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in Hong Kong: 1985-2006

Prices and the Real Exchange Rate in Hong Kong: 1985-2006

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Abstract

This paper seeks to quantify to the extent to which price dynamics in Hong Kong are due to the Balassa-Samuelson hypothesis. From 1985 to 1998, the CPI in Hong Kong increased spectacularly, yet there was dramatic deflation from 1998 to 2006. This dynamics was mainly driven by the price pattern of the nontradable goods and services. We find that, the Balassa-Samuelson hypothesis seems to be a good explanation for the inflation differentials between Hong Kong and the US from 1985 to 1998. However, in the 1998-2006 period, we find that the Balassa-Samuelson hypothesis cannot explain the inflation differentials between Hong Kong and the US. On the one hand, there is a significant deviation from the PPP in the price of tradable goods between both countries. On the other hand, the internal transmission of the Balassa-Samuelson hypothesis does not hold for either country.

Keywords: Real Exchange Rate (RER), Balassa-Samuelson hypothesis, Inflation.

JEL Classification: E13, E32, F41.

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1 Introduction

This paper studies the extent to which price dynamics in Hong Kong can be explained by the Balassa-Samuelson hypothesis. During the 1985-1998 period, the CPI in Hong Kong increased spectacularly, yet there was dramatic deflation between 1998 and 2006. In particular, we show that up until 1998[1], *i)* Hong Kong experienced a higher inflation rate than in the US, *ii)* that the relative exchange rate for tradable goods and services between Hong Kong and the US (approximately) met the Law of One Price, *iii)* that the inflation gap between Hong Kong and the US can be mostly explained by the Balassa-Samuelson hypothesis. However, during the deflationary period (1998-2006), *i)* the dynamics of the exchange rate for tradables did experience a very different pattern from that observed in the US, and *ii)* the deflation gap between Hong Kong and the US cannot be explained by the Balassa-Samuelson hypothesis[2].

In recent years, there have been some attempts to understand, on the one hand, the high inflation period suffered in Hong Kong between 1985 and 1997, as well as the deflation period from 1998 to 2006, taking into account that Hong Kong is a very small open economy, with a high degree of openness (exports plus imports represented 272% of the GDP in the 1985-2006 period). On the one hand, with respect to the former issue, Imai (2002) analyzes the Real Exchange Rate behavior for the 1985-1997 period. The author considers both the Balassa-Samuelson (BS) and the Dutch disease hypotheses to account for Hong Kong's long-term rate of inflation in excess to the US, under the dollar peg during the pre-Asian financial crisis period. He finds that the Dutch Disease effect better explains the inflation gap for that period than the Balassa-Samuelson (BS) effect. The author argues that given that Hong Kong was in an export-led economic boom for an extended period until 1997, thanks largely to its close association with the rapidly industrializing southern China region, the Dutch disease appears to be the main cause of the long-term inflation. Ito et al. (1997) likewise failed to confirm the Balassa-Samuelson hypothesis in the 1973-1996 period. However, Dodsworth and Mihaljek (1997) and Chai (1998) confirmed the Balassa-Samuelson hypothesis behind Hong Kong's inflation for the period before the Asian financial crisis[3]. On the other hand,

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[1]The inflation rate started to slow down in 1997, coinciding with the Sudden Stop and the integration of the economy with China, but deflation began in 1998 and the deflation period ended in 2004.

[2]We mainly focus on the US-Hong Kong comparative as the HK currency is pegged to the US dollar and the US is, after China, the main trading partner with HK (export to the US account for approximately 23% and imports 7% of the total).

[3]Their analysis is based on a two-goods (tradables and nontradables) single-factor (labor) model with the

as far as the deflation period is concerned, most of the papers have analyzed the deflation period from different hypotheses other than the BS hypothesis. Genberg and Pauwels, 2003; Razzak, 2003; N'Diaye, 2003, among others, analyzed the deflation suffered by Hong Kong following the Asian financial crisis. Genberg and Pauwels (2003) found that wages, import prices and property rental prices were the main factors responsible for the deflation. Razzak (2003) analyzed the role of unit labor costs in explaining deflation. N'Diaye (2003) conducted a VAR analysis and found that shocks to productivity, changes in the money supply and price convergence with trading partners were the main factors responsible for the deflation. Various papers (Ha and Fan, 2002; Wong, 2002; Schellenkens, 2003) focused on the price convergence between China and Hong Kong to explain the deflation period suffered in Hong Kong, after the Asian financial crisis and the integration with China. Wong (2002) states two factors that are important in explaining the deflation period observed in Hong Kong since 1997: *(i)* a sharp downturn of the business cycle, and *(ii)* a structural change of the economy in response to the opening up of China and its gradual integration with Hong Kong. A Schellenkens study (2003), using the Hong Kong and Shenzhen consumer price index ratio as a measure of the average price gap between Hong Kong and China, suggested that the price level gap plays only a minor role in explaining the deflation period in Hong Kong. Cyclical factors, such as proxy by unemployment rate, credit growth and nominal effective exchange rate, are much more important determinants of the deflation.

This paper analyses the extent to which the Balassa-Samuelson (Balassa, 1964; Samuelson, 1964) hypothesis can explain the price dynamics in Hong Kong throughout the 1985-2006 period. The Balassa-Samuelson hypothesis states that an increase in the productivity of the tradable over nontradable sector in the domestic country, relative to the foreign country, implies an increase in its relative price of the nontradables. As the Balassa-Samuelson hypothesis assumes that the Law of One Price holds for the tradable prices, the main questions addressed in this paper are the following: *i)* Is the Law of One Price met in the tradable sector?, *ii)* Can the relative price of the nontradable over tradable sector, between Hong Kong and the US, be explained by their relative TFP differentials, according to the Balassa-Samuelson hypothesis?, *iii)* We end by checking whether the dynamics of the Real Exchange Rate between Hong Kong and the US can be explained by their relative productivity differentials. Furthermore, we likewise check whether the so-called internal transmission of the B-S effect can explain the dynamics of the relative price of nontradables, by productivity differentials across sectors, either in Hong Kong or in the US.

post-1983 period Hong Kong data.

These questions have been studied extensively for several country samples using different econometric techniques as mentioned by Pancaro (2010). Most of the empirical work supports the implications of the relationship between the relative productivity differentials and the relative price of nontradables within the country, but the purchasing power parity assumption in the tradable sector is found not to be satisfied in most of the cases analyzed. Papers that have focused on OECD countries include Asea and Mendoza (1994), De Gregorio et al. (1994), Canzoneri et al. (1999), and Rogoff (1992). The findings of those papers, using either quarterly or annual sectorial data[4], can be summarized as follows: *i)* relative domestic prices (nontradable good over tradable good prices) are mostly explained by their respective relative productivities, *ii)* the Law of One Price for tradable is not satisfied.

In order to answer the first question, and check whether the Law of One Price holds for tradables, we here follow the literature based on Engel (1999) and Betts and Kehoe (2006, 2008). Engel (1999) showed that almost all of the variance in the bilateral real exchange rates between the United States and a number of OECD countries, particularly European Union (EU) countries, is attributable to fluctuations in the real exchange rates of traded goods, and almost none is attributable to fluctuations in the relative prices of nontraded to traded goods. Betts and Kehoe (2008) extend Engel's analysis to a large set of bilateral real exchange rates (52 countries over the 1980-2000 period) and found that the measured relationship, between the bilateral real exchange rate and the relative price of nontraded goods across countries, is strong. Nevertheless, in accordance with Engel's results, Betts and Kehoe also found significant bilateral deviations from the Law of One Price for baskets of goods traded and that these deviations play a large role in real exchange rate fluctuations. Tornell and Westermann (2002) found the same for a sample of 39 middle income countries for the 1980-1999 period. Naknoi (2008) constructed a large dataset covering 35 countries and found that in many cases the relative price of nontradables accounts for about 50 percent of the RER variability. Drozd and Nosal (2009) found that the contribution of the relative price of nontradables to the overall real exchange rate movements is at best modest. Parsley (2007) analyzed six Southeast Asian countries, cross-paired with the US dollar, for the largest available data period (1980-2000) and found that relative prices of nontradables appear to account for none of the Pacific-Rim Real Exchange Rate movements. The exception is Hong Kong, where the relative price of nontradables could explain up to 50 percent of the

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[4]Asea and Mendoza (1994) and De Gregorio et al. (1999) used data for 14 OECD countries between 1970-1985. The former used quarterly data, the latter annual data. Canzoneri et al. (1999) and Drine and Raults (2005) used annual data for 12 OECD countries. The former for the 1970-1993 period, and the latter for the 1970-2002 period.

Real Exchange Rate variability. Finally, for the Mexican case, Mendoza (2000) found that variability in the relative price of nontradables accounts for a high percentage of the RER variability of Mexico with the US. However, Kehoe and Ruhl (2008), also for the Mexican case, found that deviations in the Law of One Price in tradables accounts for about 65% of the changes in the RER. Nevertheless, Burnstein, Eichenbaum and Rebelo (2005, 2006) argued that the primary force behind large drops in the RER that occurs after major devaluations, are movements in the price of nontradables relative to pure-traded goods. The main results from this literature are twofold: *(i)* both movements in tradable and nontradable prices explain RER movements, and *(ii)* results vary depending on the price indices considered. In fact, these studies point out that the data series of price indices used for the analysis matters. Different outcomes result from differences in indices.

Following Betts and Kehoe (2006, 2008), we breakdown RER changes for the Hong Kong economy into two components: (i) the Real Exchange Rate of the tradable sector, that is, the domestic relative price of tradable goods divided by the foreign (US) relative price of tradables (RER^T). This term measures deviations of the Law of One Price (LOOP) in tradable goods, that is, the equalization of tradable sector prices across countries, and (ii) the Real Exchange Rate of nontradables (RER^N), which measures the relative price of nontradable goods in Hong Kong with respect to the US. The results show that the nontradables prices in Hong Kong display high variability, and account for a high percentage of real exchange rate variability in the 1990-1998 period (64.4 percent). However, after the Asian financial crisis, between 1998 and 2006, movements in the price of tradable goods was the only factor responsible for the RER variability (this explains a 95 percent of the RER variability).

Regarding the Balassa-Samuelson hypothesis, we find that the inflation gap between Hong Kong and the US in the 1985-1998 period, is mostly explained by the BS hypothesis. However, during the deflation period (1998-2006), the Balassa-Samuelson hypothesis cannot explain the different dynamics of Hong Kong with respect to the US. The main reason seems to be that the real exchange rate dynamics of the tradable goods did experience a very different pattern from that one observed in the US, i.e., the purchasing power parity for the tradables is not satisfied in the deflation period. Regarding the internal transmission of the BS, it is satisfied for both of the two countries throughout the 1985-2006 period.

The rest of the paper is organized as follows. Section 2 explains the data used and reviews the price developments from Hong Kong. Section 3 conducts the Hong Kong-US and its main

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trading partners real exchange rate variance analysis, following Betts and Kehoe (2006). In Section 4, we analyze the Balassa-Samuelson hypothesis for the Hong Kong economy for the 1985-2006 period. Section 5 concludes.

2   Data

This section describes the data used and describes the main facts regarding: (i) the behavior of prices (general, tradable versus nontradable) in Hong Kong before and after the Asian financial crisis (inflation followed by deflation); (ii) the behavior of the real exchange rate (tradable and nontradable).

2.1   Data description

With regards to price indices for the Hong Kong economy, we use four different data sets: the Consumer Price Index (CPI) and the GDP deflator as general price indices, and the Producer Price Index (PPI) and the Price of Export of goods and services as the price for the tradable goods and services[5]. The price of exports and GDP deflator are from the Hong Kong Census and Statistics Department, and the CPI and PPI as reported by the International Monetary Fund (IMF) in its International Financial Statistics. A complete description of the data appears in Appendix A.

In order to compare Hong Kong prices with other economies, the PPI is assumed as tradable prices and the CPI as general prices. Nontradable prices are the difference between them. All data are from the IFS. China is the country with which Hong Kong has most traded . However, lack of data for CPI and PPI from IFS forces us to omit the People's Republic of China from the sample.

Great care must be taken when measuring the prices of traded goods. According to Engel and Betts and Kehoe, "*which price series are used to measure the prices of traded goods and to construct the relative price of nontraded goods significantly affects statistical measures of the relationship between the real exchange rate and the relative price of nontraded*". That is, the price index used can alter the obtained results. Therefore, as many as possible price

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[5]Results with Unit Value Indices (both Export and Import) from IFS are the same as to results with price of exports from Hong Kong Census and Statistics. The correlation between both indices for the period 1968-2006 is 0.98.

indices are assumed, taking into account data availability. According to these authors, the best price indices are the Gross Output deflators, both at sectorial and economy level.

Unfortunately, no Gross Output data for Hong Kong is available, nor of value added deflators, which Betts and Kehoe show as close proxies to gross output deflators[6]. Therefore, the next conceptually preferred, and most broadly available, measure of a traded goods price index for Hong Kong is its producer price index (PPI) for all goods. While there are inevitably some producer goods that are not traded, the PPI is measured at the production site, and hence exclude marketing and other nontraded consumer services. While using PPI data has some benefits, it also has costs, as discussed by Engel (1999)[7]. See more on the data series analysis in Betts and Kehoe (2006).

In short, we choose the CPI as the general economy price index and PPI as the tradable sector price[8]. For the case of Hong Kong, as the PPI series are available only from 1990 onwards, we also use the Price of Exports of goods and services and the UVIs (Unit Value Index of Exports) as a proxy for tradable prices. We only show the results from Price of Exports as the results are the same as with UVI (correlation between them is 0.98 for the 1968-2006 period)[9].

Data is not detrended for the analysis in this paper. The analyzed period is 1985-2006. The choice of this period is due to the availability of data. We divide the analysis of the price dynamics in Hong Kong into two sub-periods: 1985-1998 and 1998-2006. The reasons are as follows: *(i)* the fixed exchange-rate was imposed in October 1983; *(ii)* the change in

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[6]Betts and Kehoe (2006) show that the behavior of the RER and the RER for nontradables, constructed using GDP deflators, differs substantially from that of the corresponding measures constructed using gross output deflators.

[7]Burnstein, Eichenbaum, Rebelo (2005) believe that the Producer Price Index (PPI), or the Wholesale Price Index (WPI), are both poor measures of pure traded goods prices for two reasons. First, as the PPI targets prices charged by domestic producers, import prices are generally excluded. Second, the composition, coverage and availability of the PPI and WPI vary greatly across countries (see Maitland-Smith (2000)). A standard approach in the literature is to use retail prices. Unfortunately, retail prices are heavily contaminated by the cost of nontradable distribution services such as retailing, wholesaling, and transportation (see Burnstein, Neves, and Rebelo (2005)). Another problem with the PPI is that, for roughly one third of OECD countries, it also excludes export prices (Maitland-Smith (2000)).

[8]We are aware, as discussed by Engel (1999) and Betts and Kehoe (2006), that these two series, the PPI and CPI series, are drawn from different data surveys. We follow these authors and do not choose the GDP deflator as price index (Betts and Kehoe, 2006, pag. 1306).

[9]Chinn mentions that UVIs in Hong Kong can better show the real behavior of prices of tradable sector and, specifically, it has not experienced the inflation from the nontradable sector.

the behavior in the general price index occurred in 1997-1998, coinciding with time of the Asian Financial Crisis. With 1985 chosen as the base year, the time period of this study is 13 years from 1985 to 2006[10].

The nominal exchange rate data from the IFS is used to examine the bilateral RER of Hong Kong vis-a-vis its main trading partners. We specifically focus on the Hong Kong-US RER.

In order to account for the relationship between the relative prices and the relative productivities between Hong Kong and the US, we calculate labor productivities for Hong Kong and the US. Therefore, the value added of sector over employed persons is obtained. Total Factor Productivity data[11]. is also used for the case of Hong Kong. We follow Hsieh (2008) for the composition of the tradable and nontradable sectors in Hong Kong. We follow the same decomposition for the US (results may vary depending on the classification of tradable and nontradable sectors)[12]. In both economies, nontradable sector accounts for half of the output.

2.2 International differencies

There was a period of high inflation In Hong Kong prior to the Asian financial crisis (1985-98) and a period of deflation between 1998 and 2006[13]. Since Hong Kong is a small open economy with a high degree of openness, we compare the CPI evolution for Hong Kong

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[10]The frequency of the data does not significantly affect statistical measures of the relationship between the real exchange rate and the relative price of nontraded goods according to Betts and Kehoe.

[11]Following Bergoeing et al. (2002), we decompose the change in real GDP per working age-person from period t to period $t + s$ in changes in capital and labor inputs and changes in the TFP and obtain the following expression:

$$(\ln y_{t+s} - \ln y_t)/s = \frac{1}{1-\alpha}(\ln A_{t+s} - \ln A_t)/s + \frac{\alpha}{1-\alpha}\ln(k_{t+s}/y_{t+s}) - ... \tag{1}$$

$$... - \ln(k_t/y_t)/s + (\ln h_{t+s} - \ln h_t)/s$$

The first term on the right hand side is the contribution to growth of changes in TFP, A_t, the second is the contribution of changes in the capital-output ratio, k/y, and the third is the contribution of changes in hours worked per working-age person, L/N.

[12]We do not follow De Gregorio et al. (1994). These authors assume that only the sectors that export more than 10% of their production can be considered as tradable.

[13]Official deflation was from 1998 until 2004. Nevertheless, if the following two years are included, the average is still negative price growth.

and its main trading partners (US, UK, Korea and Singapore) for the 1985-2008 period in Figure 1. As can be seen, Hong Kong suffered high inflation during the 1985-1998 period, followed by abrupt and prolonged deflation until 2006, in comparison to the other countries. From 1985 to 1998, the average annual growth rate of the aggregate prices in Hong Kong (7.68%) was higher than its US counterpart (3.25%), whereas, during the deflation period, the average annual growth rate of the aggregate prices in Hong Kong (-1.58%) was much lower than the US counterpart (2.68%). Other countries in the region, such as Japan or Korea, also suffered deflation, but it was not as deep.
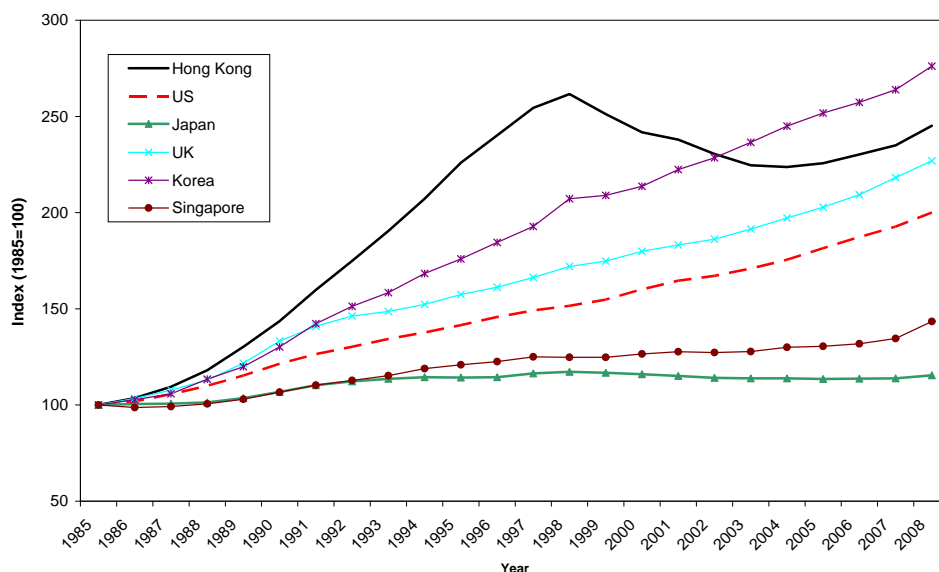

Figure 1: Evolution of CPI

The period with the highest inflation, 1985-1998, was subsequent the massive exodus of manufacturing firms to China. In this sense, according to Imai (2002) or Wong (2002), structural transformation is the reason for inflation. From 1998 to 2006, Hong Kong experienced deflation. According to the Hong Kong Monetary Authority, half of the decline of the CPI after the Asian crisis was the drop in housing prices after the Asian crisis, from an accounting perspective.

2.3   Price Index Variance Analysis: a disaggregation

In order to quantify the extent to which the dynamics of the price of the nontradable goods and services are responsible for the inflation experienced in Hong Kong between 1985 and

1998, and the subsequent deflation, we calculate its variance decomposition[14]. We therefore decompose the aggregate price index for Hong Kong into the tradable and nontradable sectors:

$$P_t = \left(P_t^T\right)^\gamma \left(P_t^{NT}\right)^{1-\gamma} \tag{2}$$

where we assume that a country's price index P is a geometrically weighted average of the price indexes of tradable and nontradable goods and services. The weights are given by the share of the tradable goods and nontradables in the total added value of the economy. The variable γ is the share of tradables in the GDP deflator. We estimate the weight of tradables to be 0.5[15]. Taking natural logarithms of the above expression, we obtain the variance decomposition following Betts and Kehoe (2006):

$$p_{HK,,t} = \gamma p_{HK,,t}^T + (1-\gamma)p_{HK,,t}^N$$

where $p_{HK,,t}$ is the price index in logarithms in period t.

And,

$$vardec(p_{HK,}, p_{HK,}^N) = \frac{\widehat{var}(p_{HK,}^N)}{\widehat{var}(p_{HK,}^N) + \widehat{var}(p_{HK,}^T)}.$$

where the sample variance of p_{HK} is

$$var(p_{HK}^x) = \frac{1}{T}\sum_{t=1}^{T}(p_{HK,t}^x - \overline{p}_{HK}^x)^2$$

and,

$$\widehat{var}(p_{HK}^x) = var(p_{HK}^x) + \left[\frac{var(p_{HK}^x)}{var(p_{HK}^T) + var(p_{HK}^N)}\right] * 2 * cov(p_{HK}^T, p_{HK}^N)$$

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[14] Appendix B shows the dynamics of the price of tradable and nontradable goods assuming different price indices for the 1985-2006 period.

[15] We obtain the weight following Kehoe and Ruhl (2008). The Nontradable deflator weight is the geometric difference of the GDP deflator and the Tradable sector's deflator. The direct weight of nontradables in the typical CPI basket is approximately 50 percent. However, Burnstein, Eichenbaum and Rebelo (2005) argue that, if distribution services are included, the total weight of nontradables increases to 75 percent.

The covariance between the two components, p_{HK}^N and p_{HK}^T, is allocated in proportion to the relative size of its corresponding variance, as in Betts and Kehoe (2006).

As we can see in Table 1, the inflation and deflation periods are mostly explained by the pattern of the price of nontradable goods and services.

Table 1: Prices of tradable and nontradable sectors

	Price of Tradables	Price of Non-tradables
$1985 - 1990$	31.5% (23%)	68.5% (77%)
$1990 - 1998$	4.1% (7%)	95.8% (93%)
$1985 - 1998$	9.35% (12.4%)	90.6% (87.5%)
$1998 - 2006$	24.4% (5.2%)	75.6% (94.7%)

Note: Prices of Tradables are Price of Exports. General prices are the CPI (GDP deflator in brackets)

If we perform the same variance decomposition for the main trading partners of Hong Kong, we find that from 1985-1997, the price of nontradables explained the evolution of prices. However, unlike Hong Kong, the prices of tradables in the 1998-2006 period explain the behavior of general prices in the US, Japan and Singapore. The prices of nontradables continue to explain the behavior of prices in Korea and the UK (Appendix C contains the results).

2.4   Tradable prices: Hong Kong versus the US

This section compares the dynamics of Hong Kong tradable prices with respect to its main trading partner (USA) using the PPI as a measure for the price of the tradable goods and the difference between the CPI and the PPI for the price of the nontradable goods (for the Hong Kong economy we use the price of exports). We analyze the 1985-2006 period.

Since October 1983, Hong Kong has adopted a fixed exchange rate in which the money supply is fully backed up by the US dollar held at the Exchange Fund of the Currency Board, and the Hong Kong dollar is effectively fixed at the rate of US$1 to HK$7.75-7.80. As the nominal exchange rate between the US and Hong Kong is fixed, one can only guess if the Law of One Price holds for tradable prices by looking at the evolution of tradable prices in

Hong Kong and the US. Figure 2 shows the similar pattern of PPI in the US and Hong Kong for 1990-1999 (there is no available PPI data from Hong Kong for 1985-1990)[16].

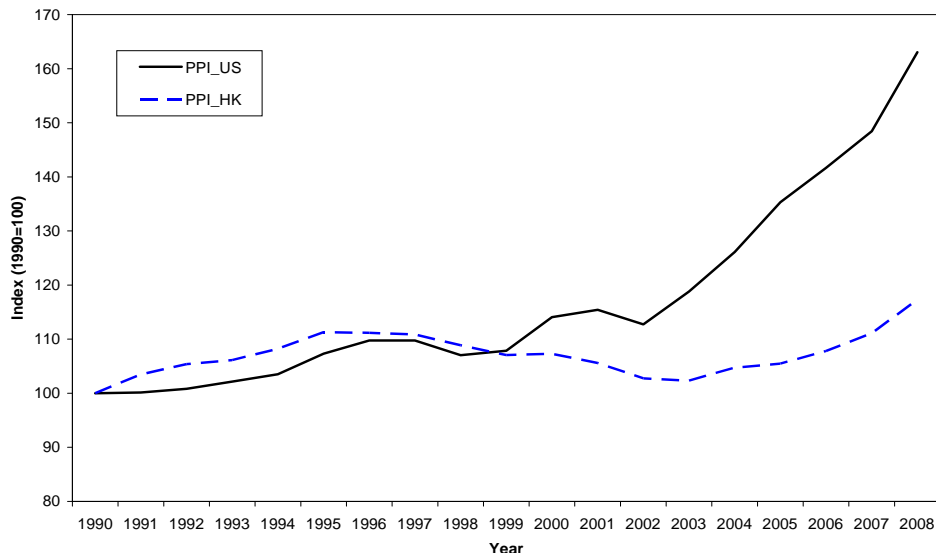Figure 2: Hong Kong and US Price of Tradables (PPI)

3   RER Variance Analysis: a disaggregation

The previous section analyzed the Hong Kong prices and compared them to the prices in the US. This section presents the results of a variance analysis, that closely follows the methodology applied by Engel and Betts and Kehoe (2006) to analyze the sources of the RER movements. We want to check whether the Purchasing Power Parity (PPP) holds for the tradable prices. The accounting exercise is based on the disaggregation of the aggregate price indexes into traded (T), and nontraded (N) prices.

We calculate the RER of Hong Kong with its main trading partners: US, Japan, Korea, Singapore, UK (we exclude China due to lack of data availability). We define the bilateral RER of Hong Kong as:

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[16]If we take the Price of exports, the price parity seems smaller, even though we obtain a high correlation between PPI and Price of Exports in Hong Kong, and according to the variance decomposition (see Section 3) the Law of One Price seems to hold during the 1985-1998period. Appendix C contains the graphs for the evolution of Price of Exports and the PPI for HK and US for the 1990-2006 period.

$$RER_{HK,i,t} = NER_{HK,i,t} \frac{P_{i,t}}{P_{HK,t}}$$

where NER is the exchange rate between the Hong Kong dollar and the currency from country i and P_i is the price index in country i. Figure 3 shows the RER of Hong Kong with its main trading partners.
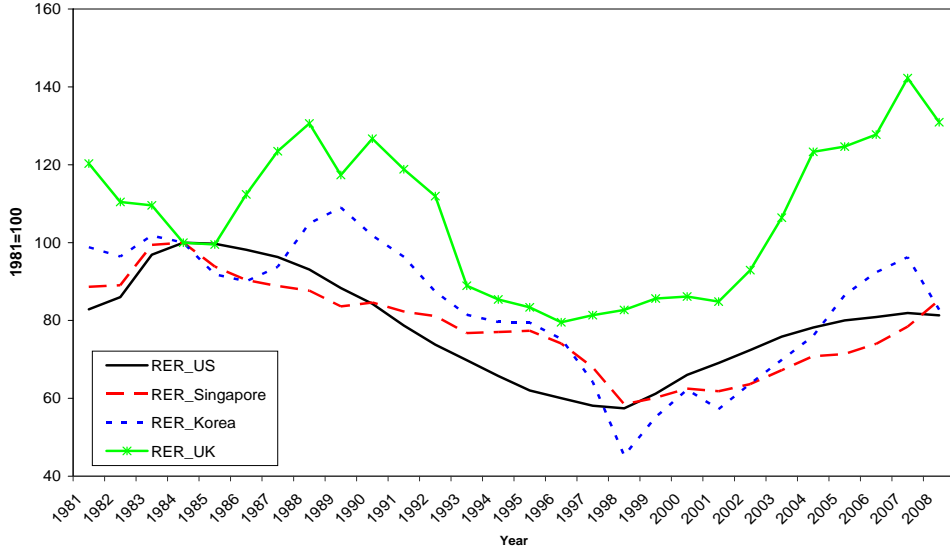

Figure 3: Hong Kong Real Exchange Rate with its main trading partners

The bilateral real exchange rate between Hong Kong and country i at date t will be separated into the real exchange rate of tradable and nontradable sectors (we assume that P_t is computed as the geometric average of the price of tradable goods and the price of nontradable goods in both countries):

$$
\begin{aligned}
RER_{HK,i,t} &= \left(NER_{HK,i,t} \frac{P_{i,t}^T}{P_{HK;t}^T} \right) \left(\frac{P_{HK,t}^T / P_{HK,t}}{P_{i,t}^T / P_{i,t}} \right) \\
&= RER_{HK,i,t}^T \text{ x } RER_{HK,i,t}^N
\end{aligned}
$$

where the domestic price of traded goods, P_t^T, is the Producer Price Index (PPI), a proxy of prices for the tradable sector, and P_t is the Consumer Price Index (CPI)[17]. For Hong Kong,

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[17]We follow Betts and Kehoe (2008) and data is neither detrended nor de-seasonalized.

we use the Price of Exports as proxy for price of tradables. Therefore, in this decomposition, the real exchange rate is divided into two components: the relative price of nontradable goods between the two countries (RER^N), and, into the Law of One Price (RER^T) in the tradable sector or, analogously, deviations of the relative price of Hong Kong's tradable output[18].

Finally, taking logs, we have that

$$rer_{HK,i,t} = rer^T_{HK,i,t} + rer^N_{HK,i,t}$$

To assess the relation between the bilateral Hong Kong - US Real Exchange Rate and the relative price of tradables, we perform a Variance decomposition exercise following Betts and Kehoe (2006), where

$$vardec(rer_{HK,i}, rer^N_{HK,i}) = \frac{\widehat{var}(rer^N_{HK,i})}{\widehat{var}(rer^N_{HK,i}) + \widehat{var}(rer^T_{HK,i})}.$$

where the sample variance of the RER is

$$var(rer^x_{HK,i}) = \frac{1}{T}\sum_{t=1}^{T}(rer^x_{HK,i,t} - \overline{rer^x_{HK,i}})^2$$

and,

$$\widehat{var}(rer^x_{HK,i}) = var(rer^x_{HK,i}) + \left[\frac{var(rer^x_{HK,i})}{var(rer^T_{HK,i}) + var(rer^N_{HK,i})}\right] * 2 * cov(rer^T_{HK,i}, rer^N_{HK,i})$$

The covariance between the two components, $rer^N_{HK,i}$ and $rer^T_{HK,i}$, is allocated in proportion to the relative size of its corresponding variance, as in Betts and Kehoe (2006).

Results are shown in Table 2. Figure 4 shows the bilateral RER of Hong Kong and US. The results with respect to the US show that the deviation from the Law of One Price of the traded goods has become more relevant in the last years. It also seems that deviations from the Law of One Price are mainly responsible for the long-term depreciation in Hong Kong

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[18]This equation shows that if all goods were tradable (and homogeneous across countries) and baskets of goods were identical between countries, and if there was no market frictions and no trade barriers, the strict version of PPP would hold and RER would be 1.

after 1998. If the relative price of nontraded to traded goods had played a major role after 1998, then, as it is shown in the graph, the RER would again have appreciated. We find that the Nontradable RER can explain 64.4% of the RER appreciation during the 1985-1998 period, and 4.86% of the depreciation from 1998 to 2006 (these results, even though they are consistent with the findings by Parsley, are a little different quantitatively speaking). For 1985-2006 period overall, the contribution of the component of the nontradable real exchange rate on the Real Exchange Rate is 56.24%. With respect to the RER with United Kingdom, we find similar behavior: deviation of the relative price of nontraded to traded goods played a main role during the Nineties and deviation of the Law of One Price of the real exchange rate of tradables after the Asian financial crisis. Regarding the results with respect to the other main trading partners (Korea, Singapore and Japan), the deviation of the real exchange rate of nontradables during the Nineties was of lower magnitude, and the deviations from the Law of One Price in tradable goods after 1998 was of higher magnitude, than with respect to the US or UK[19].

We also analyze the volatility and correlation of the RER, and Nontradable RER. Results again depend on the chosen trading partner. Nevertheless, there are some common patterns among them confirming the loss in the relevance of the nontradable RER in determining the RER, and gaining relevance of the deviation of the Law of One Price of the traded goods from 1990-1998 to 1998-2006. In particular we find: *(i)* a lower variability of the Nontradable RER relative to the volatility of RER of Hong Kong with any of its partners during the 1998-2006 period, with respect to the previous 1990-1998 period, except with Singapore, *(ii)* a high and positive correlation between Nontradable RER and RER of Hong Kong with any of its partners during the 1990-1998 period. But there are also some differences, in particular concerning the correlation between the Nontradable RER and the RER during the 1998-2006 period, it range from -0.67, with respect to Singapore to 0.90 with respect to Korea. Regarding the whole period (1985-2006), we find that nontradable RER, from Hong Kong with respect to the US, displays higher variability relative to RER volatility (0.83 compared to an average of 0.46 for countries analyzed by Betts and Kehoe) and a correlation with RER of 0.69, which is very similar to the average found by Betts and Kehoe[20].

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[19]If, instead of using the Price of Exports, the decomposition is performed with the PPI from HK, the role of the Nontradables RER increases in both periods (Hong Kong-US 98% for 1990-98 and 12.5% for 1998-2006).

[20]By subperiods, relative volatility (and correlation) of Nontradable to RER decreases from 0.76 (0.98) for the 1990-98 period to 0.20 (-0.01) for the 1998-2006 period.

Table 2: Hong Kong Real Exchange Rate. 1985-2006

US	1985-2006	1985-1998	1998-2006
vardec(rer,rer_N)	56.24%	64.4%	4.86%
corr(rer, rer_N)	0.69	0.97	-0.01
std(rer_N)/std(rer)	0.83	0.65	0.23
UK	1985-2006	1985-1998	1998-2006
vardec(rer,rer_N)	57.91%	82.3%	16.76%
corr(rer, rer_N)	0.73	0.95	0.92
std(rer_N)/std(rer)	0.83	0.85	0.32
Korea	1985-2006	1985-1998	1998-2006
vardec(rer,rer_N)	30.45%	30.61%	10.20%
corr(rer, rer_N)	0.92	0.96	0.90
std(rer_N)/std(rer)	0.43	0.42	0.26
Singapore	1985-2006	1985-1998	1998-2006
vardec(rer,rer_N)	52.36%	26.69%	15.94%
corr(rer, rer_N)	0.71	0.90	-0.88
std(rer_N)/std(rer)	0.85	0.47	0.73
Japan	1985-2006	1985-1998	1998-2006
vardec(rer,rer_N)	59.51%	47.26%	8.32%
corr(rer, rer_N)	0.90	0.90	0.78
std(rer_N)/std(rer)	0.67	0.59	0.25

Note: Tradable prices are PPI for all economies except HK (Price of exports). Aggregate prices are CPI. Correlations and standard deviations are calculated in logarithms.
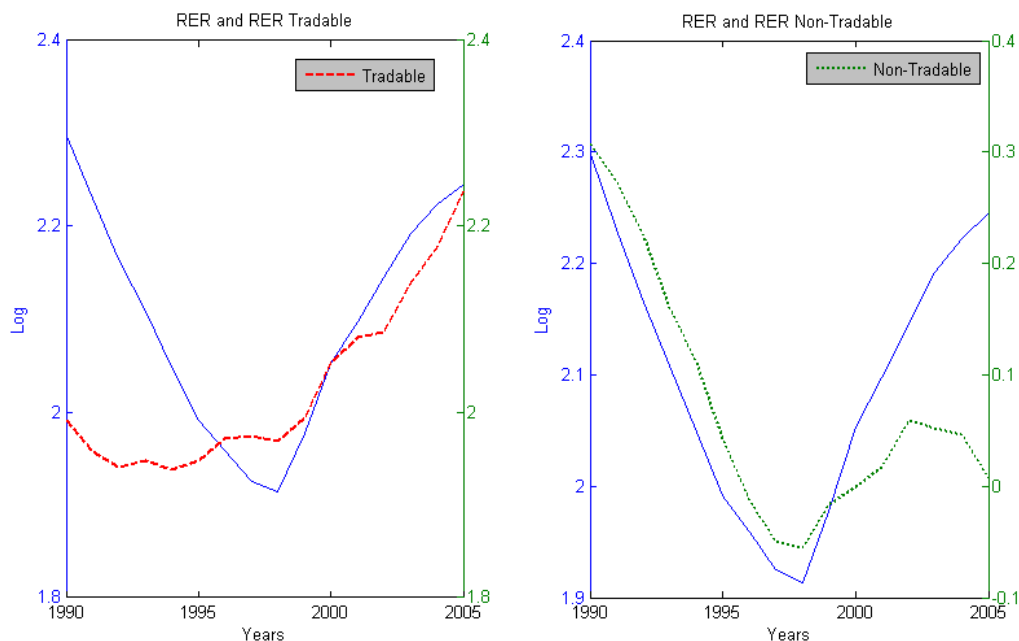
Figure 4: RER, RER Tradable and RER Non-Tradable

4 The Balassa-Samuelson hypothesis

4.1 Preliminaries

According to the Balassa-Samuelson hypothesis (Balassa, 1964; Samuelson, 1964), if a country has a higher TFP in the tradable sector than in the nontradable sector, the wages from the tradable sector will be higher. But if there is free labor mobility, wages from the nontradable sector will equalize wages from the tradable sector. Therefore, this will imply that prices in the nontradable sector will be higher than in the tradable sector (which has a higher TFP growth). Furthermore, assuming that the prices of tradable goods are equalized across countries (Law of One Price in tradable goods), the real exchange rate appreciation of a rapid economic growth is derived from the following: *i)* the higher productivity growth rates in the tradable sector versus nontradable sector causes the relative price of nontradables to increase, *ii)* the ratio of tradable sector prices across countries remains constant (assuming the Law of One Price is satisfied) and; *iii)* these facts cause real exchange rate appreciation. In this sense, the popular Balassa-Samuelson (BS) hypothesis could be considered to be responsible for the dynamics of the real exchange rate (RER) in the period (1985-1998)

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prior to the Asian financial crisis[21]. The previous section showed that there was not a large deviation from the Law of One Price for the traded goods during the 1985-1998 period, but there was a relevant deviation from the PPP for the traded goods in the 1998-2006 period.

The theoretical model behind the Balassa-Samuelson hypothesis can be summarized as follows: (i) the economy is divided into the tradable sector and the nontradable sector; (ii) the price in the tradable sector is determined on the international market due to trade integration, meaning that PPP for prices of the tradable sector are assumed and (iii) wages will be equal in these two sectors. Hong Kong is a small open economy and the previous section showed, through a variance decomposition analysis, that, during the 1990-98 period, the PPP for tradable prices holds. Regarding wage equalization, Figure 5 shows the evolution of real wages from tradable and nontradable sectors. They were similar in the 1985-2000 period and subsequently started to diverge.
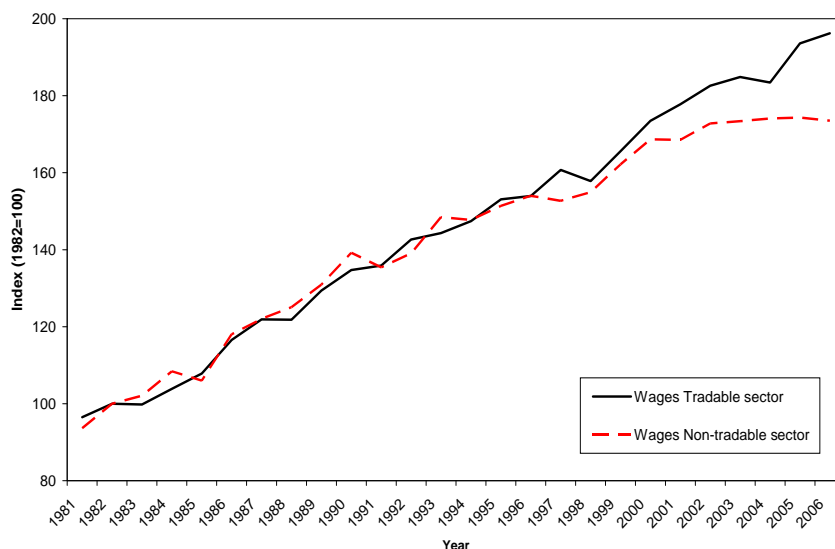

Figure 5: Real wages in Hong Kong

An increase in productivity in the tradable sector will trigger an increase in wages and, due to labor mobility, the wages in the nontradable sector will likewise increase. Consequently, in order to ensure zero profits for competitive firms, the prices in the nontradable sector will

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[21]Imai (2002), Dodsworth and Mihaljek (1997) and Chai (1998) analyze the BS hypothesis for the Hong Kong economy for the period prior to the Asian financial crisis.

increase. And assuming that general prices are a combination of the traded and nontraded prices, they will increase.

As Rogoff (1992) and Obstfeld and Rogoff (1996) emphasize, under the assumption of a small open economy, with complete capital mobility internationally and across sectors of the economy and labor mobility across sectors but not internationally, the RER is tied down by productivity and other supply factors. The price of nontraded goods is independent of demand conditions (assuming that the economy only produces tradable and nontradable goods)[22]. The demand shocks can affect the RER in a small country only to the extent that capital and labour are not perfectly mobile across sectors. Therefore, over the long term, in a perfect-foresight setting, the Balassa-Samuelson hypothesis is consistent with the neoclassical model.

4.2 The theoretical model

We follow Rogoff (1992) and Obstfeld and Rogoff (1996). We consider a small open economy that produces two goods, tradables, T, and nontradables, N. Output for each sector is produced with a Cobb-Douglas production function in each sector,

$$Y_t^i = A_t^i \left(K_t^i\right)^{\alpha_i} \left(L_t^i\right)^{1-\alpha_i} \qquad\qquad i = T, NT.$$

where A_t^i is total factor productivity in sector i, L_t^i is the labor force and K_t^i is the stock of capital in sector i.

The total labor supply is fixed at $L = L_t^T + L_t^N$. As we have mentioned, we assume that labor is internationally immobile, but can move instantaneously between sectors within the small open economy. This fact ensures that workers earn the same wage in either sector, w. On the contrary, capital is internationally mobile and resources can always be borrowed abroad and turned into domestic capital. As a consequence the capital´s domestic rate of return is tied to the world interest rate, R.

Following Obstfeld and Rogoff, for simplification, we assume that one unit of tradables can be transformed into one unit of capital at zero cost (or vice versa). Nontradables cannot

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[22]The relative price of nontraded and traded goods should be determined by the interaction of supply and demand. Nevertheless, "when productive factors are mobile domestically and capital can be freely imported or exported, supply is so elastic that demand shifts do not affect the relative price of nontraded goods" (Obstfeld and Rogoff).

be transformed into capital. Only tradables are usable for capital formation. There are no adjustments costs to change the capital stock.

Firms in each sector behave in a competitive way, in a context with perfect foresight, and they will maximize profits

$$Max \ \pi_t = p_t^i Y_t^i - w_t L_t^i - r_t K_t^i$$

where $i = T, N$. We will assume that the price of tradables is the numeraire. Therefore, p_t^N, w_t and r_t are the relative prices of nontradable goods, wage rate per unit of labor and interest rate, respectively, in terms of tradable goods. There is no physical capital depreciation.

The First Order Conditions equate marginal value products for labor and capital to the wage rate per unit of labor and real interest rate, respectively:

For the tradable sector:

$$w_t = (1 - \alpha_T)A_t^T \left(\frac{K_t^T}{L_t^T}\right)^{\alpha_T} \tag{3}$$

$$r_t = \alpha_T A_t^T \left(\frac{L_t^T}{K_t^T}\right)^{1-\alpha_T} \tag{4}$$

For the nontradable sector:

$$w_t = p_t(1 - \alpha_N)A_t^N \left(\frac{K_t^N}{L_t^N}\right)^{\alpha_N} \tag{5}$$

$$r_t = p_t \alpha_N A_t^N \left(\frac{L_t^N}{K_t^N}\right)^{1-\alpha_N} \tag{6}$$

Taking into account that interest rates are internationally determined and constant, and that there is wage equalization across sectors, the above four equations are enough to determine the relative price of nontradables p_t. If we define $k_t^T = K_t^T/L_t^T$ and $k_t^N = K_t^N/L_t^N$, we have four equations and four unknowns: k_t^T, k_t^N, w_t and p_t. It means that demand has no role in determining p_t in the long-run perfect-foresight setting.

4.3 Internal mechanism of the BS hypothesis

Next, following Dumitru (2009), we relate relative prices and Productivities from the above four equations. Taking into account the Cobb-Douglas production function, we have that $Y_t = F(K_t, L_t) = K_t F_{K_t} + L_t F_{L_t} = r_t K_t + w_t L_t$. Therefore, we can write $(1 - \alpha_T) = w_t L_t^T / Y_t^T$ and $(1 - \alpha_N) = w_t L_t^N / p_t Y_t^N$, taking logs and differentiating with respect to time we have that

$$\widehat{w}_t = \widehat{a_t^T} + \alpha_T \widehat{k_t^T} \tag{7}$$

$$\widehat{w}_t = \widehat{a_t^N} + \alpha_N \widehat{k_t^N} + \widehat{p_t^N} \tag{8}$$

where $\widehat{x}_t = dx_t / dt$, $\widehat{a_t^i} = dA_t^i / dt$, $i = \{T, N\}$ and $\widehat{p_t^N}$ is the growth of the relative price of nontradable with respect to tradable goods.

Taking into account that international rates are constant, from equations (4) and (6), we have,

$$\widehat{a_t^T} = (1 - \alpha_T) \widehat{k_t^T}$$

$$\widehat{a_t^N} = (1 - \alpha_N) \widehat{k_t^N} - \widehat{p_t^N}$$

Substituting $\widehat{k_t^T}$ in equation (7), $\widehat{k_t^N}$ in equation (8), and equalizing equations (7) and (8), we have that with perfect-foresight, the relative prices of nontradables can be expressed as follows:

$$\widehat{p_t^N} = \frac{(1 - \alpha_N)}{(1 - \alpha_T)} \widehat{a_t^T} - \widehat{a_t^N} \tag{9}$$

Given that wages are the same across sectors, $\frac{(1-\alpha_N)}{(1-\alpha_T)}$ measures the relative labor-intensity in the nontradable sector with respect to the tradable sector. It is usually assumed that the nontradable sector is more labor-intensive and therefore, $\frac{(1-\alpha_N)}{(1-\alpha_T)} \geq 1$ always holds.

Equation (9) shows that faster productivity growth in tradables than in nontradables will push the price of nontradable upwards over time. This is the so-called internal transmission of the Balassa-Samuelson effect. Moreover, as the rate of increase in relative prices depends

on wage growth, the effect is greater the greater $\frac{(1-\alpha_N)}{(1-\alpha_T)}$, that is, the more labor-intensive nontradables are relative to tradables. Following Valentinyi and Herrendorf (2008), we assume different values for capital intensity in the tradable and nontradable sectors, $\alpha_N = 0.32$ and $\alpha_T = 0.37$[23].

Firstly, in order to perform this exercise, we calculate TFP and labor productivities for the Hong Kong economy. The data for relative average productivities when measuring TFP or Labour productivities are very different. As Lee and Tang (2007) also find, the results vary when using the TFP or Labor productivity to mesure productivity. Figure 6 shows the evolution of TFP and Labour productivities for tradable and nontradable sectors.

When TFP is considered, the relative average productivity growth of tradables over nontradables in Hong Kong during the 1985-1998 period was 7.53% and decreased to 0.07% during the 1998-2006 period[24]. The relative average labor productivity of tradables over nontradables in the US was 3.26% for the 1985-1998 period, and 3.07% for the 1998-2006 period. This was so because, during both subperiods, 1985-1998 and 1998-2006, the tradable sector grew in the US at almost the same higher percentage point (3.25% (4.10%)) than the nontradable sector (−0.01% (1.01%)). In Hong Kong, the difference in the growth rates of both sectors was much higher in the first subperiod, 1985-1998, (6.23% for the tradable sector, −1.11% for the nontradable sector), than in the second subperiod, 1998-2006 (2.30% for the tradable sector, 2.23% for the nontradable sector).

Table 3 and Figure 7 show the relative prices of nontradables for the Hong Kong and the US economies, observed and predicted. As it can be observed, in the 1985-1998 period , the predicted inflation differential in Hong Kong (7.83%), between the nontraded and traded goods is very similar to the observed one in the data (8.5%). We use TFP data for Hong Kong and labor productivity for the US. However, this is not the case in the 1998-2006 period (the predicted inflation differential is 0.25% and the obtained one is −1.4%). In the US, as in the case of Hong Kong, in the 1985-1998 period , the predicted inflation differentials, between the nontraded and traded goods, is very similar to the observed one (the predicted one is 3.52% and observed one is 3.55%). Again, this is not the case in the 1998-2006 period , where the predicted inflation differential is 3.40% and the observed one is −1.70%.
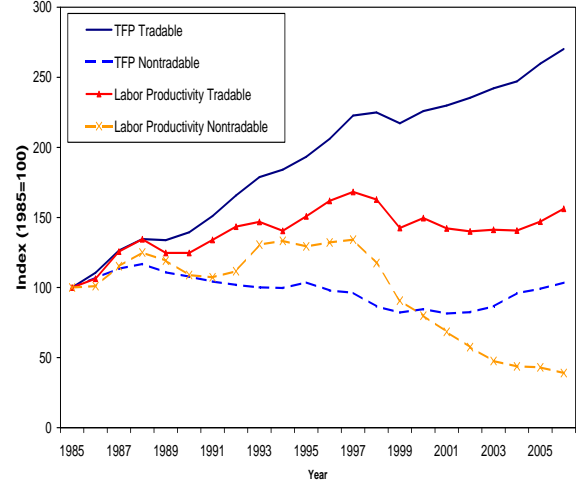
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[23]Results do not vary if we assume the same labor intensity in both sectors: $\alpha_T = \alpha_N = 0.34$.

[24]However, with labor productivity data, we obtain that the relative average labor productivity of tradables over nontradables in Hong Kong was 1.9% for the 1985-1998 period and 13.78% for the 1998-2006 period.
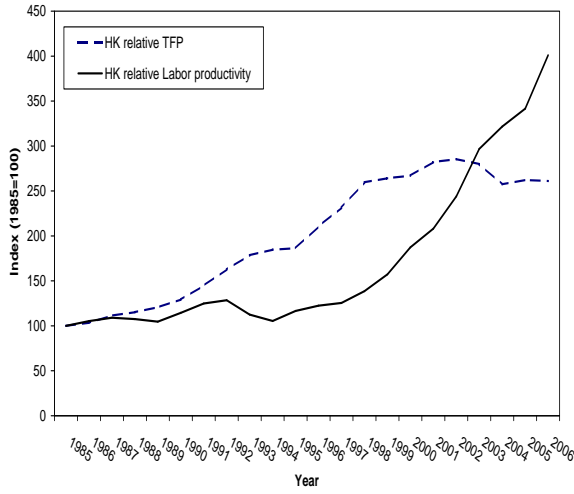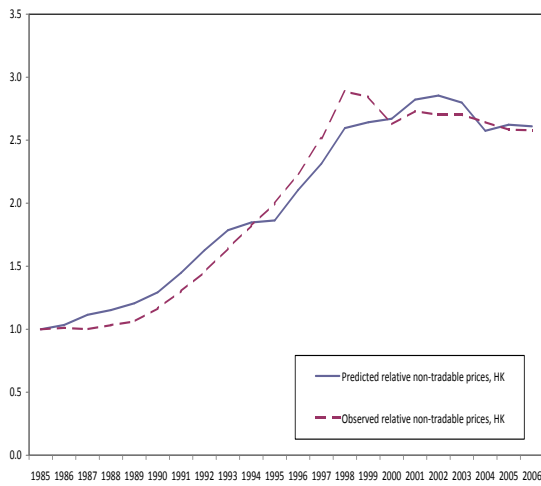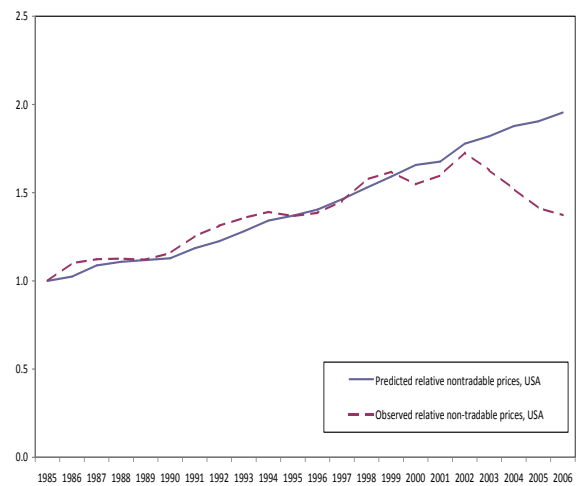
(a) Relative productivities

(b) Productivities

Figure 6: Productivities of tradables and nontradables sectors in Hong Kong

(a) Prices Hong Kong

(b) Prices USA

Figure 7: Inflation differentials

Table 3: Inflation Differentials. 1985-2006

HK	Observed	Predicted
$1985 - 1998$	8.50%	7.83%
$1998 - 2006$	-1.40%	0.25%
US	Observed	Predicted
$1985 - 1998$	3.55%	3.52%
$1998 - 2006$	-1.70%	3.40%

4.4 External mechanism of the BS hypothesis

It is stated that there is a tendency for countries with higher productivity in tradable sector, compared with nontradables, to have higher price levels. In order to understand it, we assume that there are two countries, Home, H, and Foreign, F.

First of all, assuming that the equation (9) holds across countries, the inflation differentials in relative prices (nontradable over tradable) will be given by the following expression

$$\widehat{p_t^{N,H}} - \widehat{p_t^{N,F}} = \left[\frac{(1-\alpha_N)}{(1-\alpha_T)}(\widehat{a_t^{T,H}} - \widehat{a_t^{T,F}}) - (\widehat{a_t^{N,H}} - \widehat{a_t^{N,F}})\right] \tag{10}$$

The above equation (10) states that relative nontradable prices and, hence, general prices of the Home country will increase, with respect to the Foreign country, if the productivity growth in tradables is higher than in nontradables in the Home country relative to the Foreign country.

In this case, the empirical evidence shows that in the 1985-1998 period , 91.5% of the inflation differentials in the relative price of nontraded goods between Hong Kong and the US can be explained by their relative productivity differentials (observed inflation differentials are 4.94% and predicted ones are 4.31%). In the 1998-2006 period , the inflation differentials predicted by their relative productivity differentials should have been of the opposite sign to the observed one (observed inflation differentials are 0.30% and predicted ones -3.26%). Table 4 shows the results.

Table 4: Relative prices. Inflation Differentials. 1985-2006

	Observed	Predicted
$1985 - 1998$	4.94%	4.31%
$1998 - 2006$	0.30%	-3.26%

Taking both the internal and external mechanisms into account, we will check in the next section if the BS hypothesis holds for the Hong Kong economy for the 1985-2006 period. Therefore, the Home economy will be Hong Kong and the Foreign economy, the US.

4.5   The Real Exchange Rate

Given the definition for the RER, and decomposing the general price level, for any two countries, we have the following expression,

$$RER_t = e_t \frac{P_t^F}{P_t^H} = e_t \frac{P_t^{T,F\gamma} P_t^{N,F(1-\gamma)}}{P_t^{T,H\gamma} P_t^{N,H(1-\gamma)}} = e_t \frac{P_t^{T,F} p_t^{N,F(1-\gamma)}}{P_t^{T,H} p_t^{N,H(1-\gamma)}}$$

If

$$\left(e_t \frac{P_t^{T,F}}{P_t^{T,H}} \right) = 1$$

then, the RER can be expressed as follows,

$$RER_t = \left(\frac{p_t^{N,F}}{p_t^{N,H}} \right)^{(1-\gamma)}$$

where $p_t^{N,i}$ denotes the relative price of nontradable goods over tradable goods in country i.

Therefore, the RER is going to be given by the following expression:

$$\widehat{rer}_t = (1-\gamma)(\widehat{p_t^{N,F}} - \widehat{p_t^{N,H}}) = \qquad (11)$$

$$(1-\gamma)\left[\frac{(1-\alpha_N)}{(1-\alpha_T)}(\widehat{a_t^{T,F}} - \widehat{a_t^{T,H}}) - (\widehat{a_t^{N,F}} - \widehat{a_t^{N,H}}) \right]$$

According to the Balassa-Samuelson hypothesis, there must be a positive correlation between the relative prices of Non Tradable over Tradable and relative productivities of Tradable over Non Tradables across countries. The empirical evidence shows that in the 1985-1998 period , 54.32% of the observed real appreciation between Hong Kong and the US can be explained by differences in their relative productivities (the observed RER change differential is −4.16% and the predicted one is −2.16%). Since the nominal exchange rate between Hong Kong and the US is fixed throughout the 1985-2006 period, this is the percentage of the inflation differentials, between the two countries, that can be explained by the Balassa-Samuelson effect. Nevertheless, for the 1998-2006 period , only 37% of the real depreciation observed (deflation) between Hong Kong and the US can by explained by the Balassa-Samuelson effect (the observed RER change differential is 4.37% and the predicted one is 1.63%).

Table 5: RER Change Differentials. 1985-2006

	Observed	Predicted
$1985 - 1997$	-4.16%	-2.16%
$1998 - 2006$	4.37%	1.63%

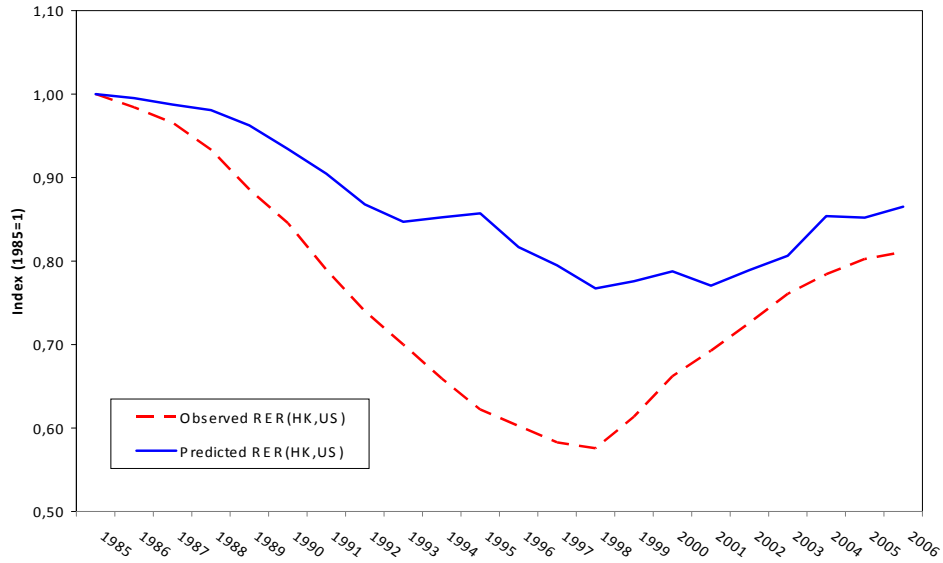Figure 8 shows the observed and predicted RER between Hong Kong and the US.

Figure 8: Observed and predicted RER

5 Conclusions

In this paper, we have quantified the extent to which the price dynamics in Hong Kong can be explained by Balassa-Samuelson hypothesis. In the 1985-1998 period , the CPI in Hong Kong underwent spectacular inflation yet, between 1998 and 2004 deflated dramatically. Most of this dynamics are driven by the pattern of the price of the nontradable goods and services.

Given that Hong Kong is an small open economy, whose degree of openness is remarkably high, we *first* compared the price behavior in Hong Kong relative to its main trade patterns: USA, United Kingdom, Korea, Singapore, Japan, and in none of them did we observe either the high inflation period nor the impressive deflation observed afterwards. *Secondly*, we analyzed whether this different behavior in the prices in Hong Kong can be explained by the Balassa-Samuelson hypothesis. In particular, we performed the analysis with respect to the US. And our results can be summarized as follows: *i)* in the 1985-1998 period , the Balassa-Samuelson hypothesis seems to be a good explanation for the inflation differentials between Hong Kong and the US, *ii)* however, during the deflation period (1998-2006), we find that the Balassa-Samuelson hypothesis cannot explain the inflation differentials between Hong Kong and the US.

We find that in the 1985-1998 period , approximately 50% of the inflation differentials between Hong Kong and the US can be explained by the Balassa-Samuelson effect. However, in the 1998-2006 period , only 37% of the deflation suffered by Hong Kong, relative to the US, can be explained by the Balassa-Samuelson effect. During the 1998-2006 period , there is a significant deviation from the PPP in the price of tradable goods, and the internal transmission of the Balassa-Samuelson effect in neither of the two countries, Hong Kong or the US, is well captured.

6 Appendix A: Data Sources and Description

This appendix provides details on the data sources.

Labour productivity Labor productivity is calculated as sectorial value added over employed persons in the tradable and nontradable sectors. Data on value added and population is provided by the Hong Kong Census and Statistics Department from the Hong Kong Government for the Hong Kong economy[25] and by the Bureau of Economic Analysis (http/www.bea.gov).

We classify tradable and nontradable sectors summing up different sectors. In the case of the Hong Kong economy the Tradable sector is: manufacturing, wholesale trade, exports and imports, transport, storage and communications, financing, insurance and business services. The nontradable sector is the aggregation of Retail, Real Estate, business services and machinery rental, Construction, hotels and restaurants and community services. In the case of the US economy, the tradable sector is Manufacturing, Wholesale, Transport, Storage and communications, Finance and Insurance. The nontradable sector is: construction, retail, Real Estate and Rental Leasing, Education services, healthcare and social assistance, Arts and entertainment, Accommodation and food services, professional and business services.

Prices The considered general prices are the Consumer Price Index (CPI) and the GDP deflator. The CPI is from the IFS. The GDP deflator isfrom the Hong Kong Census and Statistics Department and the US Bureau of Economic Analysis.

Price of tradables is calculated as PPI, price of exports of goods and services or Unit Value Index of Exports (UVI). Prices from Nontradables are the difference between general prices and tradable prices. PPI data for all the economies are from the International Financial Statistics from the IFM dataset. UVI prices are from IFS. Price of exports for the Hong Kong economy are from the Hong Kong Census and Statistics Department.

Sectorial GDP Deflators For the Hong Kong economy, the deflator for the tradable sector is a composite of the implicit price deflator for domestic exports of goods and the implicit price deflator for exports of services. The composite deflator is calculated following Kehoe and Ruhl (2008). The nontradable sector GDP deflator is obtained as the geometric

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[25]Further information in the website of the Census and Statistics Department of Hong Kong at http://www.censtatd.gov.hk

difference of the tradable sector deflator and the (whole economy)GDP deflator. Data are from Hong Kong Census and Statistics Department.

For the US economy, Gross domestic product deflators are calculated following Kehoe and Ruhl (2008): We divide the nominal value added of traded goods by the real value added of traded goods (manufacturing, wholesale trade, exports and imports, transport, storage and communications, financing, insurance and business services). We first construct the traded goods deflators for the period 1985-2006. To find nominal value added for traded goods, we total all the sectors that make up the tradable sector. Then, to find real value added for traded goods for the analyzed period with base year 2000, we multiply the volume index for each of the traded goods sectors with base year 2000, by the 2000 value of its nominal value added, and divide by 100. We total the resulting real value added series for the three sectors. Real value added for traded goods for 1985-2006 is given by: the volume index of manufacturing at the index value=100 is multiplied by the 2000 value of manufacturing GDP measured in billions and then divided by 100. This is done for all subsectors in tradable and nontradable sectors. Next, to find the value added deflator for traded goods, where 2000=1, we divide nominal value added for traded goods by real value added for traded goods.

Nominal Exchange Rate Data for Nominal Exchange rate is from the IFS.

7 Appendix B: Price of Tradables over Nontradables. Different measures

Following Engel and Betts and Kehoe, we assume different price indices for tradables: PPI, price of exports, and different indexes for the general price indexes (CPI and GDP deflator). Figure 9a compares the relative prices for Hong Kong calculated using those different indices. We can *first* observe that the behavior of the price of exports and PPI is similar. When we compare the relative price of tradable and nontradables using the Price of Exports and the PPI as tradable prices, we observe that the dynamics of the relative prices are very similar. We find that there is a high correlation between the Price of Exports and the PPI, both for the whole period, 0.95, and for the subperiods (1990-1998; 1998-2006), 1 and 0.84, respectively. Therefore, we use the price of exports for the rest of the analysis as the data series is longer, 1985-2006. There is only data for the PPI from 1990 onwards. *Second*, when we use the GDP deflator, the increase in the relative tradable price is higher during the

whole period, particularly during the deflation period (1998-2006). However, the correlation between the GDP deflator and the CPI is 0.98 for the whole 1985-2006 period.

Finally, we can see that most of the dynamics of the general prices in Hong Kong have been driven by the prices of the nontradable goods and services (Figure 9b).
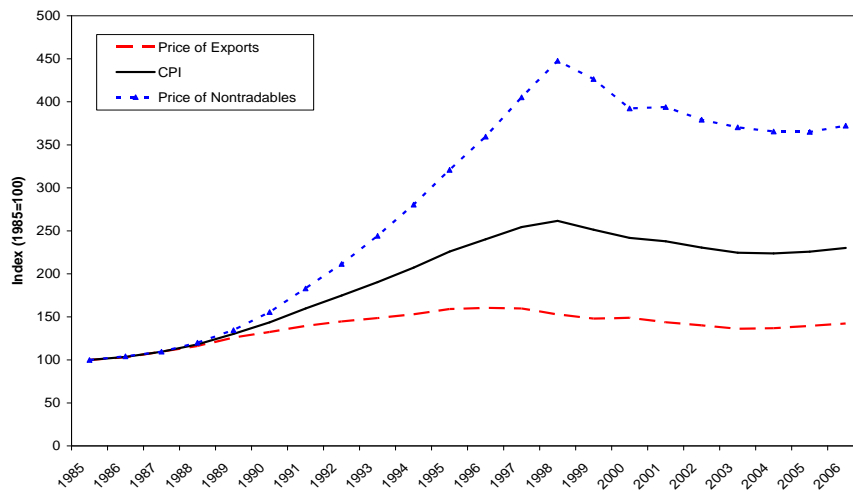
8   Appendix C: Comparison PPI and Price of Exports

The following Figure 10 compares the evolution of the PPI in Hong Kong and the US, and the Price of Exports in Hong Kong.
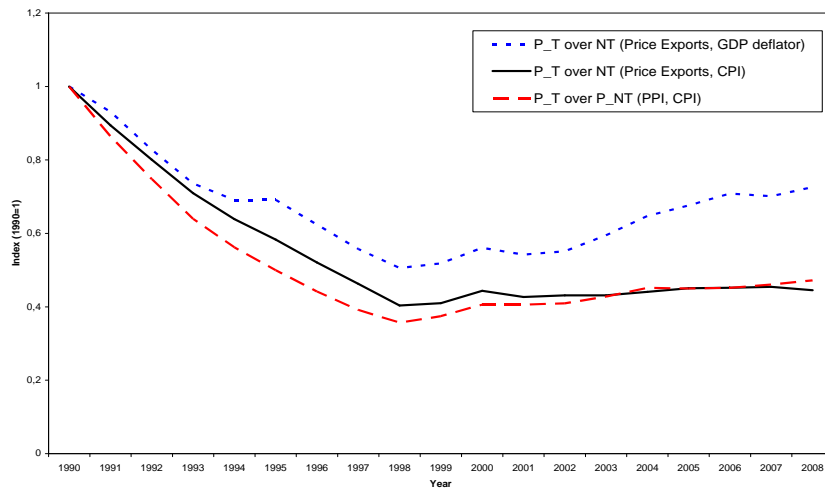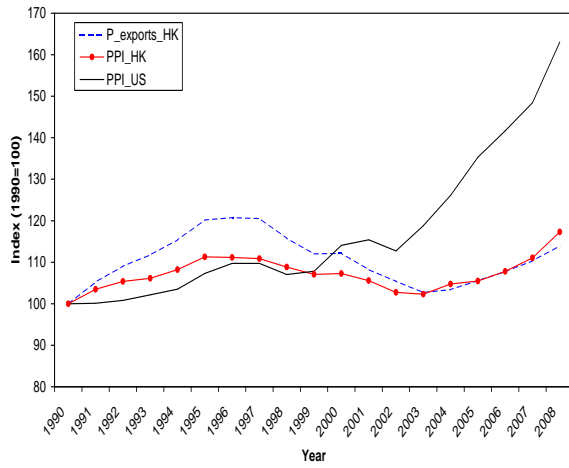
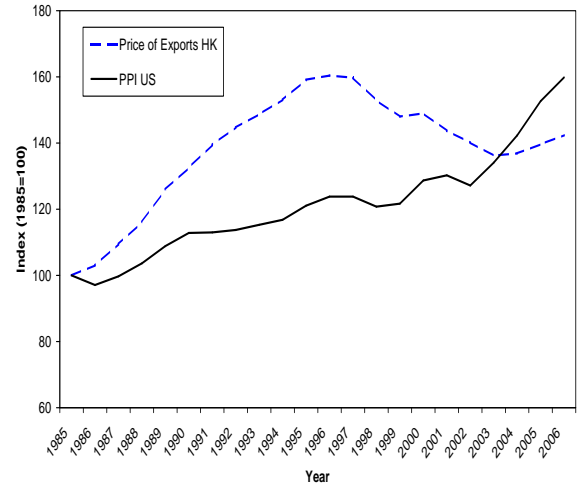(a) Different measures of relative prices

(b) Price Comparison

Figure 9: Price of tradables over Price of nontradables. Different measures

(a) 1990-2008
(b) 1985-2008

Figure 10: Price of Tradables and Nontradables in HK and US

9 Appendix D: Variance Decomposition

The following table shows the variance decomposition for the main trading partners of Hong Kong.

Table 6: Prices of tradable and nontradable sectors. 1985-2006

US	**1985-2006**	**1985-1998**	**1998-2006**
Price of Tradables	19.92%	13.67%	76.40%
Price of Nontradables	80%	86.33%	23.60%
UK	**1985-2006**	**1985-1998**	**1998-2006**
Price of Tradables	23.12%	32.90%	5.71%
Price of Nontradables	76.88%	67.10%	94.28%
Korea	**1985-2006**	**1985-1998**	**1998-2006**
Price of Tradables	14.82%	11%	13.68%
Price of Nontradables	85.18%	89%	86.32%
Singapore	**1985-2006**	**1985-1998**	**1998-2006**
Price of Tradables	10.69%	7.81%	71.58%
Price of Nontradables	89.31%	92.19%	28.42%
Japan	**1985-2006**	**1985-1998**	**1998-2006**
Price of Tradables	10.32%	4.58%	63.25%
Price of Nontradables	89.68%	95.42%	36.75%

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