ECON 1550 — Problem Set 5 Answer Key

Spring 2026

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Submission: Canvas or Gradescope

1. **The Big Mac Index, Purchasing Power Parity, and the Exchange Rate**

The Big Mac index was invented by The Economist in 1986 as a lighthearted guide to whether currencies are at their "correct" level. Read the article about the Big Mac index (attached at the end of this problem set or online at `https://www.economist.com/interactive/big-mac-index`), and the box "Some Meaty Evidence on the Law of One Price" in Chapter 5 of the textbook, then please answer the following questions:

(a) How is Purchasing Power Parity (PPP) defined in the article from The Economist?

> **Solution:** According to the article from The Economist, purchasing-power parity (PPP) is:
>
> > "the notion that in the long run exchange rates should move towards the rate that would equalise the prices of an identical basket of goods and services (in this case, a burger) in any two countries."

(b) How is Purchasing Power Parity (PPP) defined in Chapter 5 of the textbook (and in class)?

> **Solution:** From Chapter 5 of the textbook:
>
> > "The theory of purchasing power parity states that the exchange rate between two countries' currencies equals the ratio of the countries' price levels."
>
> Additional information (not part of the answer): This definition, correct as it is, fails to emphasize that the price levels for the two countries must be the prices of the *same* basket of goods.
> We can also use a formula. If E is the exchange rate, P the domestic price (in units of domestic currency) of some reference basket of goods, and P^* the

foreign price (in units of foreign currency) of the same reference basket of goods, then PPP holds if

$$E = \frac{P}{P^*}$$

Last, in the textbook and in class, PPP is a long-run theory, which means that the relation $E = P/P^*$ is only supposed to hold in the long-run. Throughout this question, we use current values rather than long-run values as a simplified approximation.

(c) Measures of exchange rates and PPP for many countries can be downloaded from the OECD at this link. Observations are annual.

Data for the Big Mac index can be found at `https://github.com/TheEconomist/big-mac-data`. For this problem set, use the pinned file `big-mac-source-data-v2-pinned.csv`, which is based on the corresponding Economist source file. For some years, observations are annual. For other years, observations are semi-annual. When comparing Big Mac index data to OECD data, transform semi-annual data to annual by taking the average of the two semi-annual observations.

Explain how the OECD PPP measure relates to our definition of PPP from the textbook (and from class).

Hint: The OECD database links to this explanation of how their measure of PPP is constructed.

Solution: Question 1 in the link provided in the hint to the question explains that:

> "PPPs are the rates of currency conversion that equalize the purchasing power of different currencies by eliminating the differences in price levels between countries. In their simplest form, PPPs are simply price relatives that show the ratio of the prices in national currencies of the same good or service in different countries. PPPs are also calculated for product groups and for each of the various levels of aggregation up to and including GDP."

Therefore, in their "simplest form", the PPP measure from the OECD is the analog to the term P/P^* in the equation $E = P/P^*$, where P is in units of national currency and P^* is in US dollars.

(d) Pick any two countries that have data for 2024 or later in both the Big Mac index data and the OECD data. Using these two countries:

For the latest year available, construct P/P^* using the Big Mac data and the OECD data. Which of the two is closest to E? Do the two P/P^* measures agree on which of the two currencies is over/under-valued?

Solution: Using Argentina as the home country and the United States as the foreign country, the solution proceeds as follows. Results for a selection of other countries can be found here.

For Argentina, there are two semi-annual observations in 2024. The local price of a Big Mac in local currency (variable local_price) in Jan-2024 is 3,150 ARS and in Jul-2024 is 6,100 ARS, where ARS are Argentinean. We create a single annual observation for 2024 by taking the average of the two prices, which is 4,625.00 ARS.

For the United States, there are also two semi-annual observations for the local_price variable, but they are both the same and equal to 5.69 USD, so we use that value as the single annual observation for 2024.

The ratio of the two prices is:

$$\frac{\text{BigMac } P}{\text{BigMac } P^*} = \frac{4{,}625.00}{5.69} = 812.83$$

The OECD's PPP measure for Argentina in 2024 is 419.90. The PPP for the U.S. is 1 (as it is the reference currency). The ratio of the two PPP measures is:

$$\frac{P}{P^*} = \frac{419.90}{1} = 419.90$$

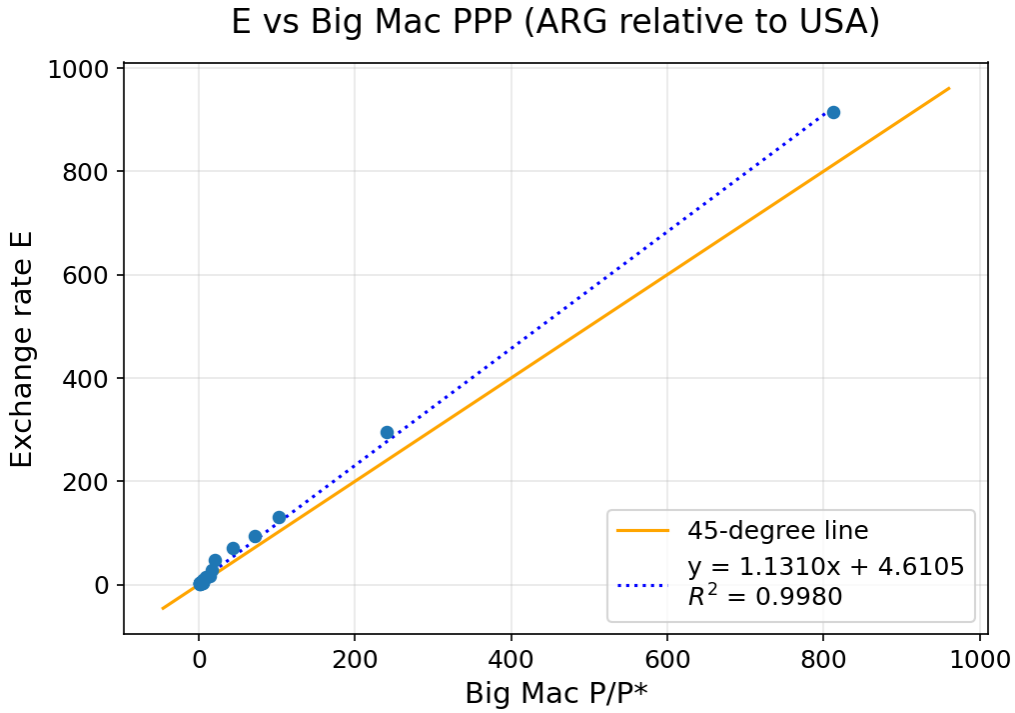
The exchange rate from the OECD data is:

$$E = 914.69 ARS/USD$$

The exchange rate predicted by the theory of PPP is $E_{\text{PPP}} = P/P^*$. The $E_{\text{PPP}} = 812.83$ using the Big Mac data is closer to the actual exchange rate $E = 914.69$ ARS/USD than the $E_{\text{PPP}} = 419.90$ using the OECD data. Both E_{PPP} measures are below E, so they agree in signaling an undervalued ARS. If the theory of PPP were true, then we would expect ARS to appreciate as time goes by, and to eventually reach E_{PPP} in the long run.

(e) Using all the years available, make a scatter plot of E against the Big Mac data's P/P^*. What should the scatter plot look like if PPP holds? What features of the scatter plot support the hypothesis that PPP holds? What features suggest the hypothesis that PPP holds is not true?

Solution: PPP holds when $E = P/P^*$. Therefore, if we plot E on one axis and P/P^* on the other, PPP holds exactly when the observations are on the line that goes through the origin and has a slope of 1, i.e., the 45-degree line that goes through the point (0,0).
A scatter plot using data between 2000 and 2024 gives:

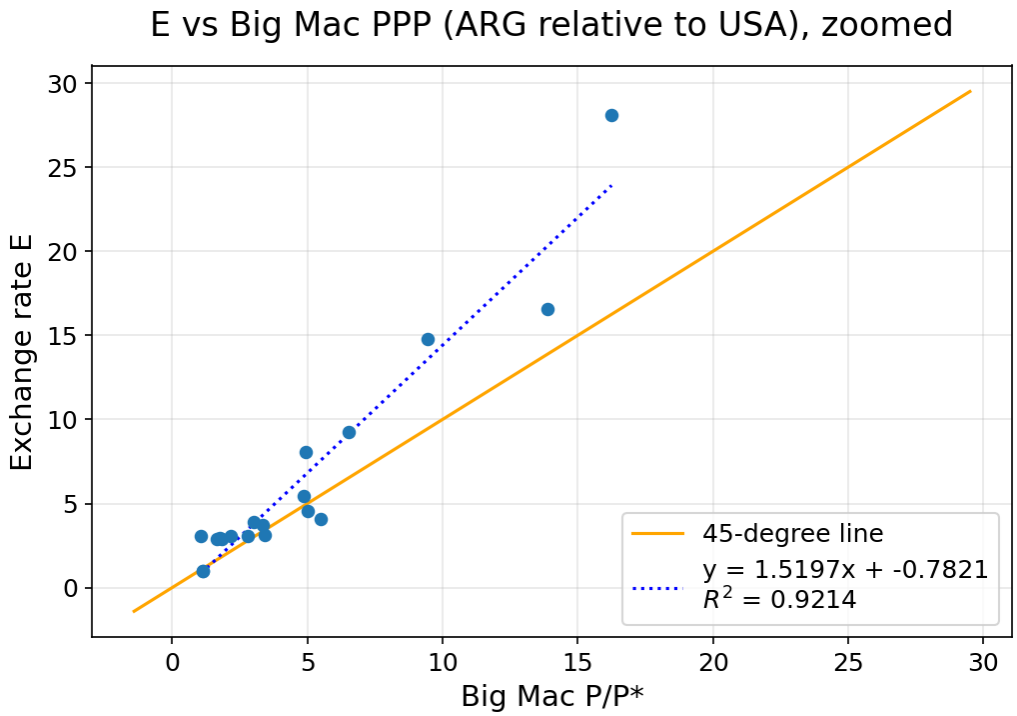


The exchange rate E is on the vertical axis, and the PPP-implied measure of the exchange rate, $E_{\text{PPP}} = P/P^*$, is on the horizontal axis. Each dot represents the pair $(P/P^*, E)$ for a particular year, constructed exactly as in part (d). The orange line is the 45-degree line through the origin.
Features of the plot that support the theory of PPP are:

- The points align along a line (rather than along some other shape of curve)
- The slope of a line fitted to the points has a slope of 1.1310, which is close to the slope of 1 predicted by PPP.

Features of the plot against the theory of PPP are:

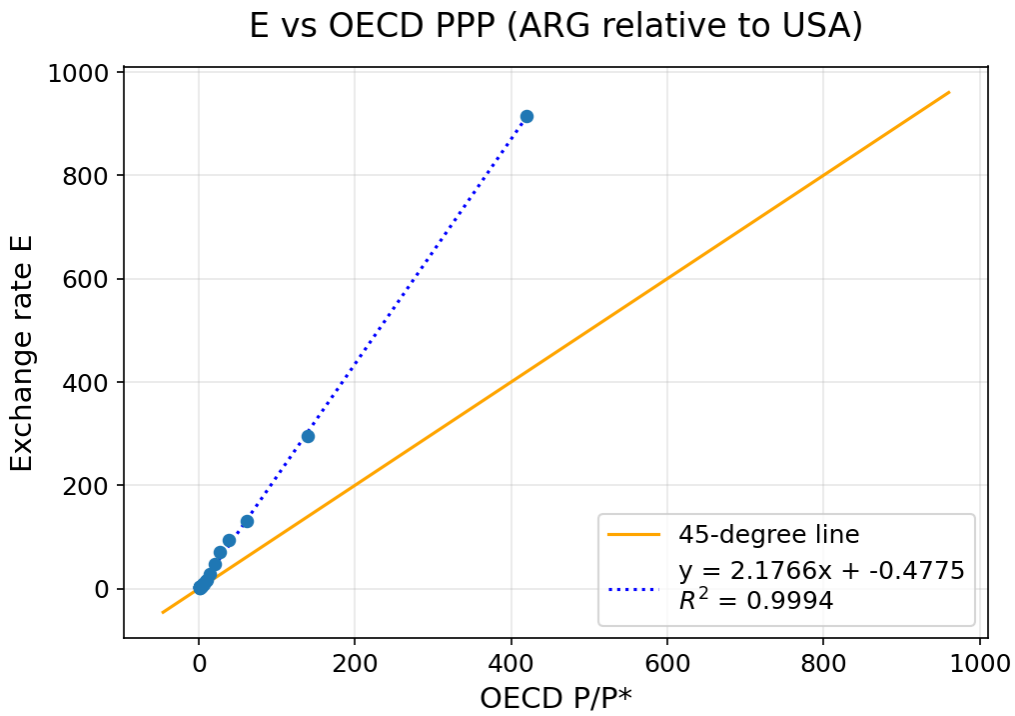
- The observations with high values of E are systematically above the 45-degree line. The fitted intercept of 4.6105 is small relative to the data range, but this systematic pattern shows that the deviations from PPP are not random.
- Even though the slope of 1.1310 is close to 1, the points fit the line with slope 1.1310 very well (with an R^2 of 0.9980). This tight fit means the slope is estimated precisely, so the deviation from the slope of 1 predicted by PPP is likely a genuine feature of the data rather than noise.
- The points with low E seem to fit the 45-degree line better, but it is hard to see in the figure above. The next figure zooms into lower values of E:



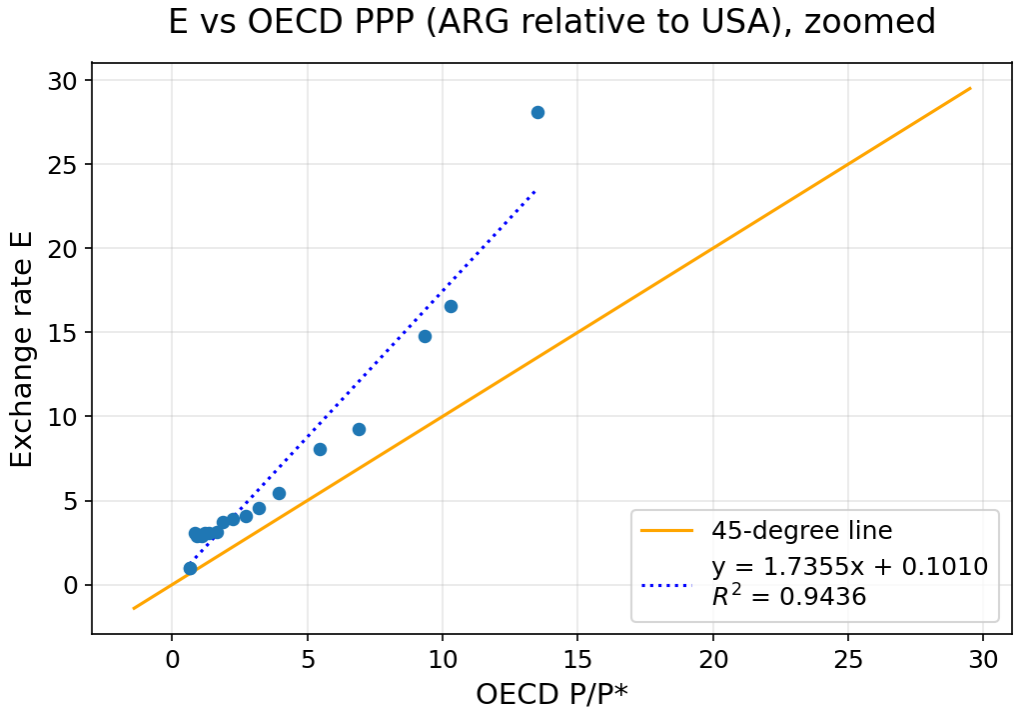
In this zoomed plot, the fitted line has slope 1.5197 and intercept -0.7821. We can more clearly see now that the low-E observations do not line up all that well with the 45-degree line.

(f) Answer the last question once again, but using OECD data to construct P/P^*.

Solution: The plot using the OECD data is:



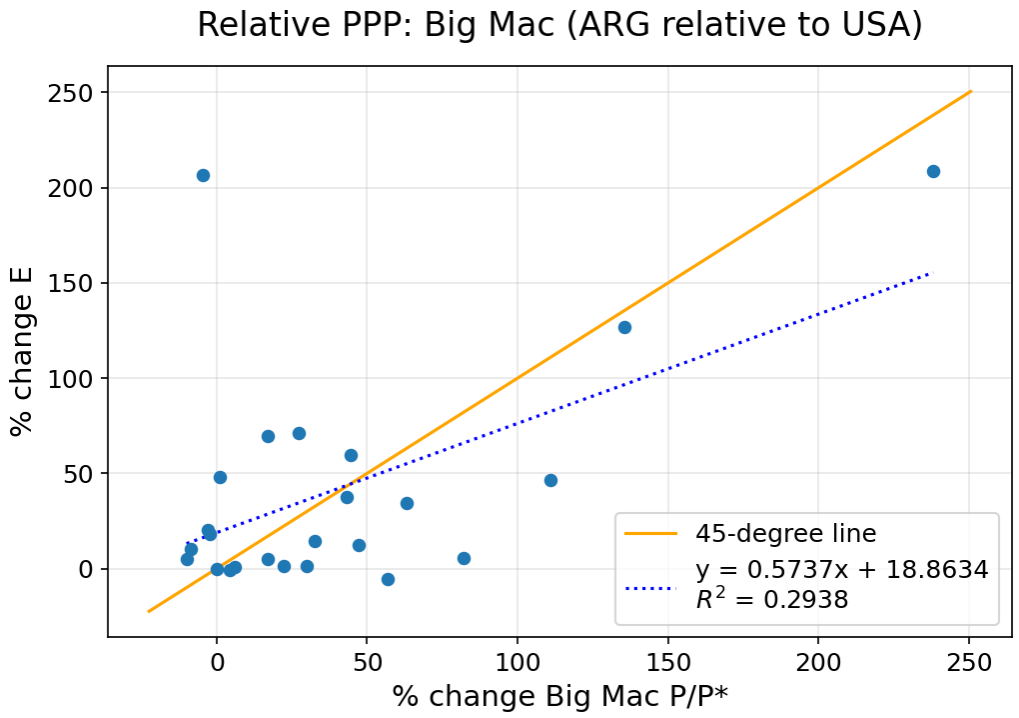
Zooming into small values:



In the full sample, the fitted line has slope 2.1766, intercept -0.4775, and $R^2 = 0.9994$. In the zoomed plot, the fitted line has slope 1.7355, intercept 0.1010, and $R^2 = 0.9436$. Similar to the Big Mac case from part (e), the points fit a line quite well when using the full sample (all the years), and not as well for low values of E. We conclude that the OECD-based PPP measure is strongly related to the exchange rate, but the relationship is still noticeably steeper than the 45-degree line predicted by PPP, has some noticeable deviations from being linear, and has an intercept different from zero.

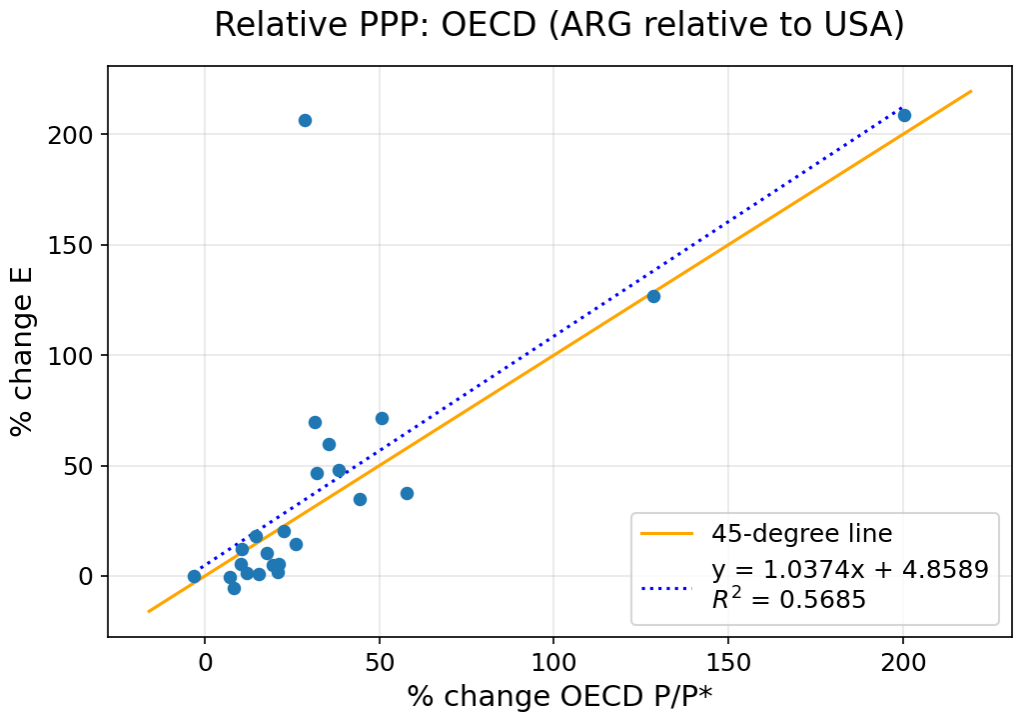
(g) Repeat parts (e) and (f) but now assess relative PPP rather than absolute PPP.

Solution: To assess relative PPP, we plot percentage changes in PPP and E rather than levels. For the Big Mac data, the plot is:



The scatterplot that uses the Big Mac data offers little support for relative PPP. The points are not neatly in a line, and the fitted line has slope 0.5737 with $R^2 = 0.2938$. In addition, the percentage change in E is often smaller than the percentage change in PPP. The outlier point labeled 2002 corresponds to the year 2002, when Argentina had its most severe financial crisis in its more than

200-year history.
For the OECD data, we get:

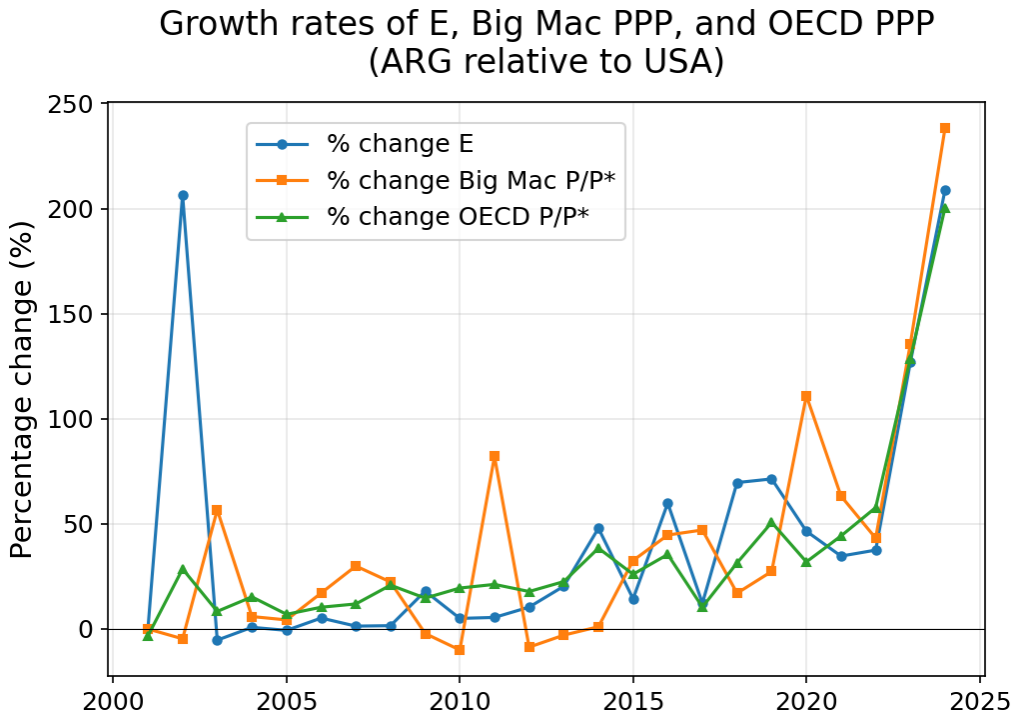


The scatterplot that uses the OECD data offers more support for relative PPP than the Big Mac data. The fitted line has slope 1.0374, which is close to the slope of 1 predicted by relative PPP. Against the theory of PPP, the points do show noticeable dispersion and the R^2 is only 0.5685. The point corresponding to the 2002 financial crisis remains a clear outlier.

(h) In a single plot, show the time series of the growth rate of the two PPP measures and the growth rate of the exchange rate (that is, plot the year in the horizontal axis and the growth rates of the three variables on the vertical axis). Do the series move together over time? Describe one feature of the plot that provides evidence in favor and one feature that provides evidence against the hypothesis that relative PPP holds.

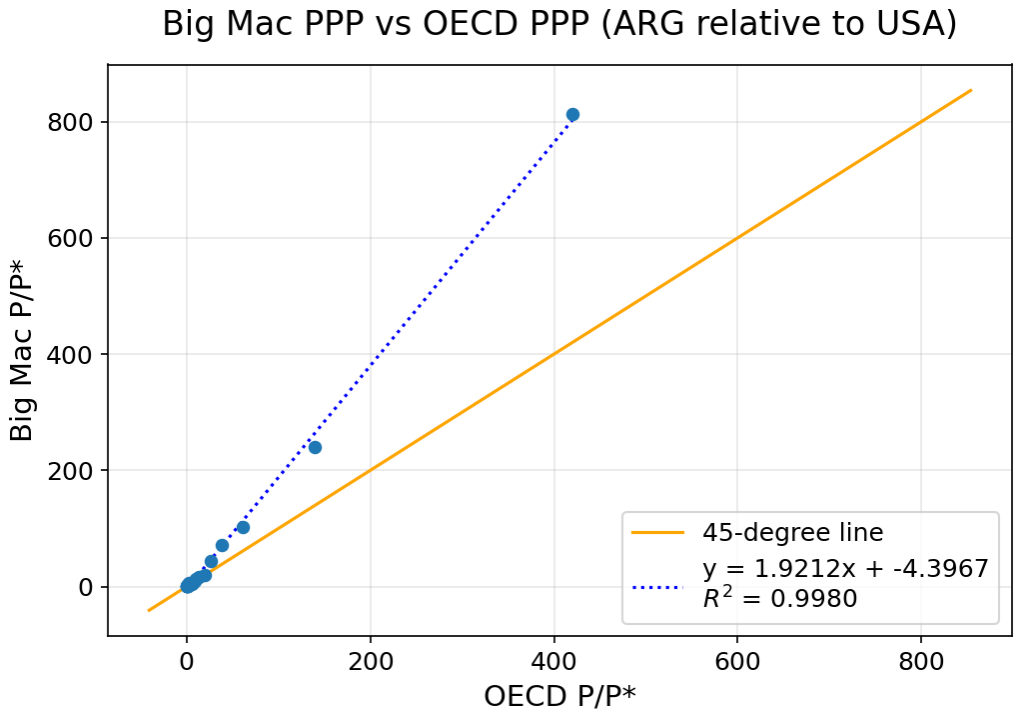
Solution: The series do move roughly together, although not in every year. If relative PPP held exactly, the exchange rate series E should lie exactly on top of the PPP series P/P^*. One feature in favor of relative PPP is that in 2023 and 2024, all three series jump sharply together, showing strong co-movement even

if the exact magnitudes differ. A feature against relative PPP is in 2002, when the exchange rate depreciated more than what is implied by either of the two PPP measures.

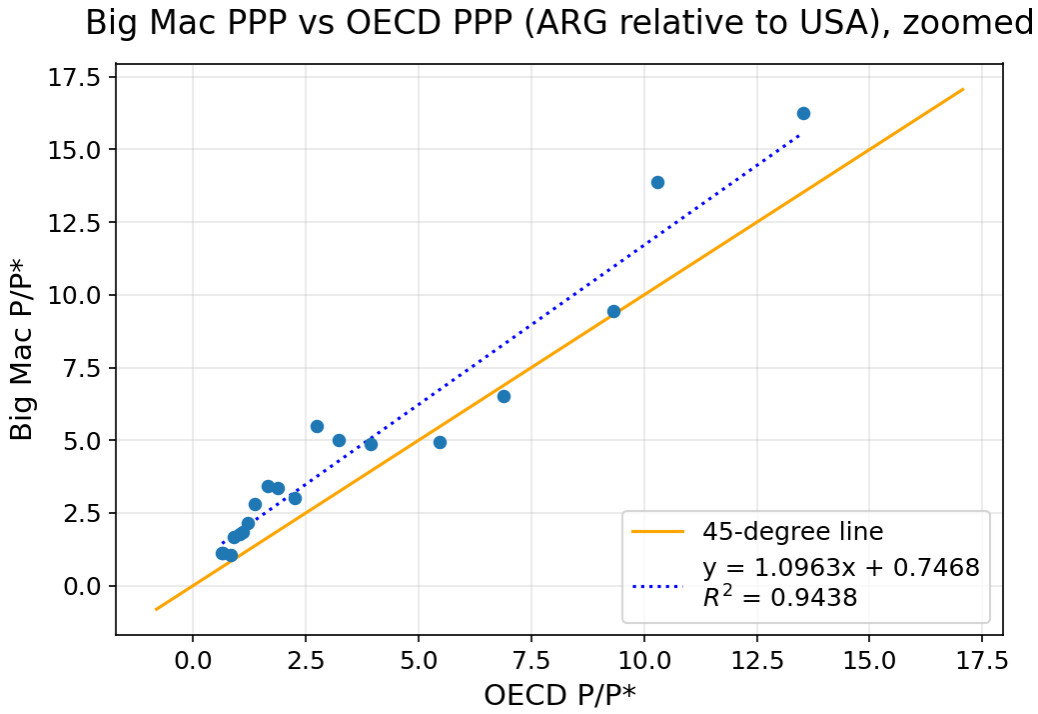


(i) Is the PPP implied by the Big Mac data close to the PPP from the OECD data? Give two reasons for why they are not supposed to perfectly agree.

Solution: The two PPP measures comove closely over time, with a correlation of 99.9%. A scatterplot of the two measures also shows relatively good agreement:



Zooming into smaller values,



Despite their closeness, they are far from identical. One reason is that the Big

Mac PPP measure uses an essentially identical basket of goods in Argentina and the U.S. (the Big Mac), while the GDP-based basket of goods for the OECD PPP measure is quite different for the two countries. In addition, the Big Mac itself has a composition of goods that is quite different from the GDP-based basket of goods of both Argentina and the U.S. The timing of when prices are measured within the year can also lead to noticeable differences, especially for prices in Argentina, which can be quite volatile in certain years.

(j) There are many criticisms of the Big Mac index as a measure of PPP. The Economist itself points out it is not meant to be a precise measure of PPP or currency valuation. On the other hand, there must be some advantages of the Big Mac index. List three advantages of the Big Mac index.

Solution: There are many correct answers. Only three are needed for full credit. We list four examples below, and many other answers would also be acceptable.

- Despite some local differences, the Big Mac is an incredibly uniform product across the world. It is likely much more uniform than any two representative or reference baskets of goods we can construct for two different countries.
- The concept of a Big Mac is much more tangible and easier to grasp than the more abstract concept of a "reference basket of goods" or a "representative basket of goods".
- There are likely many fewer data measurement errors than indices that rely on surveys or that must compile prices for thousands of goods.
- The Big Mac is not only uniform across countries, it is also remarkably uniform across time.

The Economist

Our Big Mac index shows how burger prices differ across borders

Using patty-power parity to think about exchange rates

Last updated on January 29th 2026

Raw index (January 2026)

Base currency: US dollar

Country	Currency	% Under/Over valued
Switzerland	Franc	+48.4
Uruguay	Peso	+43.1
Norway	Krone	+22.8
Sweden	Krona	+18.6
Denmark	Krone	+16.7
Britain	Pound	+15.7
Euro area	Euro	+15.3
Israel	Shekel	+4.0
Poland	Zloty	+2.2
Colombia	Peso	+1.5
Mexico	Peso	+0.8
United States	US$	*BASE*
Costa Rica	Colón	−1.3
Turkey	Lira	−3.5
Singapore	S$	−5.5
Australia	A$	−7.0

Country	Currency	% Under/Over valued
Canada	C$	−9.4
Argentina	Peso	−9.6
Czech Rep.	Koruna	−10.2
Chile	Peso	−11.4
Lebanon	Pound	−12.4
UAE	Dirham	−15.5
Saudi Arabia	Riyal	−17.2
Honduras	Lempira	−17.3
Peru	Sol	−17.8
Hungary	Forint	−18.4
New Zealand	NZ$	−19.3
Bahrain	Dinar	−22.0
Nicaragua	Córdoba	−22.4
Qatar	Riyal	−23.7
Kuwait	Dinar	−25.8
Brazil	Real	−27.3
Guatemala	Quetzal	−29.7
Thailand	Baht	−29.7
Moldova	Leu	−33.2
Venezuela	Bolívar	−33.9
Romania	Leu	−35.0
Oman	Rial	−35.1
Azerbaijan	Manat	−36.2
Pakistan	Rupee	−36.9
South Korea	Won	−38.9
China	Yuan	−40.2
Jordan	Dinar	−42.3

Country	Currency	% Under/Over valued
Malaysia	Ringgit	−44.6
South Africa	Rand	−45.1
Hong Kong	HK$	−47.6
Ukraine	Hryvnia	−47.8
Japan	Yen	−50.5
Vietnam	Dong	−52.7
Philippines	Peso	−53.6
Egypt	Pound	−56.8
Indonesia	Rupiah	−58.9
India	Rupee	−58.9
Taiwan	NT$	−59.6

> **Example: The British pound is 15.7% overvalued against the US dollar**
>
> A Big Mac costs £5.29 in Britain and US$6.12 in the United States. The implied exchange rate is 0.86. The difference between this and the actual exchange rate, 0.75, suggests the British pound is 15.7% overvalued.

About the Big Mac index

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 equalise the prices of an identical basket of goods and services (in this case, a burger) in any two countries.

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 economic textbooks and the subject of dozens of academic studies.

GDP-adjusted index

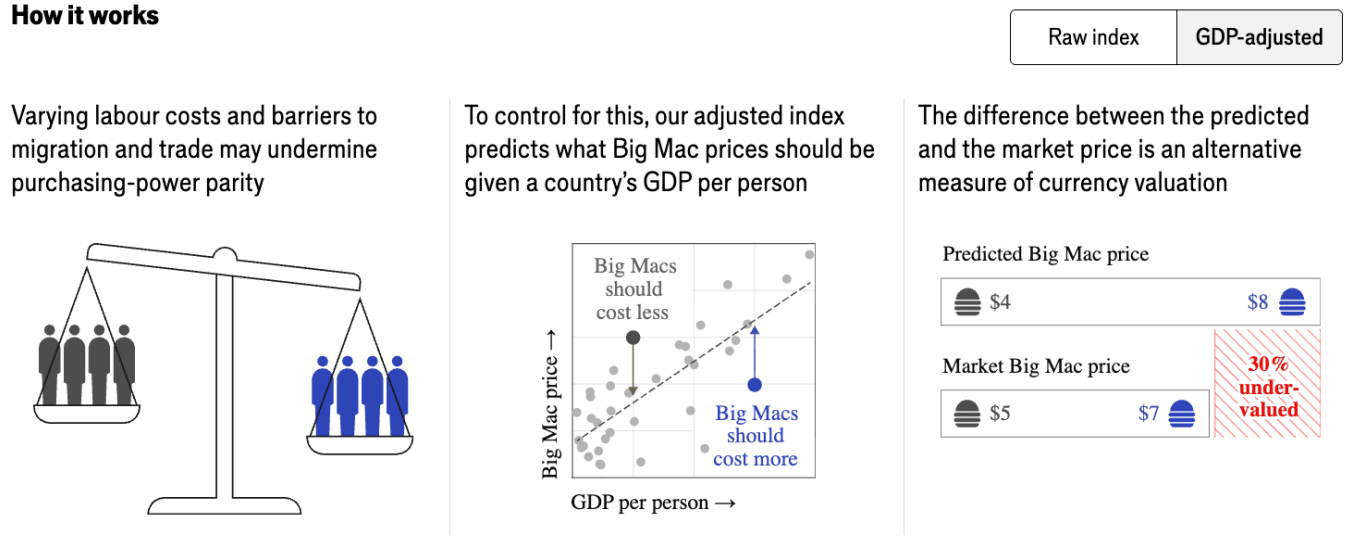
The GDP-adjusted index addresses the criticism that you would expect average burger prices to be cheaper in poor countries than in rich ones because labour costs are lower. PPP signals where exchange rates should be heading in the long run, as a country like China gets richer, but it says little about 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.

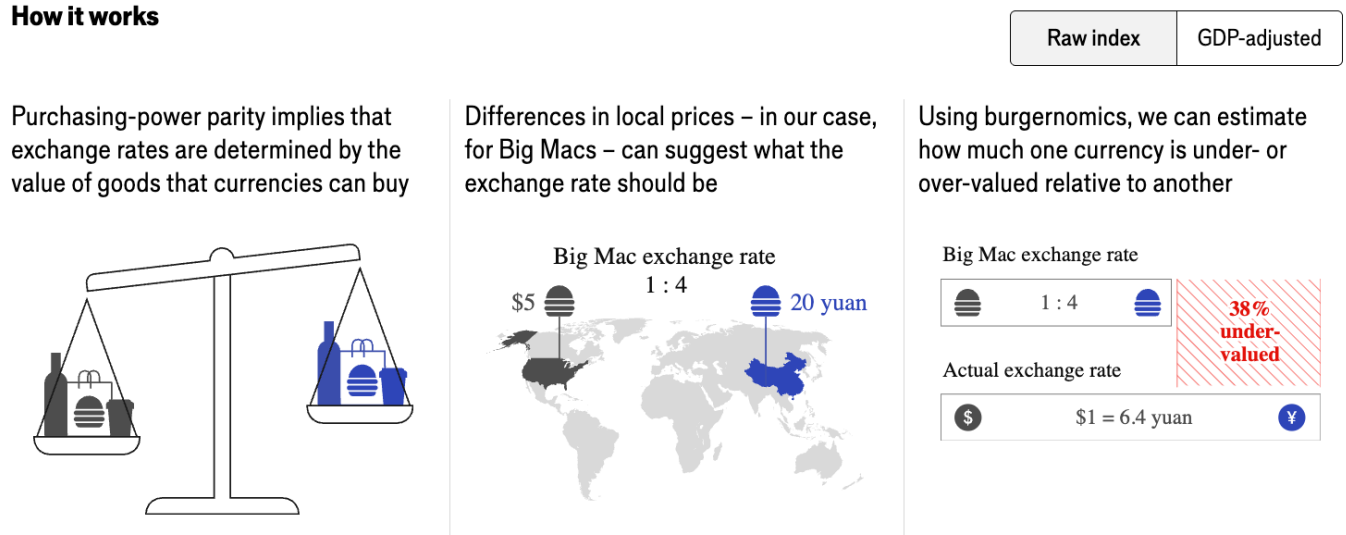
Methodology note

In July 2022 we updated the Big Mac index to use a McDonald's-provided price for the United States. We also changed our methodology for how we calculate the GDP-adjusted index, the full history of which will now be adjusted whenever the IMF's historical GDP series are updated. The previously published versions of both indices are available in our archive.

Note: All prices include tax.

Sources: McDonald's; LSEG Workspace; IMF; Eurostat; LebaneseLira.org; Banque du Liban; *The Economist*.

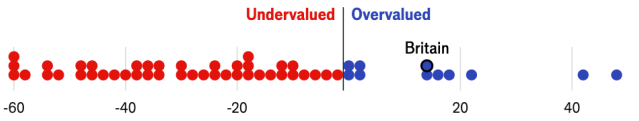




ADJUST TO ACCOUNT FOR GDP PER PERSON

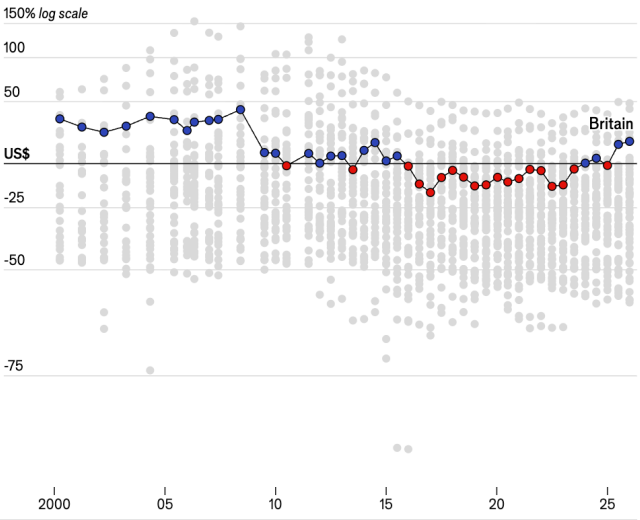
Raw index | GDP-adjusted

Jan 2026 | The British pound is 15.7% overvalued against the US dollar



A Big Mac costs **£5.29** in Britain and **US$6.12** in **the United States**. The implied exchange rate is **0.86**. The difference between this and the actual exchange rate, **0.75**, suggests the British pound is **15.7% overvalued**.

2000-2025

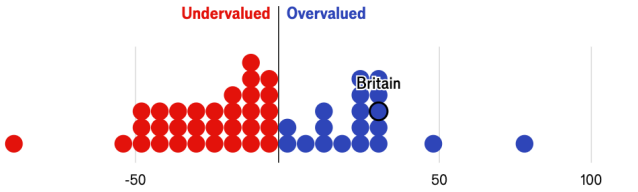


Sources: McDonald's; LSEG Workspace; IMF; Eurostat; LebaneseLira.org; Banque du Liban; *The Economist*

ADJUST TO ACCOUNT FOR GDP PER PERSON

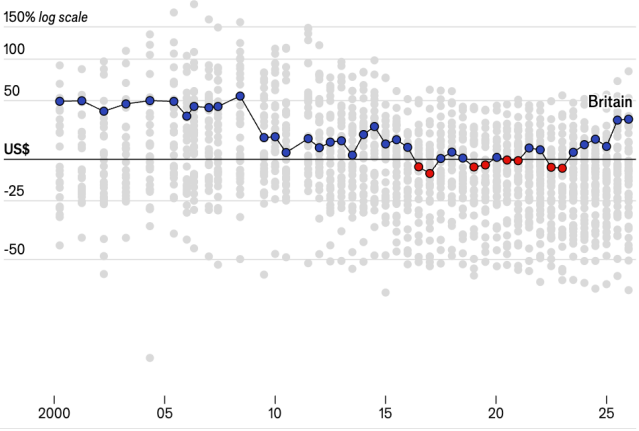
Raw index | GDP-adjusted

Jan 2026 | The British pound is 31.9% overvalued against the US dollar



A Big Mac costs **15.7% more** in **Britain** (**US$7.08**) than in **the United States** (**US$6.12**) at market exchange rates. Based on differences in GDP per person, a Big Mac should cost **12.3% less**. This suggests the British pound is **31.9% overvalued**.

2000-2025



Sources: McDonald's; LSEG Workspace; IMF; Eurostat; LebaneseLira.org; Banque du Liban; *The Economist*