WHAT HAPPENS TO YOUR HOME VALUE IF AMAZON HQ2 COMES TO YOUR CITY?

Amazon is disrupting the retail industry and the way we live and shop. But how will the global giant transform the city it will soon call its second home?

50,000 HIGH-PAYING JOBS[1] | **$5 BILLION IN INVESTMENTS[1]** | **INCREASED HOME VALUES[2]**

Quantarium, the artificial intelligence arm of Mr. Cooper, the nation's largest non-bank mortgage servicer and a leading mortgage lender, analyzed 18 of the top 20 housing markets that Amazon is considering (Toronto and Northern Virginia are missing due to lack of data). The resulting data shows the potential for a positive impact to property values for the city chosen to host the new HQ2.

So, what do homeowners need to know? How will HQ2 affect them and the housing market? And, how can homeowners best take advantage?

ESTIMATED PROPERTY VALUES IN THE AMAZON 20[2]

FROM JUNE 2018 TO JUNE 2019
(See analysis below)

	WITHOUT AMAZON	WITH AMAZON	TOTAL GAIN W/ AMAZON
NEWARK	-5%	+28.5%	+33.5%
RALEIGH	+2.8%	+30.0%	+27.2%
PITTSBURGH	+3.4%	+15.5%	+12.1%
INDIANAPOLIS	+0.15%	+12.0%	+11.9%
MONTGOMERY COUNTY, MD	+0.70%	+12.0%	+11.3%
COLUMBUS	+5.40%	+15.80%	+10.4%
AUSTIN	+5.90%	+15.8%	+9.9%
DALLAS	+3.70%	+12.4%	+8.7%
DENVER	+7.60%	+16.0%	+8.4%
MIAMI	+4.80%	+15.0%	+8.2%
NASHVILLE	+9.80%	+16.40%	+6.6%
PHILADELPHIA	+6.80%	+12.8%	+6.0%
ATLANTA	+11.0%	+16.0%	+5.0%
NYC	+4.0%	+8.3%	+4.3%
CHICAGO	+4.2%	+8.3%	+4.1%
DC	+4.4%	+8.3%	+3.9%
LA	+4.4%	+8.3%	+3.9%
BOSTON	+8.2%	+8.6%	+0.4%

WHO STANDS TO BENEFIT THE MOST?

Biggest Winners

Newark or Raleigh. For these two cities, the rate of increase is projected to be even higher and faster than that which Seattle experienced after Amazon moved into its current headquarters in 2010. The Newark government is likely eager to bring in an anchor tenant such as Amazon to help save their housing market — the only city housing market among the 18 we analyzed that is predicted to trend downward over the next two years. According to the data, the addition of Amazon HQ2 to Newark would likely see a 33.5 percent increase in housing prices in the first year alone and subsequently would likely see a 5 percent decrease in housing prices without Amazon. Raleigh, which looks extremely similar to Seattle leading up to Amazon's expansion there in 2010, is likely to see property values rise by 27.2 percent in the first year with the addition of Amazon HQ2.

Significant Increase

In addition to Newark or Raleigh, Pittsburgh, Indianapolis, Montgomery County, MD or Columbus would likely see a significant increase in their housing prices based on the current status of their local economies.

Moderate Increase

Austin, Dallas, Denver, Miami, Nashville or Philadelphia would likely see a moderate increase in home prices if any of them became the home of Amazon's HQ2. According to the data, home prices would see some uplift from a favorable Amazon announcement, but it won't be profoundly different from the current trajectory.

Smallest Increase

Atlanta, NYC, Chicago, DC, LA or Boston would likely see the smallest increase in home prices in response to Amazon's HQ2. These cities already have relatively high GDP and dense populations. Moreover, there are many large companies, like Amazon, already headquartered in these cities.

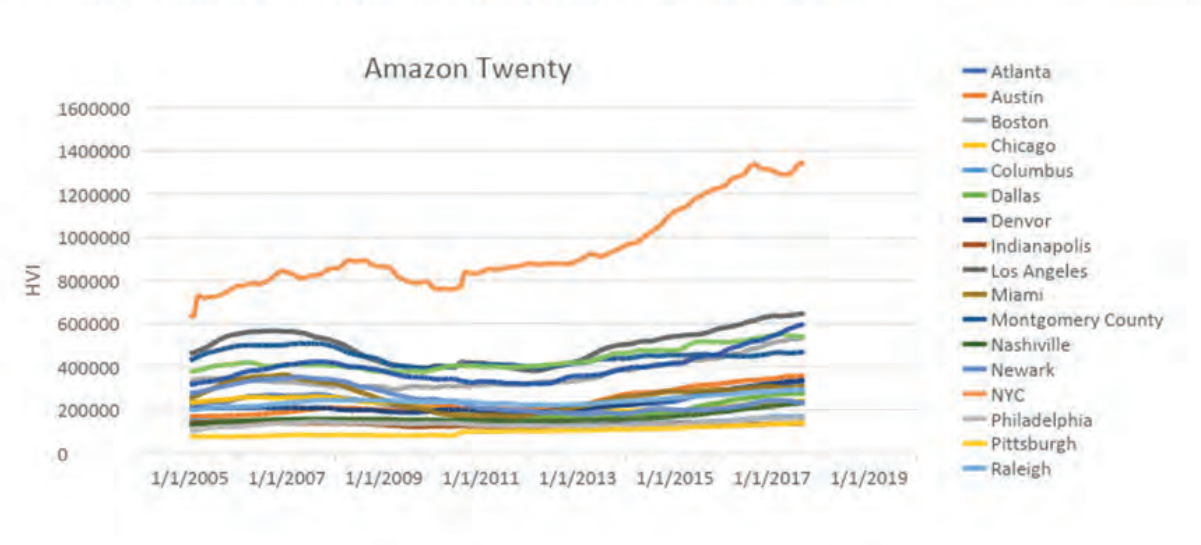
Methodology

Hypothesis

We began our analysis by observing how home prices in the Seattle Metro area changed due to Amazon's expansion of their headquarters (HQ1) there, beginning in 2010, and attempting to isolate Amazon's influence from other pricing influences in the Seattle housing market. By comparing the other cities to Seattle, we may be able to infer how home prices will respond to a new Amazon headquarters being established in these cities.

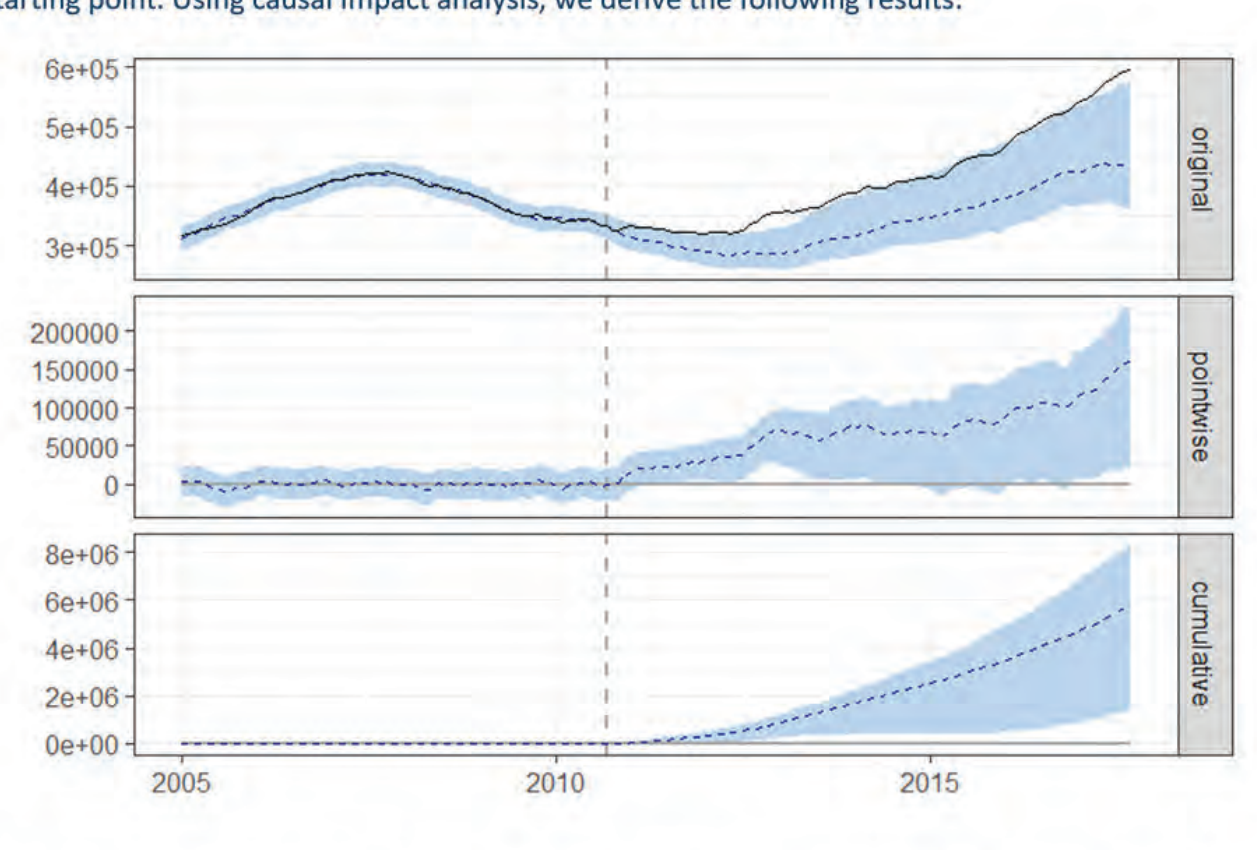
The main statistical tools we will use for our analysis are "Causal inference"[3] and "ARIMA"[4]

The graph below shows historical home price data from 18 of the 20 cities under consideration for Amazon's HQ2. (Missing Toronto and Northern Virginia owing to lack of data.) New York City is a clear outlier as home prices there have increased substantially higher and faster than the other cities under consideration, which have moved more or less in tandem with each other.



Analysis Framework

To begin, we know the start date of Amazon's Seattle area expansion in 2010, and we set 2010/08/01 as our starting point. Using causal impact analysis, we derive the following results:



During Amazon's post-intervention period in Seattle, the response variable had an average value of approximately 411.79K. By contrast, in the absence of an intervention, we would have expected an average response of 342.86K. The 95 percent interval of this counterfactual prediction is [310.32K, 395.75K]. Subtracting this prediction from the observed response yields an estimate of the causal effect the intervention had on the response variable. This effect is 68.93K with a 95 percent interval of [16.05K, 101.47K].

Summing up the individual data points during the post-intervention period (which can only sometimes be meaningfully interpreted), the response variable had an overall value of 34.59M. By contrast, had the intervention not taken place, we would have expected a sum of 28.80M. The 95 percent interval of this prediction is [26.07M, 33.24M].

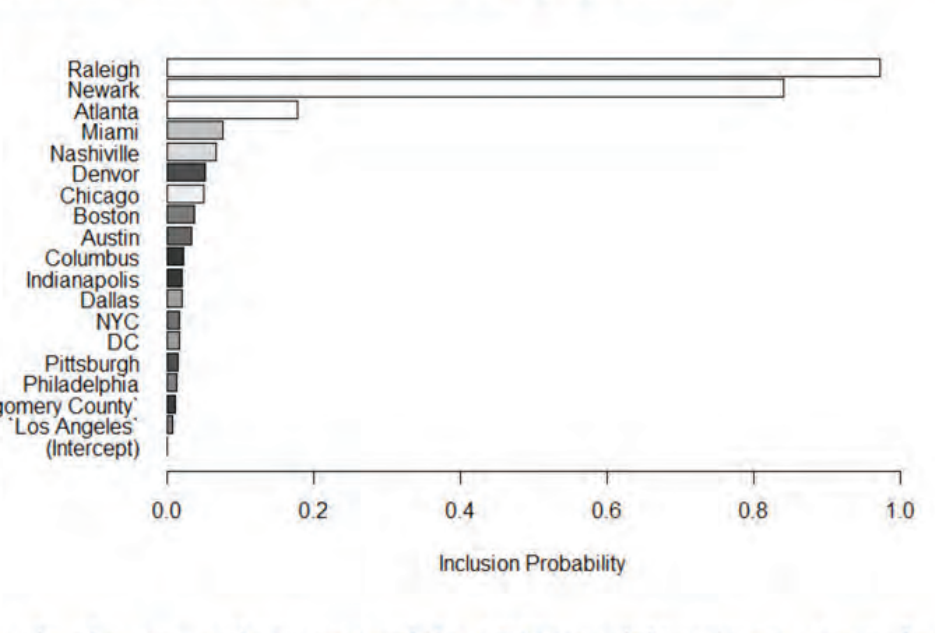
The above results are given in terms of absolute numbers. In relative terms, the response variable showed an increase of +20 percent. The 95 percent interval of this percentage is [+5 percent, +30 percent].

This means that the positive effect seen during the intervention period is *statistically significant* and unlikely to be due to random fluctuations. It should be noted, however, that the question of whether this increase also bears substantive significance can only be answered by comparing the absolute effect (68.93K) to the original goal of the underlying intervention.

The probability of obtaining this effect by chance is very small (Bayesian one-sided tail-area probability p = 0.003). This means the causal effect can be considered statistically significant.

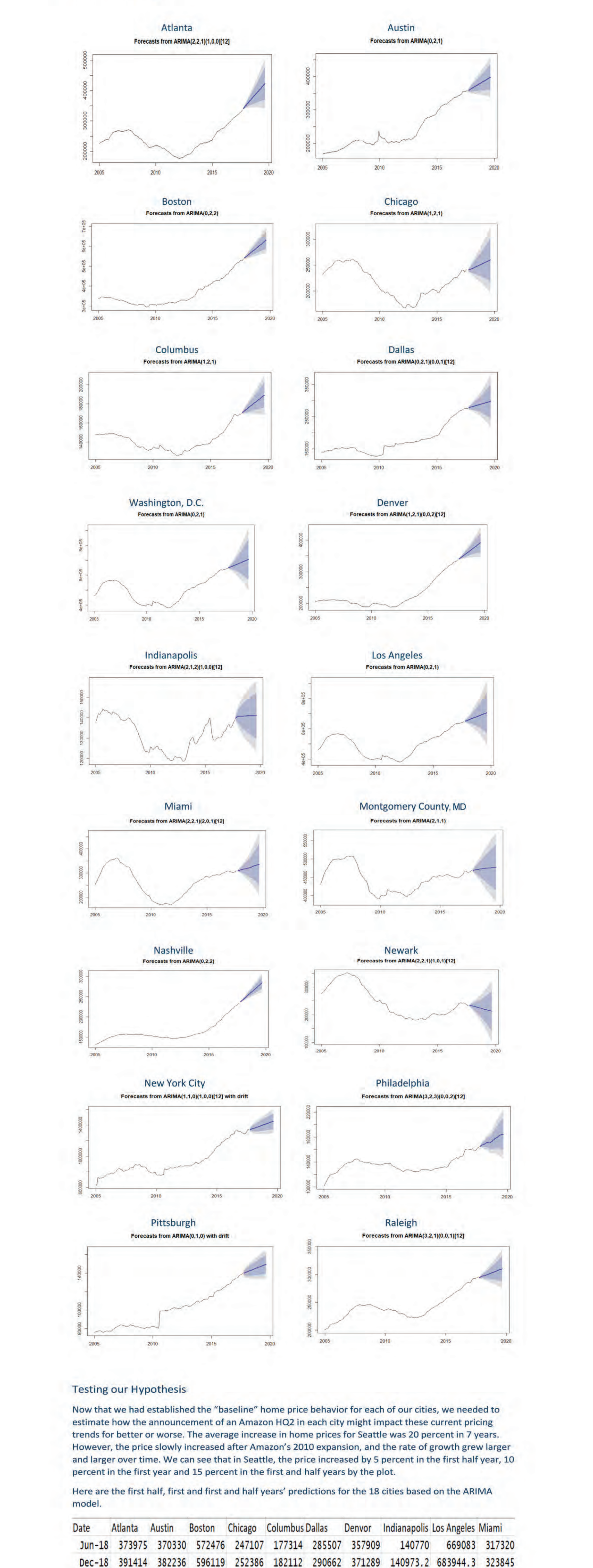
We see ~20 percent increase on home prices due to Amazon's intervention in Seattle.

The following graph shows how each of the cities have a similar price trend with Seattle in the pre-intervention period. The higher the inclusion probability, the more likely it is that the city will have the similar price change to that in Seattle following the addition of Amazon's headquarters. What this means in plain English is that our estimates for cities that are *very similar* to Seattle, such as Raleigh and Newark, will likely be the most accurate, while our estimates for cities that are *very different* from Seattle, such as Philadelphia and Los Angeles, may be less accurate, and should be viewed with more skepticism by readers. Put another way, there are so many differences between Seattle and Los Angeles, that deriving our estimate for the influence of Amazon's HQ2 on home prices in Los Angeles from Seattle's data using the Causal Inference method may be less accurate.



Next, to further develop our analysis, we used the ARIMA model in a time series to forecast future home prices in each of the cities under consideration. This gives us a baseline sense of how home prices will ordinarily behave if nothing special happens (no Amazon HQ2 gets announced) based on historical home price trends.

ARIMA Modeling



Testing our Hypothesis

Now that we had established the "baseline" home price behavior for each of our cities, we needed to estimate how the announcement of an Amazon HQ2 in each city might impact these current pricing trends for better or worse. The average increase in home prices for Seattle was 20 percent in 7 years. However, the price slowly increased after Amazon's 2010 expansion, and the rate of growth grew larger and larger over time. We can see that in Seattle, the price increased by 5 percent in the first half year, 10 percent in the first year and 15 percent in the first and half years by the plot.

Here are the first half, first and first and half years' predictions for the 18 cities based on the ARIMA model.

Date	Atlanta	Austin	Boston	Chicago	Columbus	Dallas	Denver	Indianapolis	Los Angeles	Miami
Jun-18	373975	370330	572476	247107	177314	285507	357909	140770	669083	317320
Dec-18	391414	382236	596119	252386	182112	290662	371289	140973.2	683944.3	323845
Jun-19	415958	392442	619763	257667	186911	296197	385373	140986.6	698805.6	332759

Montgomery County	Nashville	Newark	NYC	Philadelphia	Pittsburgh	Raleigh	DC
472777.3	253015	227563	1378161	171885	143248	299573.1	669083
474752.4	265422	221650	1406326	176463.1	145751.3	303895.1	683944.3
476065.8	277829	216215	1433759	183611.8	148254.6	308162	698805.6

Based on the similarity measure, which includes population, GDP, Unemployment rate, and average income between each of these cities and Seattle, we can make reasonable coefficient assumption for each of the cities.

Following is how we visualized the data for each city:

mr. cooper

Quantarium

1. http://www.businessinsider.com/amazon-hq2-jobs-2018-1
2. The Estimated Property Values, by market, are computer-generated estimates of the designated housing markets' value using both the application of ARIMA and Causal Analysis models and Quantarium's proprietary mathematical formulas and techniques for the stated time periods. Values for several of the markets being considered by Amazon have not been evaluated due to the lack of data. The data utilized in order to develop the Estimated Property Values is taken from local government records and is deemed reliable, but not guaranteed.
The data, and information derived from the data utilized, in the Estimated Property Values is provided on an "AS AVAILABLE" and "AS IS" basis and is provided for informational purposes only. Although we have attempted to provide reliable data and use reliable methodologies in providing a property's Estimated Market Value, Quantarium, LLC, its affiliates and their respective members, directors, officers and employees make no representations or warranties regarding the accuracy of the Estimated Property Values or any specific data and expressly disclaim the obligation to update such value. All uses of the Estimated Property Values are at the user's sole risk, and shall be for personal, non-commercial use and for no other purpose. Quantarium, LLC, its affiliates and their respective members, directors, officers and employees are not liable for the accuracy of the Estimated Property Values or any information related thereto.
3. https://en.wikipedia.org/wiki/Causal_inference
4. https://en.wikipedia.org/wiki/Autoregressive_integrated_moving_average

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