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ORIGINAL ARTICLE

Purchasing power parity and cultural convergence: evidence from the global video games market

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Abstract A shared activity or pursuit can have the effect of bringing about cultural convergence in the form of patterns of behaviour and consumption. This idea is supported by the Axelrod (1997) thesis, which suggests that cultures are more likely to interact and subsequently converge if they have shared traits: one of these being the use of technology. This paper seeks to apply such a cultural perspective to the body of published literature on deviations from the law of one price. Adopting a similar methodology to the popular 'Big Mac' index, disparity between official market exchange rates and the real rates of exchange between two currencies is measured using local prices of video game consoles. The results of the study suggest that, while a degree of pricing and cultural convergence across broad geographic areas is observed, many major global currencies are trading at levels that are significantly different to that which is suggested by purchasing power parity (PPP) theory.

Keywords Purchasing power parity · Video games · Cultural convergence

JEL Classification Z10 · F31

1 Introduction

The Economist Magazine's 'Big Mac index' is a well known means by which the strength of purchasing power parity (PPP) relationships between countries can be assessed. The index attempts to use the local price of a standardised product to establish the degree to which a currency is incorrectly valued compared to the US

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Dollar. Critics of the methodology state that there are inherent local differences even in this apparently 'standard' product: beef prices, for example, differ across the globe, while demand conditions and relative prices of food in each country may also be heterogeneous. One also has to consider the potential existence of barriers to trade, as well as the use of non-traded goods in the production process (Pakko and Pollard 1996). In light of this criticism, a new breed of PPP test has started to appear in publication: the Economist itself has even started branching out by publishing the 'Coca-Cola Map of the World' and the 'Tall Latte Index' based on Starbucks coffee prices. Attention has also fallen upon technology goods: chief examples being the Apple iPod[1] and iTunes[2] indices. The argument for the construction of these particular measurements revolves around the greater extent to which product standardisation is present in these products and (in the case of iTunes) a marginal cost of distribution that is effectively zero.

This study follows a similar logic by casting attention towards a high technology product—namely home video game consoles. Although the Apple iPod has enjoyed a meteoric rise in the popular public consciousness, the market for video game consoles has also experienced a dramatic upturn in performance for a number of years. By way of direct comparison, in 2004 the value of the mp3 player market to the US economy was around $4.5 billion (In-Stat Report 2005), whereas the value of the video games market at the same time was approximately $8.2 billion in the US, and $25.4 billion for the rest of the world (Crandall and Sidak 2006). In 2004, over 40% of US households owned a dedicated video gaming machine (Nielsen Wireless and Interactive Services Report 2007). The commonly held perception of the market is that it heavily comprises or is influenced by children (see, for example, a discussion in Harada 2007) is starting to change, as there has been a continued demographic expansion within video gaming into older age groups (Shankar and Bayus 2003).

The home video game market emerged in the mid-1970s with the release of 'Pong' by Atari. This was the first video game machine designed to be connected to a home television set. Subsequent advancements in technology allowed for replacement cartridges to be loaded into a unit, which in turn allowed for a variety of games to be played on a single system. However, the early players in this market, such as Coleco and Mattel, found it difficult to establish a significant presence in multiple global territories. All this changed with the rise of Nintendo's 'NES'[3] console in the mid-1980s, from which point the industry began to develop into a global entity, as the machine encountered substantial success in Japan, North America and Europe. In light of the dominance enjoyed by Nintendo, several firms released products to rival the incumbent for control of the market, including Sega (who competed with Nintendo for control of the market during the early 1990s) and Sony, who's 'Playstation' console was arguably the first to transcend the market gap that existed between children and young adults and resultantly establish video gaming as a popular cultural phenomenon. In 2007, the industry is almost entirely

[1] Published by the Commonwealth Bank of Australia.

[2] Published by Joshua Gans, Professor of Management at the Melbourne Business School.

[3] NES is an acronym of 'Nintendo Entertainment System'.

dominated by the 'big-three' oligopolistic firms (Sony, Microsoft and Nintendo), who each offer a competing and incompatible device designed to connect to a home television set and enable the owner to play a range of video games titles via optical disc. The current machines competing for dominance of the market are the Sony 'Playstation 3' (or PS3), the Microsoft 'X-Box 360' and the Nintendo 'Wii'. New game systems of this type are introduced approximately every 5 years to satisfy consumer demand for more powerful games and thus, these current devices are the result of a long running series of iterative upgrades and improvements to previous generations of hardware (in much the same way as the multitude of generations of iPods).[4] This iterative process of product evolution has led to high turnover and significant market growth for the firms involved (Clements and Ohashi 2004).

The remainder of this paper is organised as follows. In the next section, the relevant literature pertaining to PPP theory is summarised. Section 3 contains a synopsis of the potential relationship that exists between the video games market and cultural convergence, while Section 4 details the data and estimation techniques employed in the study. A discussion of results and concluding remarks are offered in the final two sections of the paper.

2 The purchasing power parity (PPP) literature

The academic literature has for some time focused on the question of whether or not the theory of PPP holds in reality.[5] Formal empirical testing of this hypothesis using time series data in the context of a standard linear model (see Isard 1977 and more recently, Rogoff 1996 for examples) suggests that the absence of co-integration between exchange rates and relative prices is evidence that PPP does not hold, even over a long-time horizon. Engel and Rogers (1996, 2001) find that the law of one price often fails to apply even within a single country—and that sticky consumer prices combined with volatile exchange rates prevent PPP from holding across borders for any significant period of time, while O'Connell (1998) indicates that, after accounting for cross-sectional dependence between series of currency values, it is not possible to reject the hypothesis of a random walk with respect to panels of multiple real exchange rates. However, studies testing for the presence of unit roots (following Dickey and Fuller 1979, 1981) have been more accepting of the possibility of the existence of PPP, typically requiring very long samples of data for rejections of the null-hypothesis of a unit root to be considered.[6] Abuaf and Jorion

[4] For a more detailed analysis of the historical development of the video games console market, see Cox (2006).

[5] The theory of purchasing power parity suggests that the value of a typical basket of goods in one country (X) should be able to be converted into the currency of another country (Y) and be able to purchase that same basket of goods. If PPP holds, $P(X) * Y/X = P(Y)$, where $P(X)$ = the price of the basket of goods in Country X, $P(Y)$ is the price of the same bundle of goods in Country Y and Y/X represents the exchange rate between the currencies of the two countries. Rearranged, this becomes $Y/X = P(Y)/P(X)$. PPP does not hold if the two sides of this equation are not equivalent.

[6] As an example, authors such as Sarno and Valente (2006) and Wallace and Shelley (2006) find evidence in support of the existence of PPP through the use of samples encompassing observations from periods in excess of 100 years.

(1990) suggest that, while deviation from PPP levels can be significant in the short run, exchange rates usually revert to long run PPP levels, taking around 3 years for the disparity created by the official exchange rate to be cut in half. It is therefore very difficult to support PPP using data that cover a short time horizon and, as a result, the output from models designed to test for the presence of PPP vary considerably depending on the size of dataset used (Mark 2001) as well as the types of economies selected for analysis (Fujiki and Kitamura 2003). Taking this into account, Click (1996) is able to demonstrate that PPP does hold, subject to the Balassa–Samuelson[7] effect, over a long-time horizon. More recent studies dealing with this issue through the use of non-linear adjustment models (see Sarno 2005; Arghyrou and Gregoriou 2007 for examples) or through the use of models where multiple structural breaks are applied to a panel unit root test to establish stationarity (see Narayan 2005) have also found evidence supporting the existence of PPP.

In spite of the detailed and serious nature of the work being conducted in the literature, a more light-hearted approach to the subject of testing for PPP has also found its way into the academic consciousness. Since 1986, the Economist Magazine has published a series of 'Big Mac' indices which compare the relative prices of a standardised product (in this case the Big Mac sandwich produced by McDonalds) to the official published exchange rates for a series of currencies. The results of these indices inform the reader of the degree to which the currency of a particular country is over or undervalued against another (typically the USD). The annual publication of this index has sparked a flurry of research and comment over the past decade, as well as numerous 'spin-off' adaptations of the theory—including the price of cigarettes (Scollo 1996) and the comparison of wage rates for identical jobs across a number of countries (see Ashenfelter and Jurajda 2001; Ong 1998 for examples). The methodology has many supporters within the academic world, where the use of the 'typical' basket of goods that had been used by past studies on PPP (and, for example, in the Penn World Table) is rejected in favour of the comparison of a standardised product (Ong 1997). Cumby (1996) provides further supporting evidence that suggests a rapid return in market valuations of world currencies to that which is suggested by Big Mac parities, and that any divergence between the two is likely to be temporary.

Despite its popularity and more digestible nature, the Big Mac index has also been the subject of some critical analysis in the literature. It has been suggested that evidence in support of the existence of PPP over long sample periods suffers from bias in the selection of countries, since only a very few industrialised countries have accurate data on which to base such a sample (Froot and Rogoff 1996). The index has also been the subject of criticism as a result of other factors, such as the presence of fixed exchange rate regimes, periods of hyperinflation resulting in rapid price adjustments on the part of MacDonalds and the 'snapshot approach' used in its estimation, which may encapsulate fluctuations in exchange rates that are not

[7] Work by Balassa (1963) and Samuelson (1964) proposes that productivity levels for the production of non-traded goods can differ across countries. If the traded goods sector displays higher levels of productivity than the non-traded goods sector (which is usually the case), it will lead to higher relative prices of non-traded goods relative to those that are traded. This is particularly relevant where final goods contain a non-traded service component.

representative of the currencies involved over the full year (Fujiki and Kitamura 2003). A substantial number of papers (such as Pakko and Pollard (1996); Krugman and Obstfeld (2003); Yang (2004)) suggest that numerous elements that influence the figures used to construct the Big Mac index (such as the inclusion of non-tradable components in the production process, barriers to trade, local product differentiations and heterogeneous production costs) are responsible, both theoretically and practically, for a evidence pointing to the lack of observable adherence to PPP in practice. Although conventional wisdom suggests that real exchange rates between the currencies of developed nations are driven by relative prices of tradable goods (Engel 1999), recent evidence (see, for example, Burstein et al. 2005) suggests that changes in prices for non-tradable goods can have a significant effect on the deviation of official exchange rates from PPP levels. Although the Big Mac index offers an interesting insight into PPP, the issues associated with the chosen product suggest that a different application of the approach is required. This paper advocates the use of a high technology good, such as video game consoles, in place of a food item such as the Big Mac. Although there are vast differences in the design and manufacturing process for both goods (the video game console, for example, undergoing a costly and rigorous R&D programme that can last for several years and requiring very specialised production facilities—the Big Mac comparatively less so on both counts), they both stand as examples of standardised products. However, a convincing factor in favour of the use of technology goods of this nature in the construction of a PPP index is the diminished influence of local non-traded resources employed in the production process. Video game consoles tend to be manufactured to a finished state in a single production facility and then distributed worldwide, whereas hamburgers require a reasonably significant amount of localised assembly before the good can be consumed. It is hoped that focus on a high technology good of this nature will minimise the influence of any heterogeneity in the prices of non-traded goods used in the production process between countries.

3 Cultural convergence

Several authors have proposed that technologically based industries such as video gaming can play a significant part in the process of cultural convergence across international borders. Prominently, Axelrod (1997), in his social influence model, argues that a person's 'culture' can fundamentally be defined in terms of a number of features, examples of which include beliefs, behaviour, language and technical standards. Within these features, any given culture can display a range of possible traits. Axelrod's simulation model assumes that cultures can interact so long as they have at least one shared cultural feature and that the percentage chance of interaction between two cultures increases when the number of common features that exist between the two cultures is greater. Subsequent to this interaction, traits can be adopted by either culture from the other, which makes further convergence more likely over a long time horizon. Axelrod cites the example of language in his paper: suggesting that a person is more likely to speak to someone who shares a similar language and the very act of communication makes patterns of speech more

similar. However, the same notion could apply to the use of technology. According to Axelrod, cultural stability is likely to occur when there are no longer any shared features between broad cultural 'regions' and no chance of further interaction exists. Axelrod finds in his simulation that the number of stable cultural regions increases with the number of possible traits within each feature and decreases with the range of interaction, the number of cultural features and with large territories.

The work of Axelrod suggests that, as the result of partaking in video gaming, people from otherwise different cultural backgrounds can be brought together through the use of a common technology. Other papers have arrived at similar conclusions, suggesting that industries such as video gaming and Hollywood movies (markets which are which are dominated by a small number of major transnational players that benefit from considerable economies of scale and scope in the global distribution of their product) are the 'driving force' behind globalisation (Kerr and Flynn 2003). As a result of this integration of technology into popular culture, young adults are forming distinct identities based on association with groups of likeminded individuals, the membership of which is likely to transcend national borders. Even within these groups, there exist a variety of consumable goods that are targeted at a multitude of demographics, with each providing the user with a unique 'sub cultural' identity and an opportunity to bond with their peers in unique ways (Petkova 2006). Video game consoles are increasingly becoming an object around which social groups can congregate and interact, with users gaining social pleasure from playing as a collective (Poole 2000). As all three products comprising the current generation of video game consoles allow for multiplayer online gaming, group play is becoming an increasingly important aspect of the medium. Online gaming groups are seen to negotiate and develop a shared way to pursue their interest, especially within the context of large scale action adventure games[8] (Schott and Kambouri 2003). Among these groups, barriers such as age, gender, nationality, etc. can be arbitrary, being difficult to determine with any certainty in an on-line environment (Berman and Bruckman 2001).

However, despite the contribution of video gaming to the process of international cultural convergence, the industry has arguably found it more difficult to pervade the shared cultural consciousness than movies, despite the higher earnings of the video game industry than the Hollywood film industry (Bolter 2002). In an economic sense, there is also significant resistance to the liberalisation of trade rules for a number of countries with respect to products exhibiting a strong cultural content, such as radio, television and video games. As a result, diversity enhancing state measures are usually found to be incompatible with free trade agreements such as GATT or GATS (Hahn 2006) and the resulting tension creates conflict between free trade and state measures designed to protect cultural industries. On the weight of this evidence, one could put forward quite a convincing argument that the video games market presents a greater scope for the study international cultural diffusion than hamburgers, especially in markets where religio-social dietary constraints are

[8] A chief example of such being the genre of 'Massively Multiplayer Online Games' (MMPOGs), which includes the incredibly popular 'World of Warcraft'.

present. It is possible, therefore, that we should not be talking in terms of 'Burgernomics' but of 'Wiiconomics' instead.

4 Evidence on PPP

It is proposed that the comparison of relative prices of video game consoles might help to provide additional insight into any deviation of market exchange rates from their long-term PPP levels. To this end, data on the prices of three video game consoles are used: namely, the Microsoft Xbox 360 (released in November 2005), the Sony 'Playstation 3' and the Nintendo 'Wii' (both released in November 2006). Launch prices[9] have been researched from a large sample of press releases made by the companies involved from various industry websites (such as http://www.ign.com). Table 1 (below) shows a selection of major currencies for which common pricing information was available, along with the price at launch of the three video game consoles that comprise the current generation of hardware, expressed in units of that currency. By comparing these launch prices against the price of each respective console in USD, it is possible to estimate an exchange rate that would provide PPP for each of these consoles across currency borders. By comparing this implied exchange rate to the actual market exchange rate between these currencies at the time of release, it is possible to determine whether the official market rate relatively 'over' or 'under' values the dollar.[10]

All data on currency exchange rates that are used in this study were taken directly from the Federal Reserve Bank published statistics and are presented in indirect terms (meaning that the values expressed show how much of the respective currency can be bought with 1 USD[11]). The data presented are mean values of currency exchange rates for the relevant month—in this case, the month of release for each respective console has been chosen as a reasonable representation of the market rates for each currency at the time that they were first available to consumers. The numerical values presented in the final column are indices of PPP currency valuations relative to the USD: a figure of 100 would indicate a market valuation for the respective currencies that is in line with strict PPP, whereas 105 would suggest that the currency is overvalued against the dollar by 5%. Any number below 100 is

[9] Ideally, a range of prices across numerous time periods would be used to test for convergence over time. However, due to the relatively static nature of nominal prices for these machines (prices may change perhaps once or twice over the significant lifespan of such a device—usually five years) and a lack of availability of consistently updated prices from the range of countries cited here, it has not been possible to do so. This may be an area for future research effort to expand upon.

[10] These terms are used in the same sense as suggested by the Big Mac Index. In truth, it is expected that official exchange rates will deviate from strict PPP levels to an extent. One should not assume that markets will adjust exchange rates to equalise the prices of individual goods such as video games consoles, hamburgers or any small market baskets.

[11] To convert these values into direct figures, one only needs to take the reciprocal of the numbers presented here—this will inform how many US Dollars can be purchased with one unit of the relevant currency.

Table 1 Console purchasing power comparisons versus market exchange rates

Country	Currency	Local price	Implied exchange rate vs dollar	Actual market exchange rate	Over/under valuation[a]
Sony Playstation 3 (60 GB model)—launch November 2006					
Australia	AUD	999	1.6678	1.294	129
Canada	CND	659	1.1002	1.1359	97
Denmark	DKK	5495	9.1736	5.7858	159
Eurozone	EUR	599	1	0.7759	129
Finland	EUR	650	1.0851	0.7759	140
Japan	YEN	59,980	100.13	117.32	85
New Zealand	NZD	1199.95	2.0033	1.4941	134
Norway	NOK	5995	10.0083	6.3991	156
Mexico	MXN	10,000	16.6945	10.913	153
Singapore	SGD	799	1.3339	1.5558	86
Sweden	SEK	5999	10.015	7.0612	142
Switzerland	CHF	899	1.5009	1.2356	121
Taiwan	NTD	17,980	30.0167	32.808	91
United Kingdom	GBP	425	0.7095	0.5229	136
United States	USD	599	–	–	–
Microsoft XBox 360 (Premium)—launch November 2005					
Australia	AUD	649.95	1.6249	1.360	119
Canada	CND	499.99	1.25	1.1815	106
Denmark	DKK	3,199	7.9977	6.3277	126
Eurozone	EUR	399.99	1	0.8482	118
Finland	EUR	409.99	1.0250	0.8482	121
Japan	YEN	39,795	99.4900	118.45	84
New Zealand	NZD	699.95	1.7499	1.4499	121
Norway	NOK	3395	8.4877	6.6399	128
Mexico	MXN	4,999.99	12.5003	10.672	117
Singapore	SGD	660	1.6500	1.6981	97
Sweden	SEK	3995	9.9877	8.1157	123
Switzerland	CHF	600	1.5000	1.3110	114
Taiwan	NTD	13,888	34.7209	33.580	103
United Kingdom	GBP	279.99	0.7000	0.5764	121
United States	USD	399.99	–	–	–
Nintendo Wii—launch November 2006					
Australia	AUD	399.95	1.5999	1.294	124
Canada	CND	279.95	1.1198	1.1359	99
Denmark	DKK	2,199	8.7964	5.7858	152
Eurozone	EUR	249.00	0.9960	0.7759	128
Finland	EUR	269.90	1.0796	0.7759	139
Japan	YEN	25,000	100.0040	117.32	85
New Zealand	NZD	499.90	1.9997	1.4941	134

Table 1 continued

Country	Currency	Local price	Implied exchange rate vs dollar	Actual market exchange rate	Over/under valuation[a]
Norway	NOK	2,499	9.9964	6.3991	156
Mexico	MXN	4,490	17.9607	10.913	165
Singapore	SGD	499.00	1.9961	1.5558	128
Sweden	SEK	2,699	10.7964	7.0612	153
Switzerland	CHF	399.00	1.5961	1.2356	129
Taiwan	NTD	7,000	28.0011	32.808	85
United Kingdom	GBP	179.00	0.7160	0.5229	137
United States	USD	249.99	–	–	–

[a] Of relevant currency against the USD

indicative of undervaluation of this currency against the dollar—a score of 85 for example implies a 15% undervaluation.

5 Implications

For the most part, the estimations of currency over or undervaluation, relative to strict PPP levels, are consistent across hardware brands. Although there are a number of small variations between the purchasing power estimates implied by the different consoles, it is still possible to discuss broad trends from the results presented in Table 1. Assuming for a moment that strict PPP holds, the market seems to overvalue the Euro, British Pound, Swiss Franc, Australian Dollar and New Zealand Dollar against the USD, while the Japanese Yen appears to be undervalued. These trends are apparent in the case of all three consoles and so appear to be appropriate indicators of the dollar's (mis)representation on the global currency markets between November 2005 and 2006. The only other major global currency not mentioned is the Canadian Dollar—the measurements of deviation from PPP are very small and differ in sign between years. This would suggest that, in video gaming terms at least, the USD is reasonably well valued against its Canadian counterpart. The obvious point to make here is the extent to which this methodology demonstrates a market overvaluation against the dollar. The trend seems to be most consistent among European currencies, as well as those of Australia and New Zealand, where the highest levels of overvaluation are observed. The minorities of currencies that show an undervaluation against the dollar are predominantly East Asian economies and in particular, the estimates show this relationship to be consistent for the Japanese Yen. The broad degree of PPP that exists within each major global territory seems to be consistent with the implications of the Axelrod hypothesis, with a certain degree of cultural convergence in key territories implied by the figures, especially within Europe.

One theory for the departure of official exchange rates from their PPP levels is simply that the market valuation of world currencies is not congruent with this

theory. This argument is supported by the respective interest rate environments that have prevailed during the middle years of this decade, and the possible effect this has had upon international capital flows. However, with interest rates rising steadily in the US between 2004 and 2006 the continuing weakness of the dollar could be ascribed to factors such as the aversion of investors to the holding of USD denominated assets (thanks to ongoing conflict in the middle east and the perceived threat of terrorism directed at the assets of the US), as well as the strong evidence suggesting the presence of 'stagflation' in the US economy and persistent problems in the sub-prime lending market. These have all had the effect of perverting market exchange rates away from their long run PPP levels.[12]

One might more reasonably arrive at the conclusion that strict PPP does not hold in reality in the context of the market for video game consoles (or, indeed, for any market). It would perhaps be fair to assume that, as a majority of video games companies are based in Japan (with the exception of Microsoft) and produced in East Asia, video games machines would be cheaper in real terms in that territory as transportation costs to the point of sale are lower. By contrast, it is also quite possible that European consumers are the subject of price discrimination, particularly in relation to the US gamer. If this is the case, the higher price paid for video game consoles in real terms around Europe would account for the persistent indication of overvaluation of European currencies against the dollar observed in Table 1. This might also be true for console owners in Australia and New Zealand, which also show the same persistent overvaluation against the dollar.

Table 2, below, shows a comparison of the estimations of departures from strict PPP exchange rates made between the Video Games, Big Mac and OECD indices for comparable time periods. As the Big Mac index is published annually in the Economist, the most recent figures published *after* the relevant release of the consoles are presented, as these are thought to be the most representative of the timeframe in question. OECD figures are taken from the relevant year of console release. There do appear to be some quite interesting similarities and differences between the sets of results. Firstly, both the Big Mac index and the index compiled from relative prices of video games machines agree that the European currencies are overvalued against the USD, with similar estimates of the extent of this overvaluation. The Yen is also found to be undervalued against the USD using both methodologies, although the Big Mac index estimates a much greater extent to which this is the case. Both indices also seem to agree that the Canadian dollar is reasonably well valued against the dollar, with any difference in sign being virtually irrelevant owing to the small absolute difference between the figures quoted. The major difference seems to be the valuation of the Australian and New Zealand dollars. Where the Big Mac index seems to suggest that these currencies are undervalued, the index based on video games prices suggests quite the opposite. The OECD figures also tend to agree that the relative value of the USD has departed from its strict PPP level, showing that most global currencies are overvalued against

[12] Although, in truth, it is unlikely that monetary policy will excessively influence the departure of official exchange rates from PPP levels—as interest rates, exchange rate sand prices are determined simultaneously in general equilibrium.

Table 2 Comparison with other indices

Currency	2006 Average valuation[a]	Big Mac index		Overall video games valuation (2005–2006)	Overall Big Mac valuation	OECD price levels	
		(31/01/07)	(27/05/06)			2005[b]	2006
AUD	126	83	79	124	81	103	104
CND	98	96	101	100	99	97	104
DKK	155	150	154	146	152	138	142
EUR	129	119	122	125	121	106	106
YEN	85	72	72	85	72	114	105
NZD	134	98	89	130	94	105	97
NOK	156	206	–	147	–	133	136
MXN	159	83	83	145	83	64	65
SGD	107	–	73	104	–	–	–
SEK	147	143	146	139	145	120	122
CHF	125	157	168	122	163	136	133
NTD	88	71	75	93	73	–	–
GBP	136	121	118	131	120	115	118

[a] Based on price data for the Playstation 3 and the Wii

[b] From the OECD purchasing parity database

the dollar. The OECD figures suggest that the sign and order of magnitude indicated by the other measures presented here are, with a few exceptions, reasonably accurate. Firstly, the OECD figures suggest that the Japanese Yen is trading at a price above its PPP level, which contradicts evidence from the Big Mac and Video Games indices. Secondly, the Video Games index points to an overvaluation of the Mexican Peso against the dollar, whereas both the OECD and Big Mac indices indicate the opposite. The OECD figures also seem to indicate slightly lower overvaluations for most of the quoted currencies, notably those of parts of Europe and Oceana. Perhaps these discrepancies are due to the composition of the 'basket' of goods used to construct the indices: where the components are more focused in scope (as in the case of the Big Mac and Video Games indices), departures from PPP exchange rates may appear more exaggerated than would appear across a broader range of goods and may arguably be less meaningful due to the increasingly non-standardised nature of the products that are being compared.

Aside from these discrepancies, it should be noted that both the Big Mac and Video Games indices broadly agree on the general deviation of the respective values of each currency from their long term PPP levels. The fact that video game consoles and Big Macs show similar price differentials supports the notion of convergence. The similarity also suggests that relative real price discrepancies across countries are smaller than that which is indicated by price measures calculated using foreign currency exchange rates. In other words, the opportunity cost of buying a video game in terms of Big Mac consumption foregone comes closer to satisfying the law of one price than does an international exchange rate comparison. The commonality that is observed between the prices of video games systems in major economic

zones cannot be ignored, with Europe, Asia and North America all broadly converging in terms of real video game exchange rates. This is a conclusion which is supported by the work of Bharath (2000), who indicates that, in the short run, deviations from PPP exchange rates are found to be correlated positively to transportation costs and negatively to common cultural ties and national borders. Thus, the relatively lower price of video games consoles in East Asia compared to North America and (especially) Europe can perhaps be accurately attributed to the disparity in transport costs associated with the distance from East Asia to these locations. Furthermore, the evidence suggesting broad PPP within certain geographical areas with many borders (again, especially Europe) shows that a degree of real pricing equality is present where there are stronger cultural ties and where countries are in close geographic proximity. Thus, it appears that the market for video game consoles plays an important part in promoting (or, depending on your point of view, demonstrating) international cultural convergence. If this is indeed correct, it provides some empirical evidence on the nature of the movement towards the adoption of a common culture within broad geographical areas as proposed by Axelrod. It is possible that these are representations of the 'stable' cultural regions that Axelrod proposes will endure in equilibrium after a process of cultural exchange (within which, but not between which, common cultural characteristics have been adopted). Whether or not any shared cultural characteristics with respect to video games that exist between these regions will allow for a degree of further convergence remains to be seen—perhaps only if further convergence is eventually achieved will the law of one price persist across the whole of the global video games market.

6 Concluding remarks

This study has sought to investigate the alternative means by which the economic community has attempted to estimate deviations of currency exchange rates from long-term PPP levels. The Big Mac index is one much cited (and often criticised) example of how this has been achieved, using a familiar and standardised product that is available globally to construct purchasing power estimates and subsequently comparing these against official market rates. With published work applying this idea to a new generation of standardised products, from cups of coffee to mp3 players, it seems perfectly logical to include the analysis of an industry such as video gaming, which is increasing in importance both commercially and culturally, in such a body of literature. The figures presented here suggest that current market exchange rates for major global currencies are indeed out of line with their long-term PPP levels. By making a brief comparison between these calculated under- or overvaluations with those published in the Big Mac index, one can see that, in a majority of cases, similar deviations from PPP prices are observed for both hamburgers and video game consoles. Finally, broad similarities are seen in relative prices amongst geographical groupings of countries (in Europe, North America and East Asia) showing that the market for video games systems is starting to exhibit signs of cultural convergence within key regions—possibly due to shared

characteristics and cultural attributes associated with the common use of video games systems, as suggested by Axelrod.

The link between culture, technology and PPP is relatively underexplored in the literature and there exists much scope for future study related to interaction between these sub-disciplines. With increasing levels of consumer expenditure on cultural technology goods, one might expect increasing international similarity in cultural behaviours/cultural consumption as a result. Cross-country regression using information on leisure consumption derived from consumer expenditure surveys may be one way that the issue can be explored further in the future.

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