Understanding the effects of exchange rates on the cost of living for expatriates and ordinary residents in Singapore and Hong Kong

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Abstract: It is important to factor in the effect that exchange rates have on cost of living rankings while computing cost of living indices, as conversion of local prices into a common currency is imperative for any ranking of cities in different parts of the world. Considering that such computations are going to be affected by exchange rate levels in the different cities, this paper empirically analyses the cases of Singapore and Hong Kong to understand the impact of exchange rates on their cost of living rankings. Our simulation analysis for these two global Asian cities shows that exchange rate fluctuations have a significant impact on the cost of living rankings for both expatriates and ordinary residents. In addition, our study indicates that cities in the developed Western countries are more expensive for ordinary residents than cities in less developed countries elsewhere, especially in Asia. We attribute this to structural differences in labour cost between these two sets of countries.

Keywords: cost of living; expatriates; ordinary residents; exchange rates; Singapore; Hong Kong.

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1 Introduction and motivation

Cost of living, wages and purchasing power have been critical issues of policy importance globally. These are key indicators of a country's standard of living. While cost of living has been routinely measured at the national level by the annual consumer price index (CPI), a reliable index for tracking and comparing costs of living and purchasing power at the sub-national level is still lacking in the literature. Commercial surveys, while useful for compensation decisions for expatriate professionals, are inadequate as they do not account for differences in consumption patterns across cities. Further, such surveys lack theoretical foundations as well as scientific rigour that are critical for fruitful policy discourse.

In this context, one of the first comprehensive attempts to measure the cost of living for expatriates and ordinary residents across 103 cities was provided by Tan et al. (2015) and Tan and Luu (2016). It was one of the first attempts to distinguish between the cost of living for expatriates and ordinary residents. The popular academic literature, such as reports frequently published by the Economist Intelligence Unit (EIU) and Mercer, has usually ignored the issue of cost of living for ordinary residents and has instead only focused on constructing cost of living indices for expatriates.[1]

However, any study which endeavours to rank different cities in the world according to their cost of living has to convert the price data used in computing the cities' cost of living indices to a common currency. This move is intended to facilitate international comparisons. While this sounds like a reasonable strategy, some complications arise with respect to the exchange rates of various currencies that are integrated into the calculation of the cost of living indices. As a result, the ranking of a city, which is based on the value of its index, reflects not only its relative expensiveness with respect to the other cities, but also the relative strength of its currency. In other words, the position of a city's ranking is not decided purely by the price levels of its consumption items but also by its exchange rates.

The effect that exchange rates have on cost of living rankings is ever-present, as conversion of local prices into a common currency is imperative for any ranking of cities in different parts of the world to be constructed. For instance, the findings of Tan et al. (2015) who compute the cost of living rankings for expatriates and ordinary residents for 103 cities across the world are likely to be affected by exchange rate levels in the different cities (also see Tan and Luu, 2016). Using the results generated in this study as the starting point and our baseline case, we investigate the cases of Singapore and Hong Kong to understand the impact of exchange rates on the cost of living rankings.

Consider the case of Singapore. Between 2005 and 2013 the Singapore dollar appreciated by almost 25% against the US dollar[2] – the common currency used to compare all prices in the analysis by Tan et al. (2015) and Tan and Luu (2016). In theory, the strong Singapore dollar ought to have pushed Singapore's cost of living rankings for expatriates and ordinary residents upwards because any generic increase in local prices over this period would be magnified during currency conversion. However, given that such exchange rate effects are not explicitly accounted for while computing the cost of living rankings, this paper undertakes an empirical exercise to understand how such exchange rate movements could possibly impact the cost of living rankings. We illustrate by focusing on the contrasting examples of Singapore and Hong Kong, both associated with very high cost of living by several popular reports.[3]

The remainder of the paper proceeds as follows. Section 2 provides a review of the literature surrounding cost of living indices and subsequently offers a succinct summary of the tangential human resource management literature which deals with the concept of expatriates. Section 3 explains the methodology employed to simulate the cost of living rankings for expatriates and ordinary residents. The results for Hong Kong and Singapore are discussed in Section 4 of this paper. Section 5 offers a comparison of cost of living across geographical regions based on our results factoring in exchange rate effects. Section 6 concludes the paper and also cites avenues for future research.

2 Literature review

The traditional economics literature has predominantly focused on constructing cost of living indices to measure the changes in costs of consumption required to sustain a standard of living. This has been the broader conceptual framework to measure CPIs in several advanced economies like the United States of America (USA). The literature relating to whether a cost of living index should be the guiding basis for the measurement of CPI is quite old and still continues to this day (For a detailed discussion, see Triplett, 2000).

As mentioned, the measurement of prices and their rate of change (i.e., inflation) are of critical importance to the study of economics. However, measuring this change in the cost of living presents considerable difficulties, due to the sheer abundance of goods and services in today's markets. Further price fluctuations induced by technological change and variables impacting costs and quality result in consumers altering their consumption patterns. With increasing affluence, demand has also gradually gravitated towards services and to goods and services with superior quality and increased variety and convenience. This trend bolstered by rapid technological advancement has resulted in an ever-increasing plethora of goods and services (e.g., high-tech consumer products and IT services) over the past few decades, making the process of capturing price fluctuations comparatively more difficult (Boskin et al., 1998; Gordon and Griliches, 1997; Berndt et al., 1995).

A cost of living index could be used to capture price fluctuations and allow users to draw comparisons between time periods of the minimum expenditure required to attain similar states of well-being. It could also be defined as the ratio of the expenditure needed in the construction of a particular indifference curve of order preferences under two price systems (Gordon and Griliches, 1997; Pollak, 1975). The underlying assumption for this index is that the average utility level and the impact of other factors (encompasses government transfers, taxes, impact of disasters and epidemics) are held constant.

There are two approaches to measuring cost-of-living indices. One approach utilises estimated systems of demand equations. However, one weakness of this approach is that it becomes untenable and difficult to implement at detailed disaggregation levels. This is owing to the fact that the number of parameters requiring estimation in a comprehensive consumer demand system increases with the square of (one less than) the number of commodities. Another weakness of this approach is that the data involved in these studies is subject to significant aggregation, resulting in the underestimation of their substitution bias estimate; the aggregation process could mask substitution in consumption inside categories (Boskin et al., 1998; Braithwait, 1980; Goldberger and Gamaletsos, 1970).

The second approach involves the calculation of index numbers, usually at a highly disaggregated level. The Laspeyres index is the best-known index number formula. The Laspeyres index could be mathematically expressed as follows:

$$L(P_1, P_0) = \sum P_1 X_0 \Big/ \sum P_0 X_0 = \sum P_1 X_0 / Y_0$$

where

P_1 comparison price

P_0 reference price

X_0 total consumption in the base year

Y_0 actual expenditure.

The above equation is the ratio of the costs of a basket of goods in a specific time period (for which statistical results are collated) under two separate price sets. This index measures fluctuations in the cost of a fixed basket of goods. It is predicated on the assumption that there is no substitution triggered by price changes. Consequently, this deliberate omission of the substitution effect results in an index that is prone to estimation errors (Afrait, 2004; Braithwait, 1980; Boskin et al., 1998).

Generally, traditional cost of living indices are subject to considerable bias. This could be due to the failure to implement necessary adjustments for changes in the quality of goods and services purchased by consumers. Additionally, they fail to adequately address the value of newly available goods to consumers. The situation is exacerbated by price variations across different retail establishments (Abraham et al., 1998). In the case of the earlier cited Laspeyres index, an upward bias could be due to the aforementioned failure to incorporate the impact of newly available products and services which provide similar or even greater utility levels to buyers. The introduction of improved new products and services (assuming if they gain widespread market acceptance) tend to exert considerable downward pressure on overall prices. However the impact of this trend is ignored, resulting in an index that could over-estimate the true cost of living (Stigler, 1961; Noe and von Furstenberg, 1972). This inherent positive substitution bias in the Laspeyres index has long been recognised in the academic literature (Dumagan and Mount, 1997).

In addition, these indices are often predicated on the implausible assumption that the environment is not subject to change, ignoring the fact that changes in demography, consumer trends and technology all have considerable impact on the cost of living (Gordon and Griliches, 1997). In an increasingly globalised world with its constantly evolving demographics, cost of living indices should also take into consideration the fact that the residents of a city often comprise the locals and expatriates. Costs of living between these two groups tend to be different because of their disparate lifestyles, incomes and spending patterns. This study builds on the pioneering effort in Tan et al. (2015) and Tan and Luu (2016) which distinguishes between the cost of living for locals and expatriates across cities worldwide.[4]

While the distinction between expatriates and ordinary residents is not evident in the literature, there appears to be a tangential literature relating to the field of human resource management that is of relevance here. To be sure, there is a dedicated body of literature that attempts to define and understand the characteristics of expatriates.

In its simplest form, the broadest definition of expatriate which we also conform to in this paper is that it refers to a person living outside his or her native country. While this might be both a reasonable and convenient starting point for any empirical analysis such as what we do in this paper, the human resource management literature calls for a more nuanced discussion that will allow a clearer definition of who expatriates are.

In a sweeping review of literature, McNulty and Brewster (2016, 2017) for instance track the conceptual evolution of the term 'business expatriates,' which they distinguish from expatriates as business expatriates are those are living abroad but also employed in organisations. One of the important points underlined by McNulty and Brewster (2016, 2017) is that even after a comprehensive review of literature that spans over fifty years, there is an evident lack of clarity surrounding the term business expatriates. In fact, in a majority of cases, the characteristics of business expatriates are intertwined with expatriates in general. They go the extent of arguing that "…that there has been a sloppy and almost casual use of terminology, a failure to define terms adequately, or in many cases at all, and too many unstated assumptions about the people being researched that, collectively, has resulted in reducing understanding of the meanings of 'expatriate'. This problem means that the measures used in empirical studies may not accurately represent the underlying concept being tested" [McNulty and Brewster, (2016), p.28].

Arguing for greater construct clarity, the authors conclude by applying the so-called 'boundary conditions' that will bring more definitional clarity on who business expatriates refer to. Specifically, they identify four conditions, of which the first one relates to the fact that business expatriates must be organisationally employed. The second one emphasises that there has to be greater clarity about the temporal dimension of such expatriate employment. The third boundary condition pertains to ascertaining whether business expatriates attain citizenship in the host country they are employed as they cease to become one when they take up one. The final boundary condition they identify is regarding "the legal context in which expatriate employment is enacted and whether people have the right to stay, and are allowed to seek work legally, in a specific country" (p.44). Overall these conditions or attributes are meant to be the guiding principles for clearly identifying who a business expatriate is.

Dealing with a related issue, similar concerns have been echoed by Dabic et al. (2015) who provide a review of the evolving research on expatriates and their impact on business performance. Using bibliometric analysis to survey over four decades of human resource management literature dealing with expatriates, Dabic et al. (2015) show evidence that the literature is nascent and lacks a systematic and holistic approach to understanding the working of expatriates, and hence requires 'higher order content'.

A few relevant empirical papers in this field are also worth mentioning. Shay and Baack (2004) for instance focus on expatriate adjustment. Using data from 194 expatriate managers and 505 subordinates working in the multinational hotel industry, they probe whether the reasons for expatriate assignment have any influence in the expatriate adjustment process and specifically explore the relationship between different modes of adjustment and outcome measures such as expatriate effectiveness.

In an interesting piece of relevant research, Biemann and Andresen (2010) analyse the differences between assigned expatriates and self-initiated expatriates in management and executive positions. The question they focus on in the paper deals with how far these two categories of expatriates differ from each other with regard to their rationale for working abroad as well as the differences in terms of their career aspirations and finally in what way they differ in terms of their individual career management. They find

evidence that self-initiated expatriates differ significantly from traditional expatriates who are sent abroad by their firms.[5]

Finally, Suutari and Tornikoski (2000) focus on the notion of compensation for expatriate. They highlight the challenges involved in empirical research on how to design appropriate compensation packages for expatriates. In other words, empirically what are the determinants of compensation packages for expatriates? Using expatriate compensation packages of Finnish expatriates, the authors present empirical evidence that a host of variables including sex, age, levels in the organisational hierarchy, nature of assignment, family situation, area of operation, and the nationality of the employer. They also allude to the importance of exchange rates in factoring in such compensation packages.

Overall, to sum up our discussion on the literature, there are two broad strands of literature that we have examined. The first strand of literature was more directly related to our study and empirical analysis dealing with cost of living. This mainly relates to the conventional economics literature on constructing cost of living indices using changes in costs of consumption required to sustain a standard of living as the proxy measure. The second strand of literature, tangential to our study, focused much more narrowly on the notion of expatriates since we deal with cost of living for both ordinary residents and expatriates in our paper. While there is virtually no study that makes such a distinction, the human resource management literature appears to have dedicated studies that focus on the evolving nature of research on expatriates. The short message from surveying over five decades of research on expatriates is that there are several definitional and conceptual ambiguities in how to define expatriates. Further, there is still quite a distance to cover in terms of obtaining a rigorous and holistic perspective on all relevant aspects of the role and functions of expatriates. While the overarching message from this strand of literature is interesting in its own right, we believe that the economics literature is much less concerned about such definitional ambiguities as the objectives motivating of our research are substantially different from those of the human resource management literature.

We next turn to our methodology of simulations that we undertake in this paper in the following section that will explicitly focus on how exchange rates affect cost of living ranking for both ordinary residents and expatriates.

3 Methodology of simulations

Following Tan et al. (2015) and Tan and Luu (2016), which remain the starting point for us in this paper, we let the exchange rates of the currencies in all 103 cities (against the US dollar) follow their actual trends.[6] The simulation scenario is one where the exchange rate of the Singapore dollar is assumed to have remained unchanged between 2005 and 2013 while rates of the other currencies are kept as they are in reality. By comparing Singapore's simulated cost of living rankings for expatriates and ordinary residents with the city's actual rankings, we can verify the extent of the effect of a strong currency on cost of living for all.

For comparison purposes, a similar exercise is also carried out for Hong Kong. In this exercise, our prior assumption is that Hong Kong's simulated rankings would not differ much from its original rankings. Unlike Singapore, which adopts a managed floating

exchange rate system, Hong Kong pegs its currency to the US dollar. As a result, if there is very little variation in the exchange rate between the Hong Kong dollar and the US dollar over the years studied in the paper, the simulated scenario is likely to be similar to the baseline scenario for Hong Kong. The following discussion explains the methodology of our empirical exercise.

3.1 Cost of living rankings for expatriates

Since the methodologies to obtain the cost of living ranking for expatriates and cost of living ranking for ordinary residents are different, the simulations for expatriates and ordinary residents also proceed differently. This section details the simulation methodology for expatriates.

First, let us recall that in the original analysis of cost of living elaborated in Tan et al. (2015), the cost of living index for expatriates in a city in a particular year is calculated as follows:

$$\text{Cost of living index for expartriates in city } m = \frac{\sum_{i=1}^{n} P_{C,m,i} \times W_i}{\sum_{i=1}^{n} P_{US,NY,i} \times W_i} \times 100 \quad (1)$$

where

m city

C the country where city m is located in;

NY New York

US USA

i item

n number of items in the consumption basket for expatriates

$P_{C,m,i}$ average price of item i in city m of country C

W_i weight of item i within cost of living index for expatriates.

Exchange rates enter the calculation through the term $P_{C,m,i}$. This is the US dollar-denominated average price of consumption item i in city m of country C. To obtain this term, we first gather all local currency prices of item i in city m from the Economist Intelligence Unit (EIU) CityData. We then convert these prices into US dollars, proxy for missing data entries where necessary[7] and take the average of all converted prices to get $P_{C,m,i}$. In doing the conversion we use the average yearly exchange rate between the local currency of city m and the US dollar[8] in the year for which the index is calculated. For example, if we are computing the cost of living index for expatriates in Tokyo in year 2013, the 2013 exchange rate of the yen will be used. The whole procedure applies to all consumption items except for miscellaneous goods and services. Price data for miscellaneous goods and services, which are acquired from the UBS prices and earnings study, are reported in US dollar to begin with. Thus, no conversion is needed and the value of $P_{C,m,i}$ for this item is simply the raw data value.

Equation (1) is used to combine all $P_{C,m,i}$ with their respective weights, W_i, to obtain the cost of living index for expatriates in each city. The cost of living ranking for

expatriates is then generated by arranging the indices in a descending order. In other words, a city which is ranked higher (lower) is the one which has a larger (smaller) index.

We conduct the simulation for all years between 2006 and 2013. In our simulation, the basic framework to compute the cost of living index for expatriates as explained above is preserved. Equation (1) is still used to calculate the indices for the city of interest, i.e., Singapore or Hong Kong and the other 102 cities. In fact, no change is made to the index computation process for the latter group, such that the indices for these cities under the simulation scenario are exactly the same as they were originally.

For the city of interest, however, some modifications are made to the calculation of the term $P_{C,m,i}$. For item i which is not considered under miscellaneous goods and services, we still begin by collecting all of its local currency prices from the EIU CityData. Nonetheless, the conversion of these prices into US dollar is now carried out using the 2005 exchange rate, regardless of the year for which the index is being calculated. Proxies, where necessary, are still derived by the same method as in the original analysis. All converted prices of item i are then averaged to give us the simulated average price of item i.

$P_{C,m,i}$ for miscellaneous goods and services in the city of interest is also modified. The raw price data for this item has been pre-converted into US dollars using the actual exchange rate of city m's local currency in the year for which the data is reported. Thus, to reflect our simulation assumption that the city of interest has not experienced any exchange rate fluctuations after 2005, we first work out the price of miscellaneous goods and services in local currency and then re-convert it back to US dollar using the 2005 exchange rate. Specifically, the simulated average price of miscellaneous goods and services in the city of interest in any year which comes after 2005 is given by the following equation:

$$P^{simulated}_{C,m,Miscellaneous,T} = P_{C,mMiscellaneous,T} \times \frac{Exchange\ rate_{C,T}}{Exchange\ rate_{C,2005}} \quad (2)$$

$$\forall T \in (2006, 2007, 2008, 2009, 2010, 2011, 2012 \text{ and } 2013)$$

where

m	Singapore or Hong Kong
C	Singapore or Hong Kong, China
Miscellaneous	miscellaneous goods and services
T	year
$P^{simulated}_{C,m,Miscellaneous,T}$	simulated average price of miscellaneous goods and services in city m of country C in year T
$P_{C,m,Miscellaneous,T}$	actual average price of miscellaneous goods and services in city m of country C in year T
$Exchange\ rate_{C,T}$	yearly average exchange rate between country C and the USA in year T (expressed as local currency unit per US dollar)
$Exchange\ rate_{C,2005}$	yearly average exchange rate between country C and the USA in year 2005 (expressed as local currency unit per US dollar).

After obtaining the simulated average prices for all consumption items in the city of interest, we plug them back into equation (1) to obtain the simulated cost of living index for expatriates in that city. We then re-rank all cities to generate a simulated cost of living ranking for expatriates and compare the simulated ranking of the city of interest with its original ranking. Findings from this comparison are discussed in Section 3.

An important underlying assumption for the simulation is that consumption patterns of expatriates are insensitive to exchange rate fluctuations. In other words, exchange rates do not affect the composition of an expatriate's consumption basket – the items in it and the importance of each item to him. This assumption is intuitive considering that consumption patterns are formed mainly from the expatriate's consideration of his wants and needs, his relative preferences between different consumption items as well as the relative quality of the goods and services in the basket. These factors are assumed to be unaffected by exchange rates. As a result of the assumption, the weight of each item in the cost of living index for expatriates, or the term W_i in equation (1), is the same in both the original analysis and the simulation scenario.

3.2 Methodology to simulate the cost of living rankings for ordinary residents

Next, we recall that in the original analysis of cost of living elaborated in Tan et al. (2015) and Tan and Luu (2016), the cost of living index for ordinary residents in a city in a particular year is calculated as follows:

$$\text{Cost of living index for ordinary residents in city } m = \frac{CP_{c,m}^{EIU} \times \dfrac{NP_C^{ICP}}{NP_C^{EIU}}}{CP_{US,NY}^{EIU} \times \dfrac{NP_{US}^{ICP}}{NP_{US}^{EIU}}} \tag{3}$$

where

m city

C the country where city m is located in

NY New York

US USA

$$CP_{C,m}^{EIU} = \sum_{i=1}^{n} P_{C,m,i} \times W_{C,i} \tag{4}$$

i item

n number of items in the consumption basket

$P_{C,m,i}$ average price of item i in city m of country C

$W_{C,i}$ weight of item i within cost of living index for ordinary residents in country C.

$$NP_C^{ICP} = \frac{\text{index of nominal expenditure per capita for country } C}{\text{index of real expenditure per capita for country } C} \tag{5}$$

index of nominal expenditure per capita for country C

$$= \frac{\text{nominal expenditure per capita for country } C}{\text{nominal expenditure per capita of the world}}$$

index of real expenditure per capita for country C

$$= \frac{\text{real expenditure per capita for country } C}{\text{real expenditure per capita of the world}}$$

NP_C^{EIU} = mean $CP_{C,m}^{EIU}$ from all cities within country C.

Exchange rates enter the calculation through two channels. The first is the term $CP_{C,m}^{EIU}$ and its mean value, the term NP_C^{EIU}. $CP_{C,m}^{EIU}$ is the weighted average of US dollar-denominated average prices of the consumption items in city m, country C. Structure-wise, this term is similar to the numerator of equation (1), except that the item weights in equation (3), $W_{C,i}$ are country-specific and represent the consumption patterns of ordinary residents in city m. Meanwhile, the average prices used to compute $CP_{C,m}^{EIU}$ or $P_{C,m,i}$ are precisely the ones used in equation (1) to calculate the cost of living for expatriates. The process through which these prices are obtained and the role that exchange rates play in the data treatment are already documented in the previous section and would not be repeated here.

The second channel is the term NP_C^{ICP}. This term can be understood as the US dollar-denominated price level per unit real consumption for ordinary residents living in country C. NP_C^{ICP} in 2005 and 2011 are calculated based on data on nominal and real expenditure per capita in country C reported in the International Comparison Programme (ICP) surveys for these years. Since the ICP data are not available for any other year, we construct the NP_C^{ICP} for the 2006–2010 period and the 2012–2013 period by incorporating extra information on exchange rates and inflation rates. In particular, the NP_C^{ICP} for any year T within the 2006–2010 period is calculated as follows:

$$NP_{C,T}^{ICP} = NP_{C,2005}^{ICP} \times \frac{Exchange\ rate_{C,2005}}{Exchange\ rate_{C,T}} \times \prod_{i=2006}^{T} \left(1 + Inflatrion\ rate_{C,t}\right) \quad (6)$$

$$\forall T \in (2006, 2007, 2008, 2009 \text{ and } 2010)$$

where

C	country
T	year
$NP_{C,T}^{ICP}$	NP_C^{ICP} in year T
$Inflation\ rate_{C,t}$	yearly average inflation rate for country C in year t
$Exchange\ rate_{C,T}$	yearly average exchange rate between country C and the USA in year T (expressed as local currency unit per US dollar).

Likewise, the NP_C^{ICP} for any year T within the 2012–2013 period is given by:

$$NP_{C,T}^{ICP} = NP_{C,2011}^{ICP} \times \frac{Exchange\ rate_{C,2011}}{Exchange\ rate_{C,T}} \times \prod_{t=2012}^{T} \left(1 + Inflation\ rate_{C,t}\right) \quad (7)$$
$$\forall T \in (2012 \text{ and } 2013)$$

where

C	country
T	year
$NP_{C,T}^{ICP}$	NP_{C}^{ICP} in year T
$Inflation\ rate_{C,t}$	yearly average inflation rate for country C in year t
$Exchange\ Rate_{C,T}$	yearly average exchange rate between country C and the USA in year T (expressed as local currency unit per US dollar).

Equation (3) is used to combine $CP_{C,m}^{EIU}$, NP_{C}^{EIU} and NP_{C}^{ICP} to obtain the cost of living index for ordinary residents in each city. The cost of living ranking for ordinary residents is then generated by arranging the indices in a descending order. In other words, a city which is ranked higher (lower) is the one which has a larger (smaller) index.

We conduct the simulation for all years in the study period except for 2005. In our simulation, the basic framework to compute the cost of living index for ordinary residents is preserved. Equation (3) is still used to calculate the indices for the city of interest, i.e., Singapore or Hong Kong and the other 102 cities. In fact, no change is made to the index computation process for the latter group, such that the indices for these cities under the simulation scenario are exactly the same as they were originally.

For the city of interest, however, we make the following modifications. Firstly, we adopt the procedure used in the simulations for expatriates to generate the simulated average price of each consumption item. Specifically, for any item i which is not considered miscellaneous goods and services, we use the 2005 exchange rate of the local currency of the city of interest to convert local prices into US dollar, make proxies where necessary and average the converted prices to obtain the item's simulated average price. Meanwhile, for miscellaneous goods and services, we employ equation (2) to calculate $P_{C,m,Miscellaneous,T}^{simulated}$. The terms $CP_{C,m}^{EIU}$ and NP_{C}^{EIU} for the city of interest are then recalculated with the simulated prices as inputs.

Second, the NP_{C}^{ICP} term for the city of interest is also modified. From our earlier descriptions, it is easy to see that NP_{C}^{ICP} for a certain year is essentially a price level pre-converted into US dollar using the actual exchange rate of country C's local currency in that year. To reflect our simulation assumption that the city of interest had not experienced any exchange rate fluctuations after 2005, we first work out the value of this price level in local currency and then re-convert it back to US dollar using the 2005 exchange rate. Specifically, the simulated NP_{C}^{ICP} for the city of interest in any year which comes after 2005 is given by the following equation:

$$NP_{C,T}^{ICP,simulated} = NP_{C,T}^{ICP} \times \frac{Exchange\ rate_{C,T}}{Exchange\ rate_{C,2005}} \quad (8)$$
$$\forall T \in (2006, 2007, 2008, 2009, 2010, 2011, 2012 \text{ and } 2013)$$

where

C	Singapore or Hong Kong, China
T	year
$NP_{C,T}^{ICP,simulated}$	simulated NP_C^{IPC} for the country C in year T
$NP_{C,T}^{ICP}$	actual NP_C^{ICP} for the country C in year T
Exchange rate$_{C,T}$	yearly average exchange rate between country C and the USA in year T (expressed as local currency unit per US dollar).
Exchange rate$_{C,2005}$	yearly average exchange rate between country C and the USA in year 2005 (expressed as local currency unit per US dollar).

After obtaining the simulated terms $CP_{C,m}^{EIU}$, NP_C^{EIU} and NP_C^{ICP} for the city of interest, we plug them back to equation (3) to calculate the simulated cost of living index for ordinary residents in that city. We then re-rank all cities to generate a simulated cost of living ranking for ordinary residents and compare the simulated ranking of the city of interest with its original ranking. Findings from this comparison are discussed in Section 3.

Just as before, the underlying assumption is that the consumption patterns of ordinary residents are insensitive to exchange rate fluctuations. The argument again is that consumption patterns are formed mainly based on ordinary residents' wants and needs, their relative preferences between the consumption items and the relative quality of the items. These factors are unlikely to be affected by exchange rates. As a result of this assumption, the set of item weights for ordinary residents in each country, $W_{C,i}$ is the same in both the simulation scenario and the original analysis.

4 Empirical results

Table 1 presents the simulation results for expatriates together with the original cost of living rankings for expatriates in Singapore and Hong Kong. Table 2 presents the simulation results for ordinary residents together with the original cost of living rankings for ordinary residents in Singapore and Hong Kong. The yearly average exchange rates of the Singapore dollar and the Hong Kong dollar against the US dollar over the study period are also shown in Tables 1 and 2.

Singapore's simulated rankings for both expatriates and ordinary residents' costs of living are lower than its original rankings in all the years for which the simulations are conducted. For example, in 2013, Singapore placed fourth in the cost of living ranking for expatriates in the original analysis. However, had the Singapore dollar not appreciated against the US dollar by almost 25% over the study period, Singapore would have been ranked 24th instead. In the other years, the simulated ranking for expatriates is always 15th or below, while the original ranking was consistently 13th or above. Not only so, while the original ranking displayed an increasing trend, the simulated ranking generally decreased between 2006 and 2011 before reversing to an increasing trend. Similarly, the simulated cost of living ranking for ordinary residents in Singapore is also always lower than the original cost of living ranking for ordinary residents. The simulated ranking is

60th or below throughout the study period while the original ranking ranged between 60th and 48th place. Thus, as alluded to previously, the strong Singapore dollar has adversely helped to push Singapore's cost of living rankings upward.

Table 1 Original and simulated cost of living rankings for expatriates in Singapore and Hong Kong, 2005–2013

	2005	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*
Cost of living ranking for expatriates in Singapore	15	13	12	12	12	10	8	7	4
Simulated cost of living ranking for expatriates in Singapore	-	15	21	31	25	24	33	22	24
Cost of living ranking for expatriates in Hong Kong	5	6	10	17	13	12	12	9	11
Simulated cost of living ranking for expatriates in Hong Kong	-	7	10	17	13	12	12	9	11
Singapore dollar/US dollar yearly average exchange rate	1.6645	1.5887	1.5068	1.4147	1.4538	1.3627	1.2572	1.2494	1.2510
Hong Kong dollar/US dollar yearly average exchange rate	7.7775	7.7684	7.8020	7.7863	7.7517	7.7689	7.7844	7.7570	7.7566

Source: Tan et al. (2015)

Meanwhile, Hong Kong's simulated rankings for both expatriates and ordinary residents' costs of living are almost always identical to its original rankings. In fact, there is no difference between the simulated cost of living ranking for ordinary residents in Hong Kong and its original counterpart. For expatriates, the simulated and original rankings are also the same for all years, except for 2006 when the two differ by only one place. These observations do not come as a surprise. As pointed out earlier on, the Hong Kong dollar is pegged against the US dollar. Thus, for Hong Kong, the simulated scenario is actually not very different from the reality hence Hong Kong's rankings remain almost unaltered after the simulation.

The simulation results serve to highlight the effect that the exchange rate of a city's local currency may have on its cost of living rankings. There is, however, another facet to the exchange rate story which is not captured by the simulation: exchange rate fluctuations in other cities may also influence the rankings of the city of interest. To see this aspect, one could analyse Singapore's recent rankings.

Table 2 Original and simulated cost of living rankings for ordinary residents in Singapore and Hong Kong, 2005–2013

	2005	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*
Cost of living ranking for ordinary residents in Singapore	58	60	59	56	59	53	55	48	48
Simulated cost of living ranking for ordinary residents in Singapore	-	60	62	65	62	64	69	66	67
Cost of living ranking for ordinary residents in Hong Kong	56	58	60	62	60	62	63	62	59
Simulated cost of living ranking for ordinary residents in Hong Kong	-	58	60	62	60	62	63	62	59
Singapore dollar/US dollar yearly average exchange rate	1.6645	1.5887	1.5068	1.4147	1.4538	1.3627	1.2572	1.2494	1.2510
Hong Kong dollar/US dollar yearly average exchange rate	7.7775	7.7684	7.8020	7.7863	7.7517	7.7689	7.7844	7.7570	7.7566

Source: Tan et al. (2015)

Consider, for example, the cost of living ranking for expatriates. Between 2011 and 2013, Singapore's actual ranking rose from eighth to fourth place. The yearly average exchange rate of the Singapore dollar against the US dollar was rather stable during this period. In climbing up the ranking table, Singapore overtook Frankfurt (Germany), Geneva (Switzerland), Oslo (Norway), Osaka/Kobe (Japan), London (UK) and Tokyo (Japan), all of which were ranked above Singapore in 2011. Interestingly, the countries where these cities are in all experienced exchange rate depreciations over the 2011–2013 period. For example, the British pound depreciated by 2.45% against the US dollar; the Norwegian krone by 4.83% and most severely, the Japanese yen by 22.44%. These depreciation episodes served to mask any price increases which had happened in the cities mentioned when the local prices are converted into US dollar. In contrast, since the exchange rate between the Singapore dollar and the US dollar remained stable, any increases in its local prices were fully articulated in the converted prices. Such unequal levels of currency depreciation among these countries against the US dollar helped to push up Singapore's cost of living index for expatriates vis-à-vis the cities mentioned and thus the city-state's ranking as well. Although exchange rate fluctuations were not the sole cause for the rise in Singapore's ranking, they were, however, an important contributing factor.

The phenomenon is also observed for Singapore's ranking for ordinary residents. Between 2011 and 2013, the cost of living ranking for ordinary residents in Singapore rose from 55th to 48th. Comparing the ranking in 2013 and 2011, Singapore overtook Atlanta (USA), Berlin (Germany), Buenos Aires (Argentina), Lexington (USA), Lyon (France), Pittsburgh (USA) and Rio de Janeiro (Brazil). Again, we observe that among these cities, the exchange rates of the non-US cities depreciated over the period. In particular, the euro, which is used in France and Germany, depreciated by 4.7% against the US dollar; the Argentinean peso depreciated by 32.7% and the Brazilian real by 29.1%.

4.1 The effects of currency appreciation on expatriates and ordinary residents

We now discuss the effects that currency appreciation may have on the lives of expatriates and ordinary residents using Singapore as an example. In particular, we highlight how a strong Singapore dollar may affect the prices of the different goods and services which they consume and the income and wealth of each group. The analysis in this section concerns a general scenario where the Singapore dollar appreciates against various currencies and not only against the US dollar. We also assume *ceteris paribus*, or that no other factor changes aside from the exchange rates of the Singapore dollar.

As the Singapore dollar strengthens, local prices of imports in Singapore are lowered as it now requires fewer Singapore dollars to buy one unit of foreign currency worth of imports. Consumption items which are imported thus become less expensive. This is beneficial for both expatriates and ordinary residents, but especially so for the former because expatriates are geared towards consuming high-end imported products to maintain comparatively more expensive Western lifestyles. At the same time, prices of locally produced goods, especially common foodstuffs, may also decrease, as these goods face greater competition from cheaper imported close substitutes. Goods which are produced using imported inputs will see a greater drop in prices. In contrast to goods, the local prices of most services consumed by expatriates and ordinary residents, such as the price of haircuts, are unlikely to be affected. As these services are largely non-tradable, there are no foreign substitutes creating competitive pressure.

Meanwhile, an appreciating Singapore dollar makes the prices of Singapore's exports in the international market less competitive. As a result, international demands for Singapore's exports are likely to be reduced. The extent of this reduction depends on the price elasticity of demand of overseas consumers for Singapore's exports. If demand is relatively inelastic, the decrease in quantities demanded is marginal. However, if the reverse is true, the slump in exports will be great and this may have repercussions on the employment prospects of ordinary residents working in the export sectors.

The above argument notwithstanding, a strong Singapore dollar does not have much of an impact on the income and wealth of ordinary residents. Ordinary residents are remunerated in local currency so the value of their income in terms of Singapore dollars is unaffected by the exchange rate. Since ordinary residents save and invest mostly in local assets, such as Singapore dollar-denominated time deposits or savings with the Central Provident Fund (CPF), exchange rate fluctuations also do not have much impact on the value of their wealth. However this argument may not apply to the upper strata of the population, as they may also hold foreign assets; the above arguments are largely

applicable to most ordinary residents. Owing to the strong Singapore dollar, some imported goods consumed by ordinary residents may experience price declines. Nonetheless, the total resources available for ordinary residents to support their lifestyles are not affected by the strength of the Singapore dollar.

In contrast, an appreciating Singapore dollar has an income effect on expatriates. The exact nature of the effect, however, depends on their remuneration arrangements. If an expatriate is paid in his home currency, or in US dollar, the value of his income in terms of Singapore dollar will decrease. He will thus have fewer resources at his disposal to support his lifestyle. On the other hand, if the expatriate is compensated in Singapore dollar, the value of his income is not reduced. In fact, a strong Singapore dollar may help to make more income available for consumption because it lessens the burden of remittances. It is likely that the expatriate has to send a portion of his income back to his home country, either to support dependants back home or to settle outstanding financial commitments such as mortgages. A strong Singapore dollar allows the expatriate to remit this pre-set amount of money with fewer Singapore dollars, thus leaving him with more income for consumption.

These conclusions are important to either reinforce, justify existing policies or as options for fine-tuning policies with respect to exchange rates. In turn, exchange rate policies affect trade policies among other matters. Singapore as one of the most open economies (in terms of total trade to gross domestic product) does watch its exchange rate policy conscientiously.

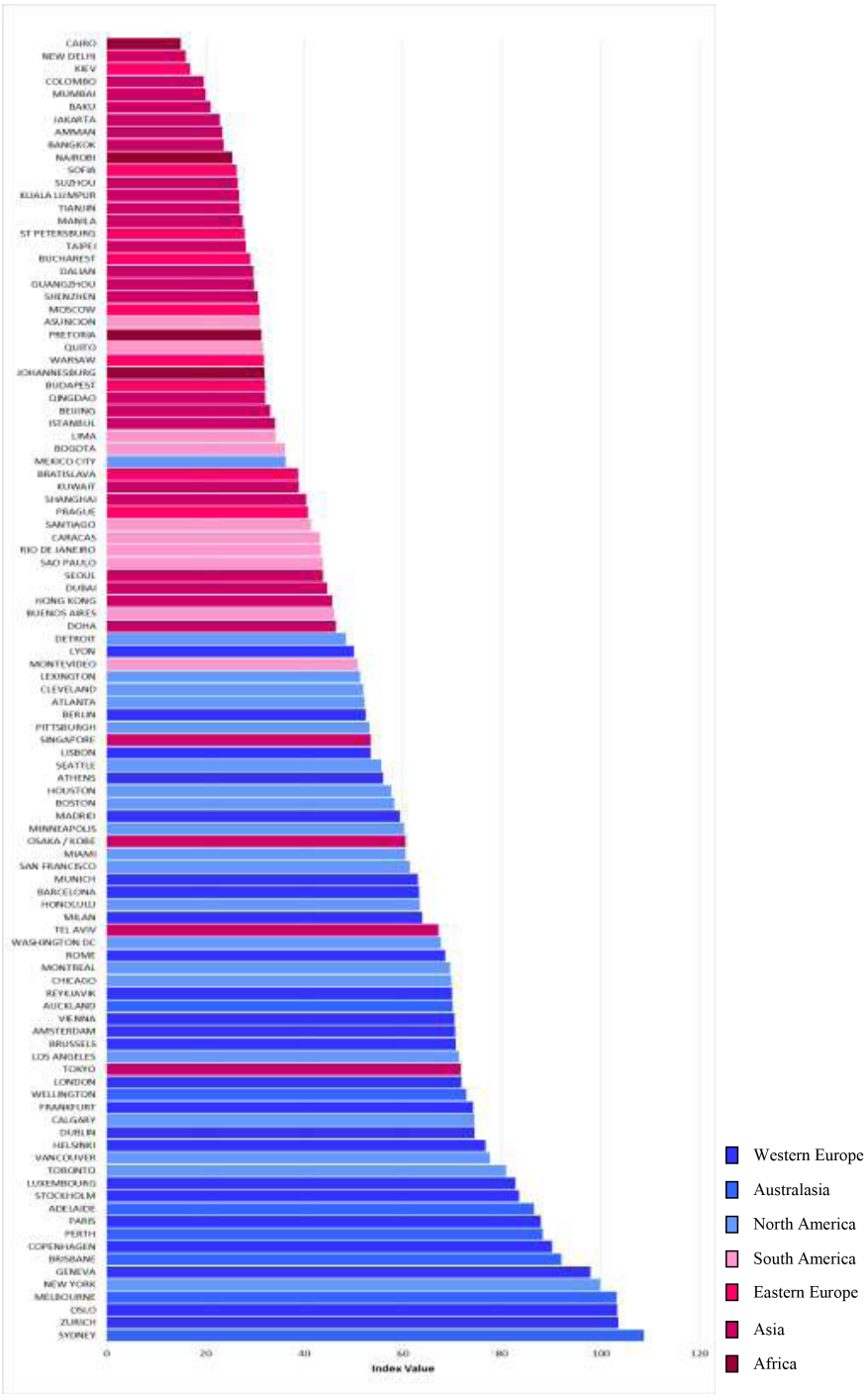
The effects we have described in this analysis do manifest in reality, subject to a host of other relevant factors (e.g., transport costs, oil prices). A strong Singapore dollar is somewhat beneficial as it helps to mitigate imported inflation. Nonetheless, its appreciation should be carefully managed because of the potential adverse consequences on exporting activities. Income-wise, expatriates are more affected than ordinary residents by exchange rate fluctuations. Whether a strong Singapore dollar is a boon or a bane for expatriates depends on their remuneration arrangements with their firms.

5 Comparing cost of living across geographical regions

An interesting observation emerges when we compare the cost of living in different cities across geographical regions. Cities in the West tend to have higher cost of living for ordinary residents than cities elsewhere. On the other hand, there is no similar pattern in the geographical distribution of cities according to their cost of living for expatriates. In other words, an Asian city, such as Shanghai, is likely to have a lower cost of living for ordinary residents as compared to a city in Western Europe, such as Amsterdam. However, it may be ranked higher or lower than the latter in terms of cost of living for expatriates.

Figure 1 illustrates the pattern concerning the cost of living for ordinary residents. It graphs the cost of living indices for ordinary residents in all cities in our study in 2013. The horizontal axis reflects the index values while the different cities are plotted on the vertical axis. The longer the bar, the higher the index value and hence the more expensive for ordinary residents in the particular city as compared to the other cities in 2013. The different colours of the bars represent the region to which each city belongs.

Figure 1 Cost of living indices for ordinary residents in 103 world's major cities in 2013 by geographical regions (see online version for colours)



Source: Tan et al. (2015)

As apparent from Figure 1, cities in Western Europe are among the most expensive cities for ordinary residents. They are followed by cities in Australasia (Australia and New Zealand) and North American cities. On the other hand, African and Asian cities tend to be the cheapest, followed by Eastern European cities and cities in South America. There are of course exceptions. A handful of Asian cities are as expensive as their Western counterparts. The cost of living for ordinary residents in Tokyo, for instance, was more or less similar to that in London and Los Angeles while cost in Singapore was comparable to that in Lisbon and Pittsburgh. Nevertheless, the general pattern is still one of which cities in the West have a higher cost of living for ordinary residents than cities in the rest of the world, notably in Asia.

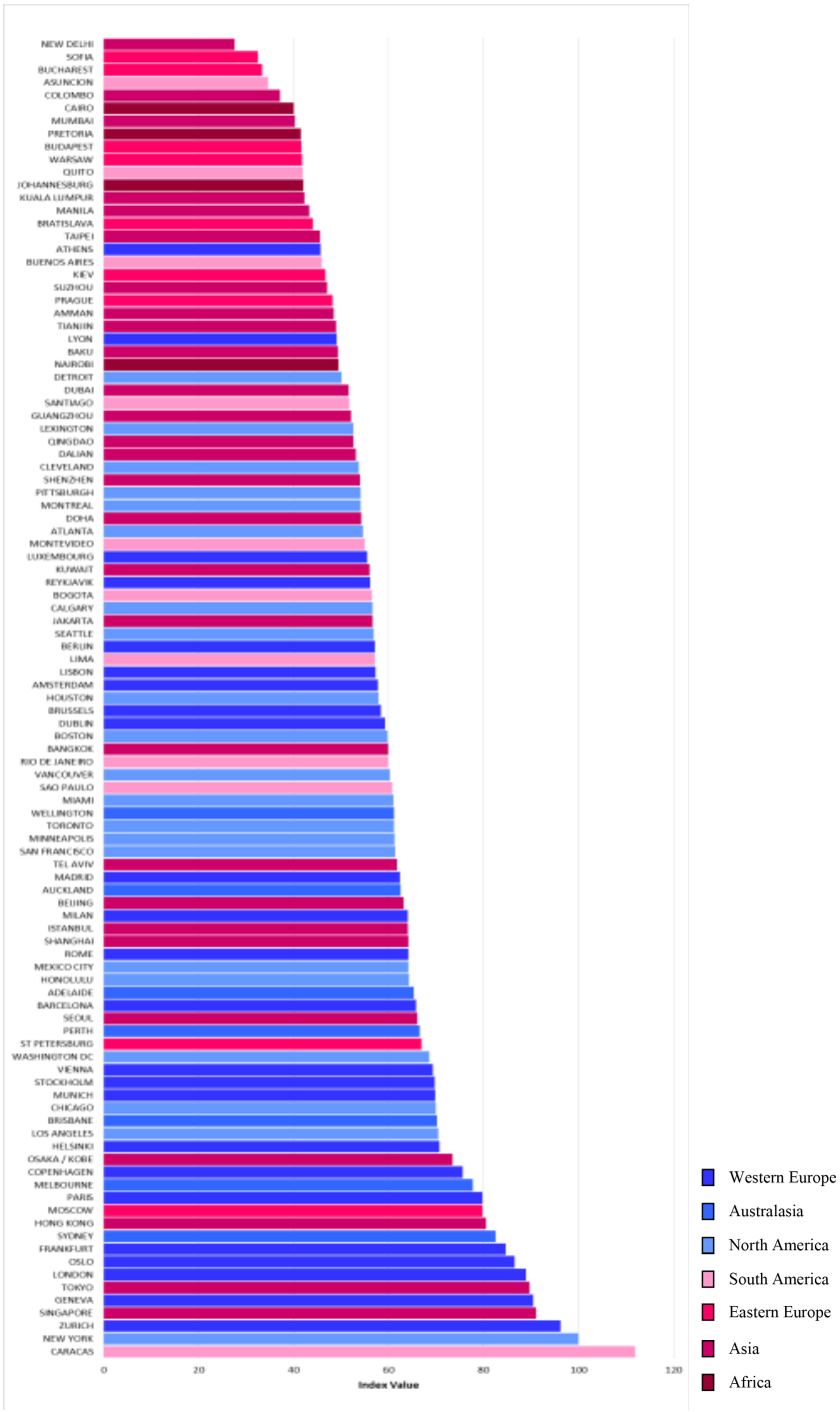
This is not so much of the cultural connotations of the Western lifestyles vis-à-vis the Eastern ones. It has more to do with the West being relatively more developed in terms of economic growth and development, while the East comprises more developing economies which neither have attained the take-off stage nor reached the economic maturity of developed countries. In turn, the cost structure of tradable and non-tradable becomes more relevant. There are exceptions such as Tokyo and Singapore, which are Asian cities with economic maturation on par with their Western counterparts.

The explanation for the observed pattern lies in the difference in the cost structure of non-traded goods and services (especially in the case of services) between the Western countries and other less developed countries. Locally provided non-tradable services such as haircuts constitute an integral part of the ordinary residents' consumption basket and therefore they are important determinants of the cost of living of ordinary residents in a country. By their very nature, the service industries are labour intensive and the average wages in Western Europe, Australasia and North America are generally significantly higher than that in Africa, Asia, Eastern Europe and South America. For example, the mean of the average gross hourly wages in all Western European cities in our study in 2013 was US$27.16 while that in the Asian cities was only US$6.48. As a result, the prices of services in the West are more expensive than comparable services in Asia and elsewhere.

It is of little surprise that our cost of living index for ordinary residents is able to capture the differences in prices of non-traded goods and services across countries. Such differences are reflected through purchasing power parity (PPP)-based exchange rates. Our cost of living index for ordinary residents incorporates data from the World Bank's ICP, which is designed to yield survey data from around the world in order to calculate PPP-based exchange rates.

In contrast to the clear pattern observed for ordinary residents, there is no discernible variation in the cost of living for expatriates regardless of the geographic distribution of the cities. This is perhaps because expatriates everywhere are geared towards high-end imports to maintain Western lifestyles. As such, their costs of living are mainly affected by exchange rate fluctuations rather than local factors. The lack of varying patterns in cost of living for expatriates is evident in Figure 2, which graphs the cost of living indices for expatriates in all cities in our study in 2013. Similar to Figure 1, the vertical axis plots the cities while the horizontal axis plots the index values. The different colours represent the geographical region which each city belongs.

Figure 2 Cost of living indices for expatriates in 103 world's major cities in 2013 by geographical regions (see online version for colours)



Source: Tan et al. (2015)

6 Conclusions

The pace of urbanisation has risen rapidly across the globe in recent years. Considering that the overwhelming majority of economic activity now takes place in cities, the speed and scale of urbanisation has critical implications for living costs across the world. International benchmarks for major cities become crucial in this context. Given this background, this paper has examined costs of living in the world's major cities for both expatriates and ordinary residents accounting for exchange rate effects. This paper, based on earlier pioneering work by Tan et al. (2015) and Tan and Luu (2016), makes an effort to contribute to the academic literature by providing a more nuanced understanding of cities than existing popular indices do. It reveals that cost of living indices should take into account the fact that the residents of a city would invariably comprise the locals and expatriates, with their differing lifestyles and spending patterns. These differences would inevitably result in diverging costs of living for locals and expatriate denizens. With this divergence in mind, it becomes imperative for cost of living studies to make a clear distinction between the cost of living for locals and expatriates across cities worldwide. This paper along with preceding work by Tan et al. (2015) and Tan and Luu (2016) addresses this gap.

Further, it is important to account for the effects that exchange rates have on cost of living rankings while computing cost of living indices, as conversion of local prices into a common currency is imperative for any ranking of cities in different parts of the world. Considering that such computations are affected by exchange rate levels across different cities, this paper empirically analyses the cases of Singapore and Hong Kong to understand the impact of exchange rates on their cost of living rankings. Our study through simulation analysis is able to assess the impact of exchange rate fluctuations on the rankings. In Singapore's case, the appreciation of the Singapore dollar has led to its rise in the cost of living rankings for both expatriates and ordinary residents. Whereas in the case of Hong Kong, the impact of exchange rate fluctuations for both expatriates and ordinary residents is minimal owing to the Hong Kong dollar's peg to the US dollar. This is borne out by the fact that Hong Kong's simulated rankings for both expatriates and ordinary residents' costs of living are almost always identical to its original rankings for the period covered in this study. However, this paper also reveals that simulation analysis does not cover every facet of the exchange rate analysis approach. It asserts that exchange rate fluctuations in other cities (based in other countries) could also influence the cost of living rankings of the concerned city. The rising cost of living ranking for expatriates in Singapore between the period 2011–2013 is cited as an example of the considerable impact wrought by exchange rate fluctuations in other cities elsewhere; the depreciation of the British pound, Norwegian krone and the Japanese yen against the US dollar played a major role in leading to the rise in Singapore's cost of living ranking for expatriates for the 2011–2013 period (a period of relative stability for the Singapore-US dollar exchange rate).

In addition, our study reveals that cities in the developed Western countries are more expensive for ordinary residents than cities in less developed countries elsewhere, especially in Asia. We attribute this to structural differences in labour cost between these two sets of countries. Non-tradable services (e.g., haircuts) are currently an integral part of the ordinary residents' consumption basket. The service industries tend to be relatively more labour intensive and the average wages in the more developed West are generally

significantly higher than wage levels in the rest of the world. Consequently, services in the West are more expensive and this invariably leads to higher living costs for ordinary residents in the West.

The strength of the cost of living index for ordinary residents presented in this paper lies in its ability to effectively capture the variations in prices of non-traded goods and services across countries. These differences are reflected through PPP exchange rates. Conversely, the index for expatriates did not discern similar variations in the cost of living for expatriates regardless of the cities' location. This could be attributed to the high-end import dependent Western lifestyles of expatriates everywhere, which largely subjects their costs of living to exchange rate fluctuations rather than local factors.

As for future research agenda, a number of caveats or assumptions made may be re-examined to incorporate rethinking and fine-tuning. One area may be to incorporate some analysis on the net effect of the substitution effect and income effect of price changes, which in our case is indirectly due to the strong Singapore dollar rather than any direct change in prices by the sellers or any goods and services tax. Thus the changes in the composition of consumer baskets over time as longitudinal studies may be interesting, as reflected in the composition of retained imports for consumption by expatriates and ordinary citizens. Cost of living studies ought to pay greater attention to the concerns and lifestyles of ordinary citizens, as they being considerably less mobile than expatriates in their choice of country of residence, are the ultimate stakeholders in any economy. Finally, future research studies could also focus on taking in to account the possible role of exchange rate fluctuations as one of the determinants of designing compensation packages for expatriates.

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Notes

1 The Worldwide Cost of Living survey by the EIU is meant to assist human resource managers and expatriates in drawing comparisons in the cost of living across 140 cities in 93 countries. This would enable them to determine equitable compensation policies when relocating employees. See Economist Intelligence Unit (2015, p.7).

2 This is computed based on the yearly average exchange rates of the Singapore dollar against the US dollar. The yearly average exchange rate is calculated based on the daily average exchange rate retrieved from Bloomberg.

3 For example, according to the EIU's 2015 Worldwide Cost of Living survey, Singapore was ranked first while Hong Kong was ranked ninth out of 140 cities in terms of cost of living for expatriates (Economist Intelligence Unit, 2015). Meanwhile, the 2015 Mercer Cost of Living survey, which also tracks cost of living for expatriates, ranked Singapore fourth and Hong Kong second out of 207 cities (see http://www.mercer.com/newsroom/costof-living-survey.html).

4 It is also notable that in a recent commentary by McDonald (2017) of the British Broadcasting Corporation (BBC), this research was cited as a critique to the existing cost of living indices produced by the likes of Economist Intelligence Unit. For more see, McDonald, T. (2017) *Is Singapore Really the World's Most Expensive City?*, 07 April, BBC [online] http://www.bbc.com/capital/story/20170407-is-singapore-really-theworlds-most-expensive-city (accessed 29 April 2017).

5 Also see Saakho (1999) who considers the role played by senior expatriate managers in global expansion strategies.

6 Table 3 (Annex) lists the 103 cities used originally in Tan et al. (2015).

7 See Tan et al. (2015) for a detailed discussion.

8 The yearly average exchange rates are calculated based on the daily average exchange rates obtained from Bloomberg. See Table 4 (Annex) for list of all yearly average exchange rates used in this study.

Annex

Table 3 List of cities

No.	*City*	*Country*	*Region*
1	Adelaide	Australia	Australasia
2	Amman	Jordan	Asia
3	Amsterdam	Netherlands	Western Europe
4	Asuncion	Paraguay	South America
5	Athens	Greece	Western Europe
6	Atlanta	USA	North America
7	Auckland	New Zealand	Australasia
8	Baku	Azerbaijan	Asia
9	Bangkok	Thailand	Asia
10	Barcelona	Spain	Western Europe
11	Beijing	China	Asia
12	Berlin	Germany	Western Europe
13	Bogota	Colombia	South America
14	Boston	USA	North America
15	Bratislava	Slovakia	Eastern Europe
16	Brisbane	Australia	Australasia
17	Brussels	Belgium	Western Europe
18	Bucharest	Romania	Eastern Europe
19	Budapest	Hungary	Eastern Europe
20	Buenos Aires	Argentina	South America
21	Cairo	Egypt	Africa
22	Calgary	Canada	North America
23	Caracas	Venezuela	South America
24	Chicago	USA	North America

Source: Tan et al. (2015)

Table 3 List of cities (continued)

No.	*City*	*Country*	*Region*
25	Cleveland	USA	North America
26	Colombo	Sri Lanka	Asia
27	Copenhagen	Denmark	Western Europe
28	Dalian	China	Asia
29	Detroit	USA	North America
30	Doha	Qatar	Asia
31	Dubai	United Arab Emirates	Asia
32	Dublin	Ireland	Western Europe
33	Frankfurt	Germany	Western Europe
34	Geneva	Switzerland	Western Europe
35	Guangzhou	China	Asia
36	Helsinki	Finland	Western Europe
37	Hong Kong	Hong Kong, China	Asia
38	Honolulu	USA	North America
39	Houston	USA	North America
40	Istanbul	Turkey	Asia
41	Jakarta	Indonesia	Asia
42	Johannesburg	South Africa	Africa
43	Kiev	Ukraine	Eastern Europe
44	Kuala Lumpur	Malaysia	Asia
45	Kuwait	Kuwait	Asia
46	Lexington	USA	North America
47	Lima	Peru	South America
48	Lisbon	Portugal	Western Europe
49	London	Great Britain	Western Europe
50	Los Angeles	USA	North America
51	Luxembourg	Luxembourg	Western Europe
52	Lyon	France	Western Europe
53	Madrid	Spain	Western Europe
54	Manila	Philippines	Asia
55	Melbourne	Australia	Australasia
56	Mexico City	Mexico	North America
57	Miami	USA	North America
58	Milan	Italy	Western Europe
59	Minneapolis	USA	North America
60	Montevideo	Uruguay	South America
61	Montreal	Canada	North America
62	Moscow	Russia	Eastern Europe
63	Mumbai	India	Asia
64	Munich	Germany	Western Europe

Source: Tan et al. (2015)

Table 3 List of cities (continued)

No.	*City*	*Country*	*Region*
65	Nairobi	Kenya	Africa
66	New Delhi	India	Asia
67	New York	USA	North America
68	Osaka/Kobe	Japan	Asia
69	Oslo	Norway	Western Europe
70	Paris	France	Western Europe
71	Perth	Australia	Australasia
72	Pittsburgh	USA	North America
73	Prague	Czech Republic	Eastern Europe
74	Pretoria	South Africa	Africa
75	Qingdao	China	Asia
76	Quito	Ecuador	South America
77	Reykjavik	Iceland	Western Europe
78	Rio de Janeiro	Brazil	South America
79	Rome	Italy	Western Europe
80	San Francisco	USA	North America
81	Santiago	Chile	South America
82	Sao Paulo	Brazil	South America
83	Seattle	USA	North America
84	Seoul	South Korea	Asia
85	Shanghai	China	Asia
86	Shenzhen	China	Asia
87	Singapore	Singapore	Asia
88	Sofia	Bulgaria	Eastern Europe
89	St Petersburg	Russia	Eastern Europe
90	Stockholm	Sweden	Western Europe
91	Suzhou	China	Asia
92	Sydney	Australia	Australasia
93	Taipei	Taiwan, China	Asia
94	Tel Aviv	Israel	Asia
95	Tianjin	China	Asia
96	Tokyo	Japan	Asia
97	Toronto	Canada	North America
98	Vancouver	Canada	North America
99	Vienna	Austria	Western Europe
100	Warsaw	Poland	Eastern Europe
101	Washington DC	USA	North America
102	Wellington	New Zealand	Australasia
103	Zurich	Switzerland	Western Europe

Source: Tan et al. (2015)

Table 4 Yearly average exchange rates in 103 world's major cities (local currency units per US dollar), 2005–2013

No.	*City*	*Country*	*Currency*	*Currency code*	*Year*								
					2005	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*
1	Adelaide	Australia	Dollar	AUD	1.3122	1.3277	1.1947	1.1972	1.2791	1.0891	0.9690	0.9659	0.9679
2	Amman	Jordan	Dinar	JOD	0.7089	0.7087	0.7084	0.7082	0.7081	0.7085	0.7088	0.7085	0.7082
3	Amsterdam	Netherlands	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
4	Asuncion	Paraguay	Guarani	PYG	6,174.1039	5,632.5646	5,029.1432	4,351.5055	4,969.7309	4,747.4964	4,195.1567	4,418.3704	4,310.1687
5	Athens	Greece	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
6	Atlanta	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	Auckland	New Zealand	Dollar	NZD	1.4204	1.5421	1.3605	1.4255	1.5965	1.3870	1.2653	1.2352	1.2188
8	Baku	Azerbaijan	Manat	AZN	0.9458	0.8966	0.8604	0.8234	0.8051	0.8031	0.7900	0.7852	0.7840
9	Bangkok	Thailand	Baht	THB	40.2728	37.9205	32.3059	33.0042	34.3213	31.7035	30.4834	31.0686	30.7233
10	Barcelona	Spain	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
11	Beijing	China	Yuan	CNY	8.1924	7.9731	7.6079	6.9502	6.8315	6.7680	6.4634	6.3093	6.1485
12	Berlin	Germany	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
13	Bogota	Colombia	Peso	COP	2,321.5521	2,360.5401	2,076.0322	1,967.6820	2,153.1986	1,897.5554	1,848.1236	1,797.2341	1,868.9212
14	Boston	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
15	Bratislava	Slovakia	Euro	SKK/EUR	31.0651	29.6483	24.6791	21.3545	0.7189	0.7553	0.7189	0.7781	0.7528
16	Brisbane	Australia	Dollar	AUD	1.3122	1.3277	1.1947	1.1972	1.2791	1.0891	0.9690	0.9659	0.9679
17	Brussels	Belgium	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
18	Bucharest	Romania	Leu	RON	2.9135	2.8083	2.4355	2.5200	3.0459	3.1829	3.0480	3.4692	3.3269
19	Budapest	Hungary	Forint	HUF	199.6883	210.3270	183.5897	172.2992	201.8224	208.0735	201.1137	225.0008	223.5381
20	Buenos Aires	Argentina	Peso	ARS	2.9229	3.0745	3.1153	3.1625	3.7279	3.9118	4.1281	4.5503	5.4797
21	Cairo	Egypt	Pound	EGP	5.7948	5.7426	5.6453	5.4378	5.5525	5.6423	5.9442	6.0707	6.8730
22	Calgary	Canada	Dollar	CAD	1.2113	1.1341	1.0740	1.0670	1.1405	1.0301	0.9891	0.9996	1.0299
23	Caracas	Venezuela	Bolivar	VEB/VEF	2,108.7918	2,147.2888	2,147.3000	2.1473	2.1473	4.2542	4.2955	4.2955	6.0635
24	Chicago	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
25	Cleveland	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
26	Colombo	Sri Lanka	Rupee	LKR	100.5102	103.9748	110.6490	108.3351	114.9658	113.0177	110.5756	127.7046	129.1382

Source: Tan et al. (2015)

Table 4 Yearly average exchange rates in 103 world's major cities (local currency units per US dollar), 2005–2013 (continued)

No.	*City*	*Country*	*Currency*	*Currency code*	*Year*								
					2005	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*
27	Copenhagen	Denmark	Krone	DKK	5.9982	5.9414	5.4426	5.0940	5.3528	5.6268	5.3561	5.7921	5.6164
28	Dalian	China	Yuan	CNY	8.1924	7.9731	7.6079	6.9502	6.8315	6.7680	6.4634	6.3093	6.1485
29	Detroit	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
30	Doha	Qatar	Riyal	QAR	3.6399	3.6406	3.6395	3.6403	3.6404	3.6405	3.6415	3.6412	3.6409
31	Dubai	United Arab Emirates	Arab Emirate Dirham	AED	3.6733	3.6735	3.6725	3.6728	3.6725	3.6724	3.6726	3.6726	3.6730
32	Dublin	Ireland	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
33	Frankfurt	Germany	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
34	Geneva	Switzerland	Franc	CHF	1.2463	1.2529	1.2000	1.0824	1.0849	1.0424	0.8866	0.9377	0.9267
35	Guangzhou	China	Yuan	CNY	8.1924	7.9731	7.6079	6.9502	6.8315	6.7680	6.4634	6.3093	6.1485
36	Helsinki	Finland	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
37	Hong Kong	Hong Kong, China	Dollar	HKD	7.7775	7.7684	7.8020	7.7863	7.7517	7.7689	7.7844	7.7570	7.7566
38	Honolulu	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
39	Houston	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
40	Istanbul	Turkey	Lira	TRY	1.3474	1.4380	1.3063	1.3053	1.5537	1.5074	1.6813	1.8002	1.9053
41	Jakarta	Indonesia	Rupiah	IDR	9,716.4020	9,170.5495	9,144.1914	9,684.7911	10,390.1787	9,084.3993	8,778.0869	9,377.1178	10,437.1308
42	Johannesburg	South Africa	Rand	ZAR	6.3664	6.7703	7.0495	8.2705	8.4068	7.3156	7.2641	8.2098	9.6460
43	Kiev	Ukraine	Hryvnia	UAH	5.0996	5.0419	5.0351	5.2556	8.0698	7.9492	7.9856	8.0821	8.1544
44	Kuala Lumpur	Malaysia	Ringgit	MYR	3.7860	3.6671	3.4367	3.3337	3.5226	3.2185	3.0597	3.0876	3.1498
45	Kuwait	Kuwait	Dinar	KWD	0.2920	0.2902	0.2843	0.2689	0.2882	0.2869	0.2763	0.2801	0.2839
46	Lexington	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
47	Lima	Peru	Nuevo sol	PEN	3.2965	3.2746	3.1286	2.9231	3.0094	2.8245	2.7535	2.6371	2.7032
48	Lisbon	Portugal	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
49	London	Great Britain	Pound	GBP	0.5502	0.5432	0.4997	0.5457	0.6405	0.6475	0.6236	0.6310	0.6389
50	Los Angeles	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
51	Luxembourg	Luxembourg	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528

Source: Tan et al. (2015)

Table 4 Yearly average exchange rates in 103 world's major cities (local currency units per US dollar), 2005–2013 (continued)

No.	*City*	*Country*	*Currency*	*Currency code*	*Year*								
					2005	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*
52	Lyon	France	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
53	Madrid	Spain	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
54	Manila	Philippines	Peso	PHP	55.0534	51.2844	46.1159	44.4386	47.5491	45.0655	43.2974	42.1874	42.4621
55	Melbourne	Australia	Dollar	AUD	1.3122	1.3277	1.1947	1.1972	1.2791	1.0891	0.9690	0.9659	0.9679
56	Mexico City	Mexico	Nuevo peso	MXN	10.8915	10.9068	10.9280	11.1625	13.5003	12.6303	12.4431	13.1560	12.7619
57	Miami	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
58	Milan	Italy	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
59	Minneapolis	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
60	Montevideo	Uruguay	Peso	UYU	24.4868	24.0979	23.4472	20.8553	22.5195	20.0171	19.2783	20.2550	20.4343
61	Montreal	Canada	Dollar	CAD	1.2113	1.1341	1.0740	1.0670	1.1405	1.0301	0.9891	0.9996	1.0299
62	Moscow	Russia	Rouble	RUB	28.3012	27.1762	25.5725	24.8779	31.7402	30.3740	29.4031	31.0608	31.8588
63	Mumbai	India	Rupee	INR	44.1129	45.3237	41.3495	43.4680	48.3415	45.7245	46.6633	53.5106	58.5864
64	Munich	Germany	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
65	Nairobi	Kenya	Shilling	KES	75.6261	72.2219	67.3399	69.2563	77.2830	79.2875	88.8696	84.4000	86.0950
66	New Delhi	India	Rupee	INR	44.1129	45.3237	41.3495	43.4680	48.3415	45.7245	46.6633	53.5106	58.5864
67	New York	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
68	Osaka/Kobe	Japan	Yen	JPY	110.1786	116.3429	117.7851	103.3671	93.6009	87.7330	79.7010	79.8371	97.5882
69	Oslo	Norway	Krone	NOK	6.4452	6.4106	5.8584	5.6485	6.2859	6.0457	5.6059	5.8184	5.8770
70	Paris	France	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
71	Perth	Australia	Dollar	AUD	1.3122	1.3277	1.1947	1.1972	1.2791	1.0891	0.9690	0.9659	0.9679
72	Pittsburgh	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
73	Prague	Czech Republic	Koruna	CZK	23.9635	22.5738	20.2900	17.0679	19.0324	19.0973	17.6839	19.5618	19.5557
74	Pretoria	South Africa	Rand	ZAR	6.3664	6.7703	7.0495	8.2705	8.4068	7.3156	7.2641	8.2098	9.6460
75	Qingdao	China	Yuan	CNY	8.1924	7.9731	7.6079	6.9502	6.8315	6.7680	6.4634	6.3093	6.1485
76	Quito	Ecuador	US Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
77	Reykjavik	Iceland	Krona	ISK	62.8837	69.9340	64.0555	88.0507	123.7447	122.1333	116.0774	125.1254	122.1445

Source: Tan et al. (2015)

Table 4 Yearly average exchange rates in 103 world's major cities (local currency units per US dollar), 2005–2013 (continued)

No.	*City*	*Country*	*Currency*	*Currency code*	*Year*								
					2005	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*
78	Rio de Janeiro	Brazil	Real	BRL	2.4342	2.1761	1.9466	1.8372	1.9986	1.7592	1.6743	1.9554	2.1612
79	Rome	Italy	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
80	San Francisco	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
81	Santiago	Chile	Peso	CLP	559.5110	530.5965	522.2462	523.6846	558.4423	510.0647	483.7583	486.3012	495.2821
82	Sao Paulo	Brazil	Real	BRL	2.4342	2.1761	1.9466	1.8372	1.9986	1.7592	1.6743	1.9554	2.1612
83	Seattle	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
84	Seoul	South Korea	Won	KRW	1,024.3810	954.9017	929.5920	1,101.6718	1,275.6766	1,156.5593	1,107.7575	1,126.2875	1,094.4689
85	Shanghai	China	Yuan	CNY	8.1924	7.9731	7.6079	6.9502	6.8315	6.7680	6.4634	6.3093	6.1485
86	Shenzhen	China	Yuan	CNY	8.1924	7.9731	7.6079	6.9502	6.8315	6.7680	6.4634	6.3093	6.1485
87	Singapore	Singapore	Dollar	SGD	1.6645	1.5887	1.5068	1.4147	1.4538	1.3627	1.2572	1.2494	1.2510
88	Sofia	Bulgaria	Leva	BGN	1.5755	1.5583	1.4303	1.3340	1.4055	1.4773	1.4061	1.5219	1.4729
89	St Petersburg	Russia	Rouble	RUB	28.3012	27.1762	25.5725	24.8779	31.7402	30.3740	29.4031	31.0608	31.8588
90	Stockholm	Sweden	Krona	SEK	7.4789	7.3719	6.7561	6.5968	7.6437	7.2037	6.4932	6.7723	6.5137
91	Suzhou	China	Yuan	CNY	8.1924	7.9731	7.6079	6.9502	6.8315	6.7680	6.4634	6.3093	6.1485
92	Sydney	Australia	Dollar	AUD	1.3122	1.3277	1.1947	1.1972	1.2791	1.0891	0.9690	0.9659	0.9679
93	Taipei	Taiwan, China	New dollar	TWD	32.1702	32.5251	32.8610	31.5430	33.0318	31.4916	29.4022	29.5732	29.6962
94	Tel Aviv	Israel	New shekel	ILS	4.4881	4.4565	4.1086	3.5843	3.9272	3.7326	3.5775	3.8542	3.6098
95	Tianjin	China	Yuan	CNY	8.1924	7.9731	7.6079	6.9502	6.8315	6.7680	6.4634	6.3093	6.1485
96	Tokyo	Japan	Yen	JPY	110.1786	116.3429	117.7851	103.3671	93.6009	87.7330	79.7010	79.8371	97.5882
97	Toronto	Canada	Dollar	CAD	1.2113	1.1341	1.0740	1.0670	1.1405	1.0301	0.9891	0.9996	1.0299
98	Vancouver	Canada	Dollar	CAD	1.2113	1.1341	1.0740	1.0670	1.1405	1.0301	0.9891	0.9996	1.0299
99	Vienna	Austria	Euro	EUR	0.8049	0.7965	0.7305	0.6832	0.7189	0.7553	0.7189	0.7781	0.7528
100	Warsaw	Poland	Zloty	PLN	3.2361	3.1025	2.7651	2.4095	3.1142	3.0174	2.9652	3.2545	3.1590
101	Washington DC	USA	Dollar	USD	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
102	Wellington	New Zealand	Dollar	NZD	1.4204	1.5421	1.3605	1.4255	1.5965	1.3870	1.2653	1.2352	1.2188
103	Zurich	Switzerland	Franc	CHF	1.2463	1.2529	1.2000	1.0824	1.0849	1.0424	0.8866	0.9377	0.9267

Source: Tan et al. (2015)