

# Section 4 Project

US House Price  
Trend Analysis

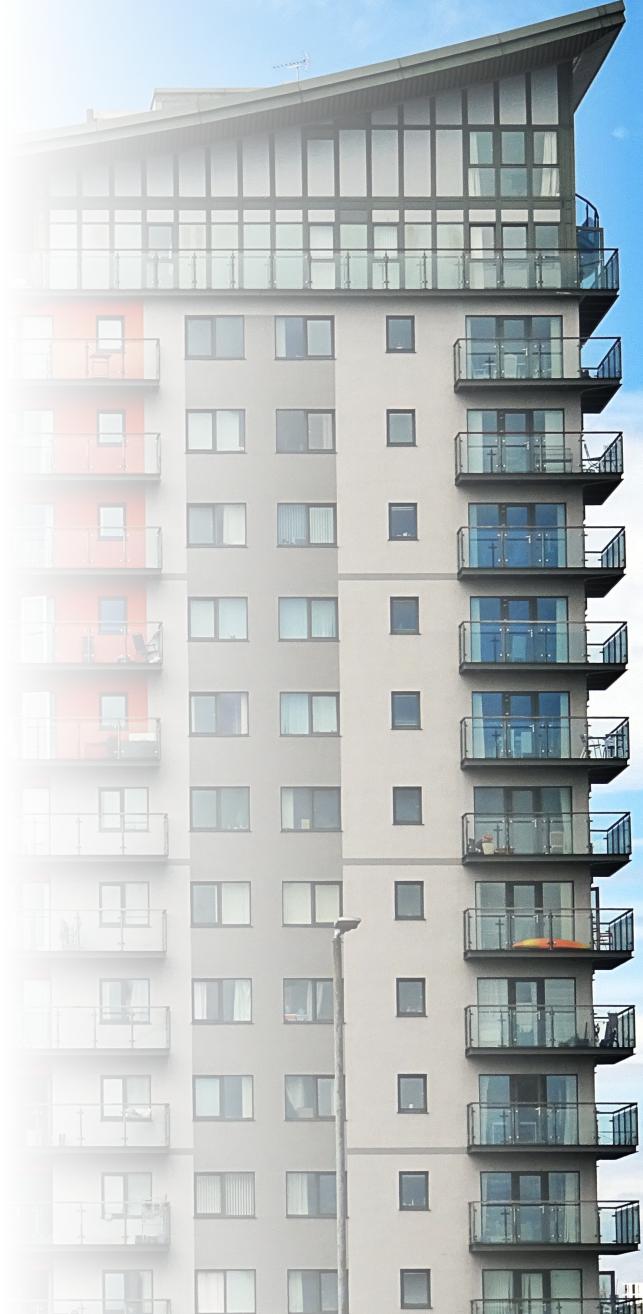


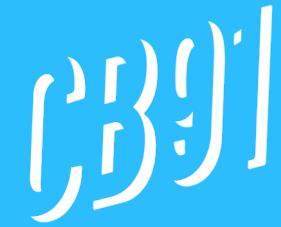


## *Executive summary*

- The business case
- Selecting regions to invest in:
  - Growth regions
  - Modelling growth
  - Risk vs. reward
- Forecasted gains
- Possible next steps

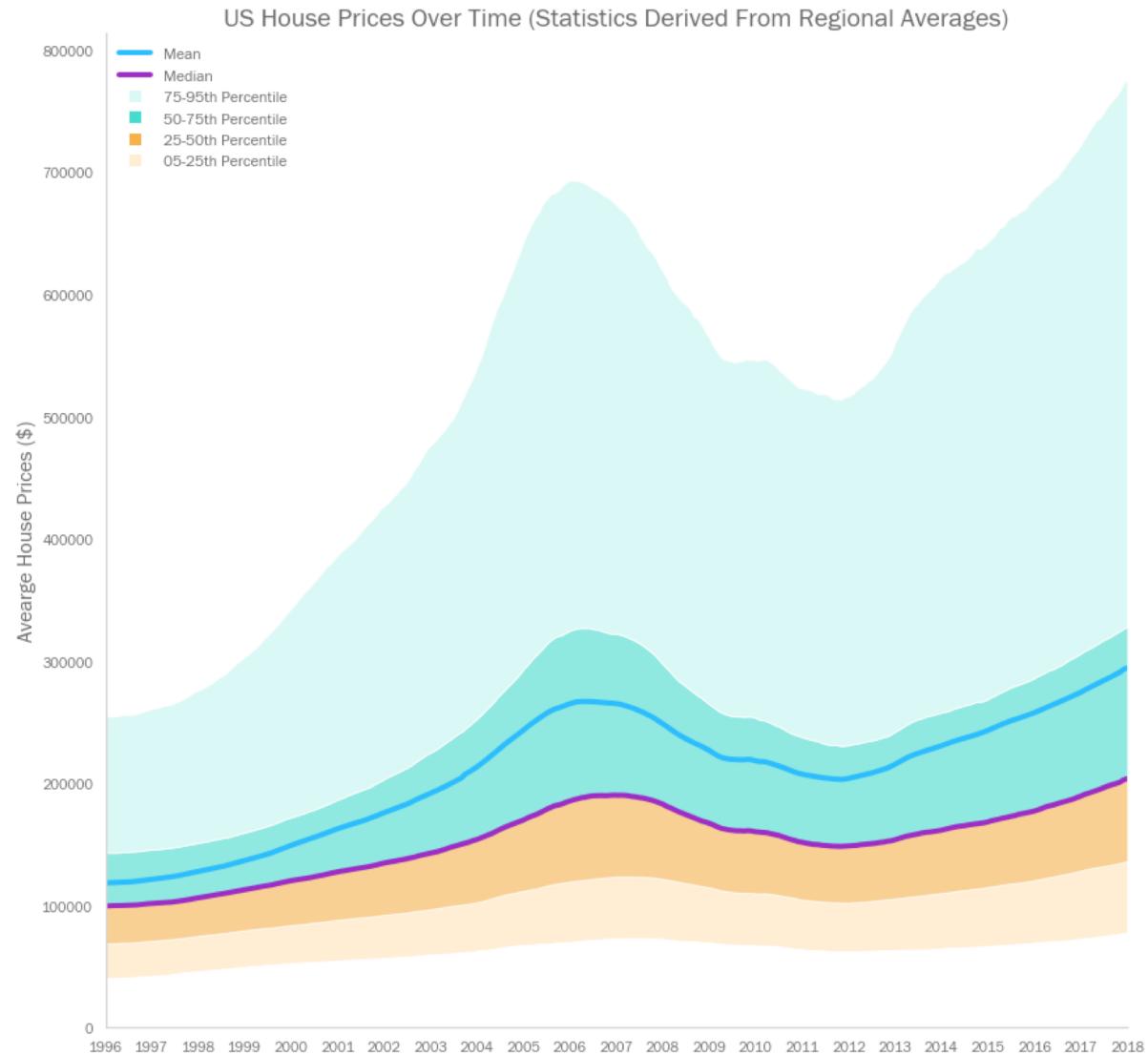
*Appendix contains additional analysis*





## The business case – the market at a glance

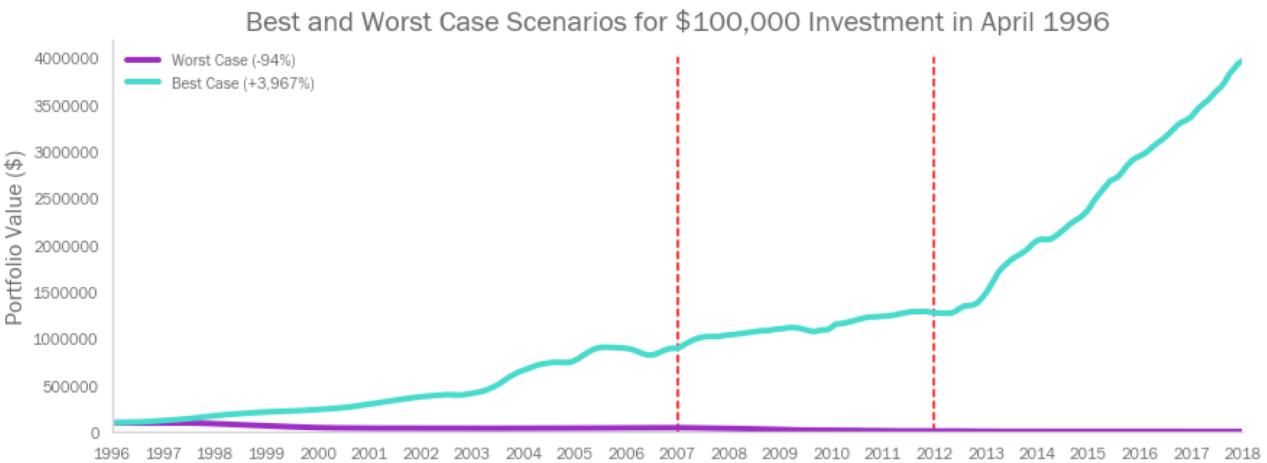
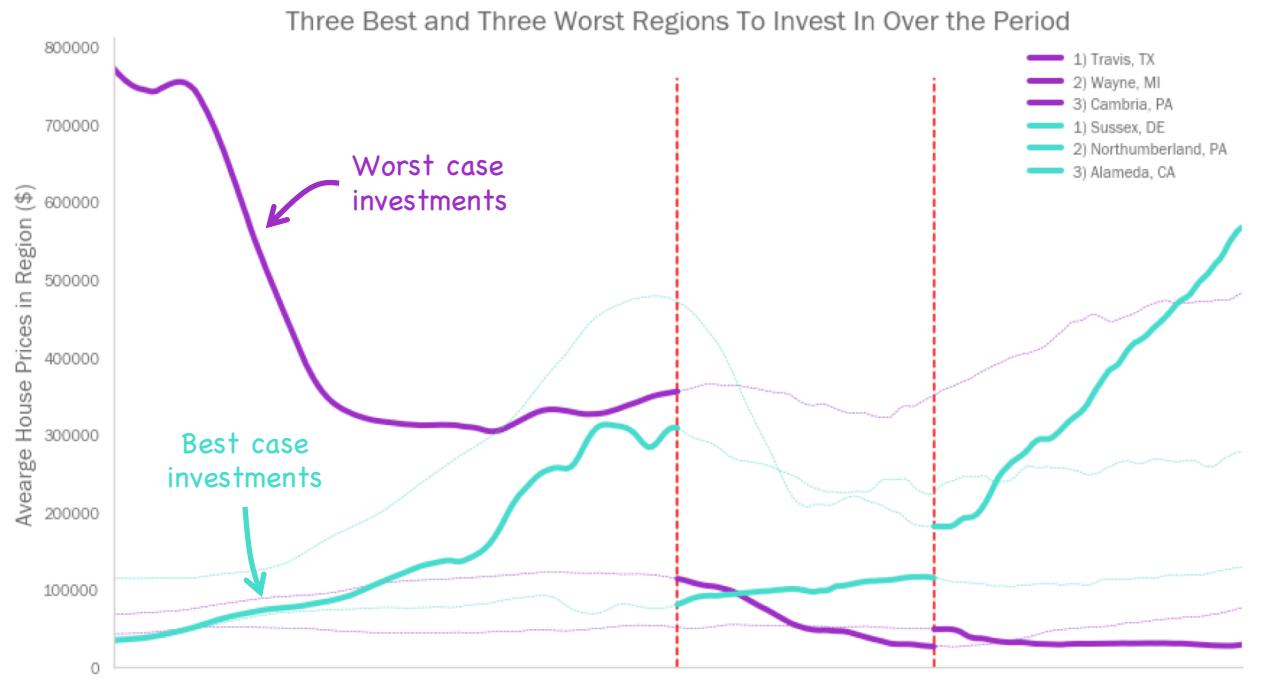
- The US housing market has been volatile in the last two decades, driven by the house price bubble and subsequent crash in 2007
- Spread has increased dramatically over time. Regions in the 95<sup>th</sup> percentile now have average prices ten times higher than those in the 5<sup>th</sup>



# The business case - getting the best returns

- Property value growth has varied wildly at a regional level
- Accurately predicting prices in a region can help an investor to make significant returns

By investing in the fastest growing region from 1996, then moving assets favourably at the '07 market peak, and again at the '12 market trough, a canny investor could have seen an overall return of 4,000%

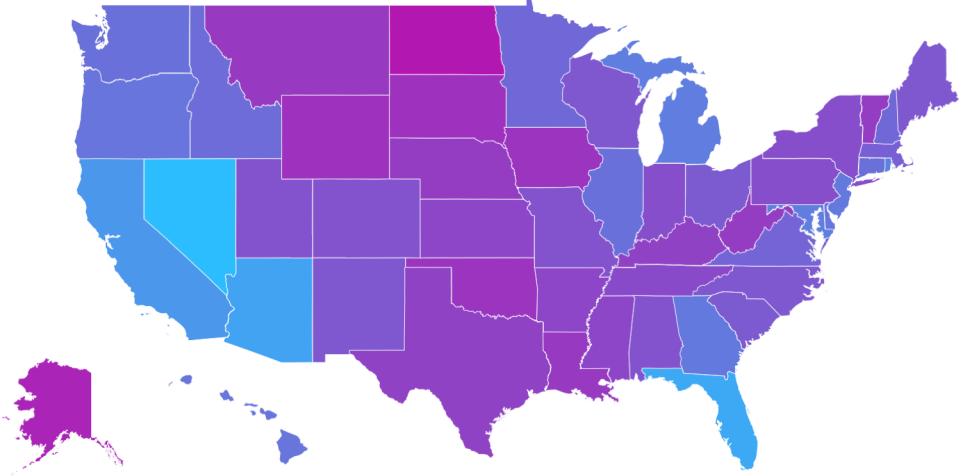




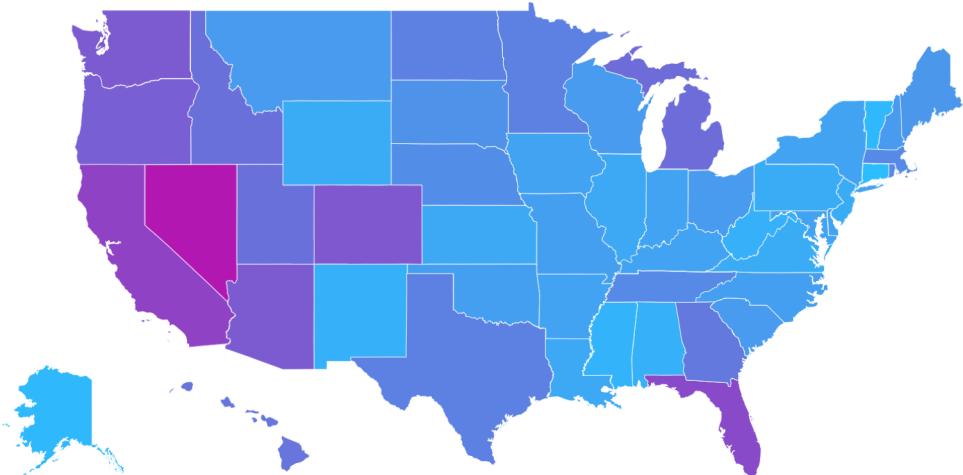
## Selecting regions – state by state

- Trend has not been felt consistently across the country – especially during economic downturns
- Many regions with strong recent growth have simply been recovering from downturns
- We should consider the risk of a region's vulnerability to economic shocks when choosing where to invest

April '07 – April '12 Average Region Price Growth by State

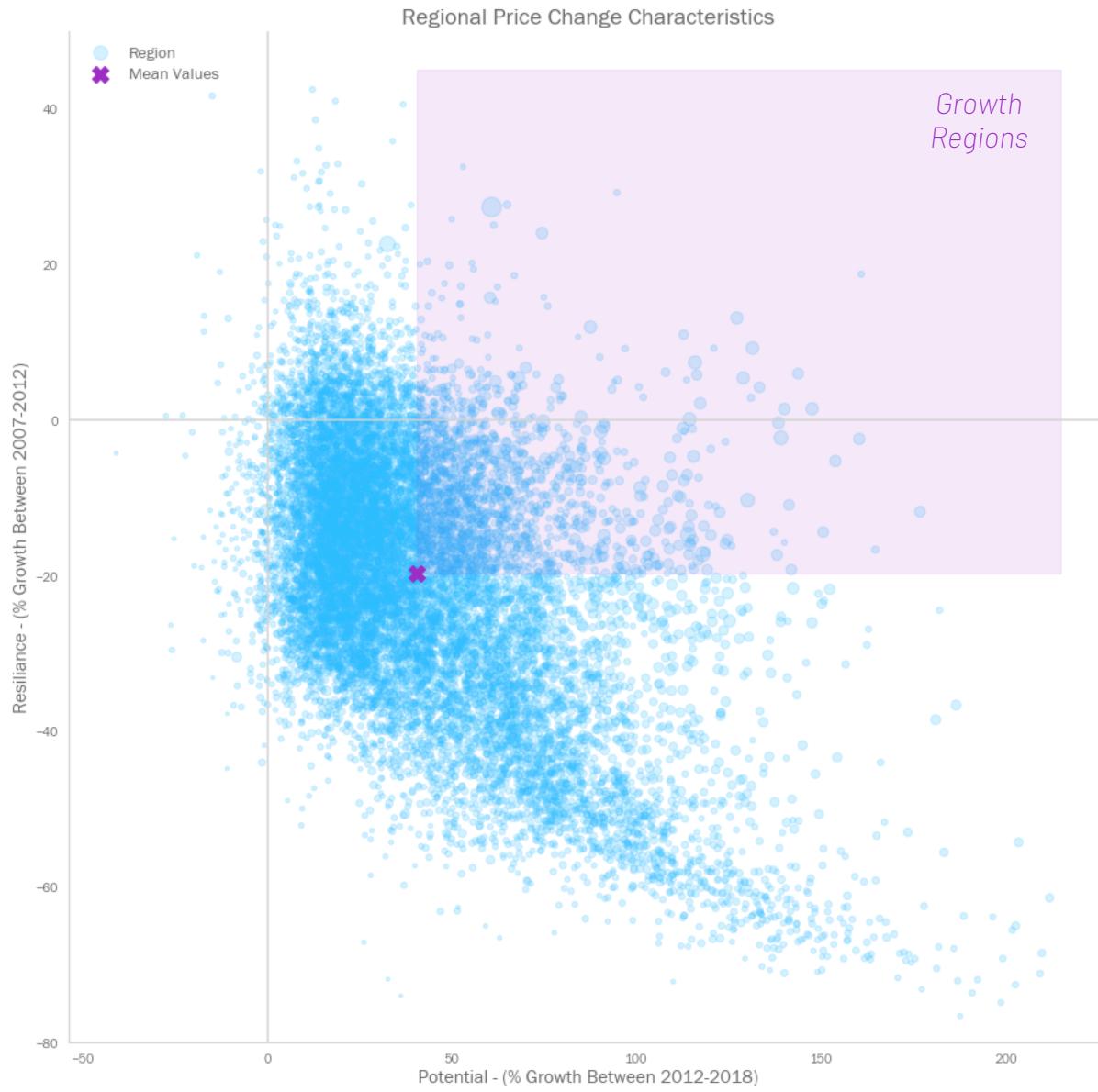


April '12 – April '18 Average Region Price Growth by State



# Selecting regions – ‘Growth Regions’

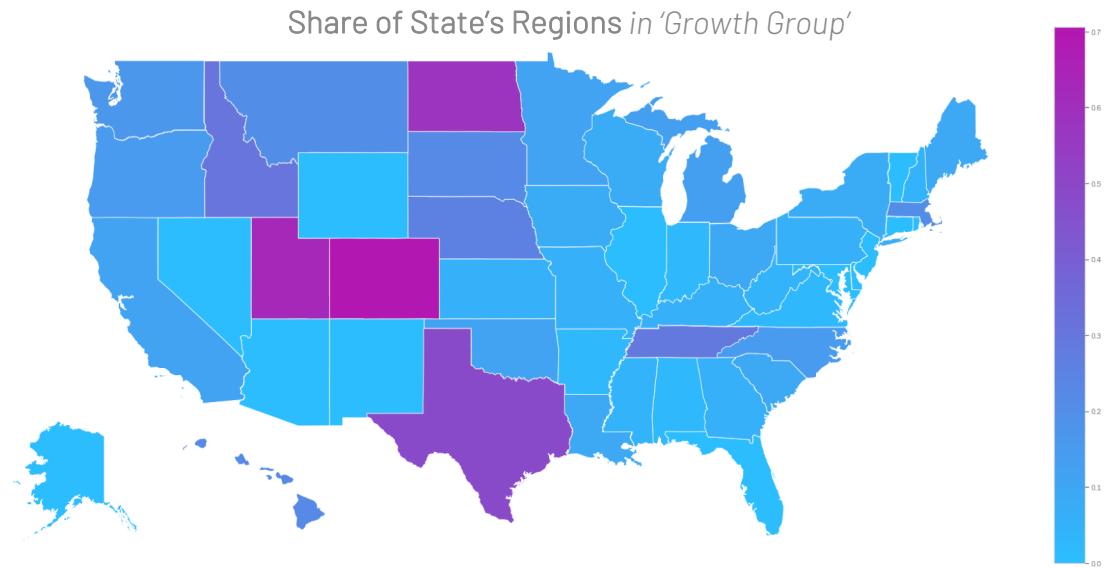
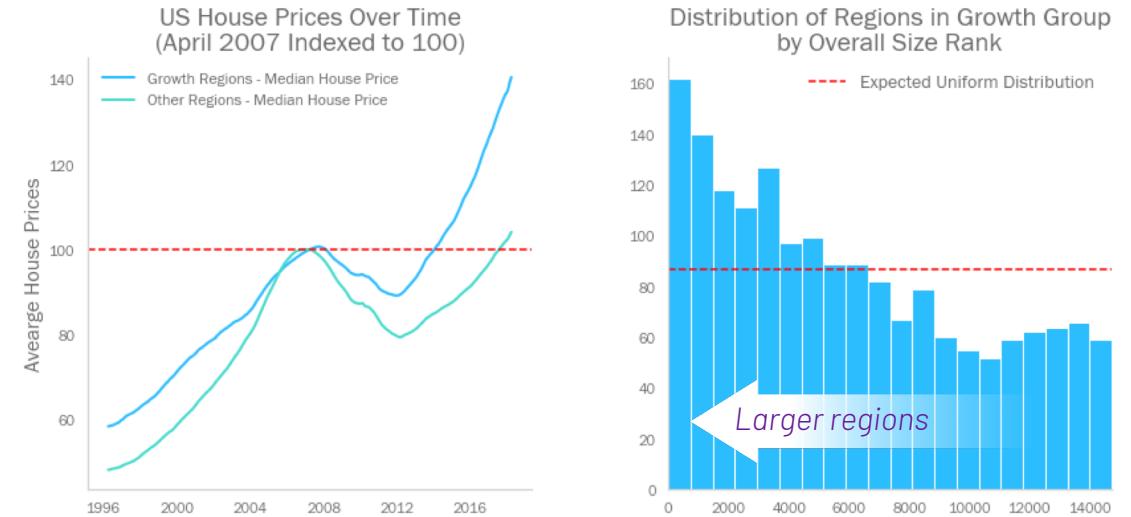
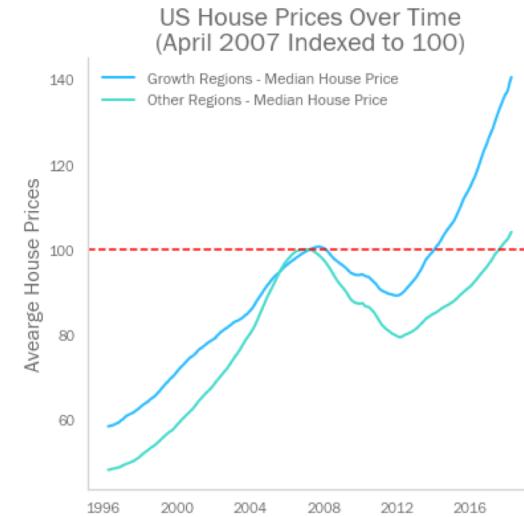
- CB91 narrowed down the initial 14,103 regions by considering how their values changed in the two key periods before and after 2012
- It isolated those regions that had above average growth in the downturn between 2007 and 2012, then above average growth from 2012 to 2018
- This left 1,737(12%) so-called ‘Growth Regions’ for further consideration

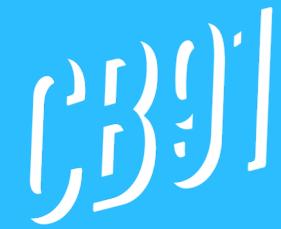




# Selecting regions – ‘Growth Region’ characteristics

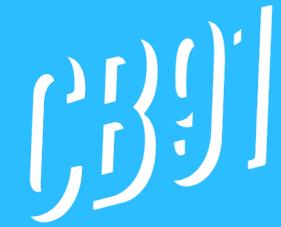
- Growth Regions have grown faster since 2007, but also grew more slowly up to 2007
- Growth Regions tend to be larger on average than non-growth regions
- A high share of regions in Colorado, Utah, North Dakota, and Texas are Growth Regions





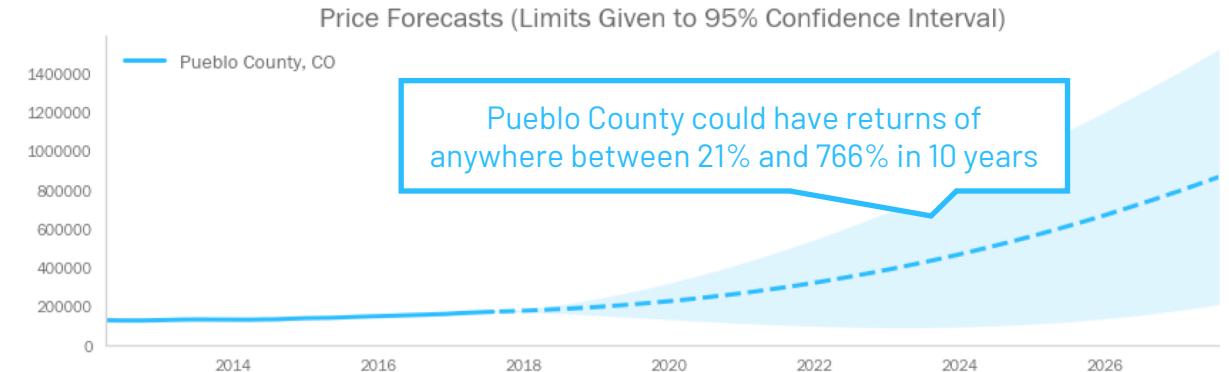
## Forecasting house prices – model building

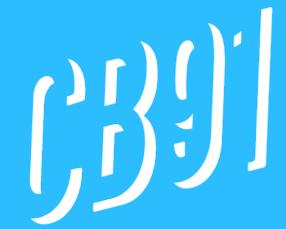
- CB91 has used ARIMA models to forecast house prices on a region-by-region basis
- This kind of modelling has advantages:
  - ↑ ARIMA modelling can deal with a wide range of time series types
  - ↑ We can fit a bespoke model for each region, allowing us to account for growth dynamics specific to that region
  - ↑ We can forecast a range of future values, within a given confidence interval
- However, there are limitations we should be aware of:
  - ↓ It can not account for freak exogenous events, such as the financial crisis
  - ↓ Sometimes, data is such that no ARIMA model can be fit. In these cases, we do not consider the region for investment, as its prices are evidently too unpredictable



# Forecasting house prices – risk vs. reward

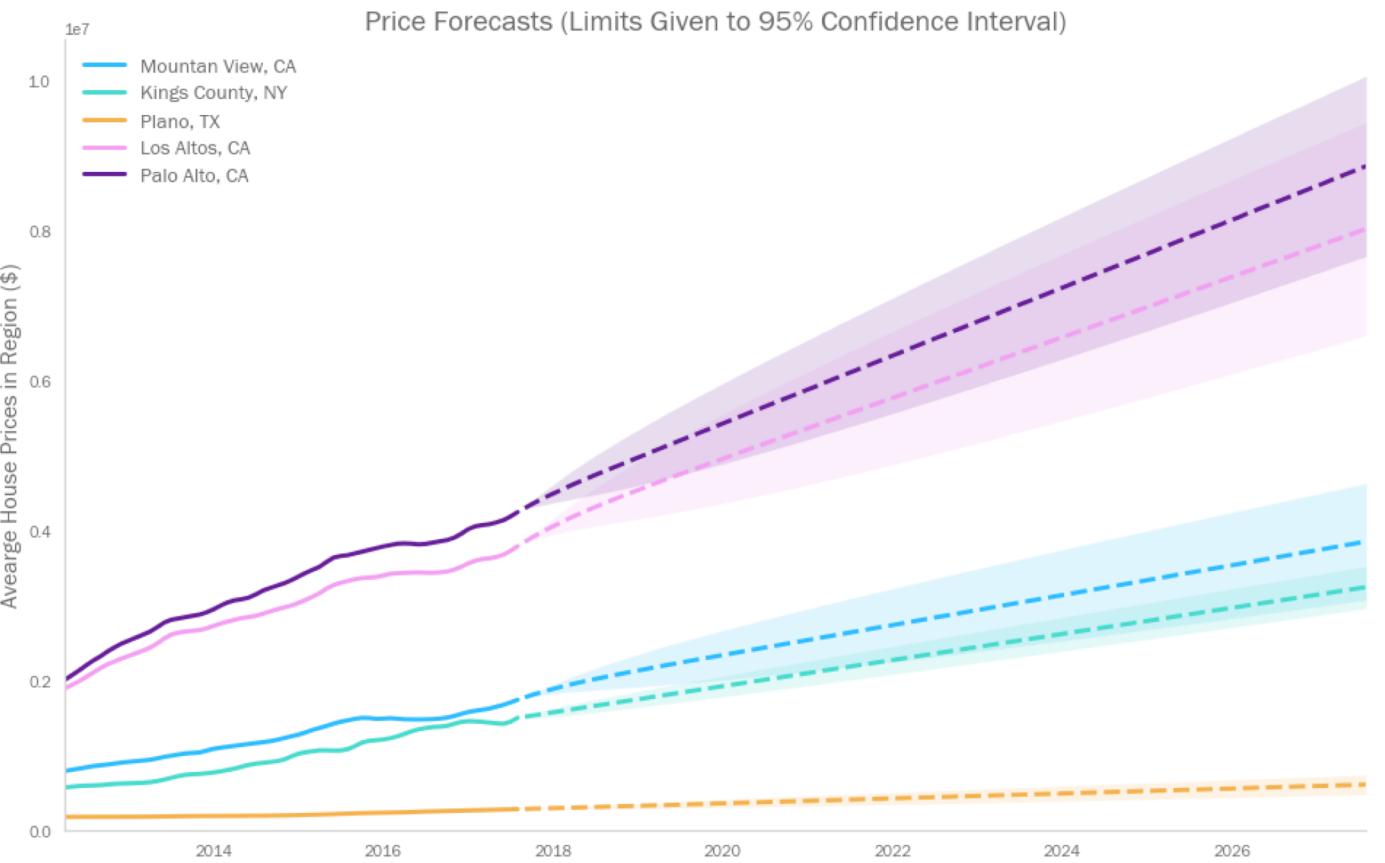
- Some regions are forecast to experience very strong growth
- However, some forecasts come with a very wide range – and would therefore make for risky investments
- We should select regions that have strong growth potential, but limited risk





# CB91's recommended regions

CB91 have isolated the 5 regions with the strongest growth potential, but with below average risk, over a 10 year horizon



Mountain View, CA



Kings County, NY



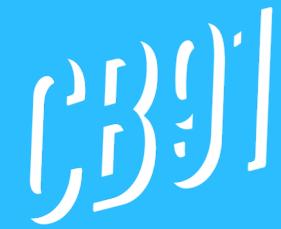
Plano, TX



Los Altos, CA

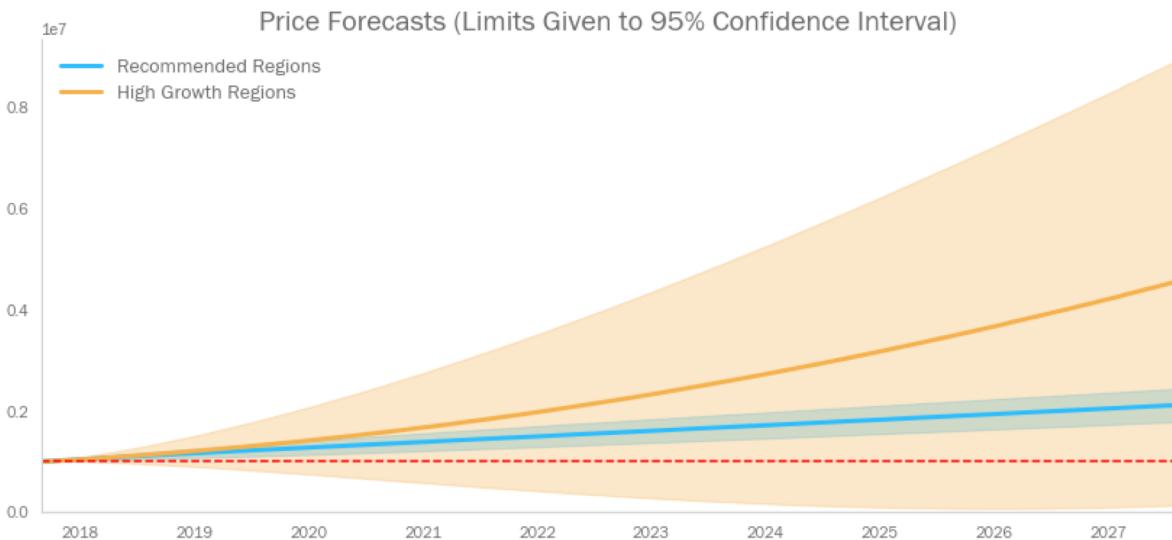
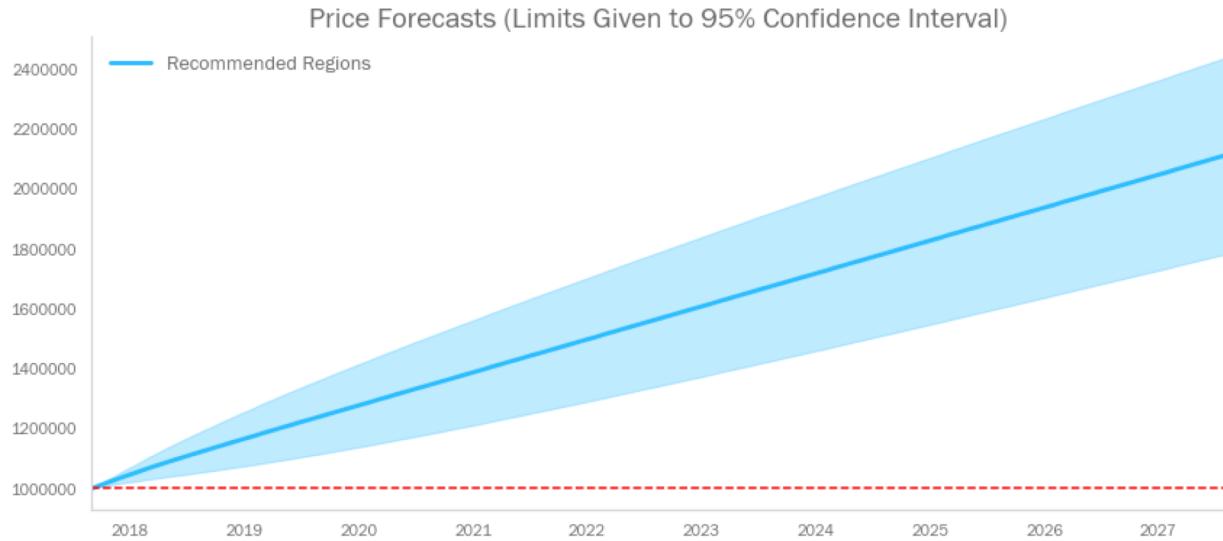


Palo Alto, CA



# CB91's recommended regions

- By investing \$1m evenly across the 5 recommended regions, CB91 predicts returns of 112% by mid 2028
- We predict with 95% confidence, that the portfolio would be worth between \$1.78m and \$2.43m
- Note – this is a narrower range than simply investing in the 5 regions with highest forecast growth (which has the potential to lose 86% of its value by 2028)





## Possible next steps

There are further steps we could take to improve the analysis and tune our recommendations. We could:

- Investigate the full selection of zip codes, as opposed to just the 'Growth Group'
- Use 'dynamic modelling', which would narrow confidence intervals
- Create a function that advises how to split investment across regions, depending on the client's risk appetite



An abstract graphic on the left side of the slide features several curved, metallic-looking bands in shades of purple, gold, and green against a light blue background. One band has a woven texture. A small gold rectangular piece is positioned near the bottom right of the graphic.

# Thank you for your time

Further detail on the model, and  
additional analysis of the dataset  
is included in further pages



# The ARIMA model - in more detail

- ARIMA modelling is a way of forecasting the future values of time series by using previous values.
- There are three key components of an ARIMA model:

## 1) Auto Regression

Calculate the next term based on the values of the last p terms, using an individually defined coefficient for each of those terms.

## 2) Integrated Term

If this term is non-zero, then 'difference' the dataset by d periods. In other words, transform the time series from its original values to the difference between values at time t, and time t-d.

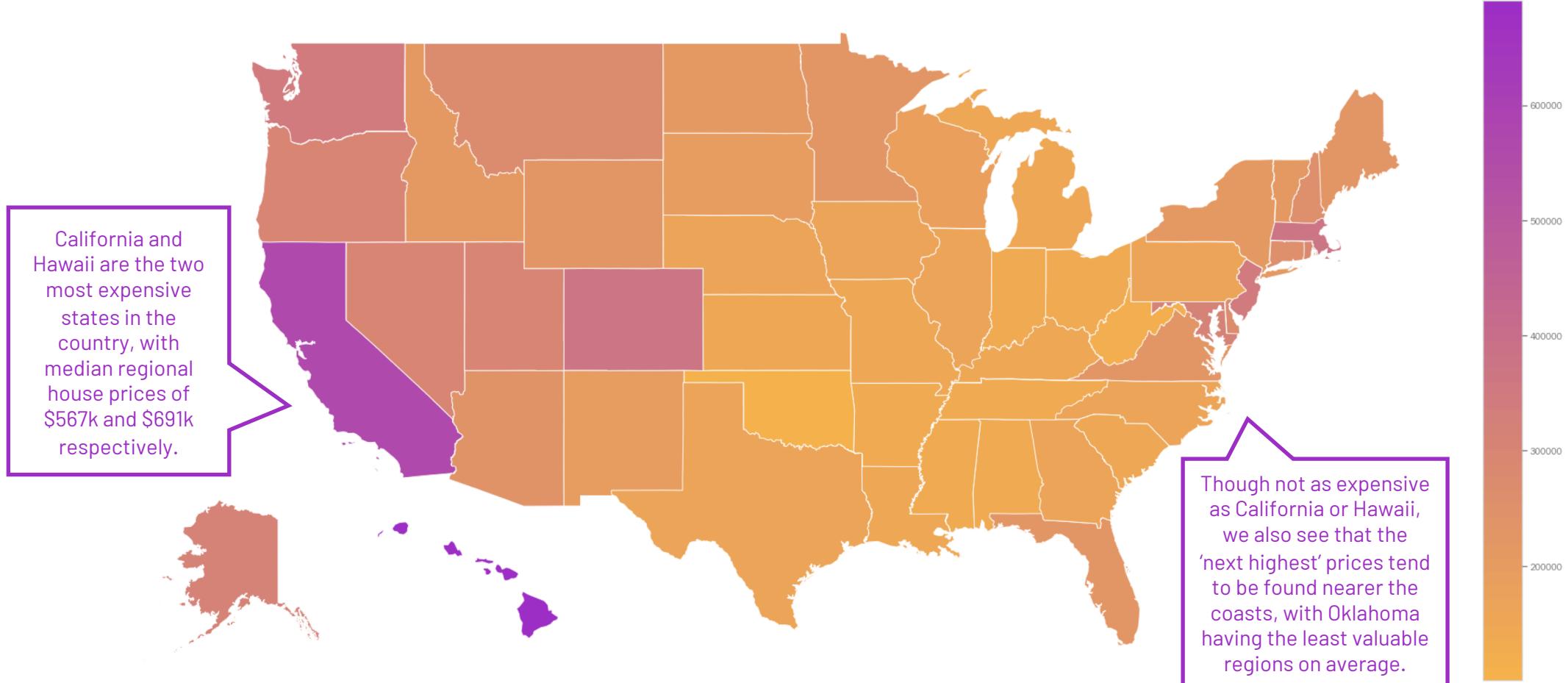
This is used in cases where we have a general drift in the data.

An ARIMA model is said to have order  $(p,d,q)$ , where p, d, and q refer to how many terms we consider for each of the model's three components

## 3) Moving Average

Calculate the next term based on the error from the moving average of the last q terms.

# Median regional house price by state



# Distribution of regional house price growth by state

