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

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Abstract

In this paper we quantify to what extent the dynamics of prices in Hong Kong are due to the Balassa-Samuelson effect. In the period 1990-1997, the CPI in Hong Kong exhibited an spectacular increase and, however, in the period 1997-2004 suffered a dramatical deflation. Most of this dynamics are driven by the pattern of the price of the non-tradable goods and services. The dynamics of the price of the tradable goods and services has been much more stable. The Balassa-Samuelson effect partly explains the price differentials between Hong Kong and the US, but it can not explain at all the deflation exhibited in the period 1997-2004.

Keywords: Real Exchange Rate, Balassa-Samuelson hypothesis, Deflation, Inflation.

JEL Classification: E13, E32, F41.

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1 Introduction

In this paper we quantify to what extent the dynamics of prices in Hong Kong can be explained by Balassa-Samuelson effect. In the period 1985-1997, the CPI in Hong Kong exhibited an spectacular increase and, however, in the period 1997-2004 suffered a dramatical deflation. Most of this pattern has been driven by the dynamics of the price of the non-tradable goods and services. The dynamics of the price of the tradable goods and services has been much more stable, despite that in the period 1985-1997, the growth of the Total Factor Productivity in the tradable sector has been much higher than in the non-tradable sector. This is not surprising given that Hong Kong is an small open economy, whose degree of openess is remarkable high. In particular, we show that until 1997 (coinciding with the Sudden Stop[1] and the integration of the economy with China), *i)* Hong Kong experienced a higher inflation rate than in the US, *ii)* that the relative exchange rate of the tradable goods and services between Hong Kong and the US have satisfied (approximately) the law of one price, *iii)* that the inflation gap between Hong Kong and the US can be mostly explained by the Balassa-Samuelson effect. However, during the deflation period, 1997-2004, *i)* the dynamics of the exchange rate of the tradable goods did experience a very different pattern from that one observed in the US, and *ii)* the deflation gap between Hong Kong and the US can not be explained by the Balassa-Samuelson effect[2]. We also analyze the relative inflation of Hong Kong with respect to UK, Korea and Singapore, the four main trading partners of the Hong Kong economy[3].

In order to check the price and inflation differences at aggregate and sectoral level, as well as the behavior of the Real Exchange Rate (RER), we develop the Balassa-Samuelson (Balassa, 1964; Samuelson, 1964) hypothesis. In particular, we are interested in checking if the differences in sectorial productivities can explain inflation differences between the US and Hong Kong. "*According to the Balassa-Samuelson hypothesis, rapid economic growth results in real exchange rate appreciation due to higher productivity growth in the tradable sector relative to the nontradable sector. The larger the productivity growth rate difference between the tradable and nontradable sectors, the faster the real exchange rate appreciation in an economy. In view of Hong Kong's high long-term output growth, the Balassa-Samuelson effect may have contributed much to Hong Kong's inflation prior to the Asian financial crisis.*" (Imai, 2002)

Because the Balassa-Samuelson hypothesis assumes that the Law of one price holds for the tradable prices, we first check, following Engel (1999) and Betts and Kehoe (2006), the contribution of changes in tradable and non-tradable prices to variations of the RER. We use an approach proposed by Engel (1999), and we

[1] It refers to sudden stops in capital flows to emerging economies.

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

[3] China is the main trading partner from Hong Kong but we exclude it because there is no avalable data. Japan is excluded because results are missleading.

decompose the variance of RER into the variance of the relative price of tradable goods across countries and the variance in the relative price of nontradable to tradable goods. In this way, we measure the proportion of real exchange rate movements that can be accounted for by movements in the relative price of traded and non-traded goods. We analyze the period 1985-2006, divided into the inflationary and deflationary periods.

Therefore, the main questions addressed in this paper are the following: *(i)* Does the law of one price is satisfied in the tradable sector?, *(ii)* Can the relative price of non-tradable over tradable sector, between Hong Kong and the US, be explained by their relative TFP differentials, according the the Balassa-Samuelson effect?

In order to answer the first question, and check if the Law of one price holds for the tradable goods, we follow the literature based on Engel (1999) and Betts and Kehoe (2006,2008). Because the Balassa-Samuelson assumes that the Law of one price holds for tradable sector prices, we check if this assumption holds for Hong Kong. Engel (1999) showed that almost all of the variance in the bilateral real exchange rates between the United States and a number of OECD, especially 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 non-traded to traded goods. Betts and Kehoe (2008) extend Engel's analysis to a large set of bilateral real exchange rates (52 countries over the period 1980-2000) and find that the measured relationship, between the bilateral real exchange rate and the relative price of non-traded goods across countries, is strong. Nevertheless, in accordance with Engel's results, Betts and Kehoe also find significant bilateral deviations from the law of one price for baskets of goods that are traded, and that these deviations play a large role in real exchange rate fluctuations. Tornell and Westermann (2002) find the same for a sample of 39 Middle income countries for the period 1980-1999. Naknoi (2005) constructs a large dataset covering 35 countries and finds that in many cases the relative price of nontradables accounts for about 50 percent of the RER variability. Drozd and Nosal (2009) find that the contribution of the relative price of nontradable goods to the overall real exchange rate movements is at best modest. Finally, for the Mexican case, Mendoza (2000) finds that variability in the relative price of nontradables accounts for a high percentage of the variability of the RER of Mexico with the US. However, Kehoe and Ruhl (2009), also for the Mexican case, find that deviations in the law of one price in tradable goods accounts for about 65% of the changes in the RER. Nevertheless, Burnstein, Eichenbaum and Rebelo (2005, 2006) argue that the primary force behind large drops in the RER that occurs after large devaluations, are movements in the price of nontradables relative to pure-traded goods.

With respect to Hong Kong, Parsley (2007) examines six Southeast Asian countries, cross-paired with the US dollar, for the largest available data period (1980-2000 in the case of Hong Kong), and finds that relative prices of non-tradables appear to account for virtually non of the movements of Pacific-Rim RER. The exception is Hong Kong. In this case, the relative price of nontrad-

ables could explain up to 50 percent of the RER variability.

The main results from this literature is twofold: *(i)* both movements in tradable and non-tradable 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. Differences in indices result on different outcomes.

Following Betts and Kehoe (2006, 2008), we decompose changes in RER 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 (LOP) in tradable goods, that is, the equalization of tradable sector prices across countries, and *(ii)* the Real Exchange Rate of non-tradable goods (RER^N), which measures the relative price of non-tradable 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 1990-1997 period (87 percent). Nevertheless, after the Asian financial crisis, during the period 1997-2006, movements in the price of tradable goods was the only factor behind the variability of the RER (explains a 96 percent of the variability of the RER).

To answer the second question we develop the Balassa-Samuelson hypothesis. This type of question has been answered by De Gregorio, et al. (1994), Asea and Mendoza (1994), Rogoff (1996), Canzoneri et al (1999), or more recently, Drine and Rault (2005), Bergin, Glick and Taylor (2006), and Dumitru and Jianu (2009), among others. Asea and Mendoza (1994) and De Gregorio et al. (1994) find, using annual, sectorial data from 14 OECD countries for the period 1970-84, that relative prices are explained by relative productivities. Canzoneri et al. (1999) find using annual data for the period 1960-1993 for a panel of 13 OECD countries that in the long-run relative prices of Non-Traded goods generally reflect relative labour productivities in Tradable and Non Tradable sectors. They argue that these results suggest that relative prices generally reflect relative labor porductivities in the long run. More recently Drine and Rault (2005) tests empirically the Balassa-Samuelson (BS) hypothesis using annual data for 1970-2002 for 12 OECD countries. Their results support the BS in some countries and prove not to follow on others (Australia, Belgium, Canada and the USA). Bergin, Glick and Taylor (2006), with a sample of 53 countries for the period 1950-1995, develop a BS model and find that, for a long period of data (last 50 years) the BS effect dissapears. Recently, there is a wide literature that analyzes the price convergence and BS effect of Eastern European countries with the European Monetary Union member countries with different econometric techinques (Egert, 2003; Dumitru and Jianu; 2009). To sum up, the results from the BS literature are mixed and may be attributable to the low power of the tests implemented with short spans of data as argued by many researchers, in some cases.

There are several authors that have analyzed the Balassa-Samuelson hypothesis for various Asian countries, including Hong Kong. Dodsworth and Mi-

haljek (1997) and Chai (1998) confirmed the Balassa-Samuelson effect behind Hong Kong's inflation for the period before the Asian financial crisis in Hong Kong[4]. Ito et al. (1997) looked at a longer period, 1973 to 1995, and failed to confirm the Balassa-Samuelson effect; they find that *despite real exchange rate appreciation, the relative price of nontradables in Hong Kong did not rise faster than that in the US*. Imai (2002) analyzes the Real Exchange Rate behavior for the period 1985-1997. 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 (real exchange rate appreciation of the Hong Kong dollar) under the dollar peg during the pre-Asian financial crisis period. He finds that the Dutch Disease effect explains better, than the BS effect, the inflation gap for that period. The author argues that considering 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. Nevertheless, with the Sudden Stop, the Dutch disease disappears. If it would have been the main factor before the crisis, RER should have gone back to its pre-crisis tendency.

Some other authors (Genberg and Pauwels, 2003; Razzak, 2003; N´Diaye, 2003) focus specifically on the analysis of the deflation suffered by Hong Kong after the Asian financial crisis. Genberg and Pauwels (2003) found that wages, import prices and property rental prices explain the deflation. Razzak (2003), analyzed the role of unit labor costs as productivity dynamics in explaing deflation. N´Diaye (2003) finds that productivity and money supply shocks and convergence with the main trading partners are the causes for deflation. Various papers (Ha and Fan, 2002; Wong,2002; IMF, 2002; Schellenkens, 2005) have focused on the price convergence between China and Hong Kong as explanation for the deflation suffered by Hong Kong after the Asian financial criss and the integration with China. *Ha and Fan (2002) showed that the pace of price convergence between China and HK has accelerated.* Wong (2002) states two factors that are important in explaining the deflationary fact 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 of China and its gradual integration with Hong Kong. A study from the IMF (2002), using the ratio of the consumer prices index of Hong Kong and Shenzhen, as a measure of the average price gap between Hong Kong and China, suggests that the price level gap plays only a minor role in explaining the deflation in Hong Kong. Cyclical factors, as proxied by unemployement rate, credit growth and nominal effective exchange rate, are much more important determinants of the deflation. *Schellenkens (2005) argues that the role of price equalization as a source of deflation is minor and shows that deflation is best explained by balance-sheet and wealth effects.*

The rest of the paper is organized as follows. Section 2 explains the data

[4]Their analysis is *based on a two-goods (tradables and nontradables) single-factor (labor) model with the post-1983 period Hong Kong data.*

used and reviews the price developments from Hong Kong. Section 3 conducts the variance analysis of the Hong Kong-U.S. real exchange rate following Betts and Kehoe (2006). In Section 4 we analyze the Balassa-Samuelson effect for the Hong Kong economy for the period 1985-2006. Section 5 concludes.

2 Data

In this section we describe the data used and describe the main facts regarding: *(i)* the behavior of prices (general, tradable versus non-tradable) in Hong Kong before and after the Asian financial crisis (inflation followed by a deflation); *(ii)* the behavior of the real exchange rate (tradable and non-tradable).

2.1 Description of data

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.

In order to compare the Hong Kong prices with other economies, we assume the PPI 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 traded the most. Nevertheless, lack of data for CPI and PPI from IFS forces us to omit from the sample the People´s Republic of China.

In measuring the prices of traded goods, we must be more careful. 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, we assume as many as possible price indices, taking into account data availability. According to these authors, the best price indices are the Gross Output deflators, both at sectoral and economy level.

Unfortunately, for Hong Kong, there is no available data of Gross Output neither 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

[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.

[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.

producer goods that are not traded, the PPI is measured at the production site, and hence exclude marketing and other non-traded 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 on 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 is available only from 1990 on, 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 because results are the same as with UVI (correlation between them is 0.98 for the period 1968-2006)[9].

For the analysis in this paper, we neither detrend nor de-seasonalize the data. The analyzed period is 1985-2006. The choice of this period is the availability of data. We divide the analysis of the dynamics of prices in Hong Kong in three sub-periods: 1985-1990, 1990-1997 and 1997-2006. The reasons are the following: *(i)* the fixed exchange-rate was imposed in October 1983; *(ii)* the fixed exchange rate stabilized in 1990; and *(iii)* the change in the behavior in the general price index occurs in 1997, coinciding with the moment in which the Asian Financial Crisis took place. Choosing 1985 as the base year, the time period of this study is 13 years from 1985 to 2006. A complete description fo the data appears in Appendix A[10].

To examine the bilateral RER of Hong Kong vis-a-vis its main trading partners, we use the nominal exchange rate data from the IFS. We focus especially on the Hong Kong-US RER.

In order to account for the Balassa-Samuelson effect, we calculate labor productivities for Hong Kong and the US. Therefore, value added of sector over employed persons is obtained. For the case of Hong Kong, we also use Total Factor Productivity data[11]. We follow Hsieh (2008) for the composition of the tradable and nontradable sectors in Hong Kong. We follow the same

[7] Burnstein, Eichenbaum, Rebelo (2006) think that the Producer Price Index (PPI), or the Wholesale Price Index (WPI), are both poor measure of pure traded goods prices for two reasons. First, since the PPI targets prices charged by domestic producers, import prices are generally excluded. Second, the composition, coverage and availability of the PPI and WPI varies widely 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 (2003)). 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.

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

[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:

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

decomposition for the US (results may vary depending on the clasification of tradable and nontradable sectors)[12]. In both economies, nontradable sector accounts for half of the output.

2.2 Domestic analysis: Prices in Hong Kong

In Hong Kong there was a period of high inflation before the Asian financial crisis (1990-97) and a period of deflation between 1997 and 2004. Since Hong Kong is an small open economy, with a high degree of openess (Average of exports and imports over GDP for the period 1985-2006 is 272%), we compare the evolution of CPI for Hong Kong and its main trading partners for the period 1985–2008 in Figure 1. As it can be seen, Hong Kong suffered a high inflation during the period 1985-1997 and, thereafter, an abrupt and prolonged deflation until 2004, in comparison to the other countries. During 1990-1997, the average annual growth rate of the aggregate prices in Hong Kong (8.74%) was higher than the US counterpart (3.41%) .

The period with the highest inflation, 1990-1997, is posterior to the massive exit of manufacturing firms to China. In this sense, according to Imai (2002) or Wong (2002) the reason for inflation is structural transformation. During the period 1997-2004, Hong Kong suffered a deflation. According to the Hong Kong Monetary Authority, from an accounting perspective, half of the decline of CPI after the Asian crisis is due to the fall of housing prices. Other countries in the region also suffered deflation, as Japan or Korea, but not so deep.

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 2 compares the relative prices from Hong Kong calculated with those different indices. We can observe, *firstly*, 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, we observe that the first rises less during the period 1990-1997 (less inflation) and falls more (more deflation) than the PPI for the period 1997-2004. We find that there is a high correlation between the UVI and Price of Exports (0.90 for the period 1985-2006), and the Price of Exports and the PPI, both for the whole period, 0.94, and for the subperiods (1985-1990: 1990-1997; 1997-2006), 0.90, 0.99 and 0.90, respectively. In consequence, for the rest of the analysis we use the price of exports because the data series is longer, 1985-2006. There is only data from 1990 on for the PPI. *Secondly*, when we use the GDP deflator, the relative price is higher. However, the correlation between the GDP deflator and the CPI is 0.98 for the whole 1985-2006 period. Appendix B

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

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.

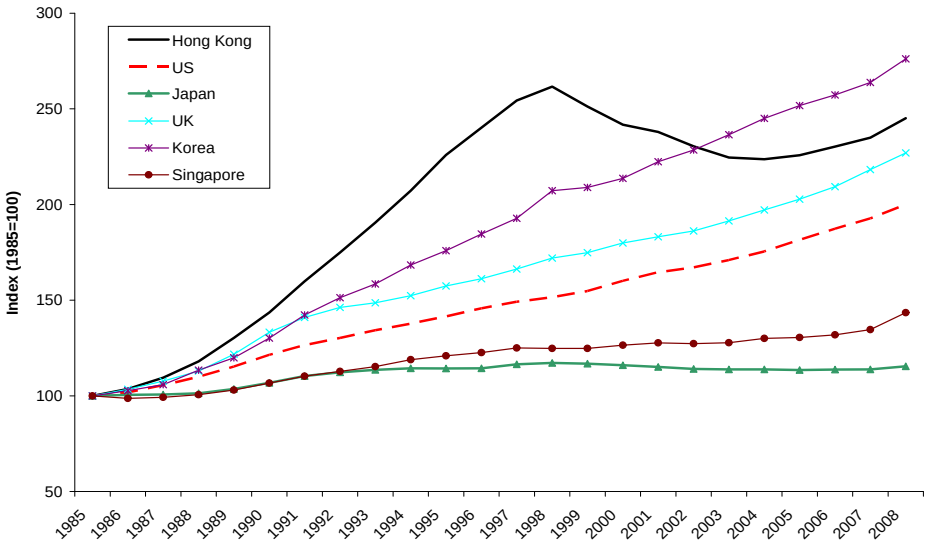


Figure 1: Evolution of CPI

summarized the volatility and correlation between the various price indices.

Finally, we can see that most of the dynamics of the general prices in Hong Kong have been driven by the prices of the non-tradable goods and services (Figure 3).

In order to quantify to what extent the dynamics of the price of the non-tradable goods and services are responsible for the inflation experienced in Hong Kong during the period 1985-1997, and the deflation afterwards, we calculate its variance decomposition. For that purpose, we decompose the aggregate price index for Hong Kong into the tradable and non-tradable 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[13]. Taking natural logarithms of the above expression, we obtain the variance decomposition. As

[13] We obtain the weight following Kehoe and Ruhl (2008). The Non-tradable deflator weight is the geometric difference of the GDP deflator and the Tradable sector´s deflator. The direct weight of Non-tradables in the typical CPI basket is approximately 50 percent. However, Burnstein, Eichenbaum and Rebelo (2003) argue that, if distribution services are included, the total weight of nontradables increases to 75 percent.

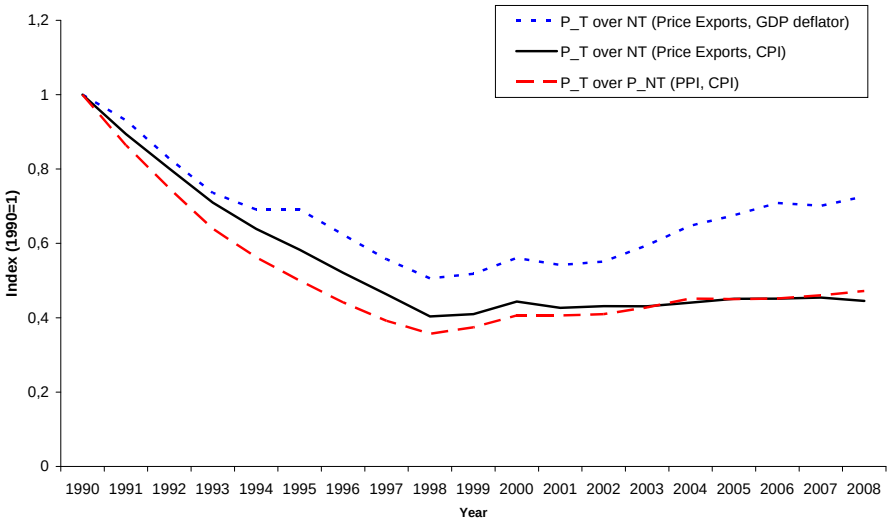


Figure 2: Price Tradable over Price Non-tradables: different measures

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

	Price of Tradables	Price of Non-tradables
$1985 - 1990$	23%	77%
$1990 - 1997$	7%	93%
$1997 - 2006$	8%	92%

Figure 4 shows the Inflation rate evolution and differences between the Tradable and Non-tradable sectors.

2.3 International differences

In this section we compare the dynamics of Hong Kong tradable prices with respect to its main trading partner (USA) using 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 non-tradable goods (for the Hong Kong economy we use the price of exports). We analyze the period 1985-2006.

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, only by looking at the evolution of tradable prices in Hong

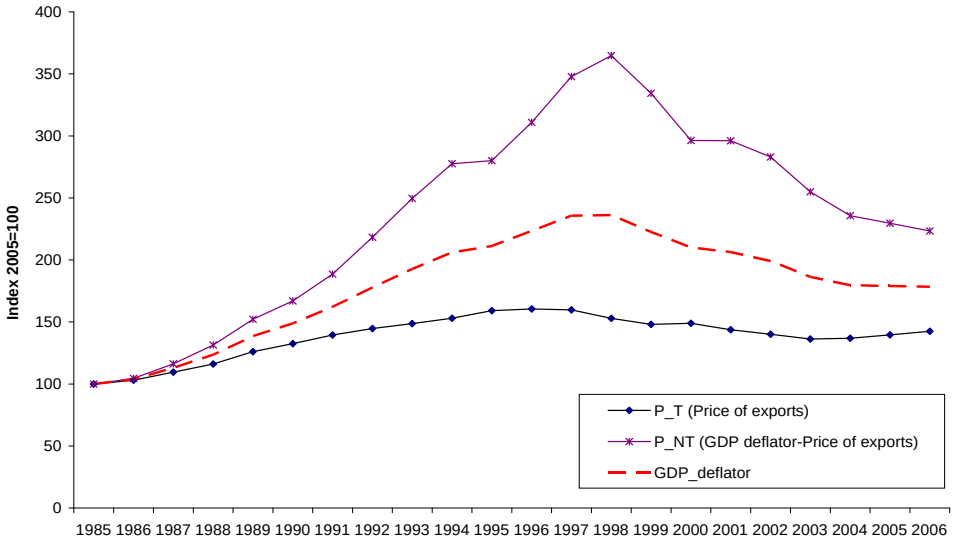


Figure 3: Price of Tradables vs Price of Nontradables

Kong and the US, one can guess if the Law of One price holds for tradable prices (Figure 5).

3 Variance Analysis of the RER: a disaggregation

In the previous section we have analyzed the Hong Kong prices and have compared them to 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 if 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 non-traded (N) prices.

We calculate the RER of Hong Kong with its main trading partners: US, Japan, Korea, Singapore, UK (we exclude China because no data availability). We define the bilateral RER of Hong Kong as:

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

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 6 shows the RER of Hong Kong with its main trading partners.

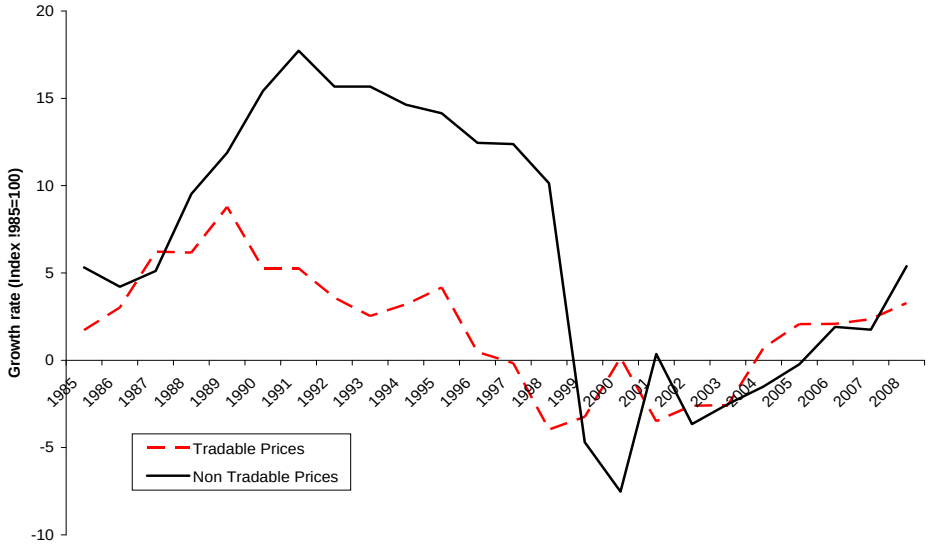


Figure 4: Inflation Rate in Tradable and Non-Tradable sectors in Hong Kong

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 non-tradable 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):

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

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)[14]. For Hong Kong, 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 non-tradable 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[15].

Finally, taking logs, we have that

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

[15] 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.

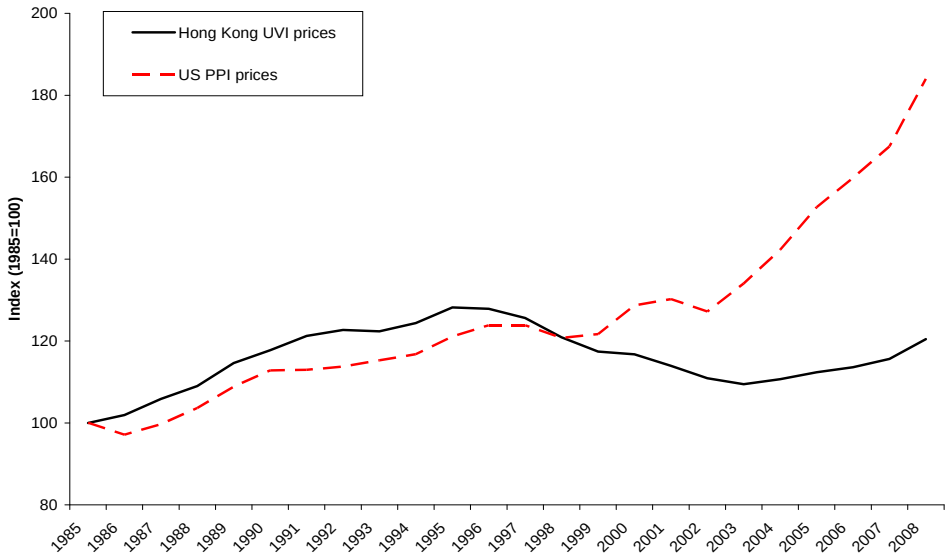


Figure 5: Hong Kong and US tradable prices

$$rer_{HK,i,t} = rer^{T}_{HK,i,t} + rer^{N}_{HK,i,t}$$

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

$$vardec(rer_{HK,i}, rer^{N}_{HK,i}) = \frac{var(rer^{N}_{HK,i})}{var(rer^{N}_{HK,i}) + var(rer^{T}_{HK,i})}.$$

and the sample variance of the RER is

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

The covariance between the two components, $rer^{N}_{HK,i}$ and $rer^{T}_{HK,i}$, *is allocated to the fluctuation in* $rer^{N}_{HK,i}$ *in proportion to the relatvie size of its variance*, as in Betts and Kehoe (2006).

Results are shown in Table 1 and Figure **??**. The results with respect to the US show: *i)* the structural change of RER and *ii)* also a change in the role of the decomposed terms. It seems that the international deviation of relative prices of non-tradables played a main role during the nineties in Hong Kong. But, it also seems that deviations from the law of one price in tradable goods have an

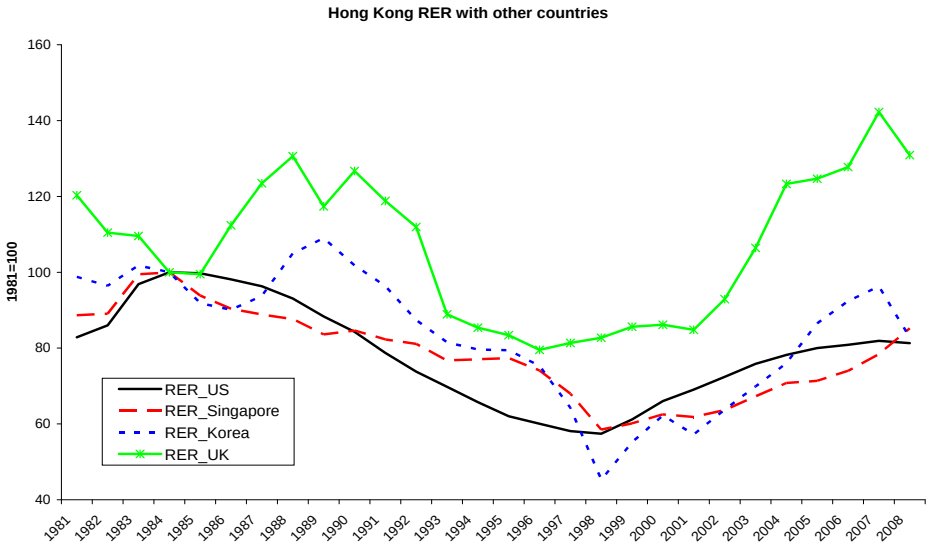


Figure 6: Real Exchange Rate

important role in explaining the long run depreciation in Hong Kong after 1997. If the relative price of non-tradable goods would have played a major role after 1997, then, as is shown in the graph, RER would have again been appreciated. We find that relative prices of non-tradables can explain 86.61% of the RER appreciation during the period 1990-1997, and 3.83% of the depreciation from 1997 to 2006 (these results, even though they are consistent with the findings by Parsley, are a little different quantitatively). For the overall period 1985-2006, the contribution of the component of the relative prices of non-tradable goods on the Real Exchange Rate is 56.24%. With respect to the RER with United Kingdom, we find a similar behavior: deviation of relative prices of non-tradables played a main role during the nineties and deviation of relative prices 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 relative prices of non-tradables during the nineties has been of lower magnitude, and the deviations from the law of one price in tradable goods after 1997 has been of higher magnitude, than with respect to US or UK.

We also analyze the volatility and correlation of RER, and Non-tradable RER. Results again depend on the chosen trading partner. Nevertheless, there are some commom patterns among them, in particular we find: (i) a lower variability of the Non-Tradable RER relative to the volatility of RER of Hong Kong with any of its partners during the 1997-2006 period with respect to the previous period 1990-1997, except with Singapore, (ii) a high and positive correlation between Non-tradable RER and RER of Hong Kong with any of its

Table 1: Hong Kong Real Exchange Rate. 1985-2006

US	**1985-2006**	**1985-1990**	**1990-1997**	**1997-2006**
vardec(rer,rer_N)	56.24%	14.04%	86.61%	3.83%
corr(rer, rer_N)	0.69	0.90	0.98	−0.01
std(rer_N)/std(rer)	0.83	0.37	0.76	0.20
UK	**1985-2006**	**1985-1990**	**1990-1997**	**1997-2006**
vardec(rer,rer_N)	57.91%	1.73%	80.79%	16.39%
corr(rer, rer_N)	0.73	0.05	0.93	0.93
std(rer_N)/std(rer)	0.83	0.14	0.36	0.32
Korea	**1985-2006**	**1985-1990**	**1990-1997**	**1997-2006**
vardec(rer,rer_N)	30.45%	54.03%	50.97%	10.17%
corr(rer, rer_N)	0.92	0.92	0.94	0.90
std(rer_N)/std(rer)	0.43	0.44	0.54	0.26
Singapore	**1985-2006**	**1985-1990**	**1990-1997**	**1997-2006**
vardec(rer,rer_N)	52.36%	30.93%	45.17%	19.90%
corr(rer, rer_N)	0.71	0.74	0.75	−0.67
std(rer_N)/std(rer)	0.85	1.01	0.61	0.84
Japan	**1985-2006**	**1985-1990**	**1990-1997**	**1997-2006**
vardec(rer,rer_N)	59.51%	5.54%	46.60%	7.02%
corr(rer, rer_N)	0.90	0.88	0.70	0.73
std(rer_N)/std(rer)	0.67	0.20	0.67	0.23

Note: Tradable prices are PPI for all economies except HK (Price of exports). Aggregate prices are CPI.

partners during the 1990-1997 period. But there are also some differences, in particular concerning the correlation between the Non-tradable RER and the RER during the period 1997-2006, going 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 is 0.83 compared to an average of 0.46 for countries analyzed by Betts and Kehoe) and a correlation with RER of 0.69, very similar to the average found by Betts and Kehoe[16].

[16] By subperiods, relative volatility (and correlation) of Non-tradable to RER decreases from 0.76 (0.98) for the period 1990-97 to 0.20 (-0.01) for the period 1997-2006.

4 The Balassa-Samuelson hypothesis

According to the Balassa-Samuelson hypothesis (Balassa, 1964; Samuelson, 1964), rapid economic growth results in real exchange rate appreciation due to a higher productivity growth in the tradable sector relative to the nontradable sector. If a country has a higher TFP on tradable sector their wages will be higher, but if there is free labor mobility, wages from non-tradable sector will equalize to wages from tradable sector. This will imply that prices in the nontradable sector will be higher than in the tradable sector (with 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 and; *iii)* these facts cause real exchange rate appreciation. In this sense, the popular Balassa-Samuelson (BS) hypothesis could be considered one of the factors behind the dynamics of the real exchange rate (RER) in the period (1990-1997), before the Asian financial crisis,[17] but then it would failed to explain the period after it (1997-2006). In particular, it appears that during the period 1997-2006 there is such deviation from the law of one price that most of the dynamics of RER can be accounted for the dynamics of the tradable RER.

The differences in productivity growth among sectors are expected to be larger in high growth countries and, therefore, the BS prediction should be more visible among high growth countries. The average output growth was 13.8% in Hong Kong compared to an 5.9% in the US for the period 1985-1997. After the Asian Financial crisis, the average growth in the period 1997-2006 was lower in Hong Kong (1.9%) than in the US (5.5%) (Figure 7). For the catching up process, it is required higher relative productivity growth in Hong Kong. Due to wage equalization, the increase in productivity in the tradable sector will trigger an increase in wages in the whole economy, and thus an increase in relative prices of non-tradable sector. If the relative productivity in the tradable sector of Hong Kong increases faster than the relative productivity in the tradable sector in the US, the inflation rate will be higher in HK than in the US. The average productivity of tradables in HK was 4.34% and in the US was 3% for the period 1985-1997. The large increase in tradable sector productivity is due to an increase in productivity and not to the reduction in employees. Consequently the Real exchange rate should appreciate. Figure **??** shows the evolution of tradable and non-tradable sector TFP and labour productivities in Hong Kong. We include both measures because results vary with the chosen series.

The theoretical model is the following: (i) the economy is divided into the tradable sector and the non-tradable sector; (ii) the price in the tradable sector is determined on the international market due to trade integration, meaning

[17] 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.

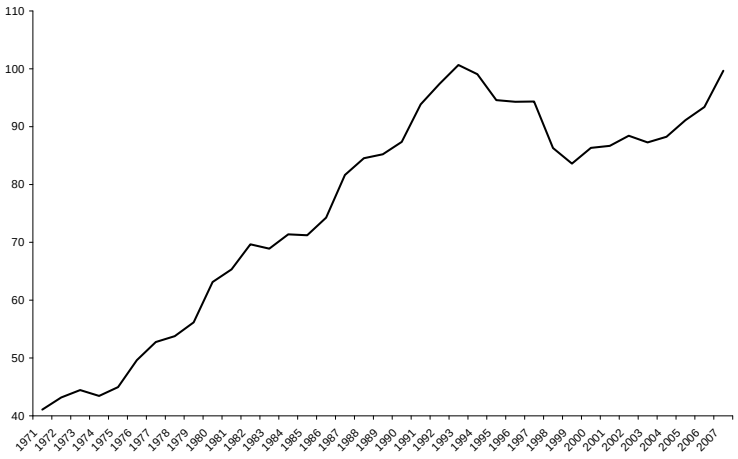


Figure 7: HK over US Real GDP per capita,

that it is assumed PPP for prices from the tradable sector and (iii) wages will equalize in these two sectors. HK is a small open economy and we have proved in the previous section through a variance analysis that, during the period 1990-97, the PPP for tradable prices holds. Regarding wage equalization, Figure 9 shows the evolution of real wages from tradable and nontradable sectors. They were similar in the period 1985-2000, and started diverging afterwards.

An increase in the productivity in the tradable sector will trigger an increase in wages and, due to labor mobility, the wages in the nontradable sector will also increase. As a consequence, in order to ensure zero profits for competitive firms, the prices in the nontradable sector will increase. General prices will increase.

Each sector follows a Cobb-Douglas production function

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

where A is total factor productivity, L is the labor force and K is the capital. In each sector firms maximize profits

$$Max\ \pi = P^i Y^i - wL^i - rK^i$$

where the FOC are:

$$\frac{w}{P^i} = (1-\alpha_i) A^i \left(\frac{K^i}{L^i}\right)^{1-\alpha_i}$$

$$\frac{r}{P^i} = \alpha_i A^i \left(\frac{L^i}{K^i}\right)^{\alpha_i}$$

Taking logs and differentiating with respect to time we have that

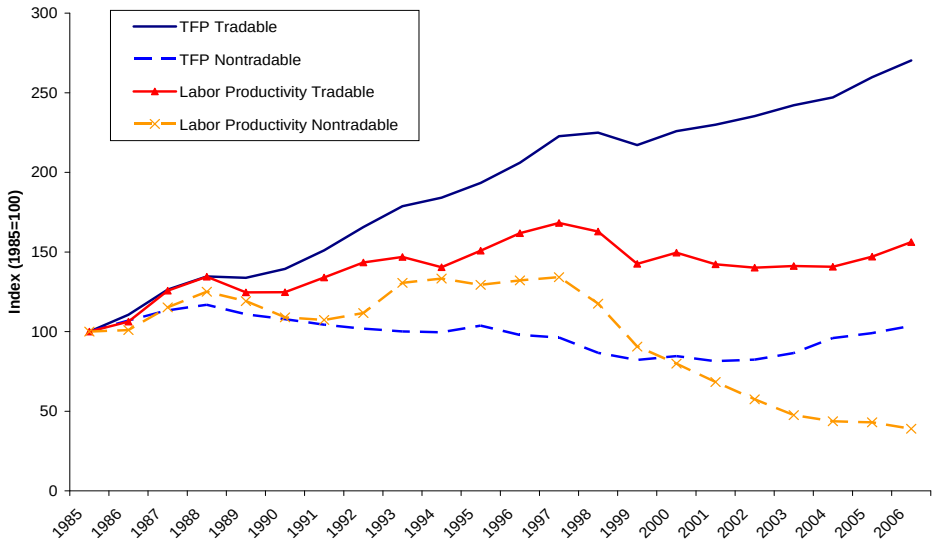


Figure 8: Tradable and Nontradable sector TFP and Labor Productivities in Hong Kong

$$\widehat{w} = \widehat{p_i} + \widehat{a_i} + (1 - \alpha_i)\widehat{\left(\frac{k^i}{l^i}\right)}$$

$$\widehat{a_i} = \alpha_i \widehat{\left(\frac{k^i}{l^i}\right)} - \widehat{p_i}$$

We assume that α is the same for both sectors. Substituting, we have that

$$\widehat{p_{NT}} - \widehat{p_T} = \widehat{a_T} - \widehat{a_{NT}}$$

or equivalently, if we assume that this expression holds for both countries

$$(\widehat{p_{NT}} - \widehat{p_T})_H - (\widehat{p_{NT}} - \widehat{p_T})_F = (\widehat{a_T} - \widehat{a_{NT}})_H - (\widehat{a_T} - \widehat{a_{NT}})_F \qquad (3)$$

where H corresponds to Hong Kong and F to the US. For US, we use labour productivity as a proxy for TFP. The data are yearly covering the period 1985-2006.

Therefore, 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 Tradable across countries. Figure 10 shows relative labor productivities and relative prices from the US and Figure 11 relative TFPs and relative prices from Hong Kong. If we calculate the correlation between relative price differential and labor productivity differential

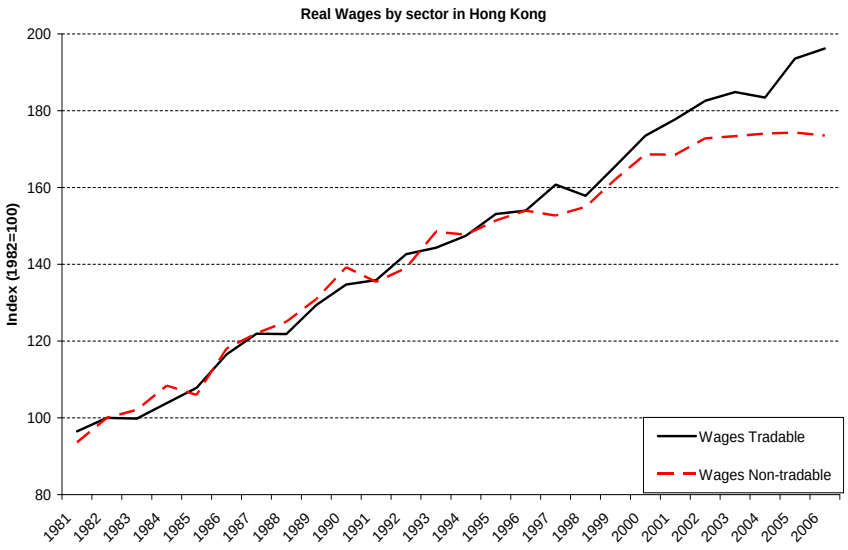


Figure 9: Real Wages in Hon Kong

for the US, we find that the correlation was 0.82 for the period 1985-2006. The correlation was very high for the period 1985-1997 (0.97) and negative (-0.26) for the period 1997-2006. In the case of Hong Kong we find that the correlation between relative prices and relative TFPs was 0.98 for the period 1985-2006. In subperiods, the correlation is high, 0.98, for the period 1985-1996, but decreases to 0.41 for the period 1997-2006[18].

Another way to check the Balassa-Samuelson effect is through the correlation between relative output growth and changes in the real exchange rate. It must be positive. Inflation can be divided into tradable and nontradable prices

$$\widehat{p} = (1-\gamma)\widehat{p_{NT}} + \gamma\widehat{p_T}$$

and assuming that $rer = e + p_F - p_H$, and that γ is the same in both countries, we obtain

$$rer = e + \widehat{p_{T,F}} - \widehat{p_{T,H}} + (1-\gamma)(\widehat{p_T} - \widehat{p_{NT}})_H - (1-\gamma)(\widehat{p_T} - \widehat{p_{NT}})_F \qquad (4)$$

Therefore, if higher relative productivity differential in Hong Kong, with respect to the US, results in higher nontradable inflation, according to Balassa-Samuelson hypothesis, then it must imply higher inflation in Hong Kong and a RER appreciation.

[18] Results are different with relative labour productivities. The correlation is 0.63 for the period 1985-2006. In subperiods, it is 0.58 for the period 1985-1997 and becames negative (-0.42) for the period 1997-2006.

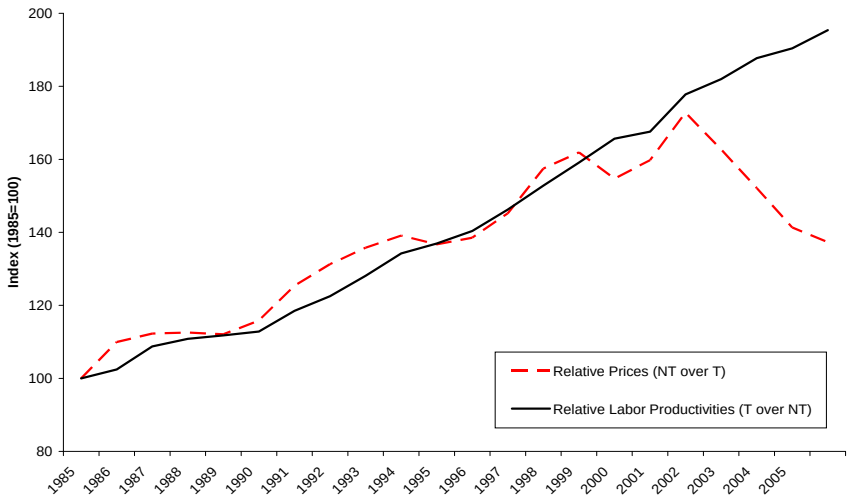


Figure 10: US Relative labor Productivities and Relative Prices

5 Conclusions

In this paper we have studied to what extent the dynamics of prices in Hong Kong can be explained by Balassa-Samuelson effect. In the period 1985-1997, the CPI in Hong Kong exhibited an spectacular inflation and, however, in the period 1997-2004 suffered a dramatical deflation.

Given that Hong Kong is an small open economy, whose degree of openess is remarkable high, *firstly*, we compare the price behavior in Hong Kong relative to its main trade patterns: USA, United Kingdom, Korea, Singapore, Japan, and in none of them we observe neither the high inflation period nor the impressive deflation observed afterwards. *Secondly*, we analyze if this different behavior in the prices in Hong Kong can be explained by the Balassa-Samuelson effect. In particular, we make the analysis with the US. And our results can be summarized as follows: *i)* in the period 1985-1997, the relative exchange rate of the tradable goods and services between Hong Kong and the US have satisfied (approximately) the law of one price, *and* that the inflation gap between Hong Kong and the US can be mostly explained by the Balassa-Samuelson effect; *ii)* however, during the deflation period, 1997-2004, the dynamics of the exchange rate of the tradable goods did experience a very different pattern from that one observed in the US, and the deflation gap between Hong Kong and the US can not be explained by the Balassa-Samuelson effect.

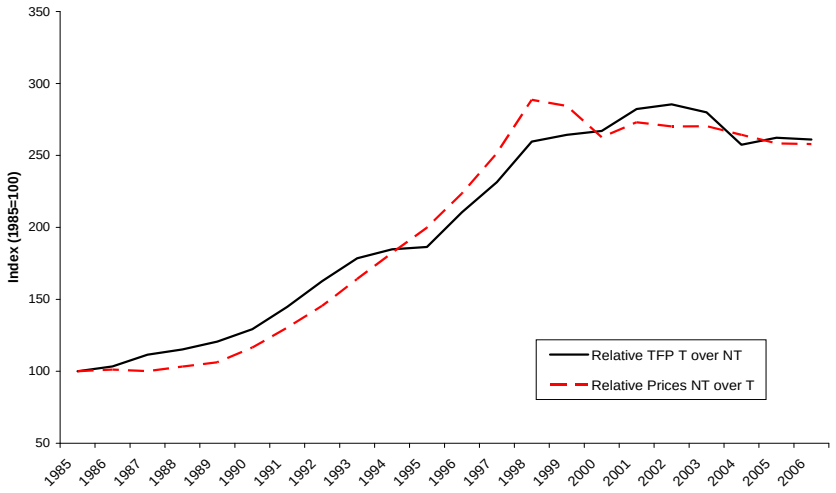


Figure 11: Hong Kong Relative TFPs and Relative Prices

6 Appendix A: Data Sources and Description

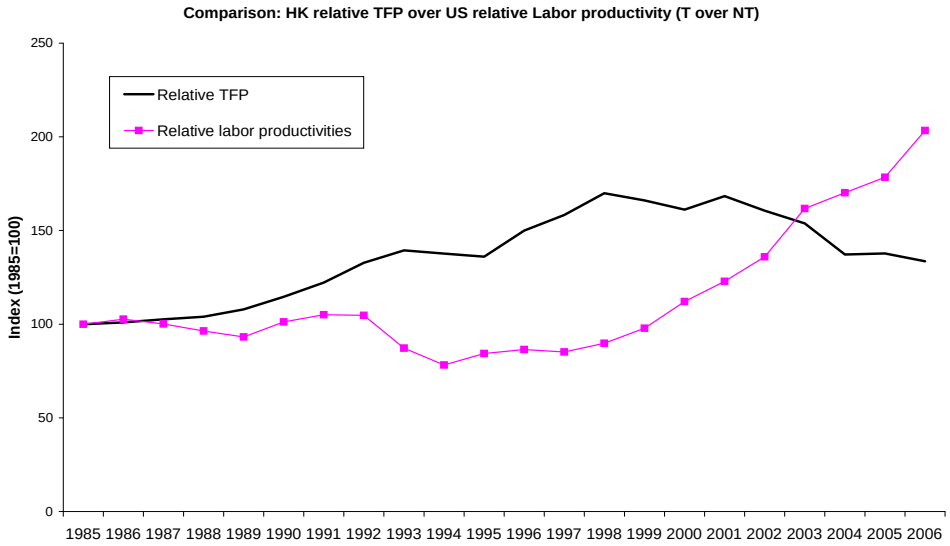
This appendix provides details on the data sources.

Labour productivity The labour productivity is calculated as sectoral value added over employed persons in the tradable and non-tradable 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[19] and by the Bureau of Economic Analysis (http/www.bea.gov).

We classify tradable and non-tradable sectors summing up different setors. 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 non-tradable sector is the aggegation 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, helthcare and social assistance, Arts and enterteinment, Accomodation and food servides, porfessional 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 are from the

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



Hong Kong Census and Statistics Department and the US Bureau of Economic Analysis.

Price of tradables is calculates as PPI, price of exports of goods and services or Unit Value Index of Exports (UVI). Prices from Non-tradables are the difference between general prices and tradable prices. PPI data for all the economies are from the International Finantial 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.

Sectoral 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 non-tradable sector GDP deflator is obtained as the geometric 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 sum all the sectors that compose he 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 sum 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 of manufacturing GDP measured in billions and then divided by 100. This is done for all subsectors in tradable and non-tradable 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 Indices

Here we show the correlations and relative standard deviations for the considered price indices.

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