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Title：

Testing PPP Theory Using the Big Mac Index and the Starbucks Index

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Abstract

This paper outlines two indices – Big Mac Index and the Starbucks Grande Latte Index – used to test for whether purchasing power parity holds in the selected four countries – Canada, Hong Kong, Taiwan and Switzerland. US dollars was used as the base currency to test for over/under valuation and to see whether exchange rates for each of the four currencies move in respect to the over/under percentage values.

The over/under valuation percentage values for each year are calculated using the following formula:

(Implied exchange rate – Actual exchange rate) / (Actual exchange rate) x 100%

The implied exchange rate for each year is calculated using the following formula:

(Foreign Currency/Base US Currency)

The over/under percentage values were then graphed and superimposed over the currency exchange rate graph for each of the four countries to test whether PPP holds for each country based on each of the two indices.

Keywords：Big Mac Index, Purchasing Power Parity, Starbucks Grande Latte Index, Over/Under Valuation, Implied Exchange Rate, Actual Exchange Rate
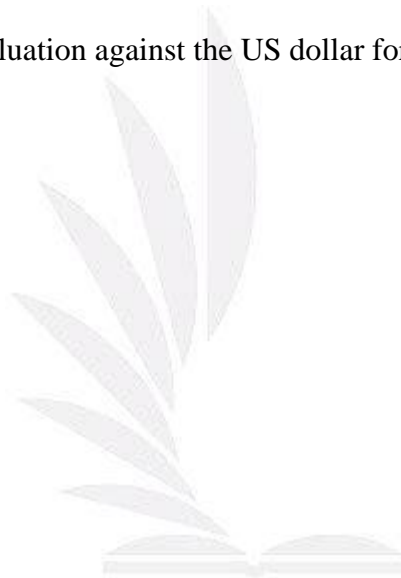
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I. Index One Introduction

i.   The Big Mac Index

Innovation and differentiation—the creation of things new and singular—are a boon to economic progress and the bane of economic measurement. It would be much easier to compare economies across borders and time if goods remained much the same, wherever and whenever they were made. Fortunately, amid all the creativity and complexity, the Big Mac remains something of a constant. It varies rather little from country to country or year to year. Its consistency is part of its appeal to customers. It is also why it appeals to us—as a handy benchmark for judging the strength of currencies and even the size of economies.

The Big Mac index was invented by The Economist in 1986 as a lighthearted guide to whether currencies are at their "correct" level. It is based on the theory of purchasing-power parity (PPP), the notion that in the long run exchange rates should move towards the rate that would equalize the prices of an identical basket of goods and services (in this case, a burger) in any two countries. For example, the average price of a Big Mac in America in July 2016 was $5.04; in China it was only $2.79 at market exchange rates. So the "raw" Big Mac index says that the yuan was undervalued by 45% at that time.

"Burgernomics" was never intended as a precise gauge of currency misalignment, merely a tool to make exchange-rate theory more digestible. Yet the Big Mac index has become a global standard, included in several
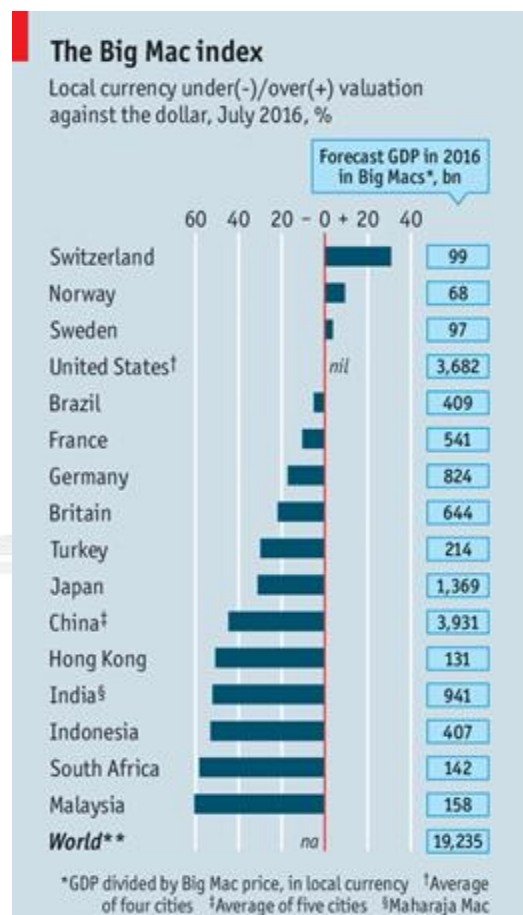
Figure 1.1   The Big Mac index: local currency over/under valuation % against the dollar (Jul 2006)

economic textbooks and the subject of at least 20 academic studies. For those who take their fast food more seriously, there was also calculated a gourmet version of the index.

This adjusted index addresses the criticism that you would expect average burger prices to be cheaper in poor countries than in rich ones because labor costs are lower. PPP signals where exchange rates should be heading in the long run, as a country like China gets richer, but it says little about today's equilibrium rate. The relationship between prices and GDP per person may be a better guide to the current fair value of a currency. The adjusted index uses the "line of best fit" between Big Mac prices and GDP per person for 48 countries (plus the euro area). The difference between the price predicted by the red line for each country, given its income per person, and its actual price gives a supersized measure of currency under- and over-valuation.

To calculate our Big Mac index, it was collect the price of the burger in 59 countries accounting for 94% of the planet's output. (In India, it was substitute by the Maharaja Mac, which is made with chicken rather than beef.) It turns out that some of these burgers are much cheaper than others in dollar terms. In America, a Big Mac costs $5.04 on average. In Hong Kong, by comparison, the same burger costs the equivalent of $2.50 or so. There are many potential reasons why Hong Kong's Big Macs are cheaper than America's. But one is that Hong Kong's currency is undervalued.

The Big Mac index thus provides a simple gut-check for judging the competitiveness of currencies. It compares each country's exchange rate with a hypothetical alternative: the rate that would equalize the price of a Big Mac around the world.

For the purpose of analyzing whether the PPP actually hold based on the Big Mac Index, we chose five countries from different levels of valuation on the index, USA (which is used as the base currency), Switzerland, Canada, Honk Kong, and Taiwan.

ii. Why we selected these five countries

At the beginning we wanted to choose each of our own countries, but there is not enough information for Paraguay or Peru, so we changed them to Switzerland – so that we have a European country – and Taiwan, to analyze the country where we are all living and studying now.

II.   Presenting and organizing the information from the Big Mac Index

According to the Purchasing Power Parity (PPP), the expenditure on a similar commodity must be same in both currencies when accounted for exchange rate ("Definition"). Spanning 120 countries, McDonalds is a very suitable company to gauge the PPP theory ("McDonald's"). By using the varying prices of the Big Mac in the five countries we chose, we are able to assess the validity of the PPP theory. If the PPP theory holds, the price of the Big Mac in a foreign country divided by the price of the Big Mac in the base country should yield the exchange rate between the two countries at the time.

For our data, we obtained a graph from The Economist that shows the implied exchange rate between the foreign country and the base country, which was calculated by the quotient of the Big Mac prices (H.D.). The graph spanned from the year 2000 to 2016. We then acquired the graph of the actual currency rate between the foreign country and the base country to compare how accurate the Big Mac Index was in postulating the actual exchange rate (XE). If the evolution of the implied exchange rate that was derived from the prices of the Big Mac were similar to the movement of the actual exchange rate, then the PPP theory holds. However, if the movements of the implied exchange rate were not similar to the movements of the actual exchange rate, then the PPP theory does not hold.

	Implied exchange rate	Actual exchange rate
Canada	$\frac{C\$2.85}{USD\$2.51} = 1.14$	1.47
Hong Kong	$\frac{HK\$10.20}{USD\$2.51} = 4.06$	7.79
Taiwan	$\frac{NT\$70.00}{USD\$2.51} = 27.89$	30.60
Switzerland	$\frac{SFr\ 5.90}{USD\$2.51} = 2.35$	1.70

Table 2.1 Big Mac implied exchange rate vs the actual exchange rate for the four countries (Apr 2002)

The table above shows a comparison between the implied exchange rate and the actual exchange rate of the four countries using data from April of 2000. As you can see, there is a varying degree of difference between the implied and the actual exchange rate.

	Implied exchange rate	Actual exchange rate
Canada	$\frac{C\$6.00}{USD\$5.04} = 1.19$	1.30
Hong Kong	$\frac{HK\$19.20}{USD\$5.04} = 3.81$	7.76
Taiwan	$\frac{NT\$69.00}{USD\$5.04} = 13.69$	32.03
Switzerland	$\frac{SFr\ 6.50}{USD\$5.04} = 1.29$	0.99

Table 2.2 Big Mac implied exchange rate vs the actual exchange rate for the four countries (Jul 2016)

The table above shows a comparison between the implied exchange rate and the actual exchange rate of the four countries using data from July 2016. There is a notable difference between the implied exchange rate and the actual exchange rate in both tables. However, while a snapshot of a period of time can be useful in gaining a detailed understanding of the data, an analysis of the validity of the PPP theory requires a more expansive perspective of the implied exchange rate and the actual exchange rate over time.

III. Big Mac Index Analysis

i. Does the PPP theory hold for the Big Mac?
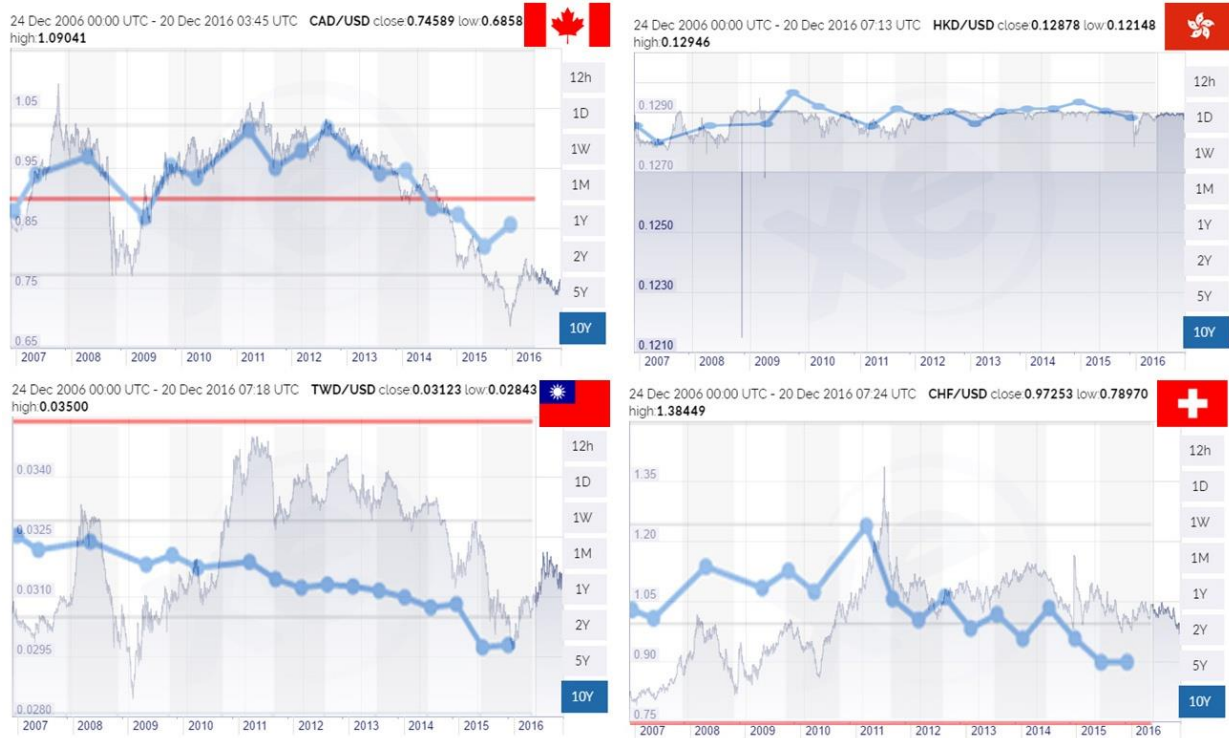
Figure 3.1   Big Mac over/under valuation % graphs vs local currency exchange rate graphs

From the compiled graphs, we can observe how the Big Mac Index (blue line) compares to the exchange rates. For Canada, we can say that the Big Mac holds. For Hong Kong and Switzerland, we can see the overall movements in both curves are similar. However, the level of discrepancy is big enough for us to presume that the Big Mac does not hold. Finally, for Taiwan it is very clear that the curves don't follow the same pattern over the years.

From the results we obtained, we can conclude that the Big Mac does not hold. When compared for Canada, a country which is more similar to the base country, the USA, the big Mac follows the exchange rate. But when compared with Taiwan and even Hong Kong and Switzerland, the discrepancies are big enough for us to say that the curves are inconsistent with each other.

ii. Why?

Finding out whether the Big Mac index holds or not is not enough. We need to be able to understand why it holds or why it does not. Although the Big Mac index would seem like a reasonable real-world measurement of purchasing power parity, this methodology has some limitations. In many countries, eating at international fast-food chain restaurants such as McDonald's is relatively expensive in comparison to eating at a local restaurant. In addition, the demand for Big Macs is not as large in countries such as India as it is in the United States. This method includes factors that are not representative of the economy as a whole. For example; potential factors may include social status of eating at fast food restaurants such as McDonald's in a local market, what proportion of sales might be to expatriates, local taxes, levels of competition, and import duties on selected items.

Moreover, McDonald's uses different commercial strategies in many locations; which can result in big differences for a product. Thus, the price of a Big Mac will not reflect currency values, but local production and delivery cost, cost of advertising (considerable in some areas), and most importantly what the local market will bear.

One may also consider than in some markets, a high-volume and low-margin approach might make the most sense to maximize profit, while in other markets, a higher margin will generate more profit. Thus, the relative prices reflect more than currency values. For example, a hamburger costs only €1 in France, and €1.50 in Belgium, but overall, McDonald's restaurants are cheaper in Belgium. In conclusion, there are many social, cultural, and commercial factors that can affect the sale of the Big Mac in different countries which in turn affects the established price of the Big Mac in that country. These factors and their lack of presence in the PPP theory results in an inaccurate conclusion if one were to rely solely upon the PPP theory.

IV. Index Two Introduction

i. The Grande Latte Index

First of all, Starbucks is implanted in 70 countries and has more than 24 000 Stores in the world. Consequently, this company provide product by international scale. Starbucks appears in consumer habits and responds to a certain demand. There are more than 55 different drinks which proves that all people can find something to their taste.

Comparing to McDonald, there is a big similarity with numbers which has reinforced our idea for Starbucks. The King of Fast Food company prosper in a little more than 100 countries with 32000 Restaurants.
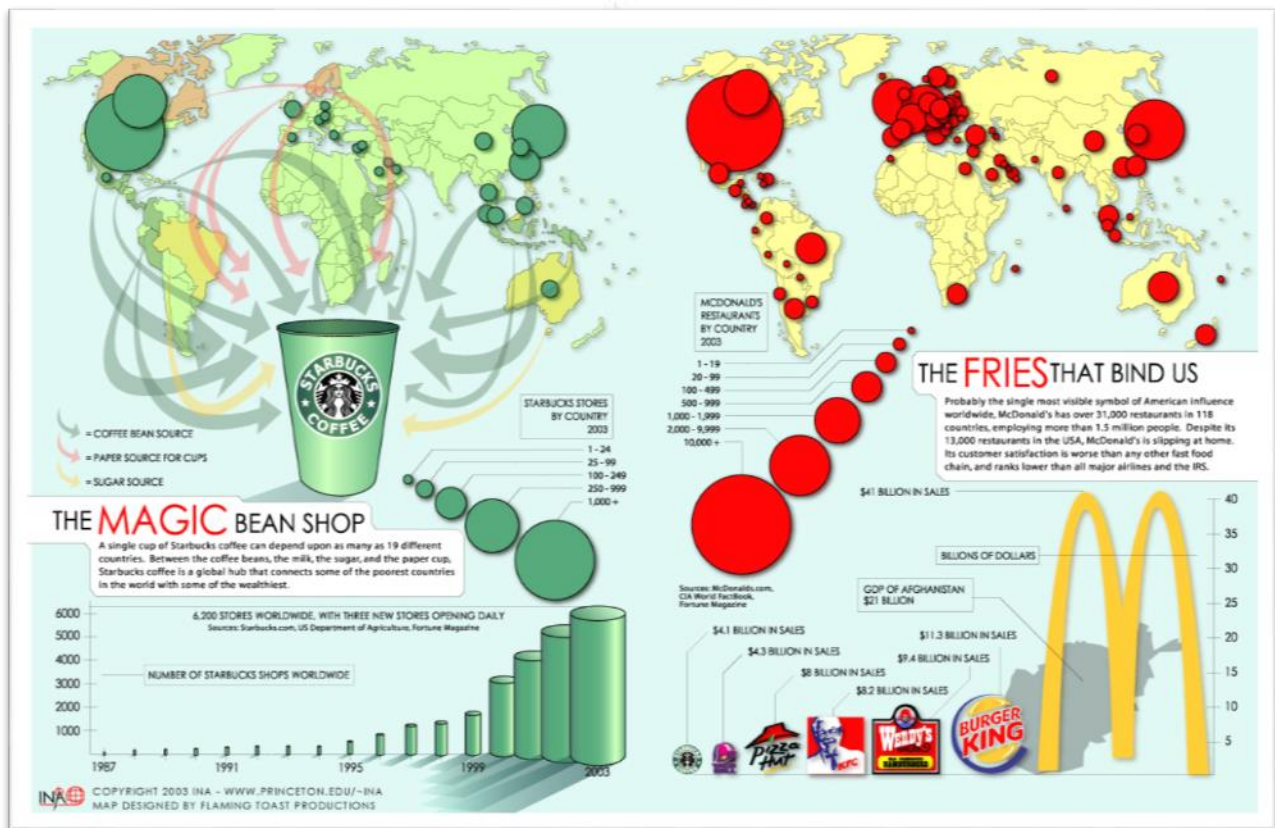

Figure 4.1   Graphic comparison between Starbucks and McDonald Stores in the world & the evolution of Starbucks stores since 1987

Finally, Starbucks is a stable company as we can see on this Graph just below. It shows the stock price since 1993 which is increasing gradually without big downfalls. Thereby we imagine that Starbucks is attractive for investors and also pleasant for customers.

Figure 4.2   Starbuck's stock price evolution (1993-2016)

ii.   Connecting the Grande Latte Index with PPP

There are 3 links that shows an interesting part with Purchasing Power parity:

1. Firstly, the Grande Latte has an easy access. Comparing to expensive products like a Car or Jewelry, everyone can buy a cup of coffee. Consequently, the number of potential consumer and the real consumer is very high which is very good in order to make some statics. It reduces risks of error.

2. Then the product has some similarity with the Big Mac which make the analysis also easier. For instance, the price of a Big Mac and Grande latte are around $5 depending the countries. Big Mac index reflect the purchasing power parity in countries. In a marketing perspective, McDonald and Starbucks have also the same strategy to beat their competitors: Differentiation from the Top & good image for clients.

3. Finally, the Purchasing Power Parity represents an important aspect about the general economic situation of a country but also about a market. Starbucks index shows an economic situation from

a country with Grande Latte because of Inputs. When a coffee is sold, there are many activities like Client service or Commodities that are supported. Principal activity & Support Activity need to be relatively stable if the market to which they are linked does not undergo voltage.

iii. Limitations of the Grande Latte Index

From one country to another, a lot of things are tending to change. Those facts reflect on the Purchasing power parity and at the same time on the Starbucks index.

First of all, consumer's habits represent an important impact on the price. Consequently, it raises the question if the purchasing power parity keeps an important role. For instance, Starbucks is a typical creation of America. Just like McDonald, products are made to be taken out, eaten on the street. But in some countries like France or Switzerland, it is not common to drink or eat a sandwich outside by walk.

Then Culture & Ethics play an important role in the price movement. The price may also change because of the image that the product reflects. The coffee from the gas station will not have the same price of a coffee from a Starbucks store. This is why the price can fluctuate between countries too. In Switzerland, the product looks more prestigious and luxurious than America.

Furthermore, the Law system variates between geographic places. Even if there are no tax imports in Europe, it's not the case in all the world. Consequently, Companies like Starbucks needs to adapt their price with surplus of costs.

Because coffee is a commodity, the price fluctuates by indirect factors like temperature and climate for instance. It is difficult to guarantee the same price on a long period.

Finally, the past proved us that Purchasing Power Parity tends to give false signal, especially with instable currencies like Deutsche Mark or French Franc. In that kind of situation, it is difficult, even impossible to analyze some statistics. Thereby we choose 5 countries without a currency that shows a huge risk like this. As we can see Starbucks index has the same failure than the Big Mac index, so it's a very good signal to use as a source of comparison.

V.   Presenting and organizing the information from the Grande Latte Index

	Price of a Grande Latte	Implied Exchange Rate
US	US$3.65 (base)	1.00
Canada	CAD$3.95	1.08
HK	36 HK$	9.86
Taiwan	105 TWD	28.77
Switzerland	5.90 CHF	1.62

Table 5.1 Starbucks implied exchange rate table

The table above lists the price of a single Grande Latte in their respective currencies (sold in their respective countries). To find out the implied exchange rate, you take the price of the currency that you want to compare with the base US currency and divide it by the price of the base US currency.

Example CAD$3.95/US$3.65 = $1.08 which implies that it if the Grande Latte Index holds true, the actual exchange rate for US$1 should be CAD$1.08.

Because the price of a single Grande Latte a decade ago has not changed significantly compared to the price of a single Grande Latte in 2016, we will be using the same implied exchange rate for all 10 years (taking obvious errors into account).

Country	12/2016 Actual Exchange Rate	12/2015 Actual Exchange Rate	12/2014 Actual Exchange Rate	12/2013 Actual Exchange Rate	12/2012 Actual Exchange Rate	12/2011 Actual Exchange Rate	12/2010 Actual Exchange Rate	12/2009 Actual Exchange Rate	12/2008 Actual Exchange Rate	12/2007 Actual Exchange Rate	12/2006 Actual Exchange Rate
USA	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
CAN	1.34	1.40	1.16	1.07	0.99	1.03	1.02	1.07	1.21	1.00	1.15
HK	7.77	7.75	7.75	7.75	7.75	7.78	7.78	7.76	7.75	7.80	7.78
TW	32.00	32.84	31.52	29.86	29.06	30.29	29.94	32.37	32.52	32.48	32.62
SUI	1.03	0.99	0.98	0.90	0.91	0.93	0.96	1.04	1.10	1.16	1.22

Table 5.2 Starbucks actual exchange rate table (2006-2016)

The above table lists the actual exchange rate against the US dollar for each of the four countries. The figures were obtained from XE.com using their historical currency rates (using December 20th of each year).

	Dec-06	Dec-07	Dec-08	Dec-09	Dec-10	Dec-11	Dec-12	Dec-13	Dec-14	Dec-15	Dec-16
Canada	-6.09%	8.00%	-10.74%	0.93%	5.88%	4.85%	9.10%	0.93%	-6.90%	-22.86%	-19.40%
HK	26.74%	26.41%	27.23%	27.06%	26.74%	26.74%	27.23%	27.23%	27.23%	27.23%	26.90%
Taiwan	-11.80%	-11.42%	-11.53%	-11.12%	-3.91%	-3.48%	-1.00%	-3.65%	-8.72%	-12.39%	-10.10%
Switzerland	32.79%	39.66%	47.27%	55.77%	68.75%	74.19%	78.02%	80.00%	65.31%	63.64%	57.30%

Table 5.3 Starbucks over (+)/under (-) valuation against the dollar (2006-2016)

The above table lists the over/under valuation against the dollar. A negative sign denotes that the currency is trading for however percentage **less** than its actual value against the US dollar (according to the implied exchange rate), and a positive sign denotes that the currency is trading for however percentage **more** than its actual value against the US dollar (according to the implied exchange rate).

An example of how the valuation is calculated:

(Implied exchange rate – Actual exchange rate) / (Actual exchange rate) x 100%

Calculating the over/under valuation for Dec-2006 for Canada:

(1.08 – 1.15) / (1.15) x 100% = -6.09%

Figure 5.1   Starbucks over/under valuation against the US dollar for Canadian dollars (2006-2016)

The above graph (left) is obtained by graphing the over/under valuation against the dollar for Canadian dollars from Dec 20, 2006 to Dec 20, 2016. The above graph (right) shows the exchange rate of CAD$ against the US$ from Dec 24, 2006 to Dec 20, 2016. For the Grande Latte Index to hold true, when you superimpose the left graph on top of the right graph, the trend (rise and fall) of both graphs should be similar if not identical, and vice-versa.
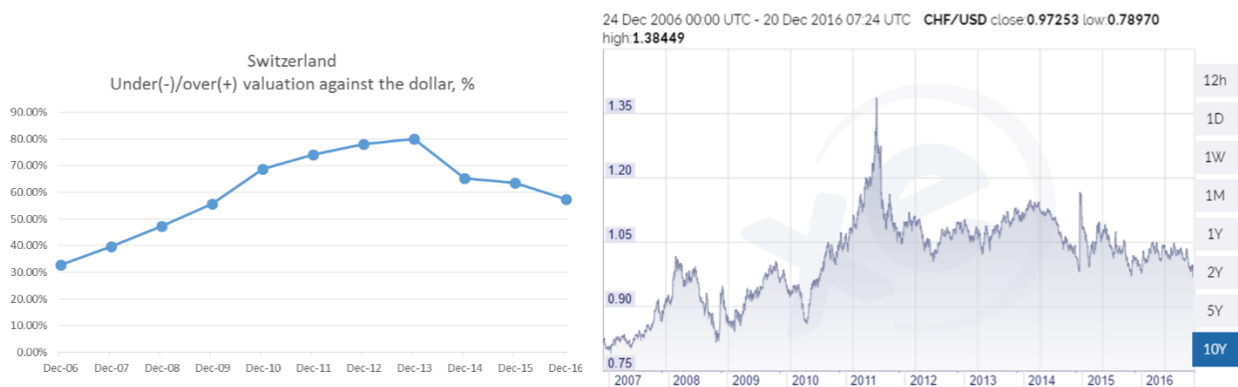
Figure 5.2   Starbucks over/under valuation against the US dollar for HK dollars (2006-2016)

   The above graph (left) is obtained by graphing the over/under valuation against the dollar for Hong Kong dollars from Dec 20, 2006 to Dec 20, 2016. The above graph (right) shows the exchange rate of HK$ against the US$ from Dec 24, 2006 to Dec 20, 2016. For the Grande Latte Index to hold true, when you superimpose the left graph on top of the right graph, the trend (rise and fall) of both graphs should be similar if not identical, and vice-versa.

Figure 5.3   Starbucks over/under valuation against the US dollar for Taiwan dollars (2006-2016)

   The above graph (left) is obtained by graphing the over/under valuation against the dollar for Taiwanese dollars from Dec 20, 2006 to Dec 20, 2016. The above graph (right) shows the exchange rate of TWD against the US$ from Dec 24, 2006 to Dec 20, 2016. For the Grande Latte Index to hold true, when you superimpose the left graph on top of the right graph, the trend (rise and fall) of both graphs should be similar if not identical, and vice-versa.

Figure 5.4   Starbucks over/under valuation against the US dollar for the Swiss Franc (2006-2016)

The above graph (left) is obtained by graphing the over/under valuation against the dollar for the Swiss Franc from Dec 20, 2006 to Dec 20, 2016. The above graph (right) shows the exchange rate of CHF against the US$ from Dec 24, 2006 to Dec 20, 2016. For the Grande Latte Index to hold true, when you superimpose the left graph on top of the right graph, the trend (rise and fall) of both graphs should be similar if not identical, and vice-versa.

VI. Grande Latte Index Analysis

i.   Does the PPP theory hold for the Grande Latte Index?

Though the diagram from part V, we can see how the Grande Latte Index compares to the exchange rates. We can tell that the Grande Latte Index holds in Canada. To Hong Kong, we can see from the graph the overall price movement is stable and similar with the exchange rate, even it is consistently overvalued by 25%, but I will say it still holds by PPP. For Taiwan and Switzerland, the movement it is larger than other country that we chose, they are not that stable and their price have a big different to compare with US. So we can say they are not hold by PPP in Taiwan and Switzerland.

ii.   Why?

From the above information, we knew that PPP holds some of the country in Grande Latte Index. So there is different reasons, first of all it is about the location, the distance between Canada and US is 2,262 km, Hong Kong is 12,719 km, Switzerland is 8,031km and Taiwan is 12,261 km. we can see that Canada have the shortest distance with US. That mean Canada have the location advantage, because they can receive the information faster that they do not have that big time different compare with other country and shorter distance.

On the other hand, the social perception is also an important reason that affect. To foreign country like Canada, Starbucks is a store that they already accustomed to it, Starbucks is just a normal shop to them. On the other side, in Asia like Hong Kong and Taiwan, it is like a luxury for young people, because of the price setting is high to them. Also, in these country they have a lot of beverage shop to choose, it makes the demand of the Starbucks is lower since it have so many subsidy, that makes the price getting higher and higher. That can explain why Canada have the most similar price with US.

Apart from that, the cost of living is another major reason influences the PPP holds in that country or not. The consumers Prices in US are 9.38% higher than Canada, Hong Kong are 5.6% higher than in United States, Taiwan are 19.46% lower than in United States, United States are 35.73% lower than in Switzerland. We can see that Hong Kong and Canada have the closer consumer price. But we have to notice that the price of restaurant in Hong Kong is 89.86% higher than US. That why we can see the price of Grande Latte in Hong Kong is much more expensive than other countries even US.

The last thing that we have to know that Hong Kong currency is pegged with US dollar, so the exchange rate is going to be really stable to compare with other country. That can explain why Hong Kong have a much higher cost of living but the price is more stable than other country even Canada. That is how PPP holds in Hong Kong's Grande Latte.
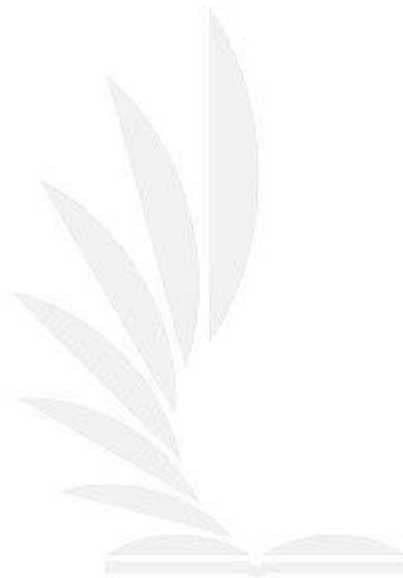
VII. Conclusion

Using the Big Mac Index, we found out that PPP does indeed hold for Canada; to a lesser degree for Hong Kong and Switzerland; and not at all for Taiwan. We consider Canada's case to be a result of geological proximity and similarity to the base country and not because the Big Mac Index holds. We believe that the Big Mac Index is limited in its methodologies in that it fails to account for factors such as social statuses, consumer preferences in each economy, differences in advertising strategies in each region, and prices set as a result of sales strategies (i.e. high margin vs high volume approach). The lack of inclusion of these factors in the PPP theory makes it a limited approach to explaining exchange rate fluctuations and trends.

Using the Grande Latte Index, we found out that PPP does again hold for Canada; to a fair degree for Hong Kong; and not much for Taiwan and Switzerland. We feel that the Grande Latte Index is also inadequate methodically as it fails to take into account many factors such as differences in marketing, the rate of inflation, cost of living, employment levels (GDP/person), tax levels and market conditions. We attribute the closeness of the Canadian and Hong Kong over/under valuation graphs to the exchange rate

graphs to the former's proximity to the base country and the former's similarity in cost of living/GDP per person/marketing and market conditions; for the latter we attribute the result to the HK$ being pegged to the US$. That factor alone is a good explanation for why PPP seems to hold for Hong Kong, and not necessarily because the Grande Latte Index supports the PPP theory.

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