Twins among the four Asian tigers?
A comparison of Hong Kong and Singapore from economic and location data.

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IBM Applied Data Science Capstone Project on Coursera

a. ***Abstract:*** Hong Kong and Singapore are two major financial hubs in the world economy. Not only these two "tigers", as they are often called, are similar geographically, they are also similar in terms of economic indicators like the growth domestic product and standards of living. We propose here to revisit some of their similarities and try to point out differences between the two economies using data science methods. We especially use location data in order to characterize and compare their different neighborhoods with machine learning techniques. In other words, we try to examine the two Asian tigers from data and see whether they are twin tigers or not.

b. ***Context of study:*** This project is written in the context of the final project of the IBM Data Science certification on Coursera. The data science presented in this paper is done with Jupyter notebook and is available on my Git Repository at the following address:

`https://github.com/FabienNugier/Coursera_Capstone`

c. ***Period:*** The project was started on Oct. 24, 2019 and submitted on October 30, 2019, spending about 50% of my work time on it.

October 30, 2019

Contents

I. INTRODUCTION: PRESENTATION OF THE TWO TIGERS

Hong Kong (HK) and Singapore (SG) are two of the four Asian tigers – along with Taiwan and South Korea – and they share multiple common features which make them suitable for a comparison without too much calibration, as we would need for example when comparing very large and small economies.

According to Wikipedia [1, 2], the populations of Hong Kong and Singapore in 2018 were respectively 7,451,000 and 5,638,676, hence Hong Kong's population being roughly 32% higher than Singapore. Still in 2018, the labour force in Hong Kong was 3,955,349 while being 3,377,908 in Singapore. This makes Hong Kong labor force just 17% higher than Singapore's, bringing the two economies to a relatively equal footing in terms of working populations.

In terms of geography, Singapore's area is 725.1 km^2 while Hong Kong reaches 1,108 km^2. Both territories host major world container ports, going hand in hand with their free trade policies, Singapore being ranked 2nd while Hong Kong ranking 7th. Economic sectors are slightly different between the two tigers, as summarized in the Table I taken from Wikipedia, Singapore being much more present in the industry sector than Hong Kong.

Asian Tiger	agriculture	industry	services
Hong Kong	0.1 %	7.6 %	92.3 %
Singapore	0.7 %	25.6 %	73.7 %

TABLE I: GDP by sector (2017 estimates) data.

In terms of Growth Domestic Product (GDP), which corresponds to the total monetary value of all the finished goods and services produced within a country border [3], the two tigers are doing very well considering the size of their population, and this is certainly in part to be attributed to their low taxation rates for companies, their important presence on international financial markets and their high economic freedom policies. In 2018, Singapore was ranked 34th in the world with a GDP of 364,157 million USD, and Hong Kong 35th with 362,993 million USD (US dollar). In 2017, the GDP growth of the two tigers was respectively 3.8% (HK) and 3.7% (SG). In 2018, the GDP growth was also quite similar between them with 3.0% (HK) and 3.1% (SG). Since the two economies have very close GDPs but slightly smaller population for Singapore, this makes Singapore's GDP per capita (i.e. GDP / population) higher. In 2018, Hong Kong's GDP per capita was 48,717 USD, ranking 14th in the world, while Singapore ranked 7th with 64,582 USD.

According to Table II, Hong Kong and Singapore were respectively ranked 2nd and 3rd in trade-to-GDP ratio among all the countries in the world (data from 2017). Although this indicator tends to favor small economies (others to mention being Luxembourg and Ireland), it is still a clear indication that these two Asian tigers are centers of trade and major actors in the world economy. Considering this, we can easily wonder how people's life is affected by the economy on a daily basis. One very important indicator of the standard of living is the Consumer Price Index (CPI) which measures the average price of a basket of consumer goods and services [4].

Last, but not least, we should remind ourselves that Hong Kong and Singapore are megacities hosting millions of people, and we can wonder how these cities (or group of connected cities) compare in terms of shops, restaurants, facilities, etc. According to an online article on *Culture Trip* [5], Hong Kong prevails in terms of attractions and shops, but both places are world-class top locations when

Asian Tiger	Exports of goods and services (% of GDP)	Imports of goods and services (% of GDP)	Imports and Exports (% of GDP)
Hong Kong	188.0 %	187.1 %	375.1 %
Singapore	173.3 %	149.1 %	322.4 %

TABLE II: Trade-to-GDP ratio according to the world bank's 2017 data.

it comes to restaurants and multicultural cuisines. Housing in Singapore is more affordable than Hong Kong. Both cities have very low crime rates and high cost of living, but Singapore does better in education and pollution rankings. As we can see, the two tigers have similarities and variations that need to be further explored and quantified.

We will thus consider here the GDP and CPI in the first place in order to understand Singapore and Hong Kong on a global scale. We will then focus more on location data in order to get a more detailed description of their economic activities. This work can benefit different kinds of stakeholders, for example of company or a bank hesitating between Singapore and Hong Kong for a forthcoming implantation. It can also be useful to a travel agency that wishing to compare some cities in the world with these two locations, and better serve requirement of clients. We describe the data collected for this work in Sec. II, present the results in Sec. II, discuss further directions that could be explored in Sec. IV, and conclude in Sec. V.

II. METHODOLOGY: COLLECTED DATA

In this section we briefly explain how the data is collected and which operations are done on it to make it usable for data exploration and modeling.

A. GDP data

We obtain GDP data as well as other economic indicators from the UNdata website [6]. These economic indicators concern both Singapore and Hong Kong in the period 1981-2017, but are given in local currencies. In order to make them comparable, we need currency exchange rates with another currency, e.g. the USD. We use exchange rates data given by *Investing.com* which provides monthly averaged values for HKD/USD and SGD/USD (see e.g. [7]). Since we have month averages, we take their average over each year to match with our year estimates of the GDPs. Cleaning the data, we get values for HKD/USD going from 1977 to 2017, while for SGD/USD the values are only available from 1981 to 2017. This data allows us to convert GDP values for each year into USD currency.

In addition to GDP values, the csv (comma-separated values) file offered by UNdata also contains expenditures of "final consumption", "household consumption" and "general government final consumption". These data columns are also converted in USD for comparison.

B.   CPI data

CPI data for Singapore is obtained from the *Department of Statistics Singapore* [8]. It provides yearly averaged prices for about 30 types of goods and also averaging a basket of goods according to their category of prices (all items lowest 20%, Middle 60%, Highest 20%). The data spans the years range 1993-2018.

CPI data for Hong Kong is obtained from the *Census and Statistics Department* [9] and contains about 25 prices by month and by year averages. We only exploit year averages of 5 indexes: "Food", "Housing", "Clothing and footwear", "Durable goods" and "Transport". After cleaning the data, the years range goes from 1982 to 2018.

C.   Localisation and Venues data

We obtain the list of several location names in each of the 28 districts of Singapore from *iProperty.com* [10] and use *Latitude.to* [11] to find their latitude and longitude that we add by hand to a csv file. When different names appear in *Latitude.to*'s search engine, we take the location that appear the most relevant (usually variations are very small). We also do an average of locations by district in order to estimate the center of each of the 28 districts.

We obtain the districts names of Hong Kong taking the names from *Wikipedia* [12] and using *Latitude.to* to build a csv file by hand. Additionally, we scrape a page on *Geodatos.net* [13] to get the cities names and locations in Hong Kong. Both sets of locations are different as cities in Hong Kong are located in the valleys while districts can encompass large areas of mountains.

Finally, all the data concerning venues in Singapore and Hong Kong, such as shops, restaurants, facilities, etc., are generated directly from commands inside the *Jupyter notebook* [14], using a *FOURSQUARE developers* account [15] to gather all the venues at multiple locations. This data accounts for a large portion of all the data used in this work.

III.   RESULTS: WHERE THE TIGERS LOOK ALIKE AND WHERE THEY DON'T

IV.   DISCUSSION: WHAT COULD BE IMPROVED

V.   CONCLUSIONS

Acknowledgement

I chose according to my personal interests.

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[15] FOURSQUARE Developers, `https://developer.foursquare.com/` See also the search engine at `https://foursquare.com/city-guide`