International Finance

Does the Purchasing Power Parity (PPP) hold between Mexico, USA and Japan?

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Introduction

This report will investigate whether the Purchasing Power Parity (PPP) holds between Mexico, USA and Japan. This theory investigates the alternating trends of exchange rate movement due to the variance of inflation rates between countries.

The PPP Theory has two forms; the absolute form and the relative form of PPP.

The absolute form assumes that without international trade barriers and tariffs and costs of transport, consumers will purchase their goods wherever the prices are lower. The same basket of goods in two different countries should in theory be equal to one another. In the scenario where there is a difference in price, demand should shift so the prices correspond with one another.

The relative form is the likelihood of market volatility when transportation costs, tariffs and quotas are taken into account, the prices of the same basket of goods will not inevitably be the same. The rate of change in the prices of the baskets should complement each other as long as the costs remain constant.

Mexico has been chosen as the home currency. The USA and Japan have been chosen as the foreign currency. These countries have been selected as they are part of the Asia-Pacific Economic Corporation and all have their own individual currencies. Three countries have been chosen to establish whether they have a correlation between each other or whether they produce contrasting results.

The data will be collated from the Economist Intelligence Unit (EIU), and will be analysed using Minitab via a regression analysis to conclude whether there is statistical evidence that the PPP holds between the three currencies.

Test Design

The data used to test the PPP theory will be the Local Currency Unit (LCU) Mexican pesos (Mex$) to the US dollar (USD $) and the Mex$ to the Japanese yen (JPN ¥). The exchange between the Mex$ and JPN ¥ will be cross exchanged from the USD $ and the JPN ¥. This data will evaluate the change in the value of the currency unit.

The Consumer Price Index (CPI) data for each country will be analysed and will determine the difference between inflation at home and the inflation in the foreign country.

Monthly data will be collated as the time period for Mexico and the USA will be 1994-2018 and Mexico and Japan will be 2005-2018. These specific timeframes signify when the Asia-Pacific Economic corporation (free trade agreement) was agreed between the two countries. The volume of data will provide a more insightful analysis of evidence.

The following formula will be used to establish whether inflation and exchange rates represent a correlation between each other.

e_F = Change in the value of the foreign currency

$infl_H$ = Inflation at home (Mexico)

$infl_F$ = Inflation at foreign country (USA & Japan)

$exch_H$ = Exchange rate at home (USDMEX) or (JPNMEX)

$exch_F$ = Exchange rate at foreign country (USD or JPN)

$$e_F \approx infl_H - infl_F$$

e_F was calculated by:

$$e_F = [(exch_t - exch_{t-1})/(exch_{t-1})] \times 100$$

Cross exchange rate formula to determine JPNMEX:

1 USD ($) = JPN (¥) exch

1 USD ($) = MEX (Mex$) exch

JPN¥:Mex$ = Mex$/1$

The below regression formula will be used in Minitab:

$$e_F = \alpha + \beta\,(infl_H - infl_F) + \varepsilon$$

e_F = Change in the value of foreign currency

α = constant

β = coefficient

$infl_H$ = Inflation at home (Mexico)

$infl_F$ = Inflation at foreign country (USA & Japan)

ε = error

Data Sample One – USAMEX

Below (Fig.1) is the data sample taken from the EIU database displaying the home currency Mex$ versus the foreign currency USD. This data shows the percentage difference in the change of value in the currency unit, the difference in inflation, and the error. The disparity in purchasing power displayed in the final column, shows whether the same basket of goods would be relatively cheaper or more expensive in the home country. The calculation is pulled from the consumer prices percentage change and the error, between the change in value of foreign currency and difference in inflation between the two countries. The formula returns whether the home country goods (Mexico) are cheaper relative to foreign goods or, whether foreign goods (USA) are cheaper relative to the home country goods.

A scatter graph will show whether there is any correlation between the exchange rate and inflation rate using Minitab.

Year	Monthly	USD	USD/MEX	ef	Mexico (Home)	USA (Foreign)	Difference Inflation %	Error	Disparity in purchasing power
		$	$/Mex$	(the change in the value of a foreign currency unit) (% difference)	Consumer prices (% change)	Consumer prices (% change)	(infl.h-infl f)	ef = (infl.h-infl.f)	Home or foreign goods cheaper
1994	Jan	1.0000	3.1075	-	7.5	2.5	5.0	-	-
	Feb	1.0000	3.1115	0.1287	7.2	2.5	4.7	-4.5313	Mexico goods cheaper relative to US goods
	Mar	1.0000	3.2841	5.5472	7.1	2.7	4.5	1.0972	Mexico goods cheaper relative to US goods
	Apr	1.0000	3.3536	2.1163	7.0	2.4	4.6	-2.5297	Mexico goods cheaper relative to US goods
	May	1.0000	3.3120	-1.2405	6.9	2.3	4.6	-5.8685	Mexico goods cheaper relative to US goods
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
2018	Jan	1.0000	19.0025	-0.3148	5.5	2.1	3.5	-3.7668	Mexico goods cheaper relative to US goods
	Feb	1.0000	18.6282	-1.9697	5.3	2.2	3.1	-5.0917	Mexico goods cheaper relative to US goods
	Mar	1.0000	18.6839	0.2990	5.0	2.4	2.7	-2.3770	Mexico goods cheaper relative to US goods
	Apr	1.0000	18.3464	-1.8064	4.6	2.4	2.1	-3.9374	Mexico goods cheaper relative to US goods
	May	1.0000	19.4894	6.2301	4.5	2.7	1.8	4.4641	Mexico goods cheaper relative to US goods

Fig.1 (Data sample, EIU Database and excel formula calculations)

Test Results

The scatter plot below shows the difference in inflation as a percentage (% Diff Infl.) versus the percentage change in the value of currency (e_f). The cluster on the graph indicates the majority of the data is represented by small changes from the % Diff Infl. versus e_f, however there are over 50 instances of outliers between the two.

The largest outlier was in January 1995 with a 40.2590% percentage change in the currency value which represents the Mexican Financial Crisis (Tequila Crisis) caused with a devaluation in the Mexican peso (The Economist, 2012). It is worth noting that in January 1995, USA goods were cheaper relative to Mexican goods. However, the unusually high percentage differences in March 1995 (17.8791%) and November 1995 (14.4565%), Mexican goods were still cheaper in relation to USA goods.

The difference in September 1998 (10.3223%) is due to the Asian financial crisis (The Economist, 1998), in this period Mexican goods were still cheaper relative to USA goods. The difference in October 2008 (17.9622%) is the world financial crisis, in this case the USA was particularly impacted in reference to the Lehman Brothers, during this period USA goods were cheaper relative to Mexican goods due to the value of USD depreciating substantially. This is shown by taking Inflation at home – Inflation at foreign country which is greater than the change in value of the foreign currency or Inflation at home is greater than Inflation in foreign country + the change in value of the foreign currency. ($I_h - I_f > e_f$ or $I_h > I_f + e_f$).

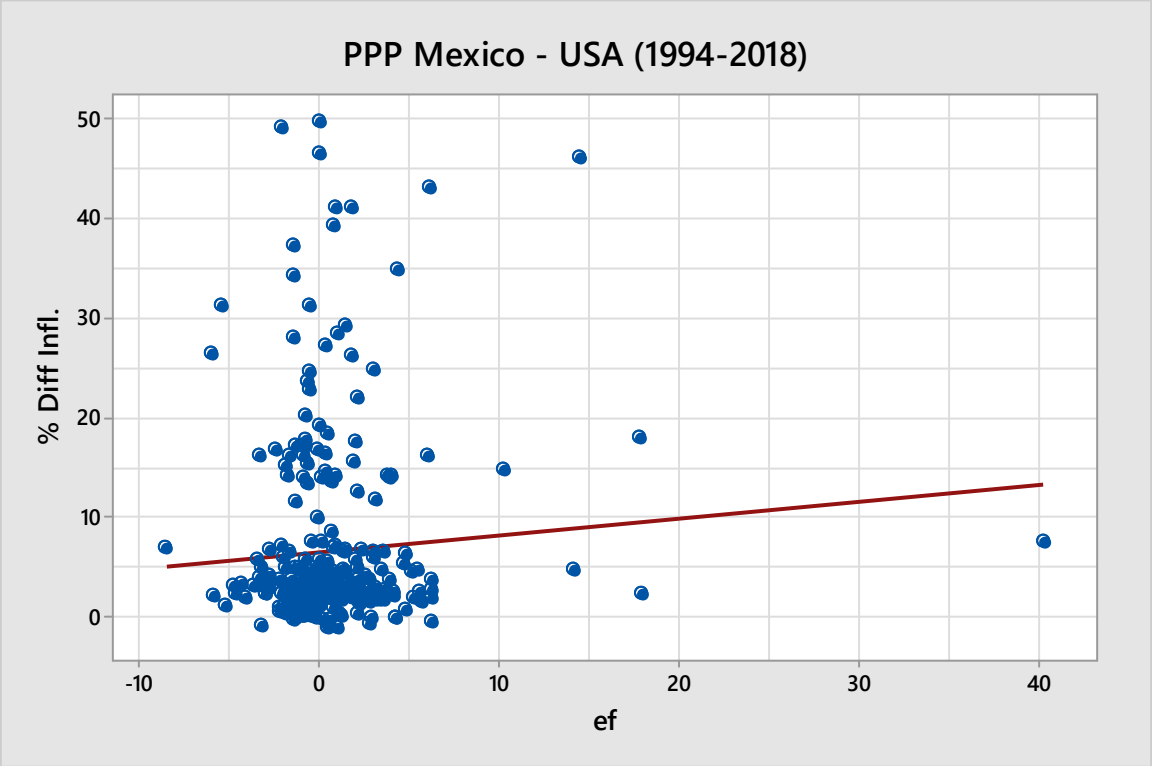

Fig.2 (Regression scatter plot, Minitab)

The regression analysis (fig.3) has produced a result of R-squared 0.44%, is explained by the difference in inflation meaning that 0.44% of the variation in the dependent variable, (i.e. e_F representing the percentage change in foreign currency.) This is a very low R-squared value and there is no significance between the change in the value of currency and the difference in inflation. This demonstrates that there are many other factors apart from the difference in inflation, that affect the exchange rate which are not included in these results.

The estimated regression equation is as follows:

$e_f = 0.519 + 0.0264$ % Diff Infl.

The coefficients value of 0.0264 suggests that for every 1% change in the value of the monthly difference in inflation of Mexico is associated with 0.0264% change in the value of the foreign currency. The P value has estimated is 0.0252, as this is not greater than 0.05, we cannot reject the H_o null hypothesis, meaning that the estimated coefficient is technically significant with 95% confidence.

Regression Analysis: ef versus % Diff Infl.

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	1	18.51	18.5052	1.32	0.252
% Diff Infl.	1	18.51	18.5052	1.32	0.252
Error	297	4170.18	14.0410		
Lack-of-Fit	292	4165.40	14.2651	14.94	0.003
Pure Error	5	4.77	0.9548		
Total	298	4188.68			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
3.74713	0.44%	0.11%	0.00%

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	0.519	0.263	1.97	0.050	
% Diff Infl.	0.0264	0.0230	1.15	0.252	1.00

Regression Equation

ef = 0.519 + 0.0264 % Diff Infl.

Fits and Diagnostics for Unusual Observations

Obs	ef	Fit	Resid	Std Resid		
11	14.181	0.636	13.545	3.62	R	
12	40.259	0.713	39.546	10.57	R	
14	17.879	0.984	16.895	4.53	R	
16	-5.348	1.338	-6.686	-1.81		X
17	4.369	1.434	2.935	0.80		X
18	-1.347	1.498	-2.844	-0.77		X
19	0.839	1.547	-0.708	-0.19		X
20	1.803	1.599	0.203	0.06		X
21	6.166	1.652	4.514	1.24		X
22	14.457	1.729	12.727	3.51	R	X
23	0.017	1.824	-1.807	-0.50		X
24	-2.022	1.810	-3.833	-1.06		X
25	-0.008	1.739	-1.747	-0.48		X
26	0.925	1.599	-0.674	-0.18		X
27	-1.351	1.419	-2.770	-0.75		X
28	-0.493	1.337	-1.830	-0.49		X
29	1.453	1.284	0.168	0.05		X
30	1.066	1.262	-0.196	-0.05		X
31	-1.427	1.252	-2.680	-0.72		X
56	10.322	0.901	9.421	2.52	R	
177	17.962	0.573	17.389	4.65	R	
183	-8.483	0.697	-9.180	-2.45	R	

R Large residual
X Unusual X

Fig.3 (Regression analysis, Minitab)

Further Tests

Data Sample Two – JPNMEX

Year	Monthly	USD/JPN	USD/MEX	Cross exchange rate JPN/MEX	ef	Mexico (Home)	Japan (Foreign)	Difference Inflation %	Error %	Disparity in purchasing power
		$/¥	$/Mex$	¥/Mex$	(the change in the value of a foreign currency unit) (% difference)	Consumer prices (% change)	Consumer prices (% change)	(infl.h-infl f)	ef = (infl.h-infl.f)	Home or foreign goods cheaper
2005	Jan	103.3400	11.2556	0.1089	-	4.5	(3.8)	8.3	-	-
	Feb	104.9400	11.1502	0.1063	-2.4468	4.3	(4.4)	8.6	-11.0698	Japanese goods cheaper relative to Mexico goods
	Mar	105.2500	11.1326	0.1058	-0.4519	4.4	(4.0)	8.3	-8.7999	Japanese goods cheaper relative to Mexico goods
	Apr	107.1900	11.1262	0.1038	-1.8663	4.6	(3.7)	8.3	-10.1373	Japanese goods cheaper relative to Mexico goods
	May	106.6000	10.9920	0.1031	-0.6594	4.6	(3.5)	8.1	-8.7344	Japanese goods cheaper relative to Mexico goods
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
2018	Aug	111.0000	18.8089	0.1694	-1.1513	4.9	1.3	3.6	-4.7593	Japanese goods cheaper relative to Mexico goods
	Sep	112.1000	19.0539	0.1700	0.3085	5.0	1.2	3.8	-3.5175	Japanese goods cheaper relative to Mexico goods
	Oct	112.7200	19.0638	0.1691	-0.4984	4.9	1.4	3.5	-4.0104	Japanese goods cheaper relative to Mexico goods
	Nov	113.3400	20.2500	0.1787	5.6412	4.7	0.9	3.8	1.8162	Mexico goods cheaper relative to Japanese goods
	Dec	112.2000	20.1775	0.1798	0.6544	4.8	0.3	4.5	-3.8806	Japanese goods cheaper relative to Mexico goods

Fig.4 (Data sample, EIU Database and excel formula calculations

Between Mexico and USA using monthly data from 1994-2018 the PPP does not hold. This further test will be between Mexico and Japan using monthly data from 2005-2018 to determine whether the PPP holds between them.

The same scatter plot has been produced as the PPP scatter plot for USA-Mexico. This data has produced a different graph and set of results, where Mexico and USA showed a large cluster, Japan and Mexico shows data points below and above the regression line with no evident clusters. There are 11 outliers with the majority being between September 2008 and April 2009. In October 2009 the largest change in the value of currency was 25.7501%. This links in with world financial crisis. Japan has an unusual situation with ongoing deflation, which has been in effect from the end of the Asian financial crisis in the late 1990s (The Economist, 2011). In total there was 33 instances of where Mexican goods were relatively cheaper to Japanese goods. Due to the deflation issues Japan has faced it would be expected that the majority of the time Japanese goods would be relatively cheaper than Mexican goods.

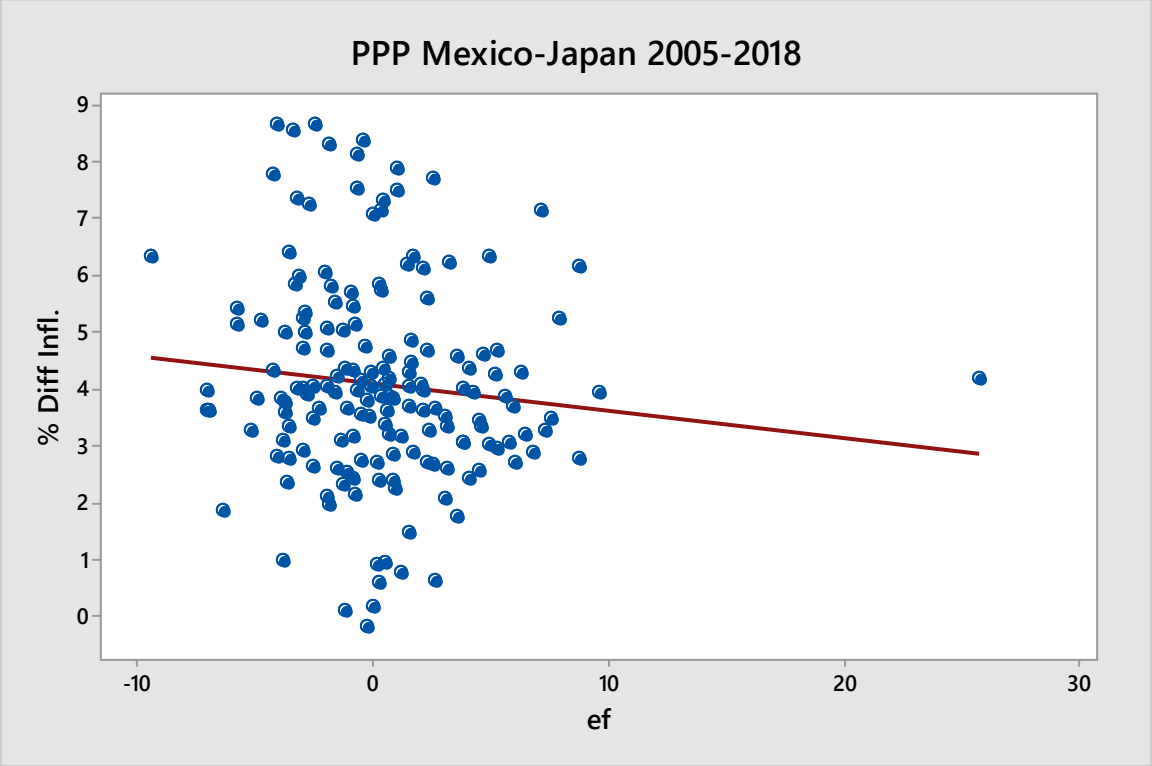

Fig.5 (regression scatter plot, Minitab)

The regression analysis (fig.5) has produced a result of R-squared 1.14% is explained by the difference in inflation meaning that 1.14% of the variation in the dependent variable, (i.e. e_F representing the percentage change in foreign currency.) This is a very low R-squared value and there is no significance between the change in the value of currency and the difference in inflation. This demonstrates that there are many other factors apart from the difference in inflation that effect the exchange rate which are not included in these results.

The estimated regression equation is as follows:

$e_f = 1.352 - 0.0239$ % Diff Infl.

The coefficients value of -0.239 suggests that for every 1% change in the value of the monthly difference in inflation in Mexico is associated with -0.0239% change in the Japanese value of foreign currency. The estimated P value has 0.170, as since this is not within the 0.05 significance level, we cannot reject the H_o null hypothesis meaning that the estimated coefficient is technically significant with 95% confidence.

Regression Analysis: ef versus % Diff Infl.

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	1	30.75	30.75	1.90	0.170
% Diff Infl.	1	30.75	30.75	1.90	0.170
Error	165	2667.56	16.17		
Lack-of-Fit	164	2604.54	15.88	0.25	0.952
Pure Error	1	63.02	63.02		
Total	166	2698.32			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
4.02083	1.14%	0.54%	0.00%

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	1.352	0.771	1.75	0.082	
% Diff Infl.	-0.239	0.173	-1.38	0.170	1.00

Regression Equation

ef = 1.352 - 0.239 % Diff Infl.

Fits and Diagnostics for Unusual Observations

Obs	ef	Fit	Resid	Std Resid		
1	-2.447	-0.705	-1.742	-0.44		X
2	-0.452	-0.639	0.188	0.05		X
3	-1.866	-0.621	-1.245	-0.32		X
5	-3.386	-0.674	-2.712	-0.69		X
6	-4.122	-0.706	-3.415	-0.87		X
45	25.750	0.363	25.387	6.33	R	
47	8.769	-0.108	8.877	2.22	R	
51	-9.463	-0.145	-9.319	-2.34	R	
101	9.578	0.426	9.151	2.28	R	
112	-0.248	1.406	-1.654	-0.42		X
132	8.791	0.705	8.086	2.02	R	

R Large residual
X Unusual X

Fig.6 (Regression analysis, Minitab)

Conclusion

According to the PPP theory, when the home or foreign currency changes in value versus the difference in inflation rates between both countries, the purchasing power between both countries should be maintained.

The regression results have both concluded that the PPP does not hold between Mexico, USA and Japan. There is no significance in the relationship between the two variables.

For further analysis a larger amount of data could be used as the data collated was restricted to certain timeframes in specific to the Asia-Pacific economic integration. The analysis could also be used on quarterly and yearly data. Other countries could also be compared from different continents such as Australasia, Asia, Africa, or the Americas.

References

The Economist. (1998, 01 22). *Taiwan and the Asian crisis*. Retrieved from The Economist - Print Edition Archive: https://www.economist.com/asia/1998/01/22/taiwan-and-the-asian-crisis

The Economist. (2011, 02 10). *Ending Deflation In Japan: An Old Problem*. Retrieved from The Economist Print Edition Archive: https://www.economist.com/finance-and-economics/2011/02/10/an-old-problem

The Economist. (2012, 09 22). *From tequila crisis to sunrise*. Retrieved from The Economist: https://www.economist.com/finance-and-economics/2012/09/22/from-tequila-crisis-to-sunrise