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International Pricing Strategy: Why Prices Rise and How Prices Change

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ABSTRACT

This work discusses the struggle to readjust local prices throughout the world, particularly considering changes in the exchange rates. Insights are drawn from data that the newspaper "The Economist" uses to calculate "The Big Mac Index" and also from the UBS study "Prices and Earnings around the Globe". Indeed, prices in US-dollars for the Big Mac and for a basket of goods are not the same around the world basically for three reasons. First, industrialised economies trading more sophisticated goods tend to present higher prices in US-dollars compared to those in developing countries that mostly deal with raw materials and goods with less added-value. Second, consumer behaviour and rate of economic growth both affect prices. Third, a country may strategically set exchange rates that deviate from the purchasing power parity, conveying the impression that prices abroad are cheaper or more expensive. Hence, multinationals' subsidiaries try to strive for an annual price readjustment in US-dollars at least equal to an international average, without bothering whether prices in US-dollars for identical goods are the same world-wide.

Keywords: Prices; Exchange rates; Law of One Price; Purchasing Power Parity Theory; Big Mac; McDonald's; Earnings; UBS study; Corporate Finance

Subject classification JEL: E30 - General: Prices, Business Fluctuations, and Cycles

MOTIVATION FOR THIS WORK

International circumstances and businesses affect both prices of imported goods, and prices of those goods, which could be exported, but are still traded domestically, as long as their prices in the internal market stay sufficiently high. This idea sustains the simplest and well-known model for international pricing. The "Law of One Price" states that identical goods which can be moved around easily are sold anywhere for the same price in a given currency provided there are no barriers to commerce, such as: significant transportation costs, harsh logistical difficulties, and stringent protectionism. Thus, ideal tradable goods should not be bought with the expectation of selling them immediately elsewhere at a profit.

Conversely, a good becomes less tradable the more the cost (or burden) of its transport and marketing increases. Thus, the price of absolute nontradable goods - namely services, which are produced and consumed in the same place, should ultimately depend on local labour costs, productivity, consumer's behaviour and purchasing power, and additional expenditures to run a business in a specific region. Hence, the Law of One Price should not hold for these goods, which actually are by far the most widespread.

Despite discharging the Law of One Price, several authors, as Wheatley, Ricardo and specially Cassel (cited in Ong 2003, p. 1), conjectured that price levels in different countries could be equal when expressed in a same currency. As a result, an exchange rate would reflect the ratio between price levels in different countries. Moreover, according to the "Purchasing Power Parity Theory" (PPP), the price of a given basket of goods in a given currency would not depend on the country where it was bought. However, there is a lack of empirical evidence to support the PPP Theory, as frequently discussed in textbooks (e.g. Appleyard and Field 2001; Brealey and Myers 1996; Krugman and Obstfeld 1994).

Once McDonald's produces, offers, and delivers in the same way world-wide the Big Mac sandwich, its data may indeed exemplify how a nontradable good does neither follow the "Law of One Price" nor sustain the "PPP Theory". However, McDonald's should have an underlying strategy to set and change Big Mac prices on about 120 countries, considering that the multinational corporation has incontestably expanded its global business in a successful and uniform manner throughout the world. Moreover, although many factors really do impede free trade of the sandwich, it should not be bluntly accepted that the price of the Big Mac may vary as much as from US$1.45 (China) up to US$5.20 (Switzerland), as published by the The Economist (July, 2007). Trade barriers, differences in productivity, as well as income, labour costs or standard of living disparities, may not alone explain such a remarkable price difference between Switzerland and China. Actually, there are other noteworthy differences in price for the Big Mac between developed and developing countries, although Big Mac prices in a given currency tend not to vary so considerably within a group of countries with about the same development.

In view of the gap between practice and long-established theory, this work reviewed a theoretical model suggested by Henriques de Brito (2003) into which recent data for Big Mac prices and new data from the UBS study "Prices and Earnings around the Globe" was inserted. The results lead to managerial insights, which explain how a similar pricing strategy accounts for price changes throughout the world, regardless of the local currency. Furthermore, it was possible to grasp why and how countries may manipulate exchange rates.

THEORETICAL BACKGROUND

This section brings the theoretical background of The Big Mac Index and describes briefly the model originally suggested by Henriques de Brito (2003), which sheds a new light on the meaning of "The Big Mac Index", whose data has been released by the British newspaper The Economist since 1986. Henriques de Brito model is presented also in order to ascertain if all data published four years later still support his conclusions, as well as to further the discussion of his insights. This section ends by showing how data from different editions of the UBS study "Prices and Earnings Around the Globe" may be compared to The Big Mac Index data. A list of symbols is given at the end of this work.

Presentation of The Big Mac Index

There are two different ways to calculate "The Big Mac Index" (iBM). First, iBM for a country quantifies in how much the price in US-dollars of the Big Mac sandwich in that country surpasses or stays below the price of the Big Mac in the United States (USA), as initially given by Equation 1. Second, iBM may also be a way of quantifying how much an estimated PPP would differ from the actual exchange rate. A likely estimate of the PPP between a country and the USA could be the ratio between the domestic Big Mac price and the price of the sandwich in the USA. Hence, when the estimated PPP equals to the exchange rate, the US dollar price of the Big Mac in a given country is the same as in the USA.

$$(1) \qquad iBM_{country} = \frac{P_{country}\big|_{US\$} - P_{USA}\big|_{US\$}}{P_{USA}\big|_{US\$}} = \frac{\left(P_{country}\big|_{local\ currency}\right)\Big/c - P_{USA}\big|_{US\$}}{P_{USA}\big|_{US\$}} = \frac{PPP - c}{c}$$

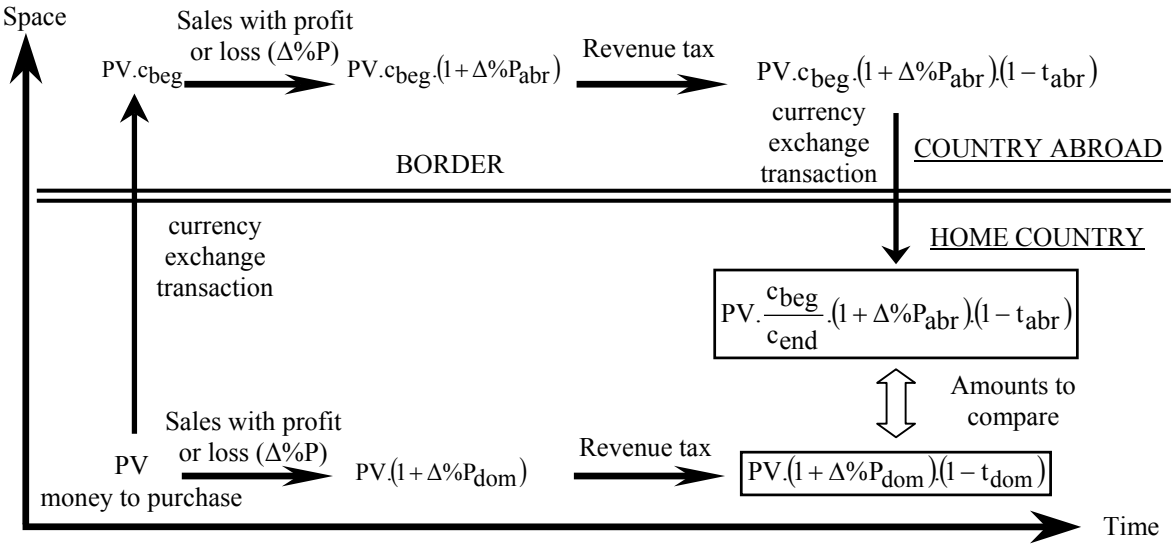
The Big Mac indexes for all countries would be zero if the PPP Theory was valid. The newspaper The Economist suggested in several editions that when iBM would deviate from zero there was an opportunity to access the evolution of exchange rates towards PPP. However, The Economist did mention that such assessment should be better between countries at a similar stage of development (The Economist July 7th 2007). Actually, previous editions did point out that The Big Mac Index would not necessarily lead to trustworthy conclusions about currency misalignments (e.g. The Economist April 12th 1997). Moreover, The Economist would in some editions doubt or even mock about the usefulness of its index (e.g. The Economist December 11th 1999). The fact is that iBM values in a row may persistently remain very different from zero (see Table A1 and Table A2).

The iHdB Index and its relationship to The Big Mac Index

In a book (Henriques de Brito 2003), and afterwards in an article (Henriques de Brito 2004), both available in Portuguese, the author deduced mathematically a financial index and named it iHdB. This index contains two consecutive values of The Big Mac Index. There are two ways of obtaining the iHdB index: a totally analytical deduction (Henriques de Brito 2004) and a deduction using a space-time graph, which is presented in Figure 1.

Figure 1 shows that a certain amount of money (PV) may be used to purchase a good either in the same country or abroad, which in this latter case requires previously a currency exchange transaction. The percentage change in price obtained by the investor ($\Delta\%P$) is defined as the ratio between the margin (profit or loss) and the purchase price of the good, being that the margin is the difference between the selling price and the purchase price of the good. Additionally, a tax may be levied on either the revenue or the value-added. These two applicable rates may be related by a mathematical equation, as given by Equation A2 on the

Appendix. Yet it runs out the scope of this article to discuss such equation more thoroughly.



Source: Adapted from Henriques de Brito (2003), Figure 1.5-1, page 16.
See list of symbols right after the references at the end of this work.
Figure 1 Comparing amounts obtained by purchase and sale abroad and domestic

Between the moment that the money PV is sent for a purchase abroad and the moment that the amount earned after a sale is remitted back to the home country, the exchange rate may vary from c_{beg} to c_{end}. Equation 2 shows the percentage change in the nominal exchange rate, which comes out of disclosed market data. For example, one US-Dollar bought once 2.40 Brazilian-reais, being that after one-year, say, US$1.00 = R$2.30. During this period, the revaluation of the Brazilian-real against the US-dollar was 4.35% (=(2.40-2.30)/2.30, using Equation 2), which is equivalent to state that the US-dollar devalued 4.17% against the Brazilian-real.

$$\varphi_{c\,nom} = \frac{1/c_{end} - 1/c_{beg}}{1/c_{beg}} = \frac{c_{beg} - c_{end}}{c_{end}} = \frac{c_{beg}}{c_{end}} - 1 \qquad (2)$$

Business abroad is financially worthwhile if, for the same initial investment, the expected amount cashed in after repatriating might be greater than the expected future value obtained at home. A way of comparing these two amounts in Figure 1 is to divide one by the other, which, after inserting Equation 2, yields the definition of the iHdB index.

$$(1 + \text{iHdB}) = \frac{(1+\Delta\%P_{abr})}{(1+\Delta\%P_{dom})} \cdot \frac{(1-t_{abr})}{(1-t_{dom})} \cdot \left(1 + \varphi_{c\,nom}\right) \qquad (3)$$

The number 1 was added on the left side of Equation 3 so that the iHdB index may convey a tangible information. The more the iHdB index is positive, the more attractive is the investment abroad. Conversely, if the iHdB index is negative, the domestic transaction is more appealing. Moreover, the iHdB index definition makes it also possible to carry out simple calculations. At the beginning of the appendixes are the equations to find the iHdB index of a foreign country in respect to new country taken as reference, as well as the annualised iHdB from a sequence of annual iHdB values.

Equation 3 may be simplified by neglecting the ratio with the revenue tax rates, since the same good may have quite similar revenue tax rates in different countries. However, even if

the revenue tax rate is, say, 5% abroad and 2.5% domestic (i.e. 50% lower), the ratio which is being neglected equals .974 (=(1-.05)/(1.025)), which is almost one. Therefore, such dissimilarity will not change the main conclusions, as thoroughly discussed by Henriques de Brito (2003). Hence:

$$(1+\text{iHdB}) = \frac{(1+\Delta\%P_{abr})}{(1+\Delta\%P_{dom})} \cdot \left(1+\varphi_{c\ nom}\right) \quad (4)$$

Equation 4 may be rewritten, also using Equation 2 and PPP definition:

$$(1+\text{iHdB}) = \frac{\frac{P_{abr\ end}}{P_{abr\ beg}}}{\frac{P_{dom\ end}}{P_{dom\ beg}}} \cdot \frac{c_{beg}}{c_{end}} = \frac{\frac{P_{abr\ end}}{P_{dom\ end}}}{\frac{P_{abr\ beg}}{P_{dom\ beg}}} \cdot \frac{c_{beg}}{c_{end}} = \frac{PPP_{end}}{PPP_{beg}} \cdot \frac{c_{beg}}{c_{end}} \quad (5)$$

The Big Mac Index (Equation 1) may also be written as Equation 6:

$$(1+\text{iBM}) = \frac{PPP}{c} \quad (6)$$

Noticing that iBM value is for a given instant, Equation 5 and Equation 6 together result in:

$$(1+\text{iHdB}) = \left(\frac{1+\text{iBM}_{end}}{1+\text{iBM}_{beg}}\right) \quad (7)$$

Two different values for The Big Mac Index (iBM) appear in the above definition for the iHdB index (Equation 7). Hence, the way by which The Big Mac index varies with time, rising or falling during a given period, will define if the iHdB index will be positive or negative. Hence, a change of The Big Mac index may indicate if business abroad in a given period is more or less attractive than in the USA.

Linking data from the UBS study "Prices and Earnings" with The Big Mac Index

Would the British newspaper The Economist compare a Big Mac price abroad in US-dollars with the average Big Mac price in the USA, publishing a price index instead of the actual prices separately, The Big Mac index (iBM) could still be determined with this price index. Another way of calculating iBM results from Equation 1 as given by:

$$\text{iBM}_{country} = \frac{P_{country}\big|_{US\$} - P_{USA}\big|_{US\$}}{P_{USA}\big|_{US\$}} = \text{iP} - 1 \quad (8)$$

Equation 8 enables the use of published data from the Swiss bank UBS. Their study "Prices and Earnings around the Globe", released by UBS every three years, disclosed a price index, which compared prices of a standardised basket of more than 100 different types of goods and services traded in more than 50 cities around the world, according to the edition. The UBS price indexes for each city was based on the reference value Zurich =100, except for the 2006 edition, which used New York as reference. This change hampers direct comparison of the published UBS price index from different years with the data in the 2006 edition. However, it is possible to change or chose a new, constant reference value by simply dividing the published price index for a given city by the price index of the selected reference.

Once The Economist uses an average price of four cities (i.e. New York, Chicago, Atlanta and San Francisco), when determining The Big Mac Index, the UBS price index should also consider an average reference value for the USA. Fortunately, UBS publishes price indexes for three cities in the USA. Therefore, all published UBS price indexes were divided by a new reference value, which was set to be the average price index value for New York, Chicago, and Los Angeles that is close to San Francisco.

Values for this transformed UBS price index may be put in Equation 8 in order to find a "UBS index" (iUBS), which can be directly compared to The Big Mac Index at a given year, and which may also be used to calculate the iHdB index with Equation 7. Since this iHdB index will refer to a three-year period, the annualised iHdB for this global period must be determined (see Equation A5 on the Appendix).

RESULTS AND DISCUSSIONS

Data for the iHdB Index obtained with data for The Big Mac Index

There are very few goods and services that are produced and sold exactly in the same way around the world. More rare is to find their selling prices regularly published. Fortunately, for many countries and years, The Economist newspaper has published exchange rates and especially Big Mac prices. The raw data was used by Henriques de Brito (2003) to compute both The Big Mac Index (with Equation 1) and the iHdB index (with Equation 7), employing the same criteria when rounding up numbers.

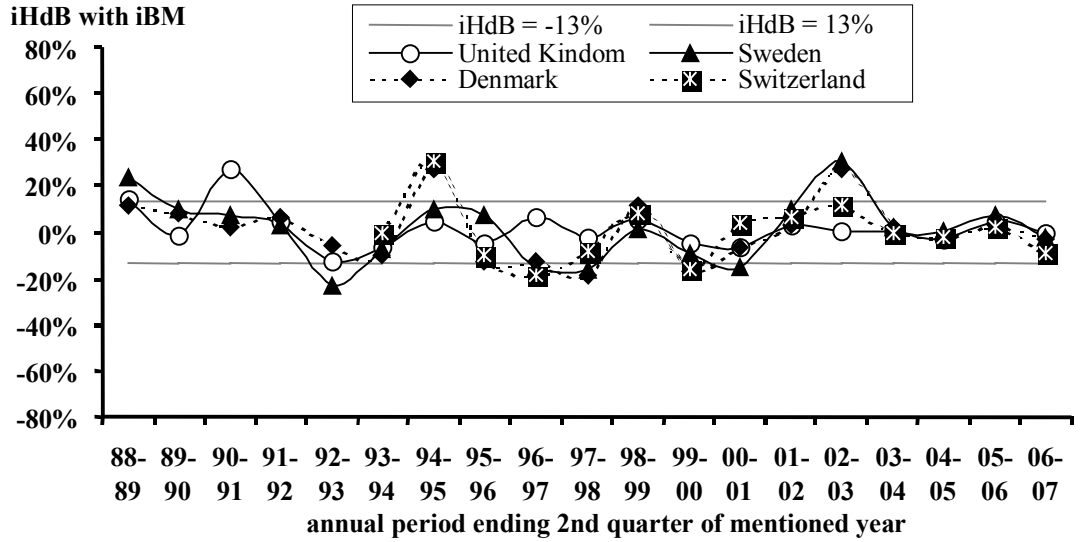
This work brings in the Appendix new data for the iBM index (Table A1) and for the iHdB index (Table A3) which are not found in Henriques de Brito (2003). This author did not publish either iBM or iHdB values for data disclosed by The Economist about the beginning or end of each year, starting in 1998 until 2007. These iBM and subsequent iHdB values are respectively available in Table A2 and Table A4. Countries with about the same stage of development or geographical position are close to each other on the tables.

The last column at right of Table A3 shows for each country the updated mean values of the annual iHdB in an interval with a 95% confidence level, taking into account the standard deviation of the sample, its size and the t-student distribution. The last line presents for each new calculated annual period the mean value for the iHdB index in an interval with a 95% confidence level. For a different period span, Table A4 brings for each country and period the iHdB mean values in an interval with a 95% confidence level. Although the periods' extent are slightly different than 12 months, as shown in the penultimate lines of Table A3 and Table A4, all these strings of data are sufficiently long and numerous to draw conclusions.

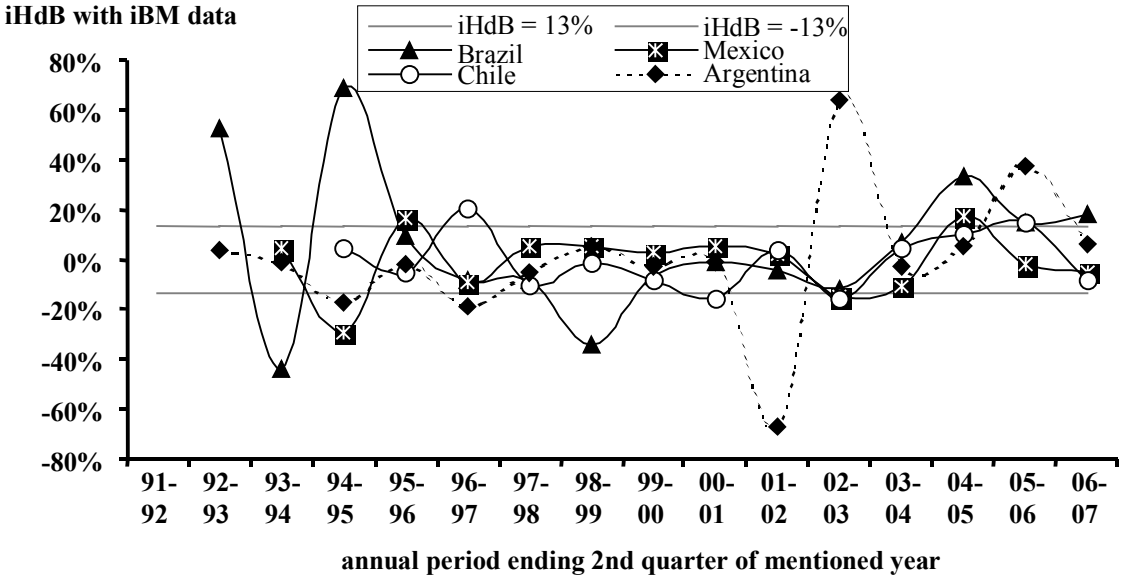
An inspection of Table A3 and Table A4 reveals that the mean intervals of the iHdB index for all countries include the value zero. Therefore, it is not possible to reject, with a confidence level of 95%, the hypothesis that mean iHdB values for annual periods are zero. Moreover, Figure 2 and Figure 3 are updates of two of the six original graphs proposed by Henriques de Brito (2003), using the recent data in Table A1. The other four graphs are not in this work in order not to overload it. Anyhow, all graphs display undoubtedly how the iHdB values swing or disperse around zero usually with a narrow scatter range (± 13%).

Two iHdB data strings for the same country do not have to present either the same values or trend, especially because each sequence begins at a different moment in the year. Yet it is worthy to investigate if the average iHdB values of both series for each country would be equal, and if the average iHdB values for each roughly annual period would also be equal. In order to find out which factor prevails, it is necessary to perform an F-test (ANOVA with double factor without repetition) for each country with the iHdB data in Table A4, in Table A3, and those already published by Henriques de Brito (2003). Table A5 displays the results for the p-value, the F-factor and the critical F-factor. The p-values of the columns tend to be

clearly lower than the p-values of the lines. This is also an evidence that the averages of both data strings for every country tend to be the same (i.e. zero), without enforcing the same mean for each annual period. As expected, there is no reason whatsoever to have the same iHdB values for annual periods beginning at different months in the same year, because iHdB values fluctuate around zero.



Update of Henriques de Brito (2003) centre graph of Figure 2.3-1, page 49.
Figure 2 Values of the iHdB index for European countries that do not use the Euro



Update of Henriques de Brito (2003) centre graph of Figure 2.3-2, page 50.
Figure 3 Values of the iHdB index for Latin American countries

Comment on McDonald's price strategy employing the above results

The Big Mac pricing policy throughout the world should not merely depend on financial issues, but should also consider how to target a certain customer behaviour and market environment, since McDonald's is known for praising standardisation. Moreover,

McDonald's probably does take into account the price list structure in its restaurant and in the neighbouring society before setting the best local selling prices for raising revenues and profits, which are crucial for enhancing the company's bottom line, market value, and stock prices. Thus, besides holding a relationship with other products on McDonald's menu, the selling price of each McDonald's good may neither be too low or too high. If prices sink needlessly, McDonald's may attract more customers, but revenue may not grow accordingly and profits may even reduce, jeopardising stock prices. On the other hand, if prices soar outrageously, apart from losing loyal customers, new customers eager to consume at McDonald's would be less (if any), which would also ruin the franchise growth strategy linked to real-estate investment carried out by McDonald's.

Additionally, McDonald's seems to clearly acknowledge that the purchasing power may vary around the world, when promptly and constantly set prices that are obviously very different in US-dollar terms, considering yet appropriately that arbitrage is definitely not a threat. Once this main assumption underlying the Law of One Price or PPP is not applicable, McDonald's pricing policy does not actually harm both concepts.

If Big Mac prices may be different, they raise essentially in the same manner. McDonald's seems to be careful about yielding almost the same price readjustment world-wide in a given hard currency. From Equation 4, it may be realised that multiplying the percentage price change in the local currency abroad by the exchange rate variation equals the percentage price change in the domestic money, when iHdB is zero. In this case, the price readjustment abroad equals the price change in the reference country, both in the same currency.

Additionally, as evidenced by Equation 7, two consecutive data for The Big Mac Index conveys information about how the price readjustment in US-dollars in a period and in a given country was above or below the price readjustment in the USA. Indeed, as already reported by Henriques de Brito (2003) and confirmed by new data in this work, a sequence of values for the iHdB index calculated with iBM data of several countries do disperse in a relatively narrow range around zero. Therefore, if the average annual iHdB for every country is zero, this implies that the price readjustment in US-dollar terms will be in the average roughly the same throughout the world, although occasionally in some countries the readjustment may be considerably higher or lower than the world's average.

When this situation occurs, especially when the annual iHdB value for a given country is higher or lower than 13%, the price readjustment in US-dollars in that country in the following annual periods should be probably similar to the readjustment in the USA. This is actually a sort of regression to the mean. Moreover, the longer the annual iHdB for a country remains below than -13%, the more probable will the iHdB increase again due to local price rise, currency valuation, or even both cases together. Hence, a currency revaluation may restrain price increase in the local currency and hold back inflation, as it has been happening in Brazil since 2003 (this work was closed by February 2008). On the other hand, the longer the annual iHdB for a country stays high above 13%, the sooner and more hard-hitting may a currency devaluation occur, since a wide-spread price decrease of goods (i.e. deflation) is less likely. This information may even be useful to know when to sell short a given currency, betting on its devaluation, which does not occur so often.

If strong currency devaluation does happen, the iHdB index for that country will plunge. Normally, the subsequent annual iHdB will soar, particularly due to a noteworthy domestic price increase, i.e. inflation, as it happened in Argentina after the currency crisis in 2001, for

example (see Figure 3). A huge inflation is generally an aftermath of a serious devaluation, also because international business managers strive to increase prices substantially in order to compensate losses in hard currency. The inflation process brings economic instability and exacerbates wealth concentration, once there are some business whose selling prices are readjusted more easily and quickly than other business, and particularly wages. A government may prevent an unacceptable domestic inflation by avoiding currency devaluation or even by stirring currency revaluation with higher domestic interest rates, which attracts foreign capital. Hence, it follows that an exchange rate variation may be a buffer to domestic price change, while multinationals, as McDonald's, are probably aware that focusing the local price readjustment alone should not be a goal, since an exchange rate variation may change the outcome positively or adversely.

How PPP may remain constant regardless price changes

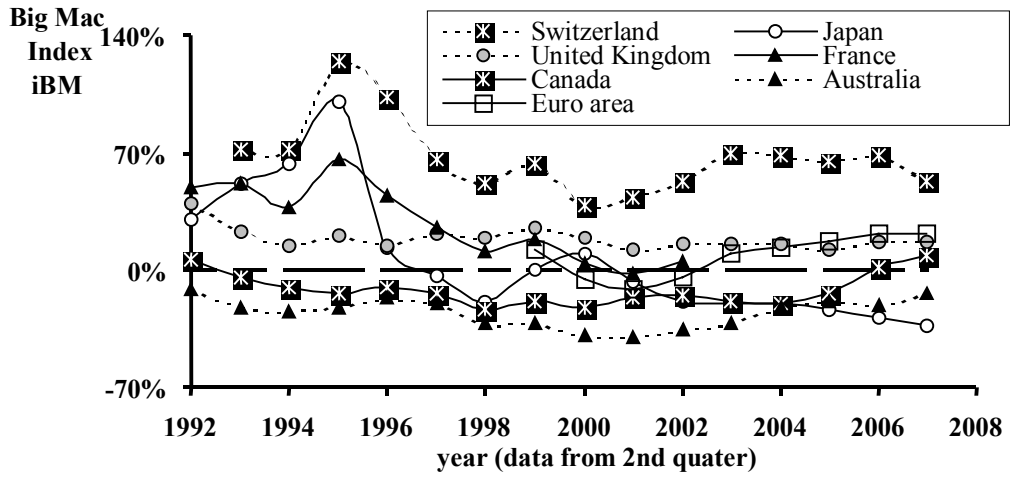
Unpredictable exchange rate movements and irregular price readjustments in different places will presumably not equal prices for identical goods and services. Even when two prices for the same good that is traded in two different places rise by the same percentage, both prices at the end will not be alike, though the ratio between them remains unaffected. There are actually two situations. First, if those prices are not in the same currency, then the PPP is kept constant. In this case, the iHdB may only vary when the nominal exchange rate shifts to a new value. Second, if those prices are in the same currency, then not only an implied PPP is kept constant, but also the iHdB is actually zero. In both situations, the end price will not be alike. All these statements can be seen mathematically looking at Equation 5.

Equation 5 indicates that if the nominal exchange rate does not modify (i.e. c_{beg} equals to c_{end}), and iHdB is about zero, then PPP remains the same. Thus, the change of the nominal exchange rate may be managed so as to restrain it from varying, which, hence, maintains a certain PPP. This monetary policy may stabilise, at a chosen level, the deviation between PPP and the nominal exchange rate, such as given by The Big Mac Index (Equation 1).

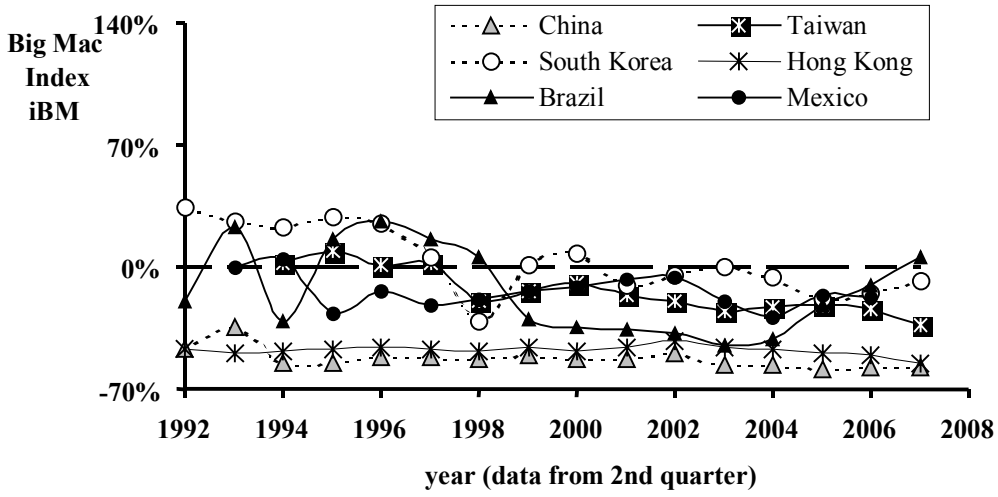
Consequently, the explanation for why the price of the Big Mac in US-dollar terms varies so widely may not solely rely on productivity, income or standard of living disparities, specially because the perception related to the purchasing power may be biased by the current exchange rate. The PPP Theory will never hold when a country conducts its monetary policy so as to adjust or fix an exchange rate, which intensifies deviation from the PPP Theory.

The newspaper The Economist is indeed correct when frequently suggests that The Big Mac Index will give a rough idea to which extent exchange rates might be "overvalued" or "undervalued" in respect to the US dollar. However, a sure shift towards equilibrium, i.e. an exchange rate that would be closer to the PPP value, may not be expected for every country, either in the short or medium run. Such statement results from analysing long data series, instead of carrying out a static analysis, as by looking up only one edition of The Economist.

Data for The Big Mac Index plotted in Figure 4 and in Figure 5, both with the same scale on the vertical axis, reveal that it is quite normal for the exchange rate to be different than the implied PPP value, since The Big Mac index is indisputably different than zero. Furthermore, as already pointed out by Henriques de Brito (2003), and confirmed by new data in Table A1 and Table A2, developed countries, especially in Europe, tend to present positive values for The Big Mac index, whereas developing countries tend to present negative values, especially China.



Update of Henriques de Brito (2003) Figure 3.5-4, page 145.
Figure 4 Values of The Big Mac Index iHdB for developed countries



Update of Henriques de Brito (2003) top graph of Figure 3.5-2, page 141.
Figure 5 Values of The Big Mac Index iHdB for developing countries

The Chinese price level

The iBM values for China have been staying systematically quite stable and very negative. As a result, prices in US-dollars for the Big Mac in China are extremely low. However, this does not mean that the Big Mac price in yuan would be cheap in China for the Chinese. The undervalued Chinese currency accounts for the very low iBM value rather. An exchange rate may lead to erroneous perception of the actual purchasing power abroad, mainly because people tend to judge foreign price levels by converting foreign prices into their own currency.

The four possibilities in Table 1 highlight how the perceived cost abroad changes when the exchange rate varies, although the local prices for the Big Mac remain the same and, hence, PPP is always equal to 3,39. Just when the exchange rate equals the implied PPP (as when c=3,39) is that Chinese and Americans would all have the impression that prices abroad are at the same level as at home. Would the Chinese currency be overvalued in respect to the US dollar (as when the exchange rate is lower than PPP, i.e. c < 3,39), someone thinking with the

Chinese currency would perceive prices and costs in the USA to be lower than in China. However, an American, comparing prices in US-dollars, would believe that the Big Mac in China would be more expensive than in the USA. On the other hand, if the Chinese yuan is undervalued (as when the exchange rate is higher than PPP, i.e. 6,78 or even 8), someone thinking with the Chinese currency perceives the cost in USA to be very high. Conversely, the cost in China appears to be very low for someone judging prices in US-dollars, although this does not mean that a Big Mac is cheap for the Chinese people. However, an undervalued currency did, and still does help China to steadily export more goods, and also to increase the Chinese foreign reserves exponentially.

Table 1 Explaining differences from PPP and exchange rate for China and USA
(e.g. price in China = Yuan 10.50 and price in the USA = US$ 3.10. Hence, implied PPP=3.39)

exchange rate	deviation between implied PPP and c		Perceived Price
c = 8.00	135.99% (PPP as reference)	how Chinese perceive cost in the USA	Yuan 24.80
	-57.63% (c as reference)	how Americans perceive cost in China	US$ 1.31
c = 6.78	100.0% (PPP as reference)	how Chinese perceive cost in the USA	Yuan 21.02
	-50.0% (c as reference)	how Americans perceive cost in China	US$ 1.55
c = 3.39	.00% (PPP as reference)	how Chinese perceive cost in the USA	Yuan 10.50
	.00% (c as reference)	how Americans perceive cost in China	US$ 3.10
c = 2.20	-35.10% (PPP as reference)	how Chinese perceive cost in the USA	Yuan 6.82
	54.09% (c as reference)	how Americans perceive cost in China	US$ 4.77

Notes: There are two ways of obtaining the deviation between PPP and c, as well as the perceived price.
i) For the deviation between the implied PPP and the exchange rate, PPP or c may be used as a reference value.
i.e., when c=8.00: 1.3599=(8.00-3.39)/3.39 and -.5763 = (3.39-8.00)/8.00 (which is The Big Mac Index)
One value for the deviation is the inverse of the other one. Hence, (1+1.3599) = 1/(1-.5763)
ii) For the perceived price, either multiply the price abroad by the exchange rate or multiply the domestic price by the deviation between PPP and c (considering as reference value PPP or c). For example:
Chinese perception: Yuan 24.80 = 3.10*8.00 = 10.50*(1+1.3599)
American perception: US$ 1.31 = 10.50 / 8.00 = 3.10*(1-.5763)

One strong clue that the Chinese government did hinder the yuan revaluation was the small reduction of The Big Mac index between April 2003 and May 2006. During this period, there was a 6.1% price raise of the Big Mac in China (from 9.90 to 10.50 in their local currency), while the price increase in the USA was of 14.4% (from US$2.71 to 3.10). The price rise in the USA, which was more than double of that in China, would justify a significant exchange rate revaluation of the Chinese currency in respect to the US-Dollar, because US price increase resulted rather from inflation and not from a better business environment.

Different inflation and economic growth rates in China and in the USA not only should trigger a different price raise, but would also change the effective exchange rate, which is related to the percentage change in the nominal exchange rate. In order to obtain this relationship, as shown in Equation 9, the value of the final exchange rate in Equation 2 must simultaneously be divided by the factor $(1+\theta_{abr})$ and multiplied by the factor $(1+\theta_{dom})$, accounting for inflation abroad and in the home country.

$$(9) \qquad \varphi c_{\text{effective}} = \frac{c_{beg}}{c_{end}\dfrac{(1+\theta_{dom})}{(1+\theta_{abr})}} - 1 = \left[\left(1+\varphi c_{\text{nom}}\right) . \frac{(1+\theta_{abr})}{(1+\theta_{dom})} \right] - 1$$

In order to write the iHdB index with the effective exchange rate, it is necessary to notice that the percentage change in price ($\Delta\%P$) may be expressed by the inflation rate (θ) times the effective price readjustment (r_E), as shown by Equation 10.

$$(10) \qquad (1+\Delta\%P) = (1+\theta)(1+r_E)$$

Inserting both Equation 9 and Equation 10 in Equation 4, the iHdB index is also given by the effective price readjustment and the effective exchange rate variation.

$$(1+\text{iHdB}) = \frac{(1+r_{E\,abr})}{(1+r_{E\,dom})} \cdot \left(1+\varphi_{c\ \text{effective}}\right) \quad (11)$$

Between April 2003 and May 2006, the nominal exchange rate revaluation of the Chinese currency was 3.1% (since the exchange rate dropped from 8.28 to 8.03). However, assuming that price raise equals inflation rate in both countries (i.e. no real price readjustment), and inserting Big Mac price change for both China and USA in Equation 9, there was actually an effective exchange rate devaluation of the Chinese currency of 4.4% (=((1+0,031)*(1+0,061)/(1+0,144))-1). This result is fairly astonishing, once the Chinese economy grew more that the US-economy. Yet such effective devaluation of the yuan may explain why the Big Mac Index in China reduced from -55.88% in April 2003 to -57.82% in May 2006, when inserting these numbers in Equation 7 (-0,044 = (1-0,5782)/(1-0,5588)-1). Equation 11 would also give the value of -4,4% to the iHdB, assuming that there was no real price readjustment.

Data from February 1st, 2007, showed that iBM for China remained about the same compared to 2006, despite a small revaluation of the yuan (from 8,03 to 7,77) and a small increase of the implied PPP (from 3,39 to 3,42), because price readjustment in China was greater than in the USA. This is another evidence that the Chinese currency is kept in an artificial state, which benefits China. Nevertheless, the recent, yet relatively small, revaluation of the Chinese currency might have helped to reduce some inflationary pressure of imports paid in US-dollars, specially food and raw materials, without harming in an unacceptable way Chinese exports, specially for Europe's high income internal market. In fact, the euro is actually rising against the Chinese currency, which is an opposite trend compared to how the US-dollar is dropping steadily in respect to the yuan, since July 2005, as given in Table 2.

Table 2 Comparison of the Chinese currency in respect to the US-dollar and the euro

Date	Jul 15th 2005	Oct 14th 2005	Jan 13th 2006	Apr 13th 2006	Jul 14th 2006	Oct 13th 2006	Jan 15th 2007	Apr 13th 2007	Jul 13th 2007	Oct 15th 2007	Jan 15th 2008
yuan per US$	8.28	8.09	8.07	8.02	8.00	7.90	7.79	7.72	7.57	7.51	7.24
yuan per euro	9.97	9.78	9.79	9.71	10.11	9.88	10.08	10.45	10.44	10.67	10.74

Source for exchange rates: Central Bank of Brazil (www.bcb.gov.br)

Table 2 exhibits that the yuan started to rise more rapidly against the US-dollar on year 2007, when the outlook for the US economy was clearly gloom. The threat of a recession seemed to haunt more and more people and may have actually favoured an effective devaluation of the dollar against the Chinese currency, which would lead to a nominal appreciation of the yuan (see Equation 9). On the other hand, although GDP growth in Europe in 2007 was definitely lower than in China, the euro was rising against the yuan, not the opposite. A higher inflation in China compared to inflation in the euro area might offset an effective revaluation of the yuan and, hence, lead to a nominal devaluation of the yuan towards the euro, which presumably is suitable for Chinese trade and business with the European Union. Thus, the yuan was not rising faster against the US dollar because the Chinese Central Bank would "allow" such revaluation. It was rather the US dollar that was tumbling down against mayor currencies, and there was no reason for China to follow the debacle of the US dollar. Nevertheless, China maintained its currency strategically undervalued against the euro.

Evidence from The UBS study "Price and Earnings around the Globe"

All the previous discussions relied on long strings of data, nonetheless for just one good. It is interesting to compare the "The Economist" data with data gathered by another independent source with other goods and services. The UBS study "Price and Earnings Around the Globe" may actually endow other conclusions, because the data refers to cities not to countries, hence also shedding light on how prices change within an area which uses the same currency, as well as between countries with independent monetary policies.

The UBS study constantly informed that the standardised basket of goods and services was principally based on European consumer habits, and was equally weighted for all cities in the survey, besides not being exactly the same for every study. Moreover, UBS (2006 p.6) even warned that "not everything in our basket of goods is available everywhere. To avoid skewing price levels when items are not available, the ratio of the price of other items in basket to average prices was extrapolated". Still the editorial in the 2006 edition of UBS survey considered that their data showed a "remarkable consistency" over the years, which accounts for a verification too.

The first four columns of table A6 exhibit data from the latest UBS studies, whereas the other columns to the right bring values for the UBS Index (iUBS), which was calculated as explained in the end of the section "Theoretical Background". The cities were chosen so as to be able to compare iUBS data with available data for The Big Mac Index (iBM) in Table A1.

The range for iBM seems to be wider than the range for iUBS. Data for London, Copenhagen, Stockholm, with the order of magnitude about 15% or 25%, are actually very high compared to other iUBS values, but there are positive values for iBM which are much higher. On the other hand, the smaller negative values for iUBS are not really different from iBM. Hence, the spread between the minimum and maximum iUBS values seems to be 'squeezed on the top' compared to iBM range, which may be explained by the fact that a huge basket of goods may reduce the influence of the expensive ones.

A perfect match between iBM and iUBS values is actually not mandatory, because customers may desire or reject more certain goods in some places due to differences in income or consumer behaviour. Hence, the marginal utility ratio for two goods (or baskets of goods and services) may also vary. This variation should alter the ratio between prices, and hence iBM and iUBS values may converge or diverge from each other.

This argument may explain why the iUBS value for Tokyo is astonishing higher than the iBM for Japan. McDonald's might have charged in Tokyo a relative lower price compared to other goods that were in the UBS basket of goods. Indeed, in all tables in the four consulted editions of the UBS survey, Tokyo was the city where the required working time required to buy one Big Mac was the lowest. It was even easier for workers in Tokyo to buy one Big Mac than 1 kg of bread or 1 kg of rice. This abnormal situation appears clearly when contrasting Tokyo's working times given in Table 3 with the numbers of almost every city in the world, including Zurich.

Table 3 also exposes that the required working time to buy a given good in a certain city remains approximately close to an average value through the years. This is an evidence that both the marginal utility ratio between two goods (or baskets of goods and services) and relative prices tend to stay constant. Consequently, data from Table 3 indicate that the Big

Mac sandwich is cheap in Tokyo, and then iBM would really be smaller than iUBS.

Table 3 Working time required to buy certain goods according to UBS survey

City	UBS survey edition	1 hamburger in minutes	1 kg of rice in minutes	1 kg of bread in minutes
Tokyo	1997	9	22	14
	2000	9	15	14
	2003	10	18	20
	2006	10	12	16
Zurich	1997	14	7	9
	2000	15	7	10
	2003	14	7	6
	2006	15	5	10

Note: UBS informed that the price of the product cited is divided by the weighted net hourly wage in 12, 13 or 14 occupations, according to the survey's edition.

Despite some exceptions as the one mentioned above, for several pairs of cities and countries, the order of magnitude and specially the trend along the years are about the same for iBM and iUBS, which indicates that iHdB values obtained from iBM and iUBS may be similar too. Table A7 brings iHdB values obtained with Equation 7 for iUBS instead of iBM. Each iHdB value refers to a period of three years. Thus, Table A7 also gives the annualised mean for iHdB calculated from iUBS, as well as the annualised mean for iHdB determined from iBM during the same period.

The iHdB values obtained from iUBS tend to swing in such a way that the annualised mean for numerous cities is close to zero. The effects of considerable currency devaluation in Argentina (at the end of 2001) and in Brazil (at the beginning of 1999 and during the second semester of 2002) appear clearly on the numbers for Buenos Aires, Rio de Janeiro and São Paulo in Table A7. The higher iHdB values for the 2003-2006 period may be explained by inflation in Argentina and revaluation of Brazil's currency. Data for iHdB using iUBS for the Euro area show how the introduction of the euro in 1999 was challenging, and how prices increased after 2000 through 2006, as the iHdB data calculated with iBM also pointed out. Comparing the last two columns on the right of Table A7, some values are alike and all of them are small, close to zero.

Despite several correspondence between iUBS and iBM data, Table A6 gives rather high iUBS values for Hong Kong and Shanghai compared to iBM data for Hong Kong and China in the same years. As well as in Tokyo, the required working time to buy a Big Mac in Hong Kong and Shanghai were also exceptionally lower than the required time to buy 1 kg of bread, except for Shanghai in 2006. In that year, the required working time to buy a Big Mac in Beijing was also higher than the required time to buy 1 kg of bread. The iUBS value for Shanghai (-46.8%) was quite close to the data for Beijing (-47.6%). Unfortunately, no data for Beijing's was published in the previous years and hence Beijing is not on Table A6.

Another explanation for the difficulty to match iUBS with iBM data for Hong Kong and Shanghai may be found on the 2006 edition of the UBS survey. The study stated that: "Yet the price data from Hong Kong and Shanghai also show that the price of food, services and households goods - although we defined the products for our survey very precisely - can vary widely within city limits" UBS (2006, p.8). This remark should draw one's attention to how prices may change within city and between countries, as discussed below.

Prices in a large area with the same currency

Even when different places employ the same currency, an identical good is not necessarily traded by a single price. Regardless of arbitrage being attractive or feasible, regional differences may induce different price readjustments and inflation rates in a large area with the same currency. Equation 12 compares the purchasing power of two places which employ the same currency, say, "place N", and "place O", which is the reference place for this comparison. Noticing that there is no possible change of the exchange rate, Equation 5 yields:

$$(12) \qquad (1+\mathrm{iHdB}) = \frac{\mathrm{PPP}_{end}}{\mathrm{PPP}_{beg}} = \frac{(1+\Delta\%P_N)}{(1+\Delta\%P_O)} = \frac{\left(P_{end}/P_{beg}\right)_N}{\left(P_{end}/P_{beg}\right)_O} = \frac{\left(P_N/P_O\right)_{end}}{\left(P_N/P_O\right)_{beg}}$$

In regions with the same currency, the inflation rate throughout the whole area is not necessarily the same. In those new and dynamic places for investment (place N), prices increase more than in the old and stagnant places (place O). It is possible to perceive empirically that prosperous places are normally more expensive by a certain factor than old and stagnant places. Consequently, the iHdB of place N will be positive in respect to place O. When the iHdB becomes zero, different places will still present different prices and the ratio between them will remain constant. The prices may only match, after the iHdB of place N in respect to place O turns out to be negative. This might occur, sooner or later, since crisis may not be avoided.

Data from several editions of the UBS survey illustrate neatly that prices in different cities in the same country may not be the same and may vary otherwise. Looking at Table A7, Zurich and Geneva have about the same iHdB values, which means that the iHdB of Zurich in respect to Geneva is zero. Consequently, price levels between the two cities remained the same, which can be seen in Table 6. On the other hand, iHdB for Berlin and Toronto were respectively greater than the values for Frankfurt and Montreal. Indeed, data on Table A6 points out that Toronto became rather more expensive than Montreal, and that the price gap between the Frankfurt and Berlin in Germany reduced. Conversely, the price level difference between New York and other cities in the USA has become wider.

All these differentiated price changes within the same country tell that although undoubtedly there is no change in the nominal exchange rate between regions inside the same area, effective exchange rate variations are actually hidden. From Equation 9, it can be seen that inflation rate differences causes effective exchange rate variations.

More than varying within a huge country, the UBS survey (2006, p.8) did also find out that in Hong Kong and Shanghai "prices may differ depending on the part of the town, but also on the person who collects the data". The same edition of the UBS study added that an Asian economic student would be able to save more than local employees would, and even more than European expatriates would. This information foster a reflection of how wealth concentration within a city may also affect consumer behaviour and price levels.

Huge cities do tend to present different market niches to attend customers with different income levels. Identical goods may indeed be bought for the different prices within a city, since purchase conditions may vary. For instance: the shops may be located in more or less pleasant or accessible areas, and the customers may be treated with more or less attention, tolerance, or time. A city expansion increases the probability of a higher price range for the

same good, and people with less income will struggle more to bargain and to look for discounts, and hence will bother less about the purchasing convenience. A student, say, in Hong Kong may indeed be more eager to save money than local employees may, and will toil harder to find cheaper goods. In contrast, a European expatriate with income in hard currency and several fringe benefits, reduced knowledge about the local customs, and perhaps less available time, might be willing to stress less by shopping. Consequently, a European expatriate will tend to pay more than the others do, as pointed out by UBS (2006 p.8).

Nevertheless, once the Big Mac pricing policy probably also takes into account the standardised way by which the sandwich is sold, McDonald's might avoid setting noteworthy price differences within countries and towns. Thus, the Big Mac price should reflect the "best average" price to be set for a given place, which should entitle the Big Mac price and iBM index to be a very good representative of the present business activity level and its evolution.

If different places may present different price levels - whether a country, a state or even a town, an average price for a large area with a single currency (as the USA and the Euro area) is a simplification. Thus, different values for The Big Mac Index and for the iUBS within a large area with the same currency are possible. However, the difference between the maximum and the minimum price may reduce with the time, as Henriques de Brito (2003, p.135) has shown with iBM data for the Euro area between 1999 a 2002. From Table A6, it may be seen that the highest iUBS value dropped from 10.3% (Paris in 1997) to 3.9% (Dublin 3.9%), whereas the lowest iUBS value raised from -29.0% to -23.6% in Lisbon. Thus, the euro drives price convergence in Europe, as also analysed by UBS (2006, p.32).

After the introduction of the euro in 1999, iUBS data in Table A6 corroborate that prices in Mediterranean European countries rose remarkably. A similar process has recently happened in several East European countries which joined the European Union. All iUBS values for Czech Republic, Hungary and Poland in 2006 are higher than in 2003. It may also be observed in Table A1 and Table A2 a certain increasing trend of iBM values for countries in East Europe in the last years. These values tend to be higher than iBM values for other developing countries, particularly those countries in South Eastern Asia.

Costs and bureaucracy by currency exchange are drawbacks in having several currencies within a large area. Moreover, exchange rate fluctuations may cause unpredictable losses, which scare private investors, and restrain capital flow and allocation inside a large area. A single currency does help to integrate a territory and increase its geopolitics relevance. Consequently, there are advantages of having a single currency in a large area along with the challenges to strive for both a homogeneous economic development and a widespread welfare, and, hence, to smooth domestic frictions due to differences in the cost of living.

Price level differences between developed and developing countries

The low iUBS values for Shanghai and Beijing in 2006 certainly strengthen the statement that the Chinese currency was undervalued. Moreover, the undoubtedly decrease of the iUBS values for Shanghai from 2000 through 2003 until 2006 (i.e. -11.6%; -26.9% and -46.8%) also confirms that the pegged Chinese currency to the US dollar disregarded the unquestionable Chinese economic growth during that period. The way China steered its currency may result from a clear comprehension of the price gulf between developed and developing countries, which both iBM and iUBS data unveil.

A developing country offering in the international market fungible goods, when the lowest price determines transaction, may compete easier internationally when its currency is undervalued in respect to the currency of its business rivals. On the other hand, developed countries tend to sell stylish high-quality merchandises and services, which are regarded as essential for improving productivity or quality of life, partly due to clever marketing strategies that are carried out to promote and distribute their goods and services. Moreover, these goods with intense know-how content tend also not to be fungible, besides enjoying intellectual property protection. Thus, developed countries are indeed frequently able to charge high when selling their production.

Developed countries are understandably willing to sell their goods and services charging as much as possible, yet willing to buy raw materials and commodities as cheap as possible. Thus, these countries may find convenient to have their currencies overvalued in respect to currencies in developing countries, as long as it does not threat their balance of payments. Furthermore, currency in developed countries must certainly be more expensive than in developing countries, where the existing business network is simpler.

The complaint of the scarcity of money "is sometimes general through a whole mercantile town and the country in its neighbourhood. Overtrading is the common cause of it" (Adam Smith 1776, Book 4, Chapter I, p. 186). Once scarcity fosters price increase, the money circulating in countries with more business must be more high-priced than elsewhere, and hard currencies in developed countries tend to be overvalued in respect to developing countries' money. Consequently, developed countries, whose exports goods are exclusive, and whose economies are complex, should tend to present higher price levels and stronger currencies than developing countries, whose exports are mainly raw materials and commodities, and whose economies are relatively small. Thus, both The Big Mac Index and the iUBS for developed countries tend to be higher, as given by Figure 4 and Figure 5.

The price level of the United States seems to lay roughly in the middle of developed and developing countries, which may be a comfortable position for a balanced foreign trade with imports and exports. However, compared to USA, both Canada and Australia have managed to keep a slightly weaker currency (and lower iBM and iUBS too). Such monetary policy must have helped exports from those both developed countries and may account for their continuous economic growth.

In contrast to these countries, Japan had at the beginning of the 1990s a strong currency (and hence a high iBM). The country had difficulties to solve problems caused by deflation, which was hindering welfare, specially in view of the neighbouring countries. Then the Japanese yen plummeted, and its iBM has constantly been negative in the recent years, yet a little higher than other iBM values for neighbouring countries in Asia, except South Korea. No wonder that Japan's iBM value of -28% by February 2007, which was precisely the same as by May 2006, made The Economist write: "European finance minister's beef with the low level of the yen" (website edition dated February 1st, 2007).

With an opposite monetary policy in order to hold back inflation, Brazil let its iBM value increase from -48% (January 15th, 2003) up to 5.9% (July 7th, 2007), mainly due to a significant currency revaluation, as mentioned before. Nevertheless, The Big Mac data shows that the Brazilian-real is still undervalued compared to the Euro, but its currency is strong compared to the US-dollar and several other currencies of developing countries. Such statement is in line with Brazil's concern at the beginning of year 2008 with current account

deficit resulting from a steadily reduction of exports and a fear that imports will increase too much. This problem, aggravated by uncertainties concerning US economy, may halt revaluation of the Brazilian real. Such assumptions of the exchange rate evolution influence both the data for comparative advantage analysis and the expected likelihood of scenarios, and, hence, modify foreign direct investment decisions too.

CONCLUSIONS

Prices of identical products and services in a given currency (US-dollars, for example) do not have to be equal throughout the world, and price differences are likely to be detected, within areas with the same currency and between countries. At first sight, transport costs, logistical obstacles, and additional barriers to free commerce may account for deviations of the "Law of One Price" and the "Purchasing Power Parity Theory". However, US-dollar prices for the same good or service may vary world-wide, also because governments may set strategically in how much the nominal exchange rate should differ from the PPP. Such deviation is quantified by The UBS Price Index and by "The Big Mac Index", which comprises a basic information, notably the interaction between the local price and the exchange rate.

If The UBS Price Index and The Big Mac Index data were irrelevant or randomly settled, it would not have been possible to obtain so coherent results for the iHdB index for numerous countries and cities during so many years, as presented in the section "Results and Discussions", using the equations in the section "Theoretical Background". The Big Mac Index published by The Economist is indeed meaningful, because Equation 1 and Equation 8 are not fortuitously formulated and that index results from exchange rates and prices, which are far from being arbitrarily established. UBS is also correct when drawing attention to the "remarkable consistency" over the past years of the results of their survey "Price and Earnings Around the Globe". Moreover, two independent data source confirm the findings.

A careful analysis of the Equation 1 (and Equation 8) together with the Equation 7 shows that the intricate evolution of prices and exchange rates should be constantly and thoroughly studied. The reason is that incidentally changes in prices and in exchange rates do influence governmental policies, and also strike corporate revenue, profits, and market value too.

Equation 11 makes it clear that if the annual average iHdB is to remain zero with time, effective price readjustments need to offset effective exchange rate variations. Once free business hinders substantial price increases above inflation rate, percentage changes in the effective exchange rate should also be rare and limited. Thus, free business hampers strong fluctuations of iHdB index values around zero, which explains why iHdB values for developed countries tend to scatter less, being meaningful a comparison between Figure 2 and Figure 3. Moreover, a country or a region is never enduring and incontestably more attractive for investments.

Finally, McDonald's pricing policy should be seen as a neat example of the strategy of 'think globally and act locally', once percentage changes in prices follow a common global rule, yet selling prices may vary widely according to local circumstances. The average annual readjustment in US-Dollars of the Big Mac sandwich tends to be similar amongst countries, even though local prices may differ. Further investigation may check whether this finding would also hold for other goods supplied internationally by other world-wide corporations.

REFERENCES

APPLEYARD, Dennis and Alfred FIELD (2001), *International Economics*, 4th. Edition, McGraw-Hill.

BREALEY, Richard A. and Stewart C. MYERS (1996), *Principles of Corporate Finance*, 5th. Edition, McGraw-Hill, international edition.

BLUSTEIN, Paul (2001), *The Chastening: inside the crisis that rocket the global financial system and humbled the IMF*, PublicAffairs.

CASSEL, Gustav (1927). "The Rate of Interest, the Bank Rate, and the Stabilization of Prices", *Quartely Journal of Economics*, vol.42, pages 511-529.

HENRIQUES DE BRITO, Marcelo (2003), *Crise e Prosperidade Comercial, Financeira e Política*, Rio de Janeiro: Probatus.

—————— (2004). "Interação entre Preços e Taxas de Câmbio" in *Encontro Norte-Nordeste de Finanças (ENEFIN)*.

KRUGMAN, Paul and Maurice OBSTFELD (1994), *International Economics: Theory and Policy*, 3rd. Edition, HarperCollins Publishers Inc.

ONG, Li Lian (2003), *The Big Mac Index: Applications of Purchasing Power Parity*, Palgrave Macmillan.

SMITH, Adam (1776), *An Inquiry into the Nature and Causes of the Wealth of Nations*, in "Great Books of the Western World", n.39, Encyclopaedia Britannica.

THE ECONOMIST. Several printed editions and the website "economist.com", as cited in this article.

UBS Switzerland. *Prices and Earnings Around the Globe*, 2003 and 2006 Editions, downloaded February 2008, www.ubs.com. The 2000 Edition is a printed brochure (Nr.80526E-0001), as the 1997 Edition (no. 965.09e).

NOTATION

c	exchange rate (US-dollar as reference)
iBM	The Big Mac Index, as defined by Equation 1 or Equation 8, using data from The Economist
iHdB	Index defined by Equation 3, Equation 4, Equation 7, Equation 11 or Equation 12
iP	Price index - ratio between price in a given place to the price in a reference place
iUBS	UBS index calculated with Equation 8, using iP from the UBS survey
P	unit price at a given place with its currency
PPP	purchasing power parity (ratio of price levels between two countries)
r_E	effective price readjustment
t	tax rate levied on revenue
v	tax rate levied on value-added
$\Delta\%P$	percentage price change (or value-added)
θ	inflation rate
φ_c	percentage change in the exchange rate,as defined by Equation 2 and Equation 9

subscripts

beg	beginning	abr	abroad	nom	nominal
end	end	dom	domestic	effective	effective

APPENDIXES

Equation linking the revenue tax rate (t) to the value-added tax rate (v)

The relationship between a revenue tax rate and a value-added tax rate results from the fact that the amount after charging the value-added tax has to be equal to the available amount after levying the revenue tax.

amount after charging the value-added tax (v) = amount after levying the revenue tax (t)

(A1) $$PV + \left[PV \,.\, (\Delta\%P) \,.\, (1 - v)\right] = PV \,.\, (1 + \Delta\%P) \,.\, (1 - t)$$

Knowing the value-added tax rate (v) and the value-added (or profit), the revenue tax rate (t) is given by:

(A2) $$t = \frac{\Delta\%P}{(1 + \Delta\%P)} \,.\, v$$

If the value-added (or profit) is 20% and the value-added tax rate is 30%, the revenue tax rate is 5%. The Equation above may hence be used to directly tax the revenue by assuming the added-value (or profit), which is actually done in Brazil, for example.

Equations for other calculations with the iHdB index

Knowing the iHdB of a certain country with the USA as the reference country, Equation A3 shows how to find the iHdB of the same country with another reference country.

(A3) $$\left(1 + iHdB_{country \,/\, new\ reference\ country}\right) = \frac{(1 + iHdB_{country\ /\ USA})}{(1 + iHdB_{new\ reference\ country\ /\ USA})}$$

The iHdB value of a global period results from the repetition of the investment during a sequence of equal periods of time, as shown by Equation A4. This derives from looking at Figure 1 and understanding that each new investment cancels the value received from the previous investment. It is necessary to note that both the percentage change in the exchange rate, as well as the percentage change in prices have time periods with the same length:

(A4) $$(1 + iHdB_{global}) = (1 + iHdB_{period\ 1}) * (1 + iHdB_{period\ 2}) * \ldots * (1 + iHdB_{period\ n})$$

The above equation allows the determination of the annualised iHdB for a global period, being "n" the number of annual periods contained in the global period, given by:

(A5) $$(1 + iHdB_{annualised}) = (1 + iHdB_{global})^{1/n}$$

The same procedure and equations above are analogously applicable to The iBM Index.

Tables

Table A1 Values for The Big Mac Index (2nd quarter each year)

Countries	Values for The Big Mac index - iBM						
	1997	**2000**	**2003**	**2004**	**2005**	**2006**	**2007**
Canada	-14.4%	-22.8%	-18.6%	-19.7%	-14.1%	1.4%	8.4%
Australia	-19.9%	-38.6%	-31.2%	-21.7%	-18.3%	-21.2%	-13.5%
Japan	-3.6%	10.5%	-19.4%	-19.7%	-23.5%	-28.0%	-32.7%
New Zealand	-7.4%	-32.6%	-18.1%	-8.6%	3.6%	-11.4%	5.4%
United Kingdom	21.9%	19.6%	16.0%	16.2%	12.4%	17.7%	17.6%
Denmark	63.2%	22.6%	51.0%	53.8%	49.7%	53.8%	49.0%
Sweden	39.2%	8.2%	32.7%	35.9%	36.3%	46.2%	42.5%
Switzerland	65.9%	38.3%	69.7%	69.0%	65.0%	68.0%	52.7%
Euro area		-5.2%	10.0%	13.1%	17.0%	21.4%	22.0%
Czech Rep.	-25.0%	-44.6%	-27.8%	-26.6%	-24.8%	-13.8%	-26.5%
Hungary	-37.1%	-51.6%	-19.3%	-13.1%	-15.0%	-12.3%	-2.2%
Poland	-42.7%	-49.0%	-40.2%	-43.8%	-35.9%	-32.4%	-26.4%
Russia	-20.8%	-44.8%	-51.4%	-50.0%	-51.6%	-42.9%	-40.4%
Argentina	3.3%	-.4%	-47.5%	-49.0%	-46.4%	-26.2%	-21.7%
Brazil	15.8%	-34.3%	-45.3%	-41.4%	-21.9%	-10.2%	5.9%
Chile	18.9%	-2.3%	-27.8%	-24.8%	-17.3%	-5.1%	-12.9%
Mexico	-22.1%	-11.5%	-19.4%	-28.3%	-15.7%	-17.2%	-21.3%
China	-51.9%	-52.4%	-55.9%	-56.6%	-58.5%	-57.8%	-57.6%
Hong Kong	-47.2%	-47.8%	-45.6%	-46.9%	-49.7%	-50.1%	-55.0%
Indonesia		-27.3%	-32.0%	-39.0%	-50.0%	-49.5%	-48.3%
Malaysia	-36.0%	-52.6%	-51.1%	-54.1%	-54.9%	-51.1%	-53.0%
Singapore	-13.9%	-25.0%	-31.6%	-33.8%	-29.1%	-27.0%	-23.8%
South Korea	6.3%	7.9%	-.2%	-6.2%	-18.6%	-15.3%	-7.9%
Taiwan	1.8%	-8.9%	-25.8%	-22.8%	-21.2%	-24.6%	-32.9%
Thailand	-26.1%	-42.3%	-49.0%	-50.0%	-51.6%	-49.6%	-47.3%
South Africa	-27.2%	-46.6%	-31.9%	-35.9%	-31.4%	-31.8%	-34.8%
The Economist edition:	12-April 1997	29-April 2000	26-April 2003	29-May 2004	11-June 2005	29-May 2006	7-July 2007

Notes:
This table is an update of Table 2.3-1 in Henriques de Brito (2003), page 45.
Data for the years 1997 and 2000 were inserted to enable comparison with data in Table A6.

Table A2 The Big Mac Index (about the beginning or end of each year)

Countries	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Canada						-21.5%	-16.4%	-13.3%	-4.4%	-4.3%
Australia						-33.6%	-16.8%	-18.0%	-22.5%	-17.1%
Japan	-12.4%	-9.1%	16.8%	-.8%	-10.8%	-15.8%	-11.8%	-16.7%	-30.5%	-28.3%
New Zealand						-20.0%	-3.6%	5.3%	-2.2%	-1.9%
United Kingdom			27.5%	17.3%	11.6%	20.4%	23.2%	20.3%	5.4%	21.1%
Denmark								65.7%	42.5%	50.3%
Sweden						30.6%	48.2%	48.7%	35.9%	42.5%
Switzerland						72.1%	82.5%	82.0%	56.5%	56.8%
Euro area			7.8%	-4.3%	-6.6%	8.3%	24.3%	25.0%	11.4%	18.6%
Czech Rep.	-36.4%	-29.7%	-36.5%	-42.4%	-40.2%	-30.9%	-21.8%	-18.3%	-17.5%	-25.2%
Hungary	-51.9%	-50.2%	-51.2%	-51.0%	-35.1%	-16.6%	-15.0%	-5.0%	-14.0%	-6.8%
Poland	-48.8%	-41.8%	-45.5%	-47.5%	-43.2%	-37.4%	-40.0%	-31.3%	-33.7%	-28.9%
Russia	-28.7%	-53.6%	-50.0%	-45.5%	-51.7%	-52.5%	-49.3%	-50.3%	-49.2%	-42.5%
Argentina	-3.1%	14.1%	2.5%	-2.0%	-3.5%	-55.5%	-48.9%	-46.7%	-50.8%	-17.7%
Brazil	7.8%	-6.8%	-34.0%	-40.8%	-41.7%	-47.9%	-37.1%	-33.7%	-13.0%	-6.5%
Chile		1.1%	-2.5%	-14.1%	-22.4%	-31.7%	-11.8%	-14.7%	-5.4%	-4.7%
Mexico	-14.7%	-27.8%	-13.5%	-15.7%	-6.6%	-20.8%	-21.1%	-29.3%	-15.6%	-17.4%
China	-50.8%	-54.4%	-50.8%	-52.9%	-53.3%	-54.7%	-56.1%	-58.0%	-58.7%	-56.2%
Hong Kong	-50.4%	-49.8%	-46.3%	-48.6%	-44.4%	-45.7%	-44.6%	-48.7%	-50.8%	-52.2%
Indonesia	-66.3%	-33.1%	-16.0%	-40.0%	-40.2%	-31.3%	-31.1%	-47.7%	-51.1%	-45.7%
Malaysia	-62.8%	-57.0%	-51.2%	-53.3%	-54.1%	-49.8%	-52.5%	-55.7%	-53.3%	-51.2%
Singapore	-30.6%	-26.2%	-20.5%	-27.5%	-30.5%	-28.3%	-30.4%	-27.0%	-30.2%	-27.3%
South Korea	-40.7%	-5.7%	-27.0%	-7.1%	-6.9%	3.0%	.0%	-21.3%	-18.7%	-4.3%
Taiwan	-19.4%	-17.5%	-6.1%	-16.1%	-21.6%	-23.0%	-20.4%	-22.7%	-25.4%	-29.2%
Thailand	-58.9%	-41.4%	-39.3%	-49.8%	-51.4%	-51.3%	-46.1%	-49.3%	-52.1%	-44.7%
South Africa	-37.6%	-45.2%	-39.8%	-53.3%	-68.3%	-40.0%	-29.6%	-18.7%	-27.3%	-33.5%
The Economist edition:	3-Jan 1998	19-Dec 1998	8-Jan 2000	13-Jan 2001	22-Dec 2001	15-Jan 2003	15-Jan 2004	18-Dec 2004	14-Jan 2006	1-Feb 2007

Note: The data for The Big Mac Index in 2007 was published only on The Economist website: economist.com.

Table A3 Values for the iHdB index (2nd quarter each year)

Countries	Values for the iHdB index					mean annual iHdB	
	2002 to 2003	2003 to 2004	2004 to 2005	2005 to 2006	2006 to 2007	number of values	mean interval with 95% confidence
Canada	-4.4%	-1.3%	7.0%	18.0%	6.9%	19	2.9% ± 5.0%
Australia	6.1%	13.8%	4.4%	-3.5%	9.7%	19	2.6% ± 5.8%
Japan	-.5%	-.3%	-4.8%	-5.8%	-6.5%	19	-1.6% ± 8.3%
New Zealand	15.6%	11.6%	13.4%	-14.5%	18.9%	12	2.9% ± 9.3%
United Kingdom	.1%	.2%	-3.3%	4.7%	-.1%	19	1.6% ± 4.2%
Denmark	27.3%	1.8%	-2.7%	2.8%	-3.1%	19	.7% ± 6.2%
Sweden	30.9%	2.4%	.3%	7.3%	-2.5%	19	1.3% ± 6.6%
Switzerland	11.3%	-.4%	-2.3%	1.8%	-9.1%	14	-.2% ± 7.2%
Euro area	15.3%	2.8%	3.4%	3.8%	.5%	8	1.4% ± 7.6%
Czech Rep.	8.7%	1.7%	2.3%	14.7%	-14.7%	11	1.6% ± 7.7%
Hungary	19.1%	7.7%	-2.2%	3.2%	11.5%	16	3.1% ± 6.9%
Poland	1.9%	-5.9%	14.0%	5.6%	8.8%	13	1.8% ± 4.6%
Russia	-3.1%	2.8%	-3.3%	18.1%	4.3%	17	1.2% ± 17.7%
Argentina	63.8%	-2.9%	5.0%	37.7%	6.1%	15	.2% ± 15.4%
Brazil	-11.5%	7.2%	33.2%	14.9%	18.0%	15	5.7% ± 16.3%
Chile	-15.9%	4.2%	10.0%	14.8%	-8.3%	13	-.4% ± 6.8%
Mexico	-15.0%	-11.0%	17.6%	-1.8%	-4.9%	14	-.9% ± 7.2%
China	-13.4%	-1.5%	-4.5%	1.6%	.6%	15	-.7% ± 6.5%
Hong Kong	-5.7%	-2.4%	-5.2%	-.8%	-9.9%	19	.7% ± 2.9%
Indonesia	-.2%	-10.2%	-18.1%	1.0%	2.4%	9	3.6% ± 18.0%
Malaysia	-8.1%	-6.3%	-1.7%	8.4%	-3.8%	14	-.8% ± 6.0%
Singapore	-6.1%	-3.2%	7.1%	3.0%	4.3%	17	6.1% ± 11.6%
South Korea	4.5%	-6.0%	-13.2%	4.1%	8.8%	18	-2.2% ± 8.5%
Taiwan	-8.1%	4.1%	2.0%	-4.3%	-11.0%	13	-2.8% ± 5.0%
Thailand	-.1%	-1.9%	-3.3%	4.2%	4.6%	14	-2.6% ± 6.3%
South Africa	90.5%	-5.8%	7.0%	-.6%	-4.4%	11	2.4% ± 20.5%
actual period extent (number of months)	12.0	13.1	12.4	11.6	13.3		
mean iHdB each year with 95% confidence	7.8% ± 9.7%	.0% ± 2.4%	2.4% ± 4.1%	5.3% ± 4.1%	1.0% ± 3.5%		

Notes:
This table is an update of Table 2.3-2 in Henriques de Brito (2003, page 48).
For the calculation for each country of the mean interval with 95% confidence, all annual iHdB values were used, including those published by Henriques de Brito (2003). Consequently, the column "number of values" indicates how many values were used to determine the interval with 95% confidence.

Table A4 iHdB index obtained from the values of The Big Mac index in Table 2

Countries	**1998 to 1999**	**1999 to 2000**	**2000 to 2001**	**2001 to 2002**	**2002 to 2003**	**2003 to 2004**	**2004 to 2005**	**2005 to 2006**	**2006 to 2007**	mean interval with 95% confidence
Canada						6.5%	3.7%	10.3%	.1%	5.1% ± 6.8%
Australia						25.3%	-1.5%	-5.5%	7.0%	6.3% ± 21.8%
Japan	3.7%	28.5%	-15.1%	-10.1%	-5.7%	4.8%	-5.5%	-16.6%	3.2%	-1.4% ± 10.6%
New Zealand						20.5%	9.2%	-7.2%	.4%	5.7% ± 19.0%
United Kingdom			-8.0%	-4.8%	7.9%	2.4%	-2.3%	-12.4%	14.9%	-.3% ± 8.7%
Denmark								-14.0%	5.5%	-4.3% ± 123.3%
Sweden						13.5%	.3%	-8.6%	4.9%	2.5% ± 14.7%
Switzerland						6.1%	-.3%	-14.0%	.2%	-2.0% ± 13.5%
Euro area			-11.2%	-2.4%	15.9%	14.8%	.6%	-10.9%	6.5%	1.9% ± 10.3%
Czech Rep.	10.7%	-9.7%	-9.3%	3.8%	15.4%	13.3%	4.4%	1.1%	-9.3%	2.3% ± 7.6%
Hungary	3.6%	-2.1%	.5%	32.3%	28.6%	1.9%	11.8%	-9.4%	8.3%	8.4% ± 10.7%
Poland	13.7%	-6.3%	-3.6%	8.0%	10.4%	-4.2%	14.4%	-3.4%	7.2%	4.0% ± 6.4%
Russia	-35.0%	7.8%	9.0%	-11.5%	-1.5%	6.7%	-2.1%	2.3%	13.1%	-1.2% ± 11.2%
Argentina	17.7%	-10.2%	-4.3%	-1.5%	-53.9%	14.7%	4.4%	-7.7%	67.3%	2.9% ± 24.4%
Brazil	-13.6%	-29.2%	-10.3%	-1.5%	-10.7%	20.7%	5.5%	31.1%	7.5%	.0% ± 14.2%
Chile		-3.6%	-12.0%	-9.6%	-12.0%	29.2%	-3.3%	10.9%	.8%	.0% ± 11.7%
Mexico	-15.3%	19.7%	-2.5%	10.8%	-15.2%	-.4%	-10.5%	19.5%	-2.2%	.4% ± 10.4%
China	-7.3%	7.8%	-4.3%	-.7%	-3.1%	-3.0%	-4.4%	-1.7%	6.1%	-1.2% ± 3.8%
Hong Kong	1.2%	7.0%	-4.3%	8.2%	-2.3%	1.9%	-7.3%	-4.1%	-2.8%	-.3% ± 4.0%
Indonesia	98.5%	25.6%	-28.6%	-.3%	14.8%	.4%	-24.1%	-6.6%	11.2%	10.1% ± 28.8%
Malaysia	15.5%	13.5%	-4.3%	-1.5%	9.2%	-5.4%	-6.7%	5.3%	4.5%	3.3% ± 6.4%
Singapore	6.3%	7.8%	-8.8%	-4.2%	3.2%	-2.9%	4.8%	-4.3%	4.1%	.7% ± 4.4%
South Korea	59.0%	-22.6%	27.4%	.1%	10.7%	-2.9%	-21.3%	3.3%	17.7%	7.9% ± 19.4%
Taiwan	2.3%	13.8%	-10.6%	-6.6%	-1.8%	3.5%	-2.9%	-3.5%	-5.1%	-1.2% ± 5.4%
Thailand	42.5%	3.6%	-17.2%	-3.1%	.1%	10.8%	-6.1%	-5.4%	15.3%	4.5% ± 13.2%
South Africa	-12.3%	10.0%	-22.5%	-32.2%	89.5%	17.3%	15.6%	-10.6%	-8.6%	5.1% ± 27.6%
actual period extent (months)	11.5	12.6	12.2	11.3	12.8	12.0	11.1	12.9	12.6	
mean iHdB in the period 95% confidence	11.3% ± 6.1%	3.4% ± 7.6%	-7.0% ± 5.4%	-1.3% ± 5.6%	5.0% ±12.2%	7.8% ± 4.0%	-.9% ± 3.9%	-2.4% ± 4.4%	6.8% ± 5.7%	

Table A5 Results of the F-test (ANOVA - double factor without repetition)

Countries	Lines - two series of iHdB values			Columns - number of periods			
	p-value	F	F critic	number	p-value	F	F critic
Canada	.54	.49	10.13	4	.27	2.20	9.28
Australia	.95	.00	10.13	4	.07	7.29	9.28
Japan	1.00	.00	5.32	9	.03	4.09	3.44
New Zealand	.82	.06	10.13	4	.17	3.50	9.28
United Kingdom	.97	.00	5.99	7	.55	.90	4.28
Denmark	.80	.10	161.45	2	.69	.29	161.45
Sweden	.92	.01	10.13	4	.75	.42	9.28
Switzerland	.93	.01	10.13	4	.72	.49	9.28
Euro area	.59	.32	5.99	7	.10	3.04	4.28
Czech Rep.	.67	.21	5.99	7	.13	2.61	4.28
Hungary	.88	.03	5.32	9	.00	7.66	3.44
Poland	.69	.17	5.32	9	.22	1.77	3.44
Russia	.84	.05	5.32	9	.04	3.90	3.44
Argentina	.92	.01	5.32	9	.85	.47	3.44
Brazil	.76	.10	5.32	9	.03	3.98	3.44
Chile	.68	.18	5.59	8	.07	3.22	3.79
Mexico	.93	.01	5.32	9	.48	1.04	3.44
China	.53	.01	5.32	9	.53	.94	3.44
Hong Kong	.61	.28	5.32	9	.12	2.35	3.44
Indonesia	.39	.83	5.32	9	.00	7.64	3.44
Malaysia	.48	.55	5.32	9	.40	1.20	3.44
Singapore	1.00	.00	5.32	9	.16	2.10	3.44
South Korea	.63	.25	5.32	9	.03	4.00	3.44
Taiwan	.74	.11	5.32	9	.01	5.97	3.44
Thailand	.40	.79	5.32	9	.05	3.53	3.44
South Africa	.79	.07	5.32	9	.00	31.83	3.44

Table A6 Data from UBS study and Values for the UBS Index (iUBS)

Cities and Countries	UBS edition				iUBS			
	1997	2000	2003	2006	1997	2000	2003	2006
Average value for Canada	70.9	74.7	66.1	88.0	-12.4%	-23.5%	-30.7%	-7.0%
Montreal (Canada)	72.6	74.4	65.6	87.5	-10.3%	-23.8%	-31.2%	-7.5%
Toronto (Canada)	69.2	74.9	66.6	88.5	-14.5%	-23.3%	-30.1%	-6.4%
Sydney (Australia)	78.8	70.9	66.1	80.4	-2.6%	-27.4%	-30.7%	-15.0%
Tokyo (Japan)	121.7	140.1	106.7	106.8	50.4%	43.5%	11.9%	12.9%
Auckland (New Zealand)		69.4	62.1	74.4		-28.9%	-34.9%	-21.4%
London (Great Britain)	89.8	94.8	97.6	110.6	11.0%	-2.9%	2.4%	16.9%
Copenhagen (Denmark)	102.1	92.7	98.9	109.2	26.2%	-5.1%	3.7%	15.4%
Stockholm (Sweden)	101.7	99.3	91.1	98.1	25.7%	1.7%	-4.4%	3.7%
Average value for Switzerland	98.2	97.2	97.8	105.2	21.4%	-.4%	2.6%	11.2%
Zurich (Switzerland)	100.0	100.0	100.0	107.4	23.6%	2.4%	4.9%	13.5%
Geneva (Switzerland)	96.4	94.4	95.6	102.9	19.2%	-3.3%	.3%	8.8%
Average value for Euro area	73.8	69.6	77.2	86.5	-8.8%	-28.8%	-19.0%	-8.6%
Berlin (Germany)	75.0	70.4	75.4	82.3	-7.3%	-27.9%	-20.9%	-13.0%
Frankfurt (Germany)	83.6	76.2	78.5	86.9	3.3%	-22.0%	-17.7%	-8.1%
Paris (France)	89.2	81.6	89.3	95.6	10.3%	-16.4%	-6.3%	1.1%
Milan (Italy)	70.9	66.8	74.4	83.1	-12.4%	-31.6%	-22.0%	-12.2%
Madrid (Spain)	67.6	55.5	68.4	80.0	-16.4%	-43.2%	-28.3%	-15.4%
Lisbon (Portugal)	57.4	56.3	65.1	72.3	-29.0%	-42.3%	-31.7%	-23.6%
Dublin (Ireland)	77.2	72.6	82.8	98.3	-4.6%	-25.6%	-13.1%	3.9%
Vienna (Austria)	79.1	80.7	84.2	95.0	-2.2%	-17.3%	-11.7%	.4%
Amsterdam (Netherlands)	74.6	74.2	77.3	87.7	-7.8%	-24.0%	-18.9%	-7.3%
Brussels (Belgium)	76.0	69.5	79.2	88.4	-6.1%	-28.8%	-16.9%	-6.6%
Luxembourg (Luxembourg)	73.4	71.3	78.2	93.3	-9.3%	-27.0%	-18.0%	-1.4%
Athens (Greece)	66.6	63.4	73.8	73.0	-17.7%	-35.1%	-22.6%	-22.8%
Prague (Czech Republic)	47.8		40.5	53.8	-40.9%		-57.5%	-43.1%
Budapest (Hungary)	48.8	45.6	55.9	58.6	-39.7%	-53.3%	-41.4%	-38.1%
Warsaw (Poland)	50.4	47.8	50.7	63.7	-37.7%	-51.0%	-46.8%	-32.7%
Moscow (Russia)	85.2	59.1	53.6	65.6	5.3%	-39.5%	-43.8%	-30.7%
Buenos Aires (Argentina)	70.7	76.6	30.6	41.9	-12.6%	-21.5%	-67.9%	-55.7%
Average value for Brazil	78.8	60.6	40.0	65.0	-2.7%	-37.9%	-58.1%	-31.3%
Rio de Janeiro (Brazil)	80.3	62.0	38.2	64.8	-.7%	-36.5%	-59.9%	-31.5%
Sao Paulo (Brazil)	77.2	59.2	41.7	65.1	-4.6%	-39.4%	-56.3%	-31.2%
Santiago de Chile (Chile)		54.0	41.5	63.1		-44.7%	-56.5%	-33.3%
Mexico City (Mexico)	55.3	62.2	61.1	60.7	-31.6%	-36.3%	-35.9%	-35.8%
Shanghai (China)	70.4	86.3	69.7	50.3	-13.0%	-11.6%	-26.9%	-46.8%
Hong Kong (China)	77.3	88.6	108.1	82.1	-4.4%	-9.3%	13.4%	-13.2%
Jakarta (Indonesia)	60.7	52.2	50.4	51.8	-25.0%	-46.5%	-47.1%	-45.2%
Kuala Lumpur (Malaysia)	69.6	59.6	42.9	36.8	-14.0%	-39.0%	-55.0%	-61.1%
Singapore (Singapore)	97.3	98.1	72.1	76.6	20.3%	.5%	-24.4%	-19.0%
Seoul (South Korea)	85.3	97.3	76.5	85.8	5.4%	-.3%	-19.8%	-9.3%
Taipei (Taiwan)	80.5	91.1	73.1	68.9	-.5%	-6.7%	-23.3%	-27.2%
Bangkok (Thailand)	66.9	55.0	45.8	55.3	-17.3%	-43.7%	-52.0%	-41.5%
Johannesburg (South Africa)	51.4	50.9	44.9	59.7	-36.5%	-47.9%	-52.9%	-36.9%
Average value for USA	**80.9**	**97.6**	**95.3**	**94.6**	**.0%**	**.0%**	**.0%**	**.0%**
New York (United States)	82.9	103.8	104.5	100.0	2.5%	6.3%	9.6%	5.7%
Chicago (United States)	81.1	100.0	97.2	92.2	.2%	2.4%	2.0%	-2.5%
Los Angeles (United States)	78.7	89.1	84.3	91.6	-2.7%	-8.7%	-11.6%	-3.2%

Source for UBS data: UBS study "Price and Earnings Around the Globe".

Table A7 Values for iHdB determined with the UBS index (iUBS)

Cities and Countries	period			iHdB value (period 1997 to 2006)		
	1997 to 2000	2000 to 2003	2003 to 2006	mean value (3-year)	annualised mean with iUBS	annualised mean with iBM
Average value for Canada	-12.8%	-9.3%	34.2%	4.0%	1.3%	2.2%
Montreal (Canada)	-15.1%	-9.7%	34.4%	3.2%	1.1%	
Toronto (Canada)	-10.3%	-8.9%	33.9%	4.9%	1.6%	
Sydney (Australia)	-25.4%	-4.5%	22.6%	-2.5%	-.8%	.2%
Tokyo (Japan)	-4.6%	-22.0%	.9%	-8.6%	-2.9%	-2.5%
Auckland (New Zealand)		-8.4%	20.7%	-	-	
London (Great Britain)	-12.5%	5.4%	14.2%	2.4%	.8%	-.3%
Copenhagen (Denmark)	-24.8%	9.3%	11.3%	-1.4%	-.5%	.2%
Stockholm (Sweden)	-19.1%	-6.0%	8.5%	-5.5%	-1.9%	1.4%
Average value for Switzerland	-18.0%	3.0%	8.3%	-2.2%	-.7%	.5%
Zurich (Switzerland)	-17.1%	2.4%	8.2%	-2.2%	-.7%	
Geneva (Switzerland)	-18.9%	3.7%	8.5%	-2.2%	-.7%	
Average value for Euro area	-21.8%	13.7%	12.8%	1.6%	.5%	
Berlin (Germany)	-22.2%	9.7%	10.0%	-.8%	-.3%	
Frankfurt (Germany)	-24.5%	5.5%	11.6%	-2.5%	-.8%	
Paris (France)	-24.2%	12.1%	7.9%	-1.4%	-.5%	
Milan (Italy)	-21.9%	14.1%	12.6%	1.6%	.5%	
Madrid (Spain)	-32.0%	26.2%	17.9%	4.0%	1.3%	
Lisbon (Portugal)	-18.7%	18.4%	11.9%	3.9%	1.3%	
Dublin (Ireland)	-22.1%	16.8%	19.6%	4.8%	1.6%	
Vienna (Austria)	-15.5%	6.9%	13.7%	1.7%	.6%	
Amsterdam (Netherlands)	-17.6%	6.7%	14.3%	1.1%	.4%	
Brussels (Belgium)	-24.2%	16.7%	12.5%	1.7%	.5%	
Luxembourg (Luxembourg)	-19.5%	12.3%	20.2%	4.3%	1.4%	
Athens (Greece)	-21.1%	19.2%	-.3%	-.7%	-.2%	
Prague (Czech Republic)			33.9%			
Budapest (Hungary)	-22.6%	25.5%	5.6%	2.9%	.9%	4.8%
Warsaw (Poland)	-21.4%	8.6%	26.6%	4.6%	1.5%	2.2%
Moscow (Russia)	-42.5%	-7.1%	23.3%	-8.8%	-3.0%	-2.8%
Buenos Aires (Argentina)	-10.2%	-59.1%	38.0%	-10.4%	-3.6%	3.5%
Average value for Brazil	-36.2%	-32.5%	63.8%	-1.6%	-.5%	-1.2%
Rio de Janeiro (Brazil)	-36.0%	-36.9%	70.9%	-.7%	-.2%	
Sao Paulo (Brazil)	-36.5%	-27.9%	57.3%	-2.3%	-.8%	
Santiago de Chile (Chile)		-21.3%	53.2%	-	-	-1.9%
Mexico City (Mexico)	-6.8%	.6%	.1%	-2.0%	-.7%	1.1%
Shanghai (China)	1.6%	-17.3%	-27.3%	-14.3%	-5.0%	-1.3%
Hong Kong (China)	-5.0%	25.0%	-23.5%	-1.2%	-.4%	-.5%
Jakarta (Indonesia)	-28.7%	-1.1%	3.6%	-8.8%	-3.0%	
Kuala Lumpur (Malaysia)	-29.0%	-26.3%	-13.6%	-23.0%	-8.3%	-2.3%
Singapore (Singapore)	-16.5%	-24.7%	7.1%	-11.4%	-3.9%	-1.6%
Seoul (South Korea)	-5.5%	-19.5%	13.0%	-4.0%	-1.3%	-.3%
Taipei (Taiwan)	-6.2%	-17.8%	-5.0%	-9.7%	-3.3%	-2.9%
Bangkok (Thailand)	-31.9%	-14.7%	21.7%	-8.3%	-2.8%	-3.2%
Johannesburg (South Africa)	-17.9%	-9.7%	34.0%	2.1%	.7%	2.9%
Average value for USA						
New York (United States)	3.8%	3.1%	-3.6%	1.1%	.4%	
Chicago (United States)	2.2%	-.5%	-4.4%	-.9%	-.3%	
Los Angeles (United States)	-6.2%	-3.1%	9.5%	.1%	.0%	