Dayton, Ohio:
Which types of employers should policy makers try to attract to spur population growth?

Introduction / Business Problem:

The city of Dayton, Ohio has experienced population declines, hurting the city's economic prospects.

From Wikipedia:

"Since the 1980s, {...] Dayton's population has declined, mainly due to the loss of manufacturing jobs and decentralization of metropolitan areas, as well as the national housing crisis that began in 2008. While much of the state [of Ohio] has suffered for similar reasons, the impact on Dayton has been greater than most. Dayton had the third-greatest percentage loss of population in the state [of Ohio] since the 1980s, behind Cleveland and Youngstown. Despite this, Dayton has begun diversifying its workforce from manufacturing into other growing sectors such as healthcare and education."

The unfortunate consequence of population declines is that there is **less tax revenue** available to allocate into services and infrastructure that would otherwise help to grow the local economy (and attract more businesses). In this context, policy makers must carefully prioritize economic incentives.

Much of the population decline has been driven by shifts in the city's employer portfolio. Investments in healthcare and education seem like sensible approaches to reversing the decline.

But what if there are other categories of employers that are linked to faster population growth?

This question could potentially be answered by examining how Dayton's employer portfolio compares to faster-growing cities of similar size.

Data Sources

The following three data sources will be used for this study:

1. https://en.wikipedia.org/wiki/List_of_United_States_cities_by_population

   This Wikipedia table lists the top cities in the United States by population. Dayton, OH is among those listed, ranked at 195. Conveniently, the table provides estimates of population growth rate since the 2010 census, along with the estimated population in 2019. The table also provides city land area, with which we can evaluate population density.

   With this data, I intend to identify a subset of cities that are like Dayton in terms of total population and city land area.

2. https://www.census.gov/quickfacts/fact/table/US/PST045219

   The Census QuickFacts website provides an interface for comparing demographic statistics between cities. Conveniently, the site also provides the ability to export stats tables for multiple cities to a CSV file.

   QuickFacts will be used to report and export census data for the cities in this study. This data set will be explored to see which city stats may be linked to population growth.

3. Foursquare Places API: https://developer.foursquare.com/docs/places-api/

   Foursquare location data will be used to compare Dayton's employer portfolio to the other cities. My goal here is to identify which employer types in Dayton are under-represented and over-represented compared to similar cities with faster population growth.

4. https://simplemaps.com/data/us-zips

   The SimpleMaps website provides a downloadable database of zip code statistics, including geographical coordinates and population data. This will be useful for setting up city-specific location data queries to Foursquare.

Methodology

1. I started this project by importing Wikipedia's list of most populous US cities into a dataframe. Then I filtered that list down to a subset of cities that were similar to Dayton, OH in terms of 2010 Census population and geographical size. There were 22 cities, including Dayton, OH.

2. For the next step I exported census statistics for each city from the QuickFacts website, then imported that information into a dataframe. I then computed the correlation of each attribute relative to the cities' estimated population growth (2010 to 2019).

3. For the third step I used the SimpleMaps zip code statistics to determine the appropriate geographical coordinates and search radius for all of the cities' zip codes in the study. I then ran several category-specific queries for cities in each zip code using the Foursquare API. The results were then stored and merged in a dataframe.

4. I then split and grouped the Foursquare results into two separate dataframes, one capturing niche-level business category proportions in each city, and one capturing top-level business category proportions in each city.

5. With each of the dataframes from step 4, I calculated a sorted list of correlations between city-level business category proportions and population growth.

6. Lastly, I compared Dayton's business category proportions to both the mean proportions across all of the cities and to the proportions in the faster growing city (McKinney, Texas).

Results

- The QuickFacts census data yielded the following notable correlation values, with respect to population growth:
    - Positive Correlations:
        - Households with a computer **0.708578**
        - Households with a broadband Internet subscription **0.608455**
        - Median household income **0.503509**
        - In civilian labor force, age 16 years+ **0.497406**
    - Negative Correlations:
        - Persons in poverty **-0.467333**
        - With a disability, under age 65 years **-0.552105**
        - Persons 65 years and over **-0.576651**
        - Total health care and social assistance receipts/revenue **-0.580882**
    - Dayton compared to the other cities:
        - Of the cities in the QuickFact set, Dayton has the lowest values for household computer ownership, civilian labor force participation, and median household income.
        - Dayton has the highest values for healthcare/social assistance receipts/revenue, population disabled under age 65, and poverty rate.
        - Dayton is surprisingly middle-of-the road on the proportion of population age 65 and over. This neither helps nor hurts population growth
- The Foursquare city data yielded the following notable correlation values, with respect to population growth:
    - Bottom-level business category correlations:
        - Positive correlations:
            - Bike Rental / Bike Share **0.780697**
            - Housing Development **0.773556**
            - Indoor Play Area **0.771330**
            - Christmas Market **0.753363**
            - Stables **0.753363**
            - Travel & Transport **0.753363**
            - Swim School **0.736183**
            - Irish Pub **0.725457**
            - Cycle Studio **0.686273**
        - Negative correlations:
            - Lawyer **-0.449540**
            - Other Repair Shop **-0.465762**
            - Flower Shop **-0.467901**
            - Furniture / Home Store **-0.473504**
            - Pawn Shop **-0.515006**
            - Business Service **-0.583470**
            - Construction & Landscaping **-0.597797**
            - Electronics Store **-0.607777**

- The Foursquare city data correlation values, continued:
  - Top-level business category correlations:
    - Residence **0.689976**
    - Arts & Entertainment **0.470641**
    - Outdoors & Recreation **0.452558**
    - Travel & Transport **0.424752**
    - Event **0.343142**
    - Food **0.072977**
    - Professional & Other Places **0.010608**
    - Nightlife Spot **0.005056**
    - College & University **-0.020197**
    - Shop & Service **-0.734539**
  - Dayton's top-level business category proportions compared to average cities:
    - Dayton currently has a **lower** proportion of unique businesses in the Residences, Arts/Entertainment, Outdoors/Recreation, and Travel/Transport categories.
    - Dayton currently has a **higher** proportion of unique businesses in the Shop & Service categories.
  - Dayton top-level business category proportions compared to the fastest growing city of similar size (McKinney, Texas):
    - Dayton currently has a **significantly lower** proportion of unique businesses in the Residences, Arts/Entertainment, Outdoors/Recreation, and Travel/Transport categories.
    - Dayton currently has a **significantly higher** proportion of businesses in the Shop & Service categories.

Discussion

The QuickFacts census measures suggests that Dayton is underperforming in several key areas that are strongly linked to population trends in similarly-sized cities. The economic picture is not pretty -- the data suggests that Dayton does not have enough **jobs**, let alone **high-paying jobs**, to support population growth. Furthermore, a larger proportion of the under-65 population is encumbered with disabilities and higher medical expenses. Computer and internet access is proportionally lower in Dayton households, which could reflect a combination of demand-side and supply-side shortages.

Reviewing the Foursquare data, we see that certain city-level niche business category proportions correlate strongly with population trends:

Positive growth correlations:

- Bike Rental / Bike Share - of all business categories - this one is most strongly correlated with population growth - Cycle Studio is not much further down the list. This likely reflects people settling into a new area and exploring their new surroundings. Bike Rentals / Shares are also a very modern and trendy technological offering that caters to younger (and growing) demographics.

- Housing Development - This could reflect a combination of both high supply and also high demand. If housing is in greater demand, more housing suppliers will attempt to fill the gap. If housing is in great supply, the prices will be lower thereby attracting more people.
- Indoor Play Area - Definitely reflects population growth!
- Travel and Transport - More people, more travel. Infrastructure growth is needed to support a growing population.

Negative growth correlations:

- Electronics store, construction & landscaping, furniture/home store, flower shop, and other repair shops - these all reflect higher demand that may be driven by pre-home-sale renovations.
- Business services - this may reflect a maturing city where companies that need services are already established. Higher-growth cities would likely have a higher concentration of startups that are risky for business service providers.
- Pawn shops - people are trying to get rid of their belongings and/or make a quick buck. It's not surprising to see these in economically-depressed areas where crime is high and populations are declining.
- Lawyers! - I chuckled at this one. A concentration of lawyers could reflect a population in economic instability, where demand for litigation is higher.

When we zoom out to aggregated top-level business category proportions, we continue to see the patterns suggested in the bottom-level categories.

- We see that residences have the strongest positive correlation, followed by arts/entertainment, outdoors/recreational, and travel/transport.
- On the opposite end, shops & service providers are strongly correlated with population decline, reflecting maturing cities that are past their prime and lack a competitive environment.

It is also interesting to see that the College & University category has little if any correlation with population growth, in contrast to what policymakers might initially believe.

Not surprisingly, when we compare Dayton's business category proportions to average cities and to the much-faster-growing city of McKinney, Texas, we see that Dayton has higher proportions of businesses that correlate with population stagnation and decline, and lower proportions of businesses that correlate with population growth.

It is left to policymakers to determine whether those proportionality differences are either the symptom or cause of population decline (or perhaps some combination thereof).

Conclusion

The data obtained in this study strongly hints that Dayton's policymakers could reverse population declines by rebalancing the proportions of business categories in the city. Doing so would require some strategically disruptive changes to economic incentives, with the long-term aim of raising living standards to attract outsiders and retain the current population.

This study suggests that initiatives toward growing the education and healthcare sectors are a maintenance measure at best and have little correlation with short-term population growth.

Alternatively, a potentially effective (albeit controversial) strategy for Dayton policymakers would be to implement negative incentives (i.e. taxes) that would target the disproportionate glut of businesses in the service sector. It is not difficult to imagine that this would help to reduce the proportions of businesses in that category, thereby encouraging competition and innovation in adjacent business categories.

The tax revenues obtained from a disruptive measure like this could then be allocated to residential, commercial, and transportation infrastructure projects, while also supporting positive tax incentives for businesses that increase residents' access to housing as well as cultural/recreational activities. In the long-term, such efforts could lead to a happier, healthier, and more productive populace – not to mention more income tax revenues through population growth!