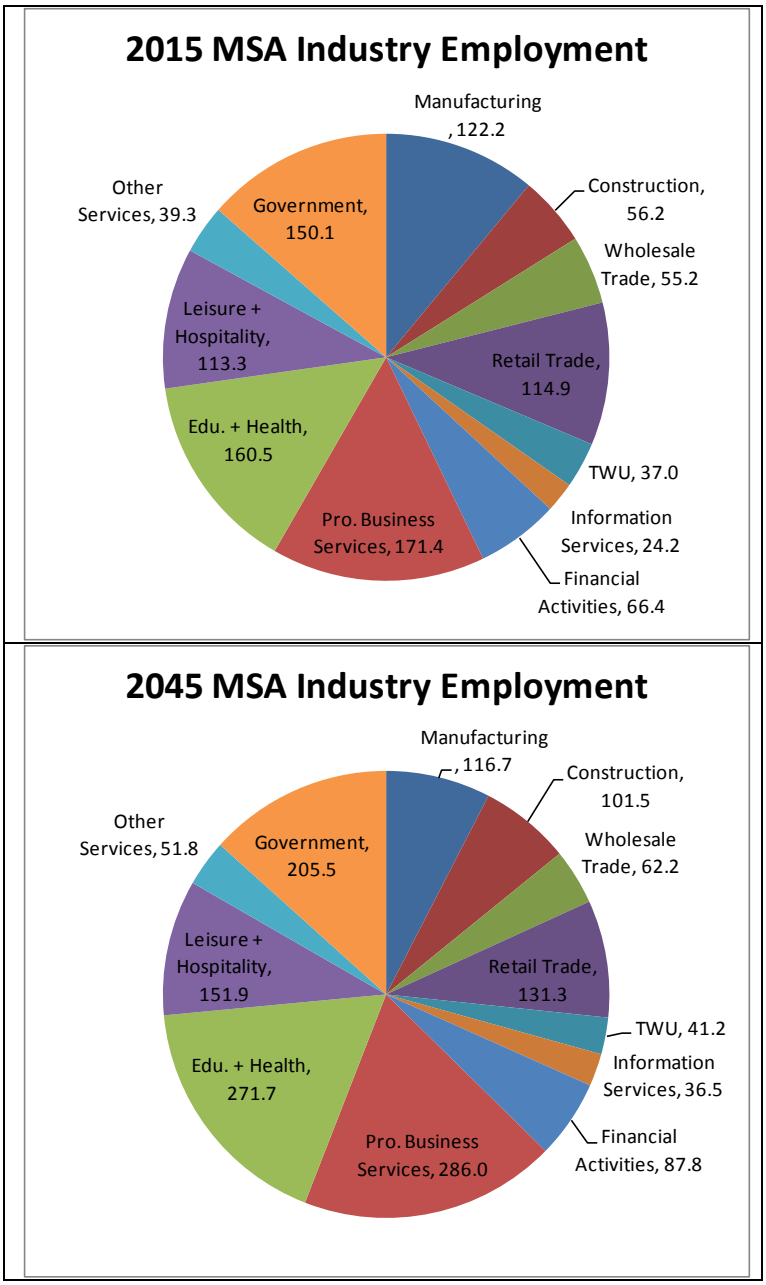


Figure 26 (source: Metro Research Center)

Construction, health and education services and professional business services are the top 3 industries in terms of percentage growth rate. On an absolute scale, professional business services leads with 83,000 more jobs between 2015 and 2040, followed by health and education services by adding 77,000 jobs.

Employment Forecast Comparison: (2018 vintage v. 2015 vintage)

Portland-Vancouver-Hillsboro, OR-WA MSA (Portland MSA)
Baseline Scenarios

(in 1,000's)	2015	2020	2025	2030	2035	2040	2045
Actual est. (BLS)	1111.92						
2015 vintage	1100.04	1228.14	1311.57	1399.79	1484.46	1571.29	n/a
2018 vintage	1111.92	1230.20	1281.36	1313.21	1363.09	1432.33	1517.96

(source: Bureau of Labor Statistics, Metro Research Center – Baseline forecast scenarios)
Figure 27

The current 2018 employment forecast adjusts to faster-than-expected job growth in the near term. About 12,000 more jobs materialized in 2015 than expected. This is incorporated into the base year calculations for the 2018 vintage. The latest regional forecast grows a bit faster but tapers off more quickly than the 2015 vintage. This is mainly due to assumptions contained in the August 2017 IHS Markit U.S. outlook. The employment trend is thus slower in the 2018 regional forecast because the national forecast predicts slower GDP growth.

The regional forecast still maintains faster growth compared to the U.S. outlook. Regional job growth is faster in the near term based on recent economic conditions. Although job growth is expected to taper off sharply after 2020, the region is expected to grow faster than the U.S. Overall job growth in the region will be faster in large part due to regional demographics and the industry mix of the region.

Employment Forecast Growth Rates: (U.S. vs. MSA)

Portland-Vancouver-Hillsboro, OR-WA MSA (Portland MSA)
MSA Baseline Scenario and U.S. Baseline Trend

(Annualized pct.)	2015	2020	2025	2030	2035	2040	2045
U.S. (IHS Markit)	1.7	1.4	0.6	0.6	0.6	0.6	0.6
Region (Metro)	2.6	2.0	0.8	0.5	0.8	1.0	1.2

(source: IHS Markit, Metro Research Center – Baseline forecast scenarios)
Figure 28

Employment Forecast Scenarios (High, Medium-baseline, Low)

Portland-Vancouver-Hillsboro, OR-WA MSA (Portland MSA)
Total Nonfarm Civilian Employment

(in 1,000's)	2015	2020	2025	2030	2035	2040	2045
High		1335.9	1400.1	1440.7	1502.9	1587.2	1691.8
Medium	1111.9	1230.2	1281.4	1313.2	1363.1	1432.3	1518.0
Low		1135.3	1167.5	1182.9	1215.6	1264.4	1327.9

(source: Metro Research Center – Baseline forecast scenarios)

The regional high, medium and low growth scenarios (employment and population) draw from a statistically based approach which calculates a confidence band of two-standard deviations from the medium or baseline trend. Between the high and low scenarios, the difference equates to a 95 percent confidence interval with baseline representing the "average" trend for the growth band.

Regional Forecast Tables

1. Comparison of Portland Metro's population forecasts and other forecasts
2. 2018-38 MSA Population – baseline forecast
3. 2018-38 MSA Household – baseline forecast
4. 2018-38 MSA Employment – baseline forecast
5. Range Projections: High, baseline, Low – MSA Population
6. Range Projections: High, baseline, Low – MSA Households
7. Range Projections: High, baseline, Low – MSA Employment

Comparison of population forecasts

Comparison of Portland Metro's population forecasts and other forecasts

Portland MSA

Metro Regional Population Forecasts

	(7-county* MSA) 2017 release	%APR		(7-county MSA) 2014 release	%APR
2000	1,927,881	2.0%		1,927,881	2.0%
2005	2,067,325	1.4%		2,067,325	1.4%
2010	2,226,009	1.5%		2,226,000	1.5%
2015	2,362,655	1.2%	0.9%	2,342,500	1.0%
2020	2,545,400	1.5%	1.0%	2,519,200	1.5%
2025	2,691,450	1.1%	0.7%	2,671,800	1.2%
2030	2,822,500	1.0%	0.3%	2,814,100	1.0%
2035	2,940,450	0.8%	0.1%	2,937,900	0.9%
2040	3,046,650	0.7%	-0.2%	3,052,100	0.8%
	1.1%			1.1%	

source: Metro Research Center

* 7 counties = Clackamas, Columbia, Multnomah, Washington, Yamhill, Clark and Skamania

PSU - NERC Population Forecast

	(7-county MSA) Oct. 2017 release	%APR
2000	1,938,861	2.0%
2005	2,071,299	1.3%
2010	2,226,009	1.5%
2015	2,365,051	1.2%
2020	2,556,321	1.6%
2025	2,729,840	1.3%
2030	2,881,619	1.1%
2035	3,009,333	0.9%
2040	3,125,301	0.8%
	1.1%	

source: Northwest Economic Research Center (April 2017 release)

IHS Global Insight Portland MSA Population Outlook

	(7-county MSA) Oct. 2017 Release	%APR	(7-county MSA) Sep. 2013 release	%APR	(7-county MSA) Sep 2008 release	%APR
2000	1,939,890	2.0%	1,940,510	2.1%	1,942,000	2.1%
2005	2,072,290	1.3%	2,072,256	1.3%	2,297,000	3.4%
2010	2,236,060	1.5%	2,236,413	1.5%	2,474,000	1.5%
2015	2,389,920	1.3%	2,380,688	1.3%	2,637,000	1.3%
2020	2,578,730	1.5%	2,525,884	1.2%	2,794,000	1.2%
2025	2,712,760	1.0%	2,651,944	1.0%	2,947,000	1.1%
2030	2,827,820	0.8%	2,769,572	0.9%	3,096,000	1.0%
2035	2,930,140	0.7%	2,884,610	0.8%	3,245,000	0.9%
2040	3,021,070	0.6%	2,997,777	0.8%		
	1.3%		1.0%		1.1%	

source: IHS Global Insight Regional Services

Oregon State

NERC Oregon Population Forecasts

	2013 release	%APR	2004 release	%APR
2000	3,431,100	1.5%	3,436,750	1.5%
2005	3,626,900	1.1%	3,618,200	1.0%
2010	3,837,300	1.1%	3,843,900	1.2%
2015	4,001,600	0.8%	4,095,708	1.3%
2020	4,252,100	1.2%	4,359,258	1.3%
2025	4,516,200	1.2%	4,626,015	1.2%
2030	4,768,000	1.1%	4,891,225	1.1%
2035	4,995,200	0.9%	5,154,793	1.1%
2040	5,203,000	0.8%	5,425,408	1.0%
	1.0%		1.2%	

source: Northwest Economic Research Center

http://www.oregon.gov/das/OEA/Pages/forecastdemographic.aspx

Census Oregon State Population Projections

(no further updates are planned)

	2005 release	%APR	1996 release	%APR
2000	3,421,399	1.4%	3,397,000	1.6%
2005	3,596,083	1.0%	3,613,000	1.2%
2010	3,790,996	1.1%	3,803,000	
2015	4,012,924	1.1%	3,992,000	1.0%
2020	4,260,393	1.2%	4,177,000	
2025	4,536,418	1.3%	4,349,000	0.9%
2030	4,833,918	1.3%	N/A	
2035	N/A		N/A	
2040	N/A		N/A	
	1.2%		0.9%	

source: U.S. Census , State Population Projections

http://www.census.gov/population/projections/data/state/index.html

IHS Global Insight Oregon Population Forecasts

	2017 release	%APR	Oct. 2013 release	%APR
2000	3,436,350	1.5%	3,434,800	1.5%
2005	3,638,420	1.1%	3,621,200	1.1%
2010	3,920,340	1.5%	3,842,100	1.2%
2015	4,034,020	0.6%	4,006,900	0.8%
2020	4,328,701	1.4%	4,195,800	0.9%
2025	4,520,450	0.9%	4,370,500	0.8%
2030	4,674,974	0.7%	4,529,100	0.7%
2035	4,809,561	0.6%	4,680,900	0.7%
2040	4,925,607	0.5%	4,825,700	0.6%
	0.8%		0.8%	

source: IHS Global Insight Regional Services

United States

Census U.S. Population Projection

	2014 release	%APR	2012 release	%APR
2000	281,421,906	1.4%	281,421,906	1.4%
2005	295,516,599	1.0%	295,516,599	1.0%
2010	309,349,689	0.9%	309,349,689	0.9%
2015	321,369,000	0.8%	321,362,789	0.8%
2020	334,503,000	0.8%	333,895,553	0.8%
2025	347,335,000	0.8%	346,407,223	0.7%
2030	359,402,000	0.7%	358,471,142	0.7%
2035	370,338,000	0.6%	369,662,023	0.6%
2040	380,219,000	0.5%	380,015,683	0.6%
	0.7%		0.7%	

source: U.S. Census

2012 and 2014 National Population Projection

https://www.census.gov/data/tables/2014/demo/popproj/2014-summary-tables.html

IHS Global Insight U.S. Population Forecast

	Aug. 2017 release	%APR	Nov 2013 release	%APR
2000	282,789,582	1.5%	282,790,000	1.5%
2005	296,459,826	0.9%	296,460,000	0.9%
2010	310,099,663	0.9%	310,064,000	0.9%
2015	321,450,406	0.7%	321,937,000	0.8%
2020	333,761,890	0.8%	334,474,000	0.8%
2025	346,579,285	0.8%	346,978,000	0.7%
2030	358,630,151	0.7%	359,025,000	0.7%
2035	369,544,337	0.6%	370,192,000	0.6%
2040	379,410,174	0.5%	380,530,000	0.6%
	0.7%		0.7%	

source: IHS Global Insight

Long-term U.S. Trend Projections, 2013 and 2017 vintages

World Bank U.S. Population Projection

	2013 release	%APR
2000	282,163,000	1.4%
2005		
2010	309,307,000	0.9%
2015		
2020	330,963,000	0.7%
2025		
2030	352,612,000	0.6%
2035		
2040	370,573,000	0.5%
	0.6%	

source: World Bank

http://datatopics.worldbank.org/hnp/popestimates

U.N. U.S. Population Projection

	2012 release	%APR
2000	284,594,000	1.6%
2005	298,166,000	0.9%
2010	312,247,000	0.9%
2015	325,128,000	0.8%
2020	337,983,000	0.8%
2025	350,626,000	0.7%
2030	362,629,000	0.7%
2035	373,468,000	0.6%
2040	383,165,000	0.5%
	0.7%	

Source: Population Division, United Nations

World Population Prospects: The 2012 Revision.

http://esa.un.org/unpd/wpp/unpp/p2k0data.asp

Comparison of employment forecasts

Comparing Portland Metro's employment forecasts and other forecasts

Portland MSA

Metro Regional Employment Forecasts

	(7-county MSA) 2017 release	%APR	(7-county MSA) 2014 release	%APR	(7-county MSA) 2010 release	%APR
2000	981,490	3.1%	973,230	2.9%	973,230	2.9%
2005	991,080	0.2%	983,530	0.2%	983,680	0.2%
2010	979,140	-0.2%	968,830	-0.3%	965,500	-0.4%
2015	1,111,920	2.6%	1,100,040	2.6%	1,090,800	2.5%
2020	1,230,200	2.0%	1,228,140	2.2%	1,189,600	1.7%
2025	1,281,360	0.8%	1,311,570	1.3%	1,282,100	1.5%
2030	1,313,210	0.5%	1,399,790	1.3%	1,380,200	1.5%
2035	1,363,090	0.7%	1,484,460	1.2%	1,486,900	1.5%
2040	1,432,330	1.0%	1,571,290	1.1%	1,596,100	1.4%
	1.3%		1.6%		1.7%	

source: Metro Research Center

* 7 counties = Clackamas, Columbia, Multnomah, Washington, Yamhill, Clark and Skamania

IHS Global Insight Portland MSA Employment Outlook

	(7-county MSA) Oct. 2017 release	%APR	(7-county MSA) Sep. 2013 release	%APR
2000	981,840	3.1%	973,500	3.0%
2005	991,030	0.2%	983,400	0.2%
2010	979,170	-0.2%	968,700	-0.3%
2015	1,111,730	2.6%	1,079,500	2.2%
2020	1,232,760	2.1%	1,175,100	1.7%
2025	1,296,230	1.0%	1,212,900	0.6%
2030	1,333,500	0.6%	1,252,600	0.6%
2035	1,383,380	0.7%	1,294,200	0.7%
2040	1,437,690	0.8%	1,349,800	0.8%
	1.3%		1.1%	

source: IHS Global Insight Regional Services

PSU - NERC Employment Forecast

	(7-county MSA) Oct. 2017 release	%APR
2000	981,592	2.8%
2005	991,160	0.2%
2010	979,218	-0.2%
2015	1,111,922	2.6%
2020	1,223,583	1.9%
2025	1,272,136	0.8%
2030	1,319,280	0.7%
2035	1,367,839	0.7%
2040	1,417,285	0.7%
	1.2%	

source: Northwest Economic Research Ctr.

Oregon State

Metro's Oregon Employment Forecasts

	(Oregon) 2010 release	%APR	(Oregon) 2014 release	%APR
2000	1,617,800	2.5%	1,617,900	2.5%
2005	1,654,300	0.4%	1,654,400	0.4%
2010	1,728,200	0.9%	1,602,100	-0.6%
2015	1,908,600	2.0%	1,836,200	2.8%
2020	2,071,800	1.7%	2,061,200	2.3%
2025	2,224,100	1.4%	2,163,500	1.0%
2030	2,384,900	1.4%	2,270,900	1.0%
2035	2,558,300	1.4%	2,379,200	0.9%
2040	2,855,900	2.2%	2,493,100	0.9%
	1.7%		1.5%	

source: Metro Research Center

IHS Global Insight Oregon Employment Outlook

	Oct. 2017 release	%APR	Jun. 2014 release	%APR
2000	1,618,000	2.5%	1,618,000	2.5%
2005	1,654,100	0.4%	1,654,100	0.4%
2010	1,601,800	-0.6%	1,601,800	-0.6%
2015	1,780,870	2.1%	1,756,400	1.9%
2020	1,963,170	2.0%	1,898,400	1.6%
2025	2,053,170	0.9%	1,952,800	0.6%
2030	2,102,790	0.5%	2,007,300	0.6%
2035	2,178,970	0.7%	2,071,900	0.6%
2040	2,264,670	0.8%	2,159,000	0.8%
			1.0%	

source: IHS Global Insight

	June 2016 release	%APR
2000	1,617,600	2.5%
2005	1,654,200	0.4%
2010	1,601,700	-0.6%
2014	1,766,200	2.5%
2020	N/A	
2024	2,010,900	1.3%
2030		
2035		
2040		

source: OED Current Employment Statistics and Employment Projections

United States

IHS Global Insight U.S. Employment Forecast (in millions)

	Aug. 2017 release	%APR	Nov 2013 release	%APR	Apr 2008 release	%APR
2000	132.03	2.4%	131.89	2.4%	131.79	2.4%
2005	134.04	0.3%	133.74	0.3%	133.69	0.3%
2010	130.35	-0.6%	129.91	-0.6%	140.77	1.0%
2015	141.81	1.7%	140.54	1.6%	147.99	1.0%
2020	151.73	1.4%	149.56	1.3%	153.39	0.7%
2025	156.59	0.6%	153.48	0.5%	159.61	0.8%
2030	161.08	0.6%	159.25	0.7%	167.03	0.9%
2035	166.33	0.6%	164.47	0.6%	175.06	0.9%
2040	171.71	0.6%	170.63	0.7%		
	0.9%		0.9%		0.9%	

source: IHS Global Insight

Long-term U.S. Trend Projection

Bureau of Labor Statistics (BLS)
U.S. Employment Projections

	Dec. 2013 release	%APR
2000	132.03	2.4%
2005	134.04	0.3%
2010	130.35	-0.6%
2016	144.98	1.8%
2020	N/A	
2026	155.73	1.8%
2030		
2035		
2040		

	Dec. 2013 release	%APR
2000	132.03	2.4%
2005	134.00	0.3%
2010	130.27	-0.6%
2012	134.43	0.3%
2022	149.75	1.1%
2025		
2030		
2035		
2040		

source: BLS employment projections (2006, 2016, 2026), Oct. 24, 2017 and CES national employment data

2018-38 MSA Population – baseline forecast

	2010	2015	2018	2020	2025	2030	2035	2038
Components of Population (in thousands)								
Population (7 counties)	2,226.0	2,362.7	2,480.8	2,545.4	2,691.5	2,822.5	2,940.4	3,005.1
Pct. Chg. (5-year avg.)	1.5	1.2	1.6	1.5	1.1	1	0.8	0.7
Annual Avg. Change	31.7	27.3	37.8	36.6	29.2	26.2	23.6	22
Births, annual avg.	29.4	27.7	29.8	31.4	32.7	33.6	34.4	34.7
Crude Birth Rate	13.5	12.1	12.4	12.7	12.4	12.1	11.9	11.7
Deaths, annual avg.	15.2	16.4	17.9	18.8	21.1	23.5	26	27.3
Crude Death Rate	7	7.1	7.4	7.6	8	8.5	9	9.2
Natural Incr., ann. avg.	14.2	11.3	11.9	12.6	11.6	10.1	8.4	7.4
Net Migr. (5-year avg.)	17.5	15.8	20.6	18.3	17	15.7	15	14.5
%Migr. Growth Share	55	57.7	54.6	50	58.1	60	63.5	65.8
Regional Pop. Cohorts	2010	2015	2018	2020	2025	2030	2035	2038
under 4 years old	145.3	152.4	158.3	161.7	168.4	173.2	176.9	178.7
5 to 9 years old	146.1	155.3	159.7	162.1	168.2	173.6	178.1	180.2
10 to 14 years old	147.5	156.3	160.4	162.4	167.4	172.7	177.6	180.2
15 to 19 years old	143.5	157	162.1	164.2	168.7	173.3	178.1	180.8
20 to 24 years old	138.9	163.6	172.3	174.9	179.1	182.8	186.7	189.1
25 to 29 years old	166.8	165.3	176.2	180.5	187.1	191.2	194.7	196.7
30 to 34 years old	168.7	165.7	174.7	179.4	188.4	194.3	198.6	200.7
35 to 39 years old	164.8	168.7	173.6	176.9	185.5	192.8	198.5	201.2
40 to 44 years old	159.1	172.2	174.2	175.8	181.5	188.6	195.1	198.5
45 to 49 years old	159.9	172.5	174.1	174.8	178.1	183.5	189.8	193.5
50 to 54 years old	159.3	166.1	169.8	171.3	174.4	178.4	183.7	187.3
55 to 59 years old	149.9	149.3	157.5	161.2	167.4	171.9	176.7	179.9
60 to 64 years old	123.7	123.4	135.7	142.1	153.7	161.1	166.7	170
65 to 69 years old	83.2	95.6	108.4	116.1	131.9	143.1	151	155
70 to 74 years old	55	71.2	81.4	88.5	105	118.6	128.9	133.9
75 to 79 years old	41.3	51.4	58.3	63.4	77.2	90.5	101.8	107.5
80 to 84 years old	34.4	34.7	38.7	41.8	51.3	61.8	71.7	77.1
85 years or older	38.2	42	45.5	48.4	58.1	71	85.7	94.9
Total	2,226.0	2,362.7	2,480.8	2,545.4	2,691.5	2,822.5	2,940.4	3,005.1

2018-38 MSA Household – baseline forecast

	2010	2015	2018	2020	2025	2030	2035	2038
(in thousands)								
Total Households	867.8	901.4	958.0	988.7	1063.7	1135.0	1200.2	1236.7
Householder by age of head								
under 25 years old	37.9	36.7	37.7	37.8	39.7	43.1	46.7	48.9
25 to 34	153.2	146.7	155.4	158.9	166.5	173.0	178.7	181.9
35 to 44	172.4	179.9	184.8	187.5	195.6	203.5	210.3	213.7
45 to 54	179.0	187.1	191.2	192.7	196.7	202.2	208.9	213.1
55 to 64	162.2	160.2	173.0	179.0	190.0	198.0	205.1	209.5
65 to 74	87.0	105.4	120.5	129.9	150.3	165.6	176.8	182.2
75 to 84	50.3	57.0	64.5	70.0	85.5	101.3	115.4	122.7
85 years and older	25.8	28.4	30.9	32.9	39.5	48.3	58.3	64.5

2018-38 MSA Employment – baseline forecast

(Employment figures in thousands)	2010	2015	2018	2020	2025	2030	2035	2038
Nonfarm Wage & Salary Jobs, TOTAL	979.14	1111.92	1193.47	1230.2	1281.36	1313.21	1363.09	1402.42
Manufacturing, TOTAL	107.06	122.24	127.09	128.05	126.76	121.96	119.15	118.28
Durables, total	79.68	90.98	94.56	95.07	94.06	90.67	89.11	88.91
Wood Products	3.53	3.75	3.99	4.13	4.33	4.25	4.25	4.27
Primary Metals	5.48	6.41	6.04	6.08	5.83	5.48	5.18	5.03
Fab. Metals	11.17	12.75	13	13.29	13.32	12.51	11.69	11.31
Machinery Mfg.	7.08	8.86	9.7	9.93	9.93	9.5	8.98	8.74
Computer & Electronics	33.26	36.63	37.81	37.81	38	37.66	38.87	39.95
Transp. Equipment	6.3	7.82	6.94	6.76	6.39	6.23	6.22	6.2
Other Durable Goods	12.86	14.77	17.07	17.07	16.26	15.04	13.93	13.41
Nondurables, total	27.38	31.26	32.53	32.98	32.69	31.29	30.04	29.37
Food Processing	9.47	12.48	13.76	13.99	14.35	13.9	13.47	13.23
Paper	3.63	3.14	2.68	2.64	2.48	2.26	2.08	1.98
Other Nondurables	14.28	15.63	16.1	16.34	15.87	15.14	14.5	14.15
Nonmanufacturing (private), TOTAL	724.71	839.63	909.2	939.82	986.36	1013.91	1057.67	1092.18
Natural Resources & Mining	1.07	1.27	1.33	1.4	1.37	1.17	1.02	0.95
Construction	45.64	56.24	73.03	75.16	80	82.49	88.06	91.93
Trade, Transport & Utilities	184.71	207.1	215.59	220.17	222.98	222.09	224.44	227.08
Wholesale Trade	50.05	55.19	55.72	57.22	58.21	58.08	58.8	59.63
Retail Trade	101.29	114.89	118.38	119.5	121.81	122.36	124.43	126.31
Auto	11.38	13.45	14.42	14.71	15.09	15.27	15.51	15.67
Food	19.85	24.04	24.65	24.43	24.29	23.83	23.69	23.85
Other	70.07	77.4	79.31	80.36	82.43	83.26	85.23	86.79
TWU	33.37	37.02	41.49	43.45	42.97	41.66	41.21	41.14
Information Services	22.65	24.19	25.64	26.85	28.66	29.96	31.85	33.12
Publishing	9.15	9.66	10.01	10.25	10.21	10.14	10.37	10.59
Internet, etc.	13.5	14.53	15.63	16.6	18.45	19.81	21.48	22.54
Financial Activities	62.17	66.36	72.34	74.15	76.44	77.09	78.68	80.27
Fin. + Ins.	40.09	41.59	45.23	46.09	47.41	47.98	49.23	50.44
Real Estate	22.08	24.77	27.11	28.06	29.03	29.11	29.46	29.83
Pro. Business Services	136.05	171.35	182.39	194.08	212.13	221.14	234.54	244.86
Pro., Sci., Tech.	53.99	70.25	75.18	78.44	83.74	87.13	92.69	97.4
Mgmt. of Co.	27.94	36.25	39.38	40.48	42.28	43.05	44.22	45.13
Admin Sup. + Waste	54.11	64.86	67.82	75.16	86.11	90.95	97.62	102.33
Edu. + Health	143.06	160.51	173.59	178.73	191	204.41	219.18	229.86
Education	25.09	27.71	29.89	30.54	31.76	32.95	34.35	35.29
Health	117.96	132.79	143.7	148.19	159.25	171.46	184.83	194.57
Leisure + Hospitality	94.6	113.33	124.3	127.18	130.76	131.88	134.92	137.89
Arts, ent. & rec.	13.69	15.61	17.66	18.03	18.78	19.29	20.1	20.75
Lodgings & Food	80.91	97.72	106.64	109.14	111.98	112.59	114.82	117.13
Other Services	34.76	39.28	41	42.1	43.02	43.69	44.98	46.21
Social Orgs.	16.36	17.34	18.6	19.09	19.51	19.94	20.64	21.3
Other	18	22	22	23	24	24	24	25
Government, Civilian TOTAL	147.37	150.06	157.17	162.33	168.25	177.35	186.27	191.96
Federal, Civilian	18.58	17.79	17.97	18.24	17.32	18.17	18.19	18.53
State & Local	128.80	132.27	139.20	144.09	150.93	159.18	168.08	173.43

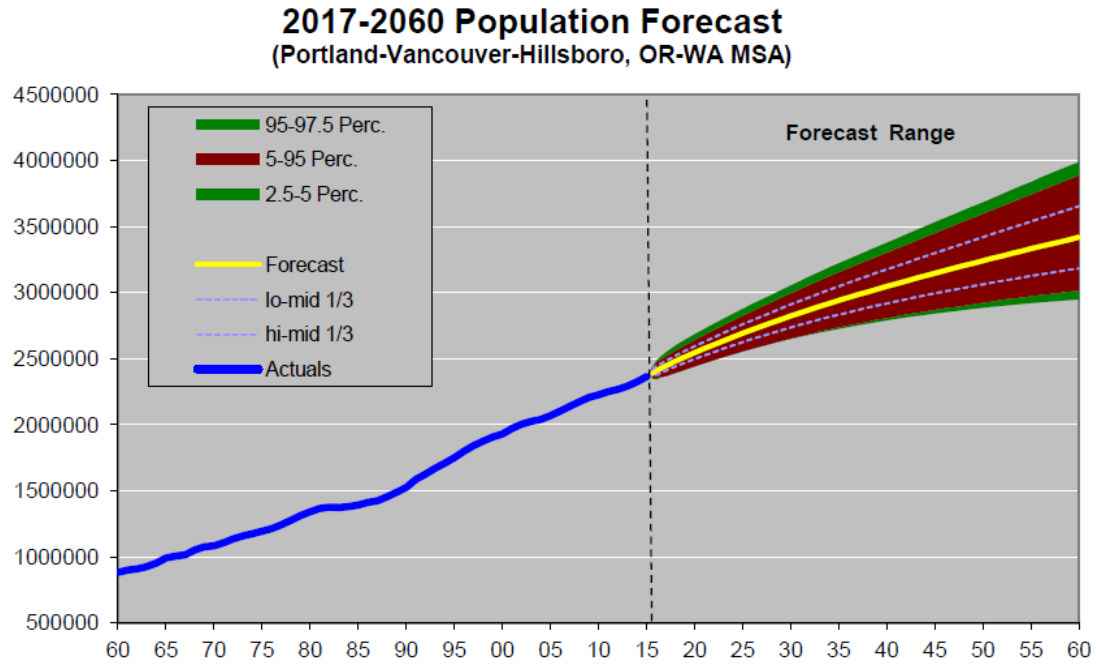
Range Projections: High, Baseline (Medium), Low

Population Range Projections through Year 2060
(7-county MSA)
Probabilistic Population Forecast Range

	POPULATION					POPULATION - annual pct. chg.				
	Low - 5%	mid-lo 1/3	Pop. Base	mid-hi 1/3	High - 95%	Low - 5%	mid-lo	Pop. Base	mid-hi	High - 95%
1990			1,523,741					1.8%		
1995			1,749,224					2.8%		
2000			1,927,881					2.0%		
2005			2,067,325					1.4%		
2010			2,226,009					1.5%		
2015			2,362,655					1.2%		
2020	2,441,500	2,496,950	2,545,400	2,593,900	2,600,550	0.7%	1.1%	1.5%	1.9%	1.9%
2025	2,554,800	2,624,200	2,691,450	2,758,700	2,775,050	0.9%	1.0%	1.1%	1.2%	1.3%
2030	2,652,700	2,735,600	2,822,500	2,909,400	2,938,500	0.8%	0.8%	1.0%	1.1%	1.2%
2035	2,737,850	2,832,600	2,940,450	3,048,300	3,090,100	0.6%	0.7%	0.8%	0.9%	1.0%
2040	2,806,200	2,918,150	3,046,650	3,175,200	3,229,650	0.5%	0.6%	0.7%	0.8%	0.9%
2045	2,869,550	2,993,850	3,146,400	3,298,950	3,369,050	0.4%	0.5%	0.6%	0.8%	0.8%
2050	2,923,250	3,063,100	3,241,350	3,419,650	3,512,700	0.4%	0.5%	0.6%	0.7%	0.8%
2055	2,972,450	3,126,350	3,332,150	3,537,900	3,649,900	0.3%	0.4%	0.6%	0.7%	0.8%
2060	3,013,850	3,183,350	3,418,700	3,654,000	3,791,100	0.3%	0.4%	0.5%	0.6%	0.8%

Annual Percentage Rate (APR):

1960-80			2.12%		
1980-00			1.83%		
2000-20	1.19%	1.30%	1.40%	1.49%	1.51%
2020-40	0.70%	0.78%	0.90%	1.02%	1.09%



Employment Range Projections through Year 2060

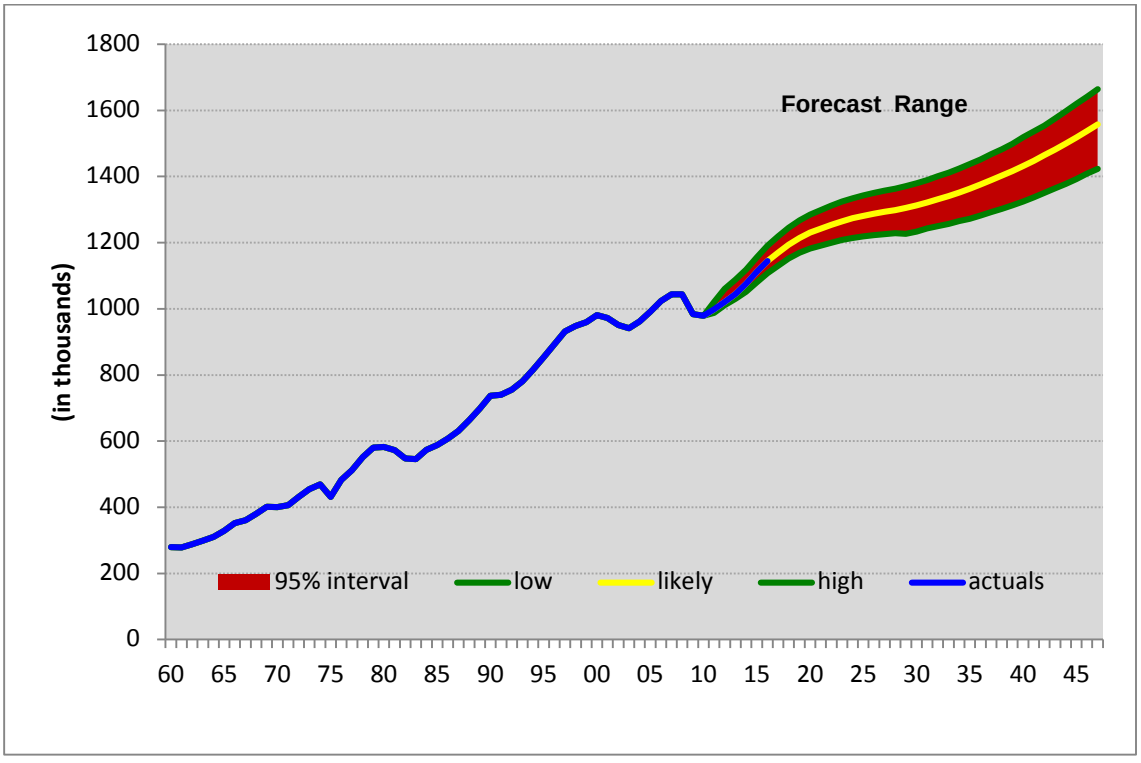
(7-county MSA)

Nonfarm Job Forecast Range

	EMPLOYMENT					e-p ratio	EMPLOYMENT - annual pct. chg.				
	Low	mid-lo 1/3	Job Base	mid-hi 1/3	High	(base)	Low	mid-lo	Job Base	mid-hi	High
1990			737,300			0.48			4.6%		
1995			854,120			0.49			3.0%		
2000			981,490			0.51			2.8%		
2005			991,080			0.48			0.2%		
2010			979,140			0.44			-0.2%		
2015			1,111,920			0.47			2.6%		
2020	1,135,290	1,185,942	1,230,200	1,276,109	1,335,900	0.48	0.4%	1.3%	2.0%	2.8%	3.7%
2025	1,167,510	1,225,331	1,281,360	1,339,951	1,400,100	0.48	0.6%	0.7%	0.8%	1.0%	0.9%
2030	1,182,860	1,246,500	1,313,210	1,383,491	1,440,710	0.47	0.3%	0.3%	0.5%	0.6%	0.6%
2035	1,215,560	1,284,555	1,363,090	1,446,426	1,502,930	0.46	0.5%	0.6%	0.7%	0.9%	0.8%
2040	1,264,440	1,342,607	1,432,330	1,528,049	1,587,190	0.47	0.8%	0.9%	1.0%	1.1%	1.1%
2045	1,327,850	1,413,206	1,517,960	1,630,479	1,691,810	0.48	1.0%	1.0%	1.2%	1.3%	1.3%
2050	1,368,200	1,454,282	1,564,000	1,681,996	1,743,200	0.48	0.6%	0.6%	0.6%	0.6%	0.6%
2055	1,409,700	1,496,041	1,611,500	1,735,869	1,796,100	0.48	0.6%	0.6%	0.6%	0.6%	0.6%
2060	1,452,500	1,539,542	1,660,400	1,790,745	1,850,600	0.49	0.6%	0.6%	0.6%	0.6%	0.6%

Annual Percentage Rate (APR):

1960-80			3.74%		
1980-00			2.64%		
2000-20	0.73%	0.95%	1.14%	1.32%	1.55%
2020-40	0.54%	0.62%	0.76%	0.90%	0.87%



Household Range Projections through Year 2060

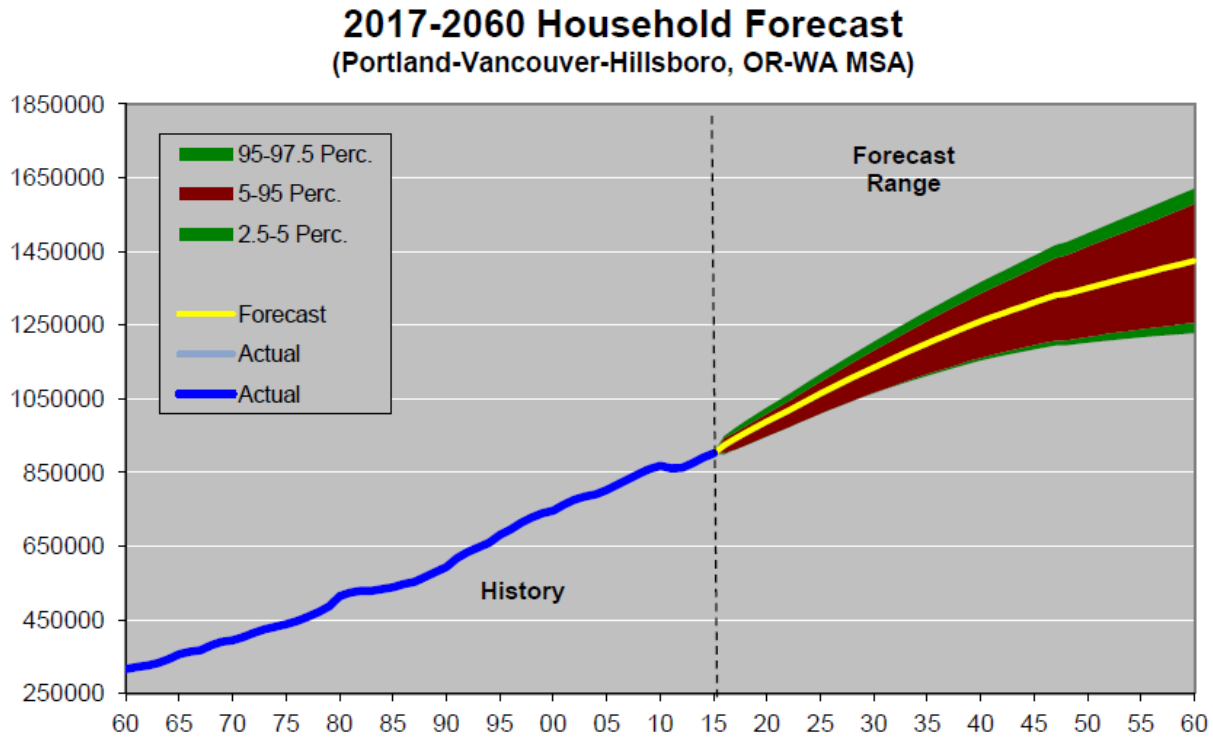
(7-county MSA)

Household Forecast Range

	HOUSEHOLDS					Avg.	HOUSEHOLD - annual pct. chg.				
	Low	mid-lo 1/3	HH Base	mid-hi 1/3	High	HH Size	Low	mid-lo	HH Base	mid-hi	High
1990			592,507			2.57			1.5%		
1995			679,640			2.60			2.8%		
2000			745,613			2.58			1.9%		
2005			802,338			2.58			1.5%		
2010			867,794			2.60			1.6%		
2015			901,402			2.61			0.8%		
2020	948,300	969,850	988,650	1,007,500	1,010,100	2.54	1.0%	1.5%	1.9%	2.3%	2.3%
2025	1,009,700	1,037,150	1,063,700	1,090,300	1,096,750	2.53	1.3%	1.4%	1.5%	1.6%	1.7%
2030	1,066,700	1,100,050	1,135,000	1,169,900	1,181,600	2.50	1.1%	1.2%	1.3%	1.4%	1.5%
2035	1,117,500	1,156,200	1,200,200	1,244,200	1,261,300	2.46	0.9%	1.0%	1.1%	1.2%	1.3%
2040	1,160,800	1,207,050	1,260,250	1,313,400	1,335,950	2.42	0.8%	0.9%	1.0%	1.1%	1.2%
2045	1,195,850	1,247,650	1,311,250	1,374,800	1,404,000	2.41	0.6%	0.7%	0.8%	0.9%	1.0%
2050	1,218,000	1,276,300	1,350,550	1,424,850	1,463,650	2.41	0.4%	0.5%	0.6%	0.7%	0.8%
2055	1,238,550	1,302,650	1,388,400	1,474,100	1,520,800	2.41	0.3%	0.4%	0.6%	0.7%	0.8%
2060	1,255,800	1,326,400	1,424,450	1,522,500	1,579,650	2.41	0.3%	0.4%	0.5%	0.6%	0.8%

Annual Percentage Rate (APR):

1990-00			2.33%		
2000-20	1.21%	1.32%	1.42%	1.52%	1.53%
2020-40	1.02%	1.10%	1.22%	1.33%	1.41%
2010-40 diff	293,000	339,300	392,500	445,600	468,200



Frequently asked questions about population and employment forecasting

How does Metro develop its employment and population forecasts?

We rely on computer models to forecast and help foresee future trends (and ranges) in employment and population growth in the region. The region is the Portland-Vancouver-Hillsboro MSA (i.e., Portland MSA). Our computer model is a statistical, regression-based economic representation of the regional economy. The econometric model is integrated with a traditional cohort-component population model. The econometric portion of the model predicts regional employment, income and wage trends while the cohort model predicts regional population growth. (This econometric model also has tie-ins to MetroScope – an integrated land use distribution model – and a Travel Demand Model {TDM} to complete Metro's suite of detailed socio-economic, land use and transportation models).

What counties make up the Portland-Vancouver-Hillsboro MSA?

The U.S. Office of Management and Budget (OMB) is responsible for the delineation of the counties that make up metropolitan statistical areas (MSA). The recent rendition of the Portland MSA includes the following counties in two states.

Oregon counties:

- Clackamas
- Columbia
- Multnomah
- Washington
- Yamhill

Washington counties:

- Clark
- Skamania

Metro updates its regional definition and associated models whenever there is an official change in MSA delineations.

Why does Metro produce a forecast for the larger metropolitan area instead of just the urban growth boundary, counties and cities?

Eventually, in coordination with cities and counties, Metro does produce forecasts for smaller geographies. However, we start with the seven-county MSA for several reasons, including:

- The most current population and employment numbers from the federal government are for the MSA geography. We want to make sure we can tie our forecast to actual historic numbers.
- We need to understand the larger context of the economic region before forecasting greater regional detail. For example, about a third of workers living in Clark County work in Oregon.
- We're "showing our work" instead of jumping to forecasts for smaller geographies.

What are the key assumptions for the regional population forecast?

A population forecast is comprised of 3 primary components:

- Births
- Deaths

- (Net) Migration.

Demographers use the term ”natural increase” to describe births and deaths added together. “Net migration” takes into account migration inflows minus migration outflows. The mechanics of any population model are simply adding together estimates of natural increases and net migration to arrive at a population forecast. Extrapolating natural increase and net migration into future years yields a population forecast.

The regional population forecast thus depends on projection rates for births, deaths and migration. The birth and death rate projections are assumptions derived from Census data and specifically adjusted for age. Race, ethnicity and sex are also major factors that affect birth and death rates. Differences caused by these factors are factored into the projections. The migration component derives from a regression analysis that considers economic trends with observed net migration data and is integrated with the Metro economic forecast. (The notion being that migration ebbs and flows with business cycles and economic trends.)

Birth rates – Metro relies on the U.S. Census Bureau to supply birth rate assumptions for future forecast years. These rates are age-adjusted according to the birth mother’s age. Because these birth rates are for the U.S., Metro re-calibrates these birth rates so that they align with historical age-adjusted birth rates observed in the Portland MSA for the last 15 years, but with greater weighting over the last 5 years.

Death rates – Metro relies on the U.S. Census Bureau and Centers for Disease Control (CDC) to supply death rate assumptions. These rates are adjusted according to age bracket. Because these death rates are for the U.S., Metro re-calibrates the death rates so that they align with historical regional age-adjusted rates observed for the last 15 years, but more emphasis placed on the last 5 years.

Net Migration – Metro bases its migration forecast on historical trends. The historical net-migration figures are derived from data provided by Portland State University Population Research Center. The Metro migration forecast is tied into the regional econometric model. We have found statistically significant socio-economic relationship between annual migration rates and the pace of regional economic activity. We exploit this relationship within the Metro regional econometric model to predict net migration flows to the MSA region.

What data sources are used in preparing the population forecast?

- Portland State University Population Center – basic county population estimates, https://www.pdx.edu/prc/population-reports-estimates
- Washington State Office of Financial Management, https://www.ofm.wa.gov/washington-data-research/county-and-city-data
- U.S. Census Bureau, National Population Projections, https://www.census.gov/programs-surveys/popproj/data/datasets.html

- Oregon county vital statistics, http://www.oregon.gov/oha/PH/BIRTHDEATHCERTIFICATES/VITALSTATISTICS/Pages/index.aspx
- Washington State county vital statistics, http://www.doh.wa.gov/DataandStatisticalReports/VitalStatisticsData.aspx

What are the main economic drivers for the regional employment forecast?

The Metro regional employment forecast is based on projections from a structural econometric model. What this means is that for each key regional industry, we use statistics – i.e., regression analysis – to forecast what direction we think the employment in the industry will grow. The point is to define an econometric or statistical relationship between the dependent variable (industry employment) and a set of one or more independent variables. This statistical relationship typically describes how we understand regional employment will grow over time with expected variations in the independent variable(s). Metro keeps this regional econometric model up to date with the most recent data available as it prepares the regional forecast.

For us to forecast regional employment trends, we need to have assumptions about future values for the independent variables in each regression equation. As we have done so in previous regional employment forecasts, we get future estimates for these independent variables from IHS Markit (formerly known as Global Insight). IHS is the leading provider of diverse global market and economic information. IHS is a global information company with world-class experts in the pivotal areas shaping today's business landscape, including energy, economics, geopolitical risk, sustainability and supply chain management.

The IHS Markit 30-year long-term U.S. macroeconomic outlook serves up the economic drivers that are the cornerstone for the Metro regional forecast. The economic drivers (or variables) include:

- forecasts of GDP and its components (e.g., consumption, investments, imports/exports and government spending)
- interest and inflation rates
- foreign exchange rates
- production and productivity
- demographics

What data sources go into preparing the employment forecast?

- IHS Markit - U.S. macro-economic drivers (variables include GDP components, interest rates, foreign exchange rates, inflation rates, production and productivity, etc.), http://www.ihs.com/index.aspx (data are proprietary and on paid subscription)
- U.S. Census, http://www.census.gov/
- Bureau of Labor Statistics, http://www.bls.gov/home.htm
- Bureau of Economic Analysis, http://www.bea.gov/
- Oregon Employment Department, https://www.qualityinfo.org/

How are the "range forecasts" created by Metro?

To recognize that forecasts carry an element of uncertainty, Metro generates a forecast range for total regional population and employment by industry sector and sums the industry ranges for total regional employment. The ranges represent a 95% confidence interval that future employment and population for the region will fall within this growth band. Another way of saying is that 5% of the time we might expect growth to be faster or slower so that population and employment growth in these instances will fall outside of the confidence interval.

Since the methodology for creating the population and employment forecasts are different, the approach for creating ranges plays to the strengths of each methodology.

Population Range Methodology – The regional population forecast employs a standard cohort-component approach for projecting future population growth. Recall that the cohort-component relies on a set of assumptions for age-adjusted birth and death rates and net migration. Since these are assumptions, it's not difficult to imagine that these assumptions could be wrong (or have a standard error to each term, as a statistician would say). Further, if we imagine that each of these assumptions is in actuality a continuous random variable, then it is possible to assign a probability density function that describes the expected value of the population component rate assumptions and to then ascribe a standard forecast error that is akin to a standard deviation to account for some uncertainty in these assumptions.

Having no prior knowledge of what the true shape of the probability density function is for the population components, we assert that the error distribution for each population component is normally distributed. A normal distribution is useful and a unique error distribution can be defined by a mean and a standard deviation. We assume that the expected values in the baseline forecast assumptions represent the mean of the normal distribution while the standard deviation is represented by estimating the standard error of the forecast for each birth and death rate component.

Applying a monte carlo computation method, each population component is randomized 10,000 times and each time a new alternative population simulation is calculated. Because of the properties of a normal distribution, the chance of one of the alternative population forecasts is more likely to fall closer to the expected or mean value represented by the baseline population forecast than near the tail ends. By tabulating all 10,000 alternative population simulations into a crosstab, we end up having a population forecast range or interval. Within this interval, we can infer from the tabulation what percentage of forecast alternatives fall within 1, 2 or more standard deviations from the forecast baseline (or mean). By repeating the simulations many times and tabulating these results, we may infer from these random draws a confidence interval that is "bell-shaped".

Employment Range Methodology – The regional employment forecast is computed from a regional econometric model that is rooted in regression analysis. This means that for each equation there is a forecast standard error calculated from the regression. From here, it is straight forward to infer a 1- or

2-standard deviation forecast range for each industry sector. The range is computed by taking the baseline forecast as an anchor point and adding/subtracting twice the value of the forecast error. This range represents a 95% confidence interval or 2 standard deviations.

What importance is attributed to the Metro baseline forecast for population and employment?

The baseline population (and employment) forecast serves as an anchor point for the range forecast. The range represents statistically a confidence interval (typically 2 standard deviations or equal to 95%) for the uncertainty the forecaster has over the forecast. The confidence bands usually grow wider over time as the forecast years increase away from the forecast base year. Typically, the base year for demographic data is a decennial census year (e.g., 2010) and the employment and other economic variables will vary with most base years set in the case of this forecast as 2017 (part year).

Why doesn't Metro use the population estimates from PSU's Population Research Center (PRC)?

In fact, we do rely on estimates of population from PSU for analysis of historical migration and population trends. But don't confuse population estimates as population forecasts (or projections) as PSU estimates are measures of current population levels and history. As the PRC says on its website, population estimates are annual population estimates prepared by the center as current year estimates for the years in the decade between the most recent decennial census and the next decennial census. (source: https://www.pdx.edu/prc/population-reports-estimates)

Why doesn't Metro use the population forecasts from PSU's Population Research Center (PRC)?

Per state law, PSU is not to issue a population forecast for Clackamas, Multnomah and Washington county (ORS 195.033 (2) (a)).

Is the Metro population forecast coordinated with PSU's Population Research Center (PRC)?

Yes. Metro and PRC review and share the component assumptions for population growth. Metro recently shared its forecast methodology with PRC and had them scrutinize the approach, component assumptions and review the forecast results for the baseline and range. This review occurred during summer 2016 in leading up to the current forecast. PRC staff also participated in Metro's regional forecast review panel (see next question).

Metro also actively participates in review of population estimates and forecast released by PRC.

Was the regional forecast peer reviewed?

Yes. Metro convened a panel of experts from the region to review the veracity of the 2018 regional forecast (and range). The panel met in November 2017. The agenda included a review of the Metro regional model, overview and discussion of the DRAFT regional forecast, and discussion of future model improvements.

Members of the peer review panel included experts from Portland State University (PSU) Population Research Center, PSU Northwest Economic Research Center, Northwest Natural, Oregon Employment

Department, Washington Employment Security Department and a local private economic consultant. A summary of the panel's discussions is included in the Urban Growth Report's appendices.

At the end of this appendix is a summary overview of the peer review proceedings, review and panel insights.

Has the 2018 regional forecast been coordinated with local governments?

As of calendar 2018 Metro coordinated with local governments informally via a technical advisory group. The regional forecast will be formally reviewed in coordination with local jurisdictions during Metro's Distributed Forecast process which takes place after state acknowledgement of the Metro Council's decision to adopt a regional forecast. When the time comes, the regional forecast will be distributed to traffic analysis zones (TAZ) for households and employment. In turn, TAZ estimates (which are smaller than census tracts) may be subtotaled to approximate population (or employment) by city limits. This work requires detailed coordination with cities and counties.

What's different about regional vs. county forecasts (or other smaller geographies)?

Smaller geographies – even counties – historically experience broader growth trend fluctuations than regional or state forecasts. Bigger areas benefit from larger numbers that tend to smooth out local variations that are hard to predict and difficult to expect. We see the regional and county differences play out in the forecast because of specific geographic disparities and advantages. For example, why did the high tech economy sprout in Silicon Forest in Washington County and not Clackamas or Multnomah? This historical idiosyncrasy creates regional and subregional growth rate differences that show up in the county-level job forecasts but are smoothed over in a regional context. Migration and differences in housing preferences and the mix of housing supply in each county played a role in bolstering suburban population growth during the 1980's and 90's. This too led to variations between county vs. regional growth rates.

What modeling tools does Metro use to prepare forecasts for areas smaller than the Portland-Vancouver-Hillsboro metropolitan statistical area? Why?

MetroScope, which is a mathematical economic/real estate model developed to analyze and simulate urban growth and predict future development patterns. It is what scientists call an integrated land use and transportation model. It is a market equilibrium model which is capable of forecasting where population and employment will locate in the future. It explicitly considers where people live and work in the future after taking into account regulatory (e.g., local zoning, urban reserves, urban renewal, system development charges, transportation investment), market trends, and socio-economic factors including future travel and commute accessibility, the price of real estate, and the availability of land supply for housing and industry growth. These are factors that a traditional cohort-component population model is not capable of assessing.

The smallest geography for which Metro produces forecasts is the Transportation Analysis Zone (TAZ). The TAZ forecast is primarily used by Metro and local area transportation forecasters and modelers.

TAZs are small areas – about ¼ the size of a typical census tract. There are over 2,100 TAZs in the Portland region. TAZ data is used as inputs in modeling congestion, transit, and traffic flows for transportation and corridor planning projects. Examples of recent uses include the Southwest Corridor Planning Project (SWCP), East Metro Connections Plan (EMCP), and updates to the Regional Transportation Plan (RTP).

Why are forecasts sometimes inaccurate?

Creating a forecast requires forecasters to make assumptions or guesses about events that have not yet occurred, and if those future actual events don't match our assumptions about them, the forecast can be incorrect. Forecasts are not always accurate because the models we use are necessarily simplifications of the real world. If events in the real world drift away from the theoretical and practical underpinnings of our models, the forecast results from our model will look very different from the events that unfold in the future.

Forecasts can be inaccurate due to unforeseen fluctuations in the inputs we use to make the forecast. Even when we are able to predict these fluctuations, we may be wrong about the magnitude of change in these factors. Sometimes these fluctuations are simply measurement errors which are eventually revised or re-benchmarked according to better and more full accounting by federal and state statistical agencies. Regardless of the type of error – whether it's measurement error or a judgment error about how input assumptions will impact future development trends – these discrepancies in what we call inputs are partly to blame for forecasts that differ from reality when the appointed time is reached.

Moreover, the models are mathematical constructs of reality based on statistical relationships observed over many years. If these statistical correlations change down in the future then regardless of how accurately we predict the input assumptions, the changed relationship between the input drivers may lead the forecast outputs astray from actual future events.

In sum, error sources include:

1. Historical estimates could be wrong (they are sometimes revised when more/better data become available)
2. Socio-economic drivers / assumptions could be wrong (some variables used in forecasting employment are themselves forecasts with their own assumptions and uncertainty)
3. Unanticipated and very large economic shocks which can't be regularly anticipated (e.g., trade war, drought, recession)
4. Statistical relationships computed from econometric data may not persist into the future and therefore could lead to wrong conclusions (e.g., structural changes in an economy, technological innovations, innate tastes and preferences).

Why do population forecasts seem more accurate than employment forecasts?

Population forecasts generally are closer to actual trends because the factors that drive population change are more easily predictable, including future assumptions about mortality and birth rates and future migration levels.

Mortality and birth rates vary over time, but generally these variations happen slowly and in relatively predictable patterns. Additionally, the differences between national rates and regional rates are generally similar so we can very reasonably rely on national data sets to predict regional natural population increases.

Predicting migration is a more difficult problem and suffers from greater historical deviations. Moreover, past migration trends may not be directly comparable to future levels because of the potential for sweeping economic fluctuations that could swing the migration level wildly up or down according to regional business cycles.

Why do employment forecasts have greater uncertainty?

There is greater uncertainty in the factors that influence economic growth, so employment forecasts will tend to diverge more. Employment forecasts are generally less accurate because there is a wider set of variables yet we are able to model only a simplified version of reality. There is also more uncertainty about the variables we use to predict regional employment. Besides more uncertainty in the input variables, the economic relationship between the regional economy and national/global economy is also subject to wider economic shifts. In other words, past performance is no guarantee of future results.

How Accurate are Metro's Regional Forecasts?

Summary

- Over long periods (ten to twenty years) Metro's population forecasts have been within ten percent of actual population change at the Metropolitan Statistical Area geography (recent Metro forecasts have been higher than observed population growth by about 3% to 4% over ten to fifteen years; Metro's 1985 forecast was 9.4% lower than observed population estimates twenty years later in 2005).
- Although Metro's regional forecasts are designed for twenty-year, long-term decision support and not short-term market timing, annual comparisons between past population forecasts and actuals/estimates are within an error band of about +/- 1 annual percent, excluding years for the Great Recession;
- Employment forecasts contain more uncertainty than population forecasts: Metro's 1985 forecast was only 3.3% low compared to 2005 observed employment. However, a forecast created in year 2000 was over 20% higher than actual employment for the Great Recession year of 2010. This emphasizes the point that Metro's forecasts are long-term trend forecasts and do not capture outlier events.

Discussion of Historic Forecasts vs. Actuals

Metro has looked back at three forecasts: those created in 1985, 2000, and 2010 (Metro staff sometimes refer to the forecast creation year as the forecast "vintage"). Note that there's not enough history gone by to make a legitimate comparison of the 2015 regional forecast.

1985 vintage regional forecast

The 1985 regional forecast shows a -9.4 percent forecast error in population. This is a pretty accurate forecast given that it has a less than 1% annual error rate (-9.4% / 15 years = -0.62%). The negative sign indicates population grew faster than projected. This is not surprising since the region experienced an unexpected higher level of migration in the late 80's and early 90's as "equity migrants" cashed out of lucrative homes in southern California and settled here in the Portland area due to its milder climate and attractive real estate opportunities.

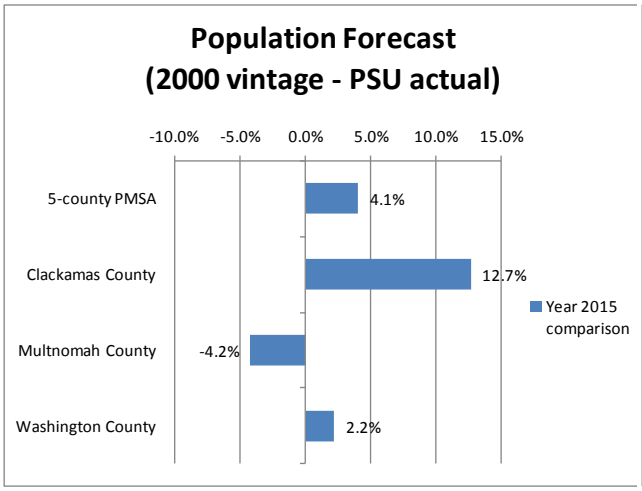
The 1985 regional forecast showed a miniscule percent forecast error in employment of -3.3 percent by the end of its 20 year forecast horizon in 2005. This forecast was remarkably accurate despite the economic turmoil (positive and negative) that played out during the 20 year time frame.

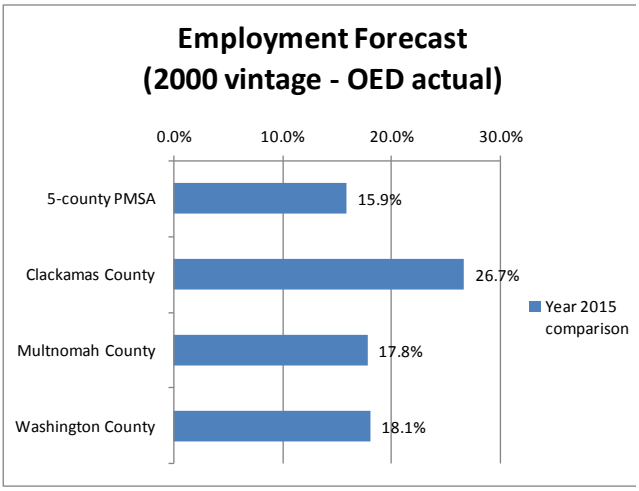
Lastly, in terms of business cycle comparisons, both 1985 and 2005 are roughly at the same stage of the business cycle – i.e., both are trending up and somewhere in the middle of the peak and trough of their respective recessions. For trend analysis point of view, this is a fair comparison.

2000 vintage regional forecast (2002/04 UGM)

The 2000 regional population forecast shows a 3.2 percent forecast error in year 2010, and 4.1% error factor in year 2015. The average forecast error for the last 15 years (2000 to 2015) shows it be less than a 0.3% per year (4.1/15 = 0.273).

The 2000 regional employment forecast shows an error margin of 22.1% in year 2010, and 15.9% in year 2015. This shows the unanticipated effect of the Great Recession. Going into and at its deepest trough, the forecast error was greatest in 2010, but with the subsequent recovery, the error factor narrows by year 2015 when the recession has long ended. However, those lost years of economic growth will take longer to recover to pre-recession trends.

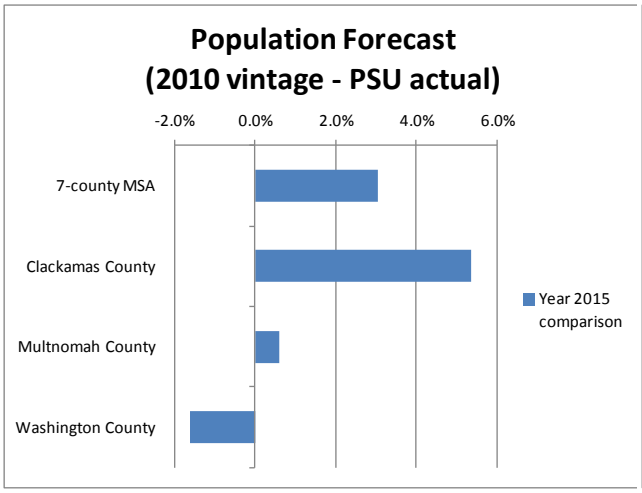


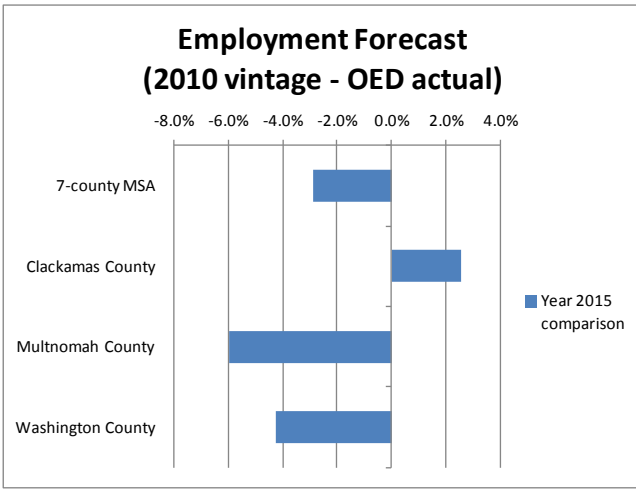


2010 vintage regional forecast (2010 UGM)

In 2010, the MSA has been revised and is now defined as a 7-county metropolitan region (Clackamas, Clark WA, Columbia, Multnomah, Skamania WA, Washington, and Yamhill).

The overall MSA population forecast error in 2015 is 3%, for an average annual error factor of 0.6%. The MSA employment forecast error in 2015 is -2.9%, for an average annual error of less than -0.6%. County-level error rates show a wider variance because they represent smaller regions and are less diversified than the MSA as a whole. Therefore structural economic differences add to the higher error factor in some cases.





Actual estimates for population are from PSU population research center. Actual job estimates are derived from the OR employment department.

November 2017 Regional Economic Model & Forecast Peer Review

Peer Review Background

A peer review of Metro's regional macro-economic forecast model and its latest regional forecast (population and employment) was completed in November 2017. The purpose of this peer review was to analyze the reasonableness of the forecast and to validate the soundness of the Metro regional model for forecasting long-term (at least 20 years) employment and population trends for the Portland-Vancouver-Hillsboro MSA region. The review was conducted by a panel of experts in the field at the request of Metro Research Center (RC) staff. Members of the peer review panel included:

- Mr. Scott Bailey, Regional Economist, Washington Employment Security Department
- Mr. Nicholas Chun, Population Forecast Program Manager, Population Research Center, PSU
- Mr. Eric Hovee, Principal, ED Hovee LLC
- Mr. Peter Hulseman, Senior Economist, Northwest Economic Research Center, PSU
- Mr. Christian Kaylor, Workforce Analyst, Oregon Employment Department
- Dr. G. Hossein Parandvash, Principal Economist, Portland Water Bureau
- Dr. Thomas Potiowsky, Director, Northwest Economic Research Center, PSU
- Mr. Steve Storm, Economist, Northwest Natural

Research Center staff in attendance included Jeff Frkonja, director, Chris Johnson, manager, and Dennis Yee, Metro economist.

The peer review panel focused their discussion first on a set of general questions regarding the forecast model's general fitness for producing information that would be useful for urban growth management and travel demand modeling. The panel reviewed and discussed the soundness of the embedded input-output strategy incorporated into the regression-based regional model. More broadly, the panel was directed to comment on uncertainty in the regional forecast and in particular to comment on the impact climate change might have on growth projections.

The second part of the review focused on the forecast results from the regional model, assumptions and key economic and demographic drivers. Trends and forecast drivers were discussed in-depth by panelist. A key focus was on retail employment, construction activity and jobs trends. Because the Metro population model had undergone an extensive review by PSU Population Research Center demographers less than a year ago, the review of the demographic submodel in the regional model was more focused on household headship rate assumptions and projections for the distribution of households by income bracket. The review closed with a discussion and a few recommendations for future model enhancements.

The following is a summary of comments from individual panelists. Names have been redacted. Comments have been edited for brevity and clarity and where appropriate additional context from Metro staff added [in brackets]. Similar ideas and recommendations – good, bad or indifferent – were

grouped together into similar themes. Errors in the interpretation of panel reviews are the responsibility of Metro staff.

Metro Regional Forecast 2017 Peer Review Questions

Overall methodology:

- Does the model perform the forecast functions needed in a reasonable and sound approach based on your understanding of the requirements of the model?

  There was consensus that Metro's regional economic model is sound and reasonable applied meets Metro's policy and forecast requirements. A peer review panelist aptly summarized the thoughts of the panel: "the objective is to forecast the economic measures . . . so it [the model] is a reasonable approach". The methodology behind this model is overall sound.

  Over the short term - 10 years - the forecast appears quite reasonable to a panelist more acquainted with shorter forecast horizons. Other panelists seemed comfortable with the projection figures for the longer term period.

  A panel member well versed in Metro's population submodel said the "structure of the population forecast model looks fine overall." But he notes a "fairly minor issue" seems to exist between the last year of population history for retirement age residents in years 65 to 74 and the short-run forecast for this age group. This discrepancy seems to disappear in later years of the forecast. [Metro has reviewed this comment, made necessary adjustments in the current forecast to rectify this minor issue in the final forecast.]

  Metro staff asked for feedback and if the review panel had any concerns over the inter-industry demand variable (IDV) term in the regional model. This is further discussed in the next question. Other issues raised individually include possible presence of multi-collinearity, extensive use of autoregressive (AR) terms in the model specifications. [Metro will address these concerns in the next major model update. Multi-collinearity generally does not bias the forecast parameters, only distorts the magnitude of the standard error of the forecast. AR terms are needed to correct serial autocorrelation. This is a serious problem and is properly addressed with the AR function.]

- Do you have any concerns about the approach of the inter-industry demand variable (IDV) as a means of incorporating an I-O function into a regression approach?

  Panelists were divided in their opinion of the efficacy of the IDV term. Some were highly positive and while others were a bit skeptical and a third faction wanted Metro to reformulate the industry output matrix to explicitly exclude industries such as tobacco, oil and gas, and chemicals, which are not major industries in the region. [The way the IDV term is constructed, industries with little or zero employment have negligible or zero influence on the IDV values. In future construction of the IDV terms, Metro will explicitly exclude the listed industries.] Overall,

the panel did not voice serious concerns with incorporating the IDV (inter-industry demand variable) strategy in a regression-based econometric model. The strongest critique seemed to be from panelists who were unsure of the IDV's usefulness as a forecast indicator for future industrial growth.

Pros: A panelist said "the IDVs are a good way of capturing industry dependencies and increase the possibilities for scenario analysis . . . this [approach] especially helps to balance the long-term forecast."

Skeptics: Other panelists, unfamiliar with the IDV term, voiced these specific concerns with the IDV approach: (1) it needs more economic justification, (2) may not be stable, (3) may be biased because of relatively under represented industries in the region (e.g., tobacco, chemical, oil and gas), (4) and more local I-O matrix should be used instead of national figures. The exact wording of panelist who had concerns with the IDV term is repeated below:

- The use of IDV variables need[s] more economic justification. Since the models are used for forecasting, the coefficient of the IDV variables [is] not as important. However, it is important to see how much of the variation in the dependent variables are explained by the IDV variables without the AR terms and whether the coefficients are stable. As was also discussed, it is interesting to see how the IDV variables perform if the industries that do not exist in the MSA are excluded from the IDV "C" matrix [the C-matrix refers to the flow of dollars spent in an industry from all other industries at the national level – it represents the so-called input-output of industry dependencies].
- I do see issues with the fixed effects - I/O term approach, but don't know the extent to which this limits model usefulness; i.e., industry homogeneity and fixed scaling. I'm curious on interpretations as to why coefficients of the lagged IDV term in the Manufacturing – Wood Products and Equipment and Manufacturing – Paper models are greater than 1.0, while less than 1.0 in other manufacturing employment models.

In summary, Metro believes that the panel has no strong objections on use of the IDV as forecast driver. This is summarized in a quote from one of the panelists: "No real concerns. I'm still not sure of the value-added by doing this and the extent that the I-O function approach increases forecasting accuracy."

- Climate change, migration and regional population growth – what is your recommendation for including (if any) climate change assumptions into the regional forecast?

Panelists did not think that climate change effects should be explicitly incorporated into the model forecast, except for picking up naturally occurring effects that are already in recent migration trends. One panelist stated that due to the inherent difficulties, the incorporation of climate refugee estimates would likely reduce the accuracy of the regional forecast and increase bias.

There remains too much uncertainty, not enough research, and lack of detailed information "to incorporate into a forecast model, let alone a model to measure climate effects on migration patterns" according to a regional forecaster on the peer review panel. He goes on to say: "the effects of climate change are discussed as if they are homogenous across time and space, but that isn't the case. Coastal erosion and temperature fluctuations have different implications and parsing out climate change from the litany of factors influencing people's decision to migrate has not been measured extensively." Although some expect the Portland MSA to see an increase of in-migration, there is no certainty that this would be an outcome. It may be just as plausible that the region see more climate volatility and see instead an increase in out-migration said other panel members during the review.

This was echoed by a second panel member who stated that climate change might mean more drought prone conditions in the northwest and if so, this could impact residential and industrial growth going forward. The implication is less economic growth, not more, here in the region.

A panelist summarized well the opinion of the entire panel ". . . recommend not including any climate change assumptions in the regional forecast." He goes on to state that the "population impact of climate change is already embedded in the historical data as a trend." Also, other factors such as a major earthquake should also be considered in the regional forecast as equally relevant as climate change if climate impacts are included in the regional forecast. The implication is that these factors may actually offset one another.

A panel member familiar with climate models indicated that the climate models widely predict the consequences of climate changes would occur in the second half of this century. This means that within the Metro forecast horizon, not much climate driven migration is likely to happen. However, catastrophic meteorological events (e.g., extreme hurricanes) still could occur whether because of climate change or otherwise could still impact the regional forecast. Out-migration is of equal concern due to an earthquake in the region should be considered as well.

- Regional forecast risk and uncertainty – what's your expert opinion on how Metro is quantifying uncertainty in its regional forecast? Do you have suggestions on improving how we portray uncertainty to stakeholders and UGB decision makers?

  A scenario-based approach is preferred according to one panelist. He goes on to argue that developing high and low growth scenario bands should be derived from migration assumptions rooted on historic highs and lows carried forward, in his opinion. He appreciates the probabilistic approach used by Metro to quantify uncertainty, but finds this method less preferable to developing uncertainty bands based on constructing scenarios by alternating input assumptions to create the respective high and low growth scenarios.

  Another forecaster shared an opposite opinion. He favored the Monte Carlo forecast for estimating uncertainty bands that can be interpreted as confidence intervals. He stated that an

upside risk to regional population growth is "climate change, stronger than expected in-migration, increased housing supply (ADU's, SF units, MF units), getting another major employer". According to this same panelist, downside risks to the forecast include "climate change, national recession, a large employer like Intel downsizing in the region, natural disasters".

A peer review panelist suggests testing log-normal, Weibull or other distributions that are limited to positive random variables. [Presently, the Metro model utilizes normal distributions. Metro will investigate changing probability distributions before the next UGM cycle in 2024.]

Finally, a panel member offered potentially two more risks inherent to the forecast. First, administrative changes to the classification of Portland area firms present a risk to the forecast. Government agencies assign one, and only one, classification to a single firm. As businesses in high tech areas shift their staffing, they can be reclassified. For example: It's easy to imagine a large manufacturer shifting from being primarily a manufacturer to a design or engineering firm with a smaller manufacturing footprint. If enough manufacturers shift, even mildly, away from manufacturing toward planning, engineering, design, etc., then employment in the manufacturing industry could fall off dramatically, even as the total number of manufacturing workers may only decline modestly. It isn't really possible to model or forecast this behavior, but should be considered as a forecast risk.

Second, in the panelist's individual opinion the population forecast for the region feels low. The growth rate going forward is well below what Portland has experienced historically. "I understand that these forecasts are in line with national population forecasts. However, I can think of three reasons to think we could experience significantly stronger population growth".

These added topics emerged through this line of inquiry:

1) The Portland region has been an area of relatively high in migration for at least 50 years compared to the rest of the United States. As an extreme example, West Virginia has a smaller population today than it did in 1940, while Oregon has grown 4 fold since 1940. National population forecast models may not capture this variance among the US states.

2) National immigration policy is impossible to predict. Compared to most developed nations, such as Canada, the United States has a relatively restrictive immigration policy. If immigration policies were to loosen in the next 10 years, it is possible we would see an measurable surge of population growth. As point of contrast, Vancouver BC is roughly the same size as Portland Oregon, with a much larger international immigrant community. About half of Vancouver's population speaks a primary language other than English. Again, immigration policy change is impossible to forecast, but the potential for a foreign policy change presents a risk for much greater population growth in the Portland region.

3) Global climate change presents a serious challenge to the forecast. Many climatologists forecast an increase in severe climate events in the United States: hurricanes, flooding, arctic inversions, heat waves, drought, etc. Portland is unique in the United States for our temperate climate, relatively higher elevation and abundant clean water. It's easy to imagine increased population growth as Portland becomes relatively more attractive to people around the United States living in harsher climates. Again, the effect of climate change on population migration is probably impossible to model, but should be considered as uncertainty in any population forecast.

More-detailed forecast questions:

- Retail growth trends – Global Insight perceives a sharp downturn in retail employment in the long-run, what is your opinion regarding the long-term trend of retail employment growth in the Portland MSA?

  Both the U.S. and regional forecast for retail employment growth expect major changes in employment due to online retailing. Short-term (about 10 years), the panel is in agreement that retail employment ought to decrease from current levels in the region.

  A panel member succinctly states the panel's opinion: "I think there are many headwinds in the short and medium term for retail industry employment – such as retailers carrying high debt loads and increased productivity (which will require fewer workers). However, in the long run there is potential for the industry to look very different from today as different firms get reassigned into retail (e.g. cannabis). On top of that, it is difficult to see the demand for retail stores permanently disappearing."

  "I think a long-term rate of growth in retail employment that is less than the rate for total nonfarm is probably right. While I'm thinking that a long-term downturn (extended period of decline) is not likely, retail employment as a shrinking proportion of total employment is highly likely."

- The region's high-tech industry has been a key growth driver in this region for at least the last couple decades. There have been a few instances of "corrections" that have led to layoffs and industry slowdowns. The IHS Global Insight forecast pictures much slower growth in the long-run for the U.S. industry. Will the region follow the national trend or are we different enough to go a different direction? If the regional high-tech sector begins to taper, what industry (or groupings) do you foresee replacing high-tech as the next key driver?

  All panelists recognize the important role of the high-tech sector in shaping regional events and regional trends. However, most were unwilling or unable to say with confidence how trends in the industry might unfold given that growth is essentially based on innovations and technological change, both extremely volatile and largely unknown.

Individual panel members are quoted saying:

"The Portland MSA should have a similarly difficult time in the high-tech industry as hardware – which is the region's specialty – faces increased competition from firms abroad and new technology shocks. "

"Probably more like 30 – 40 years as a growth driver, [panelist was referring to how long computers and electronics would continue to be a key regional economic driver] I think that, while NAICS 334 may be less of a key driver, some service industry clusters may evolve that effectively replace the role 334 [334 = computer and electronics manufacturing] has played in recent decades for the Portland MSA; e.g., NAICS 5112/5415." [5112 = software publishers; 5415 = computer system design and related.]

"We [MSA forecast] will follow the national trend with declining growth but not as fast declining as the US projection. I thought that software (professional and business services and information) would be the next key driver, but now not so sure. Let me stick with them and throw in health services…"

"Water is a key input to many industrial processes, particularly the high-tech industry. The region's relative abundance and purity may attract more high-tech firms to locate in this MSA. This might be a positive risk factor in the forecast."

- Household size (headship rate assumptions) – the average number of persons per household has been declining steadily with the onset of urbanization. The regional forecast generally expects a floor of about 2.4 persons per household. Can it realistically fall much lower? Does this seem reasonable as a long-term assumption?

  Panel members were divided over how much lower average persons per household (PPH) could fall. Those with strong opinions seemed evenly divided.

  Those in favor of assuming a PPH under 2.4 in the long-run cited the "live small movement" and "potential of ADU development". [Point of clarification – according to a Census representative – ADU's are a separate structure and so occupants residing in an ADU domicile is counted as a separate household.] Higher relative housing costs, an aging population, and additional delay in child births may add up to household sizes falling below 2.4, but this panelist did not think that they would fall below 2.0.

  Panelist in support of a 2.4 PPH floor cited the small impact that ADU development would have on the total housing stock and that this small proportion would not be enough to move the needle on average PPH for the whole MSA. The PPH for the 7 county MSA "has been fairly stable over time". Moreover, a large share of ADU's are not likely to be counted as primary residences because they are AirBnB units. Finally, the Metro forecast already assumes PPH to fall from today's rate. This seems reasonable said half the researchers on the panel.

Another panelists goes on to explain his thoughts on the subject: "there are many expected economic and demographic changes that should be coming in the next decade – such as baby boomers downsizing in retirement or aging in place (decreases household size) or Millennials starting families (increases household size) – which means the timing of these events is what should drive short term fluctuations. Surveys indicate that Millennials and iGen both have similar housing preferences to baby boomers; however, a falling fertility rate puts downward pressure on household size. Putting this all together, in the long-term I expect slightly smaller household sizes."

A panelist suggested looking to Western Europe or Japan for guidance on projecting PPH in the Portland MSA, but cautions that the U.S. has higher immigration levels so this might act as a counterweight against a steeper decline in regional PPH.

A panelist summarized his and the opinions of others who agree with Metro's household size projection: "I believe this assumption takes into account the aging population and changing behavior among ethnic groups. You also have a delayed millennial impact coming. So I would say [2.4 PPH is] a reasonable long-term assumption."

- Net migration (excluding potential climate change) – does the regional net migration outlook appear reasonable to you?

  Near term net migration projections (2016-19) in the Metro forecast are too low. "Recommend raising the forecast component to account for recent and anticipate rebound in migration inflows in the near term. Near term fertility rates and thus the number of live births in the short-run may be a bit too robust." . . . "Long-term outlook of migration is fine" according to several panelists familiar with recent population details.

  A panelist bolstered the consensus by bringing up actual observations. Historically annual net migration as a share of population growth has ranged from 50% to 70%. The Metro net migration forecast seems reasonable given the historical range.

  A contingent of panelists believed the regional population outlook to be reasonable, but likely represented the low-end of a baseline forecast. ". . .would not recommend it [MSA population forecast] be any lower than it is right now." [This comment was made with migration in mind as historically over half of annual population growth in the region has stemmed from net in-migration. Going forward, net-migration is expected to contribute up to two-thirds of annual population growth. Implied by this comment is that projected migration is in their opinion on the low-end of a plausible range.]

- Income distribution – the regional forecast doesn't directly forecast the distribution of households by income bracket (we have another post-processor model that calculates this outlook), but we would be interested in your expertise on the direction and magnitude of how

the share of high, middle and low income brackets may be spreading wider (or not) in the long-run.

Panelists generally agree that income distributions will become more dispersed in the future, meaning a higher proportion of higher income households and lower income households at the expense of a smaller share of middle income households. In particular, the distribution is likely to skew more in the direction of a greater share of lower income households.

A panel member stated his conclusions on the topic as "all national evidence points to this problem exacerbating and the income brackets spreading wider. There is no reason to believe this would be different for the Portland MSA."

A third panelist suggested that: "the spread could increase ("wider") over a decade or two before stabilizing. I don't know that I see it significantly contracting over Metro's planning horizon".

A fourth panelist had a tad more optimism in that the equity distributions would not worsen as much as other panelist had feared: "I think the top quintile will continue to pull away while the relative positions of the other quintiles we stay close to what they are now, some further movement of the second highest quintile."

Questions for long-term model development:

- Given your understanding of the forecasting needs and policy environment inherent in growth management, in your opinion, how important is it that Metro begins the development of a computable general equilibrium (CGE) model for this MSA?

  Some differing thoughts on CGE models and to extent to which they are a useful tool for informing policy.

  Pros:

  "A 'quick look' indicates there is a material literature on use of CGE modeling for regional planning. Acknowledging my understanding of needs is very imperfect, I suggest a rigorous assessment of the shortcomings of Metro's current approach(es) in meeting the organization's needs (gap analysis). If this indicates regional CGE modeling may be an improvement, it may be worth a deeper investigation of resources required for development. I can see that, with reasonably accurate parameters, CGE modeling is an improvement over the "regionalization of U.S. fixed effects" I/O approach incorporated within the employment models currently. However, GIGO and having a very good handle on border effects is essential. In summary, while I can't see how this requires less in the way of planning resources (almost certainly more), developing and using CGE models potentially provides better forecasts."

"General equilibrium models are more useful for structural analysis. They might not perform well for forecasting purposes. However, one can entertain estimating the equations as a system or consider using Vector Auto Regression models."

"For the same reasons as they have a CGE model for tax policy impacts at the state level, people are interested in policy impacts scenarios at the metro level. Depending on how modeled, it would provide a richer dynamic analysis than what you can get from IMPLAN. Hopefully it would also assist with those difficult supply impact issues. "
Cons:

Computable general equilibrium (CGE) models tend to underperform more standard time-series models in forecasting, so I would not recommend developing a CGE model for that purpose. However, for policy analysis they can be a great tool as they take many economic factors into account. One concern I would have is that CGE models are very data dependent, and the smaller the region the less likely regional data exists. This means the model would have to base its estimations on national data, which could potentially bias the results if the Portland MSA behaved fundamentally different from the nation in certain ways.

- Businesses and residents are free to migrate in and out of the region, however the regional model is unable to project the outlook of counterfactual examples of firms and residents who made the choice to migrate but did not choose the Portland MSA because of land supply or land use restrictions. Are there models that can be used to address this concern?

  Not too many comments, but these two from the review panel:

  "All models rely on data, and I am not sure data exists that get at this question. For me, a survey would be preferable to a model."

  "You might be able to use the IRS migration data and look at everyone (sample) of people that moved and have a probabilistic regression (e.g., logit, probit) with 0 moved to Portland and 1 did not move to Portland. Depending on the characteristics you could scrape from the IRS, you could see what factors might have caused people to not move to Portland. What is still missing is not knowing if Portland was one of their choices, so this regression might not show anything. "

- Do you have any other suggestions for long-term model improvements?

  Only one suggestion from the panel members: "Trying different model forms: Systems of equations and VAR and if possible, including more explanatory variables in the models."