Economics Bulletin

Volume 36, Issue 4

iPad Purchasing Parity: Farewell to the Big Mac Index

Sandeep Mazumder
Wake Forest University

Abstract

It has been 30 years since The Economist magazine launched its popular Big Mac index-a playful way to test the theory of purchasing power parity (PPP). In this light-hearted follow-up investigation on the use of a single product to test PPP, we present evidence that The Economist should now ditch Big Macs and instead turn to iPads. When using data on Apple's iPad tablet computer, we find that the international prices on this product conform much more closely to PPP than the Big Mac does. This is in turn driven by the tradable nature of iPads, unlike the Big Mac which is a perishable product. Thus it is time to bid farewell to the Big Mac index in its 30th year, and time to usher in an updated test of PPP, namely the iPad index.

Citation: Sandeep Mazumder, (2016) "iPad Purchasing Parity: Farewell to the Big Mac Index", *Economics Bulletin*, Volume 36, Issue 4, pages 2128-2136
Contact: Sandeep Mazumder - mazumds@wfu.edu.
Submitted: September 06, 2016. **Published:** November 09, 2016.

1 Introduction

In 1986, The Economist magazine invented a light-hearted way in which to test the theory of purchasing power parity (PPP), namely the Big Mac index (for more details see The Economist, 2016). While the Big Mac index cannot seriously be a test of PPP since we consume far more goods and services than just Big Macs, it has become a global standard which is even included in several economic textbooks while also being the subject of numerous academic studies. It is an attractive index to follow due to the uniform composition of the Big Mac that comes from identical component ingredients that are used in its production worldwide, not to mention its whimsical nature.

This paper follows the tongue-in-cheek spirit of the Economist's Big Mac index to argue that we should test PPP by concentrating on an internationally-available product which is near-identical, regardless of the country in which it is purchased, yet which is tradable. We propose the iPad index, and present evidence that international iPad prices are far closer to obeying PPP than Big Macs. Hence, 30 years since the introduction of the Big Mac index, The Economist magazine should bid it farewell and instead launch the aforementioned iPad index.

2 Background

One of the early academic studies looking into the Big Mac index was Cumby (1996), who finds that the implied PPP exchange rate from Big Macs provides substantive content when predicting future exchange rates. Lutz (2002) finds that Cumby's findings also extend to many of the price series reported by UBS in their price indices, while Chen et al. (2007) find that Big Mac prices approximate PPP more closely than the consumer price index does. Similarly, Ong (1997) reports that the Big Mac index tracks long-term exchange rates quite accurately, while Click (1996) presents time series evidence in favor of the Big Mac index's test of PPP.[1] Landry (2013) uses Big Mac prices to examine border frictions that exist between different countries, and finds little evidence of price wedges between international Big Mac prices.

The theoretical and practical limitations of the theory of PPP are widely-known: the existence of transport costs, trade barriers, and tax differentials, different typical consumer baskets in different countries, the ability of firms to price-to-market in some countries, and lastly goods and services which cannot be traded (Pakko and Pollard, 2003 provide a nice discussion of these factors). The latter is one large problem that faces the Big Mac index (other than the fact that we are assuming Big Macs to be the only good in a typical basket of goods and services). Being a food product, Big Macs are clearly non-tradable due to their perishability.[2] Crucini and Landry (2012) explicitly show the implications of this by highlighting the importance of distinguishing between traded and non-traded goods and services when comparing international retail prices.

[1] Kitamura and Fujiki (2004) argue that Click's results are not robust to alternative estimation methods and alternative time periods.

[2] Landry (2008) presents interesting evidence on the variation of Big Mac prices even within the United States.

3 Data and Calculations

3.1 The iPad Index

Our data on worldwide iPad prices come from HuMuch.com, which is a global price comparison website. To verify the reliability of the data from HuMuch.com, we examine the prices of Big Macs reported on HuMuch.com against those reported by The Economist's Big Mac index. Figure 1 plots the log of Big Mac prices from HuMuch.com against those from The Economist, where we see a 45-degree line fits the scatter points nearly perfectly, thus assuring us of the reliability of our data.[3]

We next take the iPad price data from HuMuch.com from 25 countries.[4] We then take the local price of the iPad in each country and divide by the U.S. price of $499 to obtain an implied PPP exchange rate. For instance, in Germany the iPad retailed for €399, implying a PPP exchange rate of €399/$499=€0.800 per dollar. We can then calculate the amount of over- or undervaluation of the actual exchange rate relative to the PPP exchange rate.[5] For instance, the foreign exchange market rate was €0.788 per dollar at the time, implying that the euro was 1.441% overvalued against the dollar.[6]

Finally, we can compare the amount of over/undervaluation implied by iPad prices against The Economist's Big Mac series on over/undervaluation. Figure 2 visually shows how the series compare, where with the exception of one or two countries, the iPad series produces much smaller magnitudes of over/undervaluation. We then compare these series more rigorously in four different ways, the statistics for which can be seen in Table 1.

First we sum the absolute values of the amount of over- or undervaluation for each country when using iPad or Big Mac prices. For the former, we obtain a statistic of 334.38, and for the latter 636.44. This means that the magnitude of the deviation of the implied PPP exchange rate from the actual exchange rate is roughly half the amount for iPads as it is for Big Macs. Thus iPad prices come far closer to achieving PPP than Big Mac prices. Second, we take the mean amount of over/undervaluation for each series, where we again see iPad prices yielding an implied PPP exchange rate that is closer to the actual observed exchange rate. Third, we take the median instead of the mean, where not only do iPad prices dominate again, but the median amount of over- or undervaluation is 3.69% which suggests that the PPP rates derived from iPads almost exactly explain market exchange rates. Finally, we conduct a horse race for each country to determine which set of prices comes closest to matching PPP to actual rates, and we find that iPad prices wins 67% of the time.[7]

[3]We use the January 2013 Big Mac index data since the median data entry date on HuMuch.com for Big Mac prices is early 2013.

[4]Specifically the iPad 2, with a 9.7 inch touch screen, a 1 Ghz Dual-Core CPU, and 16GB storage. This is a Wi-Fi only model with no contract price. Sales tax is not included in the prices considered. Note that for some countries, multiple HuMuch.com entries exist. In these cases, we take the modal price if the same price is reported more than once. If not, we take the mean of the price entries that are reported.

[5]Our actual exchange rate data are taken from The Economist's January 2012 Big Mac Index, which corresponds to the iPad price median data entry date on HuMuch.com.

[6]Throughout this paper, positive numbers denote overvaluation of the foreign currency against the dollar, and negative numbers denote undervaluation.

[7]We also find that the iPad and Big Mac prices predict different signs of the over/undervaluation for

All four tests show that the iPad index clearly does a better job of matching observed international price data to the theory of PPP. This finding is undoubtedly being driven by the tradability of the iPads, where a seller in the U.S. can take an iPad and sell the very same product in Europe the following year. On the other hand, a seller cannot very well purchase a Big Mac and ship it in the same way due to its perishability. In all instances the Big Mac's performance is inferior to that of the iPad, which suggests to us that The Economist should consider switching their test of PPP.

3.2 The iPhone Index

Clearly the iPad is not the only product we could have considered if looking at tradable goods. For robustness, we also gather data on iPhone prices and conduct the same tests as we did with iPad prices.[8] In Table 2, we see that using iPhone prices to back out a measure of the PPP exchange rate again does better than what one gets with Big Mac prices, although the benefit is substantially smaller than it was with iPad prices.[9]

4 Determinants of Over- or Undervaluation

To test more explicitly the notion of tradability playing a role in the different results we get with iPad, iPhone, and Big Mac prices, we then regress each measure of over/undervaluation on a constant and a measure of geographical distance (as is considered in Landry, 2013) and the interest rate differential (motivated by the interest parity condition). We measure geographical distance by the log of the distance in miles between the capital city of the respective country and Washington, DC, and the interest rate differential is measured by the short-term interest rate less the U.S. short-term interest rate.[10]

In Table 3, we see that overvaluation derived from Big Mac prices is driven by geographical distance in a positive and significant way. This is in keeping with the arguments about the Big Mac being non-tradable. By the same logic, we see distance is statistically indistinguishable from zero when considering iPad or iPhone measures of over/undervaluation. The interest rate differential seems to be driving some of the overvaluation that comes from iPhone prices, but not with iPad prices. This surely reflects the fact that the implied PPP exchange rate derived from iPad prices is far closer to actual market exchange rates than that obtained using iPhone prices.

about 45% of the countries in the sample.

[8]The model of the iPhone for which we collect data is the iPhone 6 with 64GB of memory. The data come from MobileUnlocked.com who publish iPhone price data for 38 countries, collected in June 2015. Our actual exchange rate data comes from The Economist's July 2015 Big Mac index release. For three countries, the exchange rate data were not available from The Economist. In these cases, we take the average of the daily exchange rates from the first and last days of the month from Exchangerates.org.uk.

[9]A report by CommSecc argues that using iPads is preferable to iPhones, since iPhone prices are harder to compare due to complications caused by telecommunication charges and bundling deals (Commonwealth Securities, 2014).

[10]Interest rate data are taken from the OECD. If they are missing for a particular country, we use the World Bank or TradingEconomics.com for rate data.

5 Conclusion

Just like its namesake, the Big Mac index seems pleasant to digest at first. It is fun, tasty, and satisfies a hungry appetite. But shortly afterwards, we realize that the Big Mac index was perhaps not the best choice. Ignoring the fact that the Big Mac index is a test of the law of one price and not PPP, we come to our senses and remember that the Big Mac is a perishable product which means arbitrage opportunities cannot be exploited and thus PPP need not hold.

In this paper we propose a healthier solution to Big Macs, namely iPads. This is a uniform, homogeneous and widely-available product, and most importantly of all, it is tradable. When we switch from the Big Mac index to the iPad index, we find much greater evidence in favor of market exchange rates conforming to the predictions of PPP. Therefore, in the thirtieth year of the Big Mac index, we urge The Economist to bid it adieu, and to instead usher in the iPad index instead.[11]

References

Chen, C., C. Wang, and C. Shen (2007): "Does PPP hold for Big Mac price or consumer price index? Evidence from panel cointegration," *Economics Bulletin*, 6, 1–15.

Click, R. (1996): "Contrarian MacParity," *Economics Letters*, 53, 209–212.

Commonwealth Securities (2014): "CommSec iPad Index: Australia slips down leaderboard," *Economic Insights*.

Crucini, M. and A. Landry (2012): "Accounting for Real Exchange Rates Using Microdata," NBER Working Papers 17812.

Cumby, R. (1996): "Forecasting Exchange Rates and Relative Prices with the Hamburger Standard: Is What You Want What You Get With McParity?" NBER Working Paper 5675.

Kitamura, Y. and H. Fujiki (2004): "The Big Mac Standard: A statistical Illustration," *Economics Bulletin*, 6, 1–18.

Landry, A. (2008): "The Big Mac: a global-to-local look at pricing," *Federal Reserve Bank of Dallas Economic Letter*, 3.

——— (2013): "Borders and Big Macs," *Economics Letters*, 120, 318–322.

Lutz, M. (2002): "Beyond Burgernomics and MacParity: Exchange Rate Forecasts Based on the Law of One Price," 10th International Conference on Panel Data, Berlin, July 5-6, 2002 D4-1, International Conferences on Panel Data.

[11] Alternatively, whatever future technological product is most popular is likely to match PPP just as well: be it the Apple Watch or whatever else that is released in the future. The point is that it be a widely-recognized, widely-popular, and widely-available product that is identical across all countries, while also being tradable.

Ong, L. (1997): "Burgernomics: the economics of the Big Mac standard," *Journal of International Money and Finance*, 16, 865–878.

Pakko, M. and P. Pollard (2003): "Burgernomics: a Big Mac guide to purchasing power parity," *Federal Reserve Bank of St. Louis Review*, 9–28.

The Economist (2016): "The Big Mac Index," *The Economist*.

Table 1: iPads vs. Big Macs Measure of the PPP Exchange Rate

Country	Currency	iPad Price in Local Currency	Actual Exchange Rate (Currency per $, as of Jan 2012)	Economist's Over/ Undervaluation from Big Macs (%)	iPad's Implied PPP Exchange Rate	HuMuch.com's Over/ Undervaluation from iPads (%)	Closest to PPP: Big Mac or iPad?	Signs of Over/ Undervaluation Different?
Australia	AUD	504	0.972	17.615	1.010	3.876	iPad	N
Brazil	BRL	1649	1.805	35.296	3.305	83.081	Big Mac	N
Canada	CAD	519	1.021	10.381	1.040	1.874	iPad	N
China	CNY	4800	6.316	-41.903	9.619	52.312	Big Mac	Y
Czech Republic	CZK	9800	20.365	-17.850	19.639	-3.565	iPad	N
Denmark	DKK	3699	5.861	28.042	7.413	26.470	iPad	N
France	EUR	489	0.788	8.813	0.980	24.323	Big Mac	N
Germany	EUR	399	0.788	6.698	0.800	1.441	iPad	N
Hong Kong	HKD	3888	7.767	-49.388	7.792	0.312	iPad	Y
Italy	EUR	479	0.788	5.791	0.960	21.780	Big Mac	N
Japan	JPY	39800	76.920	-0.883	79.760	3.692	Big Mac	Y
Korea	KRW	593333.33	1158.750	-23.924	1189.045	2.614	iPad	Y
Malaysia	MYR	1499	3.140	-44.223	3.004	-4.317	iPad	N
Mexico	MXN	6999	13.684	-35.581	14.026	2.497	iPad	Y
New Zealand	NZD	689	1.260	-3.564	1.381	9.584	Big Mac	Y
Norway	NOK	2990	6.040	61.731	5.992	-0.793	iPad	Y
Philippines	PHP	22000	44.005	-36.112	44.088	0.189	iPad	Y
Russia	RUB	15824.94	31.769	-39.254	31.713	-0.176	iPad	N
Singapore	SGD	621.33	1.293	-10.618	1.245	-3.685	iPad	N
South Africa	ZAR	4399	8.130	-41.539	8.816	8.428	iPad	Y
Spain	EUR	479	0.788	5.791	0.960	21.780	Big Mac	N
Switzerland	CHF	489	0.955	62.145	0.980	2.603	iPad	N
Taiwan	TWD	23000	29.980	-40.396	46.092	53.746	Big Mac	Y
UK	GBP	329	0.651	-8.906	0.659	1.238	iPad	Y
USA	USD	499						
Sum of Absolute Values of Over/Undervaluation				636.444		334.376		
Mean Over/ Undervaluation Amount				26.518		13.932		
Median Over/ Undervaluation Amount				25.983		3.688		
% of countries where iPad is closest to PPP							67%	

Note: Positive numbers denote overvaluation of the foreign currency against the dollar, and negative numbers denote undervaluation.

Table 2: iPhones vs. Big Macs Measure of the PPP Exchange Rate

Country	Currency	iPhone Price in Local Currency	Actual Exchange Rate (Currency per $, as of July 2015)	Economist's Over/ Undervaluation from Big Macs (%)	iPhone's Implied PPP Exchange Rate	Mobile Unlocked's Over/Undervaluation from iPhones (%)	Closest to PPP: Big Mac or iPhone?	Signs of Over/ Undervaluation Different?
Australia	AUD	1149	1.351	-18.116	1.534	13.527	iPhone	Y
Austria	EUR	799	0.913	-22.458	1.067	16.879	iPhone	Y
Belgium	EUR	799	0.913	-15.367	1.067	16.879	Big Mac	Y
Brazil	BRL	3899	3.152	-10.595	5.206	65.134	Big Mac	Y
Bulgaria	BGN	1229	1.774		1.641	-7.498		
Canada	CAD	969	1.290	-5.304	1.294	0.312	iPhone	Y
China	CNY	6088	6.209	-42.842	8.128	30.905	iPhone	Y
Czech Republic	CZK	24390	24.702	-40.840	32.563	31.824	iPhone	Y
Denmark	DKK	6699	6.811	6.023	8.944	31.315	Big Mac	N
France	EUR	819	0.913	-6.218	1.093	19.805	Big Mac	Y
Finland	EUR	799	0.913	-6.218	1.067	16.879	Big Mac	Y
Germany	EUR	799	0.913	-17.883	1.067	16.879	iPhone	Y
Greece	EUR	859	0.913	-30.235	1.147	25.656	iPhone	Y
Hungary	HUF	286990	282.878	-33.579	383.164	35.452	Big Mac	Y
India	INR	53999	63.430	-61.738	72.095	13.660	iPhone	Y
Ireland	EUR	799	0.913	-15.367	1.067	16.879	Big Mac	Y
Italy	EUR	839	0.913	-8.505	1.120	22.730	Big Mac	Y
Korea	KRW	980000	1143.500	-21.495	1308.411	14.422	iPhone	Y
Lithuania	LTL	2896.9	3.098		3.868	24.859		
Malaysia	MYR	3126	3.807	-58.043	4.174	9.643	iPhone	Y
Mexico	MXN	13999	15.740	-35.008	18.690	18.746	iPhone	Y
Netherlands	EUR	799	0.913	-21.086	1.067	16.879	iPhone	Y
New Zealand	NZD	1249	1.509	-18.379	1.668	10.501	iPhone	Y
Norway	NOK	7590	8.143	17.940	10.134	24.451	Big Mac	N
Phillipines	PHP	32300	45.213	-24.735	43.124	-4.619	iPhone	N
Poland	PLN	3699	3.774	-46.890	4.939	30.872	iPhone	Y
Portugal	EUR	799	0.913	-31.379	1.067	16.879	iPhone	Y
Russia	RUB	55990	56.815	-60.683	74.753	31.573	iPhone	Y
Saudi Arabia	SAR	3199	3.751	-33.204	4.271	13.877	iPhone	Y
Slovakia	EUR	763	0.913		1.019	11.613		
Spain	EUR	799	0.913	-16.511	1.067	16.879	Big Mac	Y
Sweden	SEK	8595	8.523	7.046	11.475	34.645	Big Mac	N
Switzerland	CHF	879	0.953	42.422	1.174	23.170	iPhone	N
Taiwan	TWD	25900	31.020	-46.832	34.579	11.475	iPhone	Y
Thailand	THB	28900	34.088	-33.856	38.585	13.193	iPhone	Y
Turkey	TRY	3099	2.646	-19.119	4.138	56.386	Big Mac	Y
UK	GBP	619	0.640	-5.794	0.826	29.040	Big Mac	Y
USA	USD	749						
Sum of Absolute Values of Over/Undervaluation				881.710		795.935		
Mean Over/ Undervaluation Amount				25.933		21.512		
Median Over/ Undervaluation Amount				21.290		16.879		
% of countries where iPhone is closest to PPP							62%	

Note: Positive numbers denote overvaluation of the foreign currency against the dollar, and negative numbers denote undervaluation.

Table 3: Determinants of Over/Undervaluation from 3 Competing Products

A) Big Mac Measure of Over/Undervaluation			
	1	2	3
Constant	2.275	2.914	1.950
	(1.306)*	(0.140)***	(1.268)
Distance	0.626		0.579
	(0.151)***		(0.148)***
Interest Rate Differential		0.051	0.038
		(0.033)	(0.031)
N	34		
R^2	0.210	0.079	0.252
B) iPad Measure of Over/Undervaluation			
	1	2	3
Constant	0.721	1.399	0.693
	(2.918)	(0.457)***	(2.934)
Distance	0.088		0.083
	(0.351)		(0.360)
Interest Rate Differential		0.036	0.035
		(0.222)	(0.228)
N	24		
R^2	0.001	0.002	0.003
C) iPhone Measure of Over/Undervaluation			
	1	2	3
Constant	2.734	2.746	2.334
	(5.467)	(0.171)***	(5.729)
Distance	0.663		0.604
	(0.640)		(0.673)
Interest Rate Differential		0.060	0.047
		(0.021)***	(0.024)*
N	34		
R^2	0.167	0.079	0.214

Note: OLS estimation is used with robust standard errors (standard errors in parentheses). Dependent variable is the amount of over/undervaluation of the exchange rate according to PPP, based on Big Macs, iPads, and iPhones respectively. "Distance" is the log of the number of miles from Washington, DC to respective country's capital city, and "Interest Rate Differential" is the difference between the respective country's short-term interest rate and that of the United States. ***, **, and * denotes 1, 5, and 10% significance levels respectively.

Figure 1: Comparison of Big Mac Country Prices from The Economist and HuMuch.com

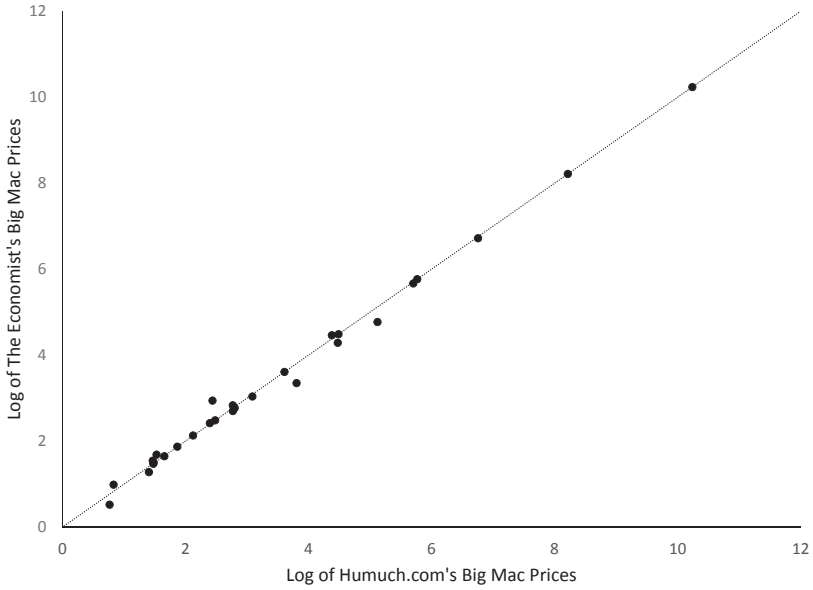

Figure 2: Comparison Over/Undervaluation from Big Mac Prices and iPad Prices