Universidade Federal do Rio de Janeiro
Instituto de Economia

TRENDS AND FLUCTUATIONS IN BRAZILIAN AND ARGENTINE TRADE FLOWS

TD. 014/2004

Nelson H. Barbosa-Filho

Série
Textos para Discussão

December 21, 2004

TRENDS AND FLUCTUATIONS IN BRAZILIAN AND ARGENTINE TRADE FLOWS[*]

Nelson H. Barbosa-Filho[**]

Abstract: This paper analyzes the trends and fluctuations of the price and quantity indexes of Brazilian and Argentine exports and imports in 1980-2002. The analysis uses quarterly data and obtains the trend and fluctuations by applying either the Hodrick-Prescott or the band-pass filter (with periodicity between 1.5 and 8 years) to the original series. The main statistical findings are that: (i) even though the fluctuations of the export and import prices of the two countries are highly correlated, their terms of trade are not because the export price of one country is also highly correlated with the import price of the other country; (ii) in both countries the fluctuations of real imports basically follow the fluctuations of real GDP; and (iii) fluctuations of Brazilian GDP and real imports are highly correlated and seem to lead fluctuations of Argentine exports. To obtain these results the paper analyzes the lead, lag and contemporaneous correlation between the series in question and applies the Granger causality test to investigate whether or not one variable helps to explain the other statistically. The statistical results for the fluctuations are robust for both filters. The trends are also basically the same independently of the filter used and, overall, they seem to converge in the late 1990s. The main policy implication is that exchange-rate coordination may be useful to compensate or smooth the adjustment of the two countries to terms-of-trade shocks, provided that the managed float is flexible enough to allow the bilateral real exchange rate to change according to which country is most affected by the shock. On the real side, synchronization of real GDP would lead to synchronization of real imports, whereas exchange-rate coordination may eliminate the swings of the bilateral real exchange rate between Brazil and Argentina, which is one of the sources of their desynchronized export fluctuations.

Keywords: Brazil, Argentina, Trade, Business Cycles.

JEL area codes: F020, F420, O540

1 – Introduction

Brazil and Argentina respond for 96% of the population and GDP of *Mercosur*, that is, the success or failure of *Mercosur* depends basically on the economic integration of these two countries.[1] In the recent past, the misalignment of the Brazilian-Argentine bilateral real exchange rate was a major source of stress and an impediment to deepening the economic integration of *Mercosul*. After the Argentine crisis of 2001-02, the relative prices between the

[*] This paper is part of the research project "Macroeconomic Policy Coordination" of the *Mercosur* Economic Research Network. Financial support from the International Development Research Centre (IDRC, Canada) is acknowledged.

[**] Institute of Economics, Federal University of Rio de Janeiro. E-mail: nhbarbosa@ie.ufrj.br.

[1] The numbers are based on the population and GDP (PPP concept) data of the World Bank, available at www.worldbank.org.

two countries returned to the levels verified in the mid-1990s and, once again, the two countries face the issue of coordinating their macroeconomic policies, especially their exchange-rate policy, to promote the economic integration of *Mercosul*.

Because of the financial shocks to the two countries in recent years, the discussion of macroeconomic coordination has been predominantly focused on capital flows and financial issues. The basic issue is whether and how macroeconomic coordination can help Brazil and Argentina to cope with the fluctuations in foreign financial conditions without disrupting their trade and financial relations. Since most of the foreign shocks now come through the capital account, the analysis of macro policy tends to be focused on the impact of domestic interest rates and budget deficits on investors' expectations about the countries' foreign financial fragility. However, independently of the importance of capital flows for foreign finance, it is also necessary to analyze macroeconomic coordination from the perspective of the current account. Fluctuations of international capital flows tend to loose or tighten the liquidity constraint on Brazil and Argentina and, through this, they end up determining the current-account adjustments of the two countries. If the two countries aim to coordinate their macro policies, it is therefore necessary to check whether their current account deficits tend to fluctuate in a similar way.

For Brazil and Argentina, fluctuations of the current account are basically determined by fluctuations of the trade balance. The pattern in the two countries is for the trade balance to adjust to the availability of foreign finance. In periods of high international liquidity, the trade balance tends to fall after the increase in capital flows, which are usually accompanied by a reduction of real exchange rates. In periods of low international liquidity the opposite tends to happen.

The objective of this paper is to analyze whether or not the trade flows of Brazil and Argentina fluctuate together. In other words, the objective is to estimate and analyze the degree of co-movement of the price and quantity indexes of Brazilian and Argentine exports and imports. To do this we de-trend the series using standard statistical filters used in macroeconometrics, and then analyze the synchronization of price and quantity fluctuations.

The text is organized in four sections in addition to this introduction. Section two presents the trend and fluctuations of the price and quantity indexes of the trade flows. Section three analyzes the degree of co-movement and Granger causality between the price and terms-of-trade series. Section four does the same for real exports and imports, as well as analyzes the relationship of these series with GDP fluctuations. Section five concludes with analysis of exchange-rate coordination in face of the correlations and Granger causality observed between the series.

2 – Alternative estimates of trends and fluctuations

This section presents the trends and fluctuations of Brazilian and Argentine exports and imports based on the Hodrick-Prescott (HP) and Band-Pass (BP) filtering methodologies. The HP filter was applied to the seasonally adjusted series with a smoothing parameter of 1600. The BP filter was set to capture fluctuations with periodicity between 6 to 32 quarters (1.5 to 8 years) and applied to the series without seasonal adjustment.[2] As shown in figures 1 and 2, both methodologies estimate basically the same long-run trends for the value, price and quantity indexes of exports and imports. The main difference is that the BP series are shorter than the HP ones because we used the first and last 12 observations to apply the BP filter.[3]

See figures1 and 2.

In economic terms, the trends can be interpreted as the result of long-run "waves" with a periodicity of eight years of more.[4] By analogy, the fluctuations represent short-run and medium-run "waves" with a periodicity of less than eighth years. The main difference between the HP and BP estimates is that the former does not separate short from medium-run factors, whereas the latter captures only medium-run factors, that is, fluctuations with periodicity within the pre-specified bounds.[5] As shown in figures 3 and 4, for all series under analysis the HP and BP fluctuations are highly synchronized, but the BP estimates are smoother than the HP ones. The main reason is that seasonally adjusting the series before applying the HP filter does not completely eliminate short-run (high-frequency) fluctuations.

See figures 3 and 4

To measure the synchronization of the HP and BP trends and fluctuations, table 1 presents the contemporaneous correlation between the two estimates of each series under analysis. On the one hand, the correlation between the trends is very close to one for all variables considered. On the other hand, the correlation between the fluctuations is also high, ranging from 0.78 to 0.86 depending on the variable considered. See table 1.

Since the estimated trend components are basically the same independently of the filter we use, the next sections refer only to the HP estimate when analyzing long-run factors. The

[2] For the foundations and implications of the HP filter, see, for instance, Hodrick and Prescott (1997). For the BP filter see, for instance, Baxter and King (1995). The HP smoothing parameter was set at 1600 because this is the value recommended by Hodrick and Prescott (1997) and adopted in the literature. The higher this value, the more the trend series resembles a linear trend. The BP periodicity was set between 1.5 and 8 years because this are the values recommended by Baxter and King (1995) and used in the literature on business fluctuations.

[3] The higher the number of observations used, the more precise the filter. The BP filter uses the first and last 12 observations because of the short sample.

[4] The long-run BP trend was estimated through a high-pass filter that excludes fluctuations with a periodicity of less than eight years.

[5] In fact, the HP filter can be interpreted as an approximation of a low-pass filter, that is, a filter that captures fluctuations with periodicity above a pre-specified value.

analysis of business fluctuations will compare the HP with the BP results to check whether or not the filtering methodology has an important impact on the estimated correlation coefficients.

To complete the statistical description of the series, tables 2 and 3 present the variance and autocorrelation coefficients of the HP and BP estimated fluctuations. See tables 2 and 3.

Overall, the variances of the HP and BP series are basically the same and, in any cross-variable or cross-country comparisons, the ordering of volatility is also the same. For instance, during the period under analysis, Brazilian import prices were more volatile than Brazilian export prices independently of the filter we use. In the same way, Brazilian export prices were less volatile than Argentine export prices independently of the filter we use. Altogether, the stylized facts about the volatility of the series can be summarized as follows:

(i) For Brazil, the fluctuations were less volatile for export prices than for import prices, and for real exports than for real imports. The exact opposite holds for Argentina.

(ii) The fluctuations of export prices were more volatile for Argentina than for Brazil, whereas the fluctuations of import prices were more volatile for Brazil than for Argentina.

(iii) The fluctuations of the terms of trade were more volatile for Brazil than for Argentina.

(iv) The fluctuations of real exports were more volatile for Brazil than for Argentina, whereas the fluctuations of real imports were more volatile for Argentina than for Brazil.

Moving to serial correlation, for each series the ordering of the estimated coefficients is the same independently of the filter we use. For instance, take the fluctuations of the Brazilian export price. According to the tables 2 and 3 the 1^{st}-order serial correlation is higher than the 2^{nd}-order serial correlation and so on in both the HP and BP methodologies.

Comparing the price and real indexes of exports and imports of the same country, in almost all cases the price fluctuations show a higher serial correlation than the “quantity” fluctuations. Only for Argentine imports the serial correlation for prices is smaller than the serial correlation for quantities. Since the absolute value of serial correlation can be interpreted as a proxy of the persistence of exogenous shocks, we can conclude that real shocks die out faster than price shocks for Brazilian exports and imports and for Argentine exports. The opposite happens only for Argentine imports.

Comparing the price and real indexes of the two countries, the values in table 2 and 3 indicate that, in the case of export prices, the persistence of shocks is higher for Brazil than for Argentina independently of the filter we use to de-trend the original series. Conversely, in the

case of real imports, persistence is lower for Brazil than for Argentina. For the rest of the variables the ordering of the countries varies according to the filter we use. Assuming that the BP filter gives us the best estimates of business (medium-run) fluctuations, then persistence is higher for Brazil in the case of exports prices and lower for all of the other variables.

3 – Prices and terms of trade

Figure 5 shows the long-run trends of the export price, import price and terms of trade Brazil and Argentina. Considering each trend series separately, the main stylized facts are:

(i) Export prices: the trends of both countries fell in the early 1980s, grew from the mid-1980s through the mid 1990s, and fell again thereafter. The main differences were that the ups and downs were larger for Argentina than for Brazil, and that the Argentine trend grew continuously from 1987 through 1996, while the Brazilian trend grew from 1984 through 1990, remained fairly stable in 1991-92, and then grew again from 1993 through 1997.

(ii) Import prices: the trends of both countries moved in opposite direction during most of the 1980s, but in the same direction during the most of the 1990s. More specifically, while the Brazilian trend reached a peak in 1983, a trough in 1987, and another peak in 1990, the Argentine trend reached a trough in 1984 and a peak in 1990. After 1990 both trends of prices moved downward, but, until 1996, the reduction for Argentina was much slower than for Brazil.

(iii) Terms of trade: the sample can be divided in a sequence of common and opposite trends. First, in 1980-84, both countries had a downward trend. Then, in 1984-88, the Brazilian trend recovered while the Argentine one continued to fall. After desynchronized turning points in the late 1980s, both countries had a common upward trend in 1990-97 and, after that, the Brazilian trend fell while the Argentine trend remained fairly stable.

See figure 5.

Focusing on the fluctuations around the trends, figure 6 shows the HP and BP estimates for price and terms-of-trade series of Brazil and Argentina. In general, there seems to be a synchronized fluctuation of the export prices of both countries, especially when we use the HP estimate. There also seems to be a synchronized fluctuation of import prices after 1988. Despite this, the resulting fluctuations of the terms of trade do not show a clear pattern. The main stylized facts are:

(i) Export prices: there was a synchronized and common fluctuation in 1983-85, followed by an also synchronized but opposite fluctuation in 1985-87. Then, in 1988-91, there was once again a common synchronized fluctuation and, after a brief divergence in 1992-93, both countries experienced a similar wave-like pattern in the rest of the 1990s.

(ii) Import prices: there were synchronized and common fluctuations of the import prices of both countries only after 1988. Even though the volatility and timing of the fluctuations are not exactly the same, both series moved in the same direction during most years after 1988, that is, they both reached a peak in 1991, a trough in 1993 and another peak in 1996.

(iii) Terms of trade: because of the low common movement of import prices, the fluctuations of the terms of trade were basically driven by the fluctuation of export prices. The resulting terms-of-trade series alternates periods of common fluctuations with periods of opposite fluctuations and, in this way, do not reveal any clear pattern.

See figure 6.

In order to measure the degree of common fluctuations between the series, tables 4 and 5 present the lead, lag and contemporaneous correlation between the cyclical components of the export price, import price and terms of trade. Even though the values of the estimated correlation coefficients vary according to the filter used, the ordering is basically the same. In other words, for almost all pairs of variables considered, the estimated correlation coefficients give us the same qualitative information. See tables 4 and 5.

Let us use the absolute value of the coefficients in tables 4 and 5 as a guide for the existence of lead, lag or contemporaneous correlation. In all pairs of variables considered the correlation coefficient between the BP variables is higher than the one between the HP variables. Since the former excluded short-run (high-frequency) components, the economic intuition is that the “medium-run” correlation (periodicity between 1.5 and 8 years) is higher than the “short-run” correlation (periodicity smaller than 1.5 year) for all series under analysis.

Considering the fluctuations of each pair of variables separately, the stylized facts are:

(i) There is a high positive contemporaneous correlation between the Brazilian and Argentine exports prices. The highest coefficients occur with no lead or lag for both the HP (0.624) and BP (0.719) estimates of fluctuations.

(ii) There is a medium positive contemporaneous correlation between Brazilian and Argentine import prices. The highest coefficients occur again with no lead or lag for both the HP (0.464) and BP (0.528) estimates of fluctuations.

(iii) There is a high positive contemporaneous correlation Brazilian export and Argentine import prices. The highest coefficients occur with no lead or lag for both the HP (0.692) and BP (0.821) estimates of fluctuations.

(iv) There is a medium positive contemporaneous correlation between Brazilian import and Argentine export prices. The highest coefficients occur with no lead or lag for both the HP (0.391) and BP (0.451) estimates of fluctuations.

(v) Within the same country, there is a medium to high positive and lead correlation between import and export prices. The exact order of the lead depends on how we estimated the fluctuations. According to the HP estimates, changes in import prices lead to changes of export prices after two quarters in Brazil (0.564) and three quarters in Argentina (0.399). According to the BP estimates, the import-export lead is three quarters in Brazil (0.556) and one quarter in Argentina (0.581).

The results for the terms of trade depend on the filtering methodology. When we use the HP estimates, the estimated coefficients indicate a small negative lead correlation between Argentina and Brazil (-0.136). In other words, given an increase in the Argentine terms of trade, the Brazilian terms of trade tend to fall after four lags. In contrast, when we use the BP measures, the estimated coefficient indicates a small positive contemporaneous correlation (0.149) between the two countries. Given that both methodologies give us a positive contemporaneous correlation between the two countries, and a negative lead correlation of Argentina over Brazil, the discrepancy comes from differences in the values rather than in the sign of the correlations.

It should be noted that, also according to the BP estimates, the contemporaneous (0.149) and lead Argentina-Brazil (-0.148) correlation coefficients have approximately the same absolute value. Because of this, the best conclusion is that the there is both a low positive contemporaneous correlation between Brazil and Argentina, and a small negative lead correlation of Argentina over Brazil.

The next natural question is why the contemporaneous correlation between the terms of trade is low given the high positive contemporaneous correlations between the export prices on the one hand, and the import prices on the other hand? The answer lies on the correlation between the export prices one country and the import price of the other country. For instance, consider the BP estimates. The correlation between export prices of both countries is high (0.719), but the correlation between the export price of Brazil and import price of Argentina is even higher (0.821). Thus, given a shock to the Brazilian export price, both the export and

import prices of Argentina tend to move in the same direction and approximately in the same proportion. As a result, the Argentine terms of trade do not vary much.[6]

By analogy, the same reasoning applies to the import prices, that is, the positive correlation between the import prices (0.528) of both countries is almost fully compensated by the also positive correlation between Brazilian import prices and Argentine export prices (0.451). The result is again a small positive correlation between the terms of trade of both countries.

The "cross-price" correlations also indicate an asymmetry between the two countries, that is, the "impact" of the Brazilian export price on the Argentine import price (0.692 and 0.821 according to the HP and BP estimates, respectively) is substantially higher than the "impact" of the Argentine export price on the Brazilian import price (0.391 and 0.451 according to the HP and BP estimates, respectively). In economic terms this means that the composition of Brazilian exports is more similar to the composition of Argentine imports than the reverse.

In order to investigate the statistical causal relation between any two series, we estimated a vector auto regressive (VAR) system with four lags and a constant term for the HP estimates of price fluctuations, and then used the estimated autoregressive (AR) coefficients to test whether or not there exists Granger causality between any two variables.[7] In general terms the Granger causality test indicates whether or not one variable helps to explain the other variable at some pre-specified significance level.[8] As shown in table 6, at 10% of statistical significance we have that:

(i) Brazilian and Argentine export prices do not Granger cause each other.

(ii) Brazilian and Argentine import prices Granger cause each other, that is, changes in the import price of one country tends to precede changes in the import price of the other country.

(iii) Brazilian export prices and Argentine import prices also Granger cause each other.

(iv) Brazilian import prices do not Granger cause Argentine export prices, but Argentine export prices do Granger cause Brazilian import prices.

(v) Within each country, export prices Granger cause import prices, but the reverse is not true.

In short, the main findings are that changes in export prices tend to precede changes in import prices within the same country and, changes in the export or import prices of one country

[6] As presented in Barbosa-Filho (2004a), a similar pattern emerges from the annual data on all four Mercosul countries.
[7] We do not estimate VAR models for the BP series because we have less 24 observations than for the HP series.
[8] See, for instance, Hamilton (1994, pp.302-309).

tend to lead changes in the import price of the other country. Despite these relationships, as also shown in table 6, there is no evidence of Granger causality between the terms of trade of both countries at 10% of statistical significance. See table 6.

4 – Real exports and imports

Figure 7 shows the HP trends of real exports and imports of Brazil and Argentina. Considering each trend series separately, the main stylized facts are:

(i) Real exports: both countries had an upward trend during the period under analysis. The main difference is that Brazilian real exports grew faster in the early and mid-1980s, whereas Argentine real exports grew faster between the mid-1980s and mid-1990s.

(ii) Real imports: both countries had a common wave-like trend during the period under analysis, that is, both trends reached a trough in the mid-1980s and a peak in the late 1990s.

The common trend of real imports of Brazil and Argentina can be interpreted as the result of the boom and bust of international finance to these countries during the 1990s, which in their turn resulted in a boom and bust of the GDP of both countries.[9]

Figure 8 shows the fluctuations of real exports and imports according to the HP and BP methodologies. The main evidence from the graphs is that, from the late 1980s through the late 1990s, there seems to have happened synchronized fluctuations, but in opposite directions. More specifically, the main stylized facts are:

(i) Real exports: no clear pattern until 1987, synchronized fluctuations in opposite directions from 1987 through 1996, and no clear pattern after that.

(ii) Real imports: common fluctuations in the early and mid-1980s, followed by opposite fluctuations from 1988 through 1996, and then once again common fluctuations after 1996.

As we did with the price series, tables 7 and 8 shows the lead, lag and contemporaneous correlation between the fluctuations of real exports and imports of Brazil and Argentina. The correlation pattern is almost the same for both the HP and BP estimates of fluctuations. Considering each pair of variables separately, we can conclude that:

[9] For an analysis of how foreign financial conditions tend to impact on the level of economic activity of liquidity-constrained countries, see Barbosa-Filho (2004b).

(i) There is a medium negative lead correlation between Brazilian and Argentine exports, that is, given a change in the former, we tend to observe an opposite change in the latter after four quarters.

(ii) There is approximately no lead, lag or contemporaneous correlation between the imports of Brazil an Argentina. The absolute values of all estimated coefficients are low and the sign depends on which methodology we use to filter the original series.

(iii) There is a low positive lead correlation between Brazilian exports and Argentine imports, that is, given a change in the former, we tend to observe a change in the latter in the same direction after one year.

(iv) There is a low positive contemporaneous correlation between Brazilian real imports and Argentine real exports.

(v) Within the same country, there is a negative contemporaneous correlation between exports and imports.

See tables 7 and 8.

Comparing figure 8 with the results in table 7 and 8, we confirm that there seems to be a negative correlation between the real exports of Brazil and Argentina. On the other hand, the alternation of periods of common and opposite fluctuations of real imports results in no clear pattern between the two countries. In addition to this, the positive correlation between the real exports of one country and real imports of the other country confirm the expected impact of bilateral trade.

In order to investigate how the fluctuations of real exports and imports are related to income, figures 9 and 10 plot the HP and BP series against the corresponding fluctuations of the real GDP of Brazil and Argentina. To facilitate the interpretation, each graph uses a double scale with real GDP on the left axis and real exports or imports on the right axis. The visual analysis confirms the economic intuition, that is, exports tend to be counter-cyclical and imports pro-cyclical. More specifically:

(i) For both Brazil and Argentina, exports and income fluctuated in opposite directions during most years between the mid-1980s and mid-1990s.

(ii) For both Brazil and Argentina and during almost all the period under analysis, fluctuations of real imports are highly synchronized with fluctuations of real GDP.

See figures 9 and 10.

Tables 9 and 10 translate the time paths into numbers and confirm the expected relation between income and exports and imports. In short:

(i) Within the same country there is a negative correlation between income and exports. The absolute value of the correlation is higher for Argentina than for Brazil and, in the case of Brazil, changes in real exports seem to precede changes in real income (in the opposite direction) in one quarter.

(ii) Within the same country there is also a high positive correlation between income and imports. The correlation is higher for Argentina than for Brazil and, in the case of Brazil, changes in imports seem to precede and be positively correlated with changes in income after one lag.

See tables 9 and 10.

The general conclusion is that, for Brazil, the trade balance tends to worsen shortly before upswings, and improve shortly before downswings in real GDP. For Argentina the trade balance also tends to fluctuate in the opposite direction, but at the same time as real GDP.

Finally, in order to test whether or not one variable Granger causes another, we estimated a VAR model with four lags for the exports, imports and income of both countries. Table 11 presents the results of all Granger causality tests and, at 10% of statistical significance, the main findings are:

(i) In both countries real GDP Granger causes real imports.

(ii) Brazilian real GDP and real imports Granger causes Argentine real exports.[10]

(iii) Brazilian real exports Granger causes Argentine real exports.

(iv) Argentine real GDP Granger causes Brazilian real imports.

In economic terms the first finding confirms the intuitive idea that income fluctuations lead and cause import fluctuations within the same country, whereas the second finding confirms the also intuitive idea that, between any two adjacent economies, income fluctuations in the largest economy lead export fluctuations in the smallest economy.

The third finding may reflect two factors: the similar composition of the two countries' exports to the rest of the world and the different timing of macro policy. In other words, Brazilian exports may lead Argentine exports because of common fluctuations in the world demand for the products of both countries, or because the different timing of real-exchange-rate variations in each countries. Given that Brazilian real exports have a positive impact on Argentine exports, the world demand seem to be the driving force behind the Granger causality

The last finding implies that fluctuations in the income of the smallest economy (Argentina) lead fluctuations in the imports of the largest economy (Brazil). Given the counter

[10] Note that, at 10.5% of statistical significance, Brazilian real GDP also Granger causes Argentine real imports.

intuitive meaning of this, the Granger causality is probably a result of the different timing of devaluations and revaluations in both countries during the period under analysis. In other words, the Argentine GDP may have a negative impact on Brazilian imports because of changes in the bilateral real exchange rate of the two countries. For instance, take the case where Argentina revalue and Brazil devalue against the US dollar. The Argentine GDP is likely to increase because of the positive wealth and income effects of currency appreciation, whereas Brazilian imports are likely to fall because of the negative wealth and income effects of depreciation. See table 11.

5 – Conclusion

The previous sections presented many statistical results. To complete the analysis we have to translate these results into economic assumptions, which in their turn can be used to analyze the implications of the stylized facts for macro policy, especially exchange-rate coordination. To facilitate the analysis and based on the assumption that Brazil and Argentina are price takers in the world economy, let us analyze price and quantity issues separately.

Starting with prices, the main finding is that even though the export and import prices of Brazil and Argentina are highly correlated, their terms of trade are not. In economic terms this result means that, on the one hand, both countries have a similar position in the world division of production, that is, they tend to export and import a similar basket of goods. On the other hand, their bilateral trade is also important, in the sense that an increase in the export price of Brazil tends to increase the import price of Argentina and vice versa. The final effect is a small positive correlation between the terms of trade of both countries, with no country seeming to Granger cause the other.

In the above context, exchange-rate coordination may be useful to adjust the trade balance to foreign shocks (because the terms of trade do move in the same direction), provided that the managed float is flexible enough to allow risk diversification (because the terms of trend do not move in the same proportion). For instance, take the case of an adverse terms-of-trade shock to Brazil.[11] In order to avoid or smooth the reduction in its trade balance, Brazil may devalue its currency against the rest of the world. Because domestic prices are rigid, the change in the nominal exchange rate results in a change in the real exchange rate and, through this, it impacts on the trade balance. Since the Argentine terms of trade are also likely to fall, it may also be useful for Argentina to follow Brazil and devalue. However, because of the reduction in the terms of trade tend to be smaller for Argentina than for Brazil after a shock to

[11] The same pattern and conclusion can be obtained from the annual data analyzed in Barbosa-Filho (2004b).

the latter, the subsequent devaluation should be larger for Brazil than for Argentina. The reverse would happen in the case where the adverse shock is more intense for Argentina.

In short, after a negative terms-of-trade shock to Brazil, both Brazil and Argentina may devalue to avoid a change in their trade and current account balances away from what is considered safe for macroeconomic stability. Between the two countries, the Argentine currency should appreciate in relation to the Brazilian currency, in real terms, because Brazil is the country most affected by the shock. The result is that Argentina will partly bear the cost of adverse shocks to Brazil and, when the roles are reversed, Brazil will partly bear the cost of adverse shocks to Argentina.

Given the small positive correlation between their terms of trade, and assuming that both countries want to manage their exchange rates to adjust trade to foreign financial conditions (the liquidity-constraint hypothesis), it may be sensible for Brazil and Argentina to jointly manage the float of their currencies against the rest of the world. The initial arrangement should be flexible and similar to the European Monetary System of 1979-98, that is, it should start by specifying wide intervals for the fluctuation of the Brazilian and Argentine currencies around a common exchange rate against, say, the US dollar. To avoid creating opportunities for speculative attacks, the exchange-rate coordination should also contain exit clauses to deal with extraordinary conditions.

Besides helping trade and current-account adjustments, a Brazilian-Argentine exchange-rate coordination would also reduce the risk of a regional currency misalignment leading to massive and de-stabilizing capital flows between the two countries. Both countries will still have to cope with the de-stabilizing impact of the booms and busts in international finance coming from advanced countries but, with regional exchange-rate coordination, the timing of such booms and busts would tend to be the same for both countries. Finally, the stability of the bilateral real exchange rate would also boost bilateral trade and open room for the integration and deepening of the financial markets of both countries.

Moving to quantities, the main findings are that import fluctuations tend to follow income fluctuations very closely in both countries; that fluctuations in Brazilian real GDP tend to lead fluctuations in Argentine exports; and that fluctuations of Brazilian and Argentine real exports are negatively correlated. In economic terms, these findings mean that a synchronization of GDP fluctuations would be sufficient to bring a synchronization of real imports. Since misalignments of real exchange rates have been one of the main sources of GDP de-synchronization between Brazil and Argentina, exchange rate coordination could be useful to promote a common fluctuation of imports.

On the side of exports the situation is not so straightforward. If anything, Brazilian and Argentine real exports seem to be negatively correlated, with the former seeming to Granger cause the latter. Thus given a positive shock to Brazilian real exports, Argentine exports tend to fall in the subsequent quarters and the trade balances of both countries tend to move in opposite directions. In this case exchange-rate coordination would not be useful to adjust trade because when one country (Brazil) needs to appreciate its currency, the other (Argentina) needs to depreciate and vice versa.

Two factors may attenuate the above effect of exchange-rate coordination. First, because the results do not control for exchange-rate variations, the negative correlation between real exports may be itself a result of the different timing of devaluations and revaluations in Brazil and Argentina during the period under analysis. If so, exchange-rate coordination would actually promote synchronized fluctuations of real exports. Second, even if real exports are still negatively correlated after we control for exchange-rate factors, exchange-rate coordination may still be useful to compensate or smooth the adjustment of the trade balance of both countries to changes in international prices. In this case the bilateral real exchange rate would not move to compensate fluctuations of real exports and imports, but only to compensate or smooth fluctuations in terms of trade.

The final conclusion is that, from the perspective of trade and current-account adjustments, there is room for exchange-rate coordination between Brazil and Argentina, provided that the coordination is flexible enough to accommodate the difference in the intensities of price shocks to both countries. At their current stage of integration, Brazil and Argentina could jointly manage the float of their currencies to stabilize their bilateral real exchange rate and, through this, promote trade and financial integration between each other, and increase their competitiveness in the world economy. After the first steps are taken, the positive feedback of exchange-rate coordination to economic and financial integration would then indicate whether or not the two countries should carry the process toward monetary unification.

References:

Barbosa-Filho, N.H. (2004a). Terms-of-trade fluctuations and their implications for exchange rate coordination in Mercosul. Institute of Economics, Federal University of Rio de Janeiro.

Barbosa-Filho, N.H. (2004b). “International Liquidity and Growth in Brazil.” In. G Epstein (org). Financialization and the Global Economy, Cheltenham: Edward Elgar, forthcoming.

Hamilton, J.D. (1994). Time Series Analysis. Princeton: Princeton University Press.

Hodrick, R.J. and E.C. Prescott (1997). “Postwar US business cycles: AN empirical investigation.” Journal of Money, Credit and Banking, 29 (1), pp. 1-16.

Baxter, M. and King, R. (1995). “Measuring business cycles: approximate band-pass filters for economic time series.” NBER Working Paper 5022.

Figure 1: Long-run trends of Brazilian exports and imports obtained through the Hodrick-Prescott (HP) and Band-Pass (BP) filters.

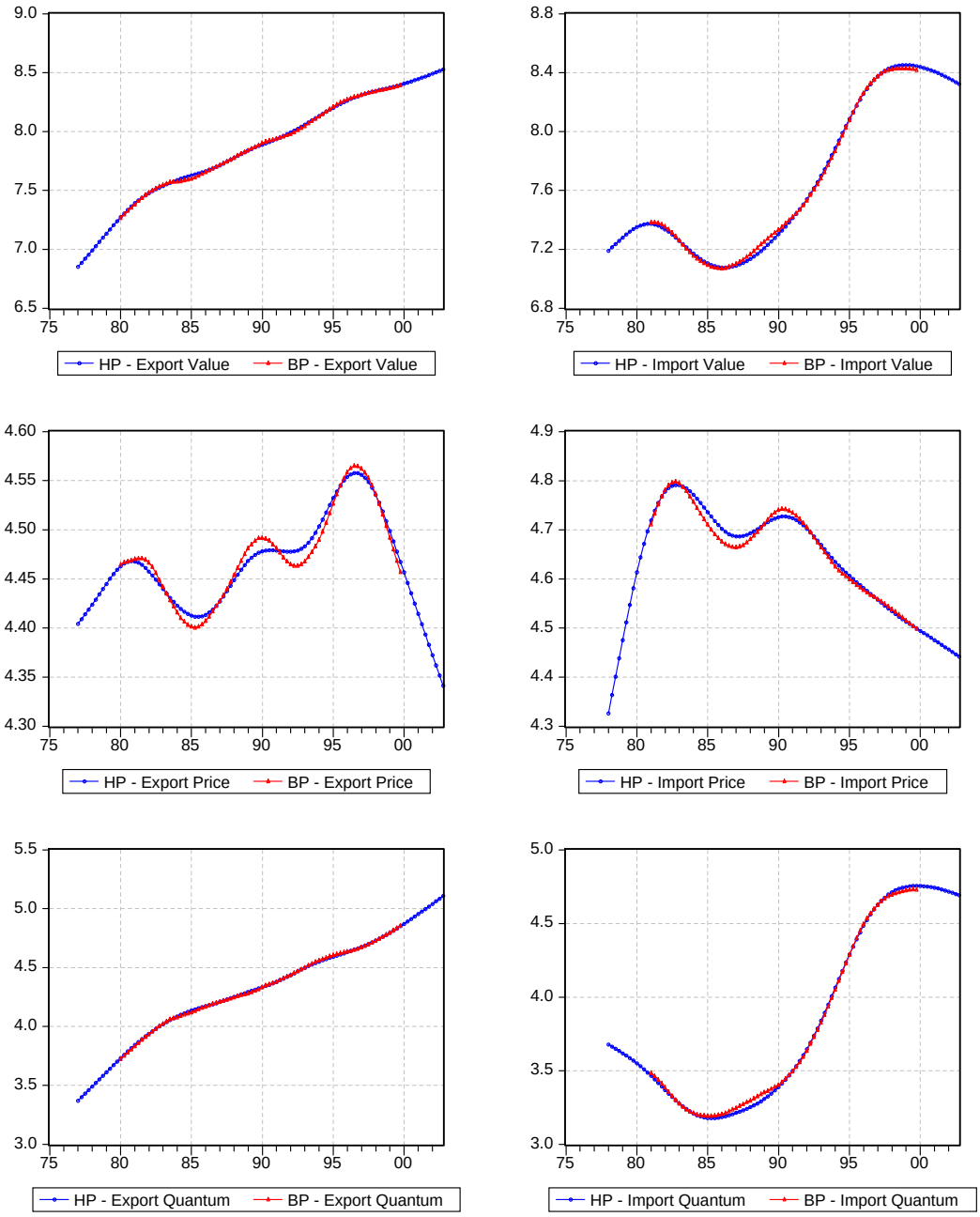


Figure 2: Long-run trends of Argentine exports and imports obtained through the Hodrick-Prescott (HP) and Band-Pass (BP) filters.

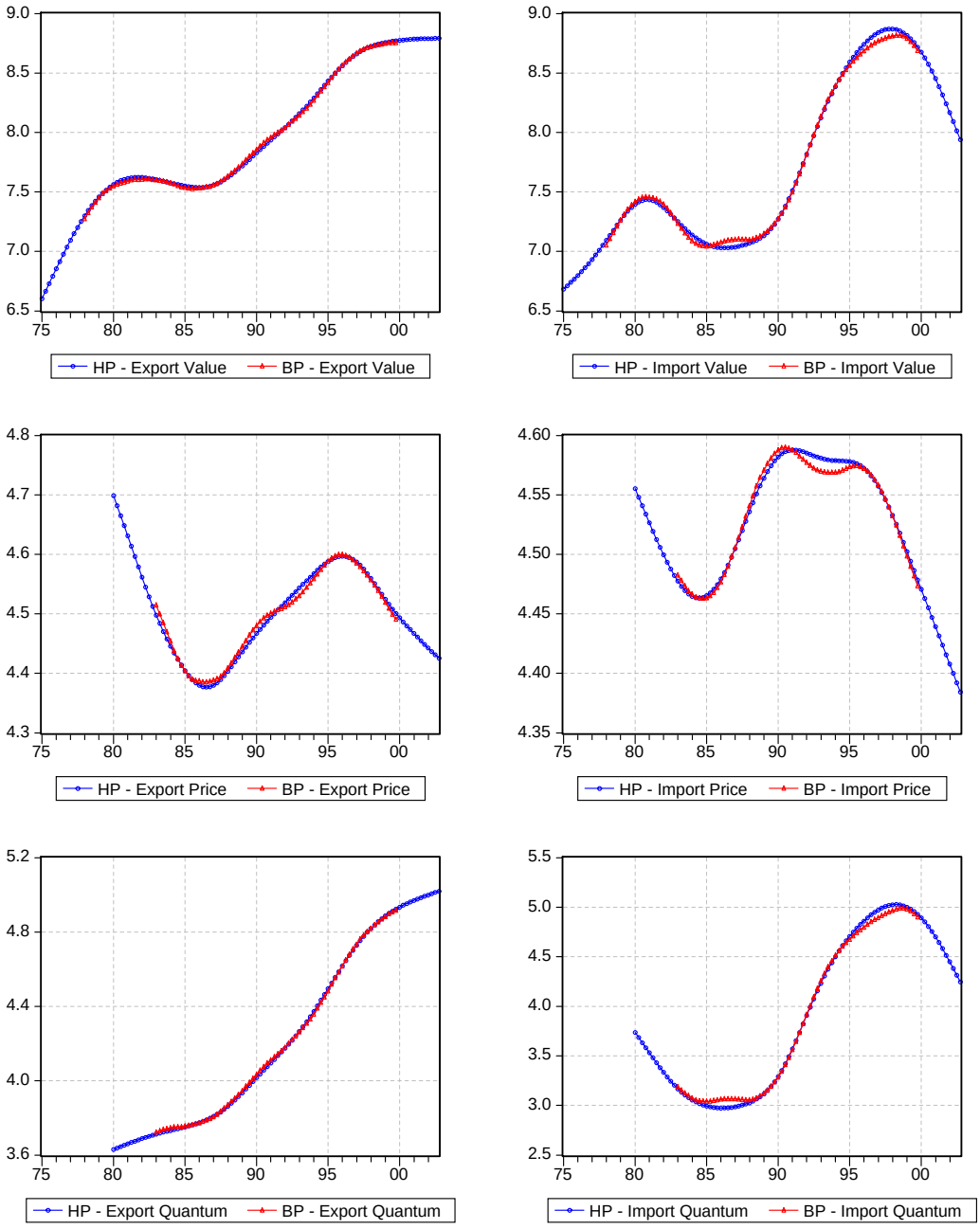


Figure 3: Business fluctuations of Brazilian exports and imports obtained through the Hodrick-Prescott (HP) and Band-Pass (BP) filters.

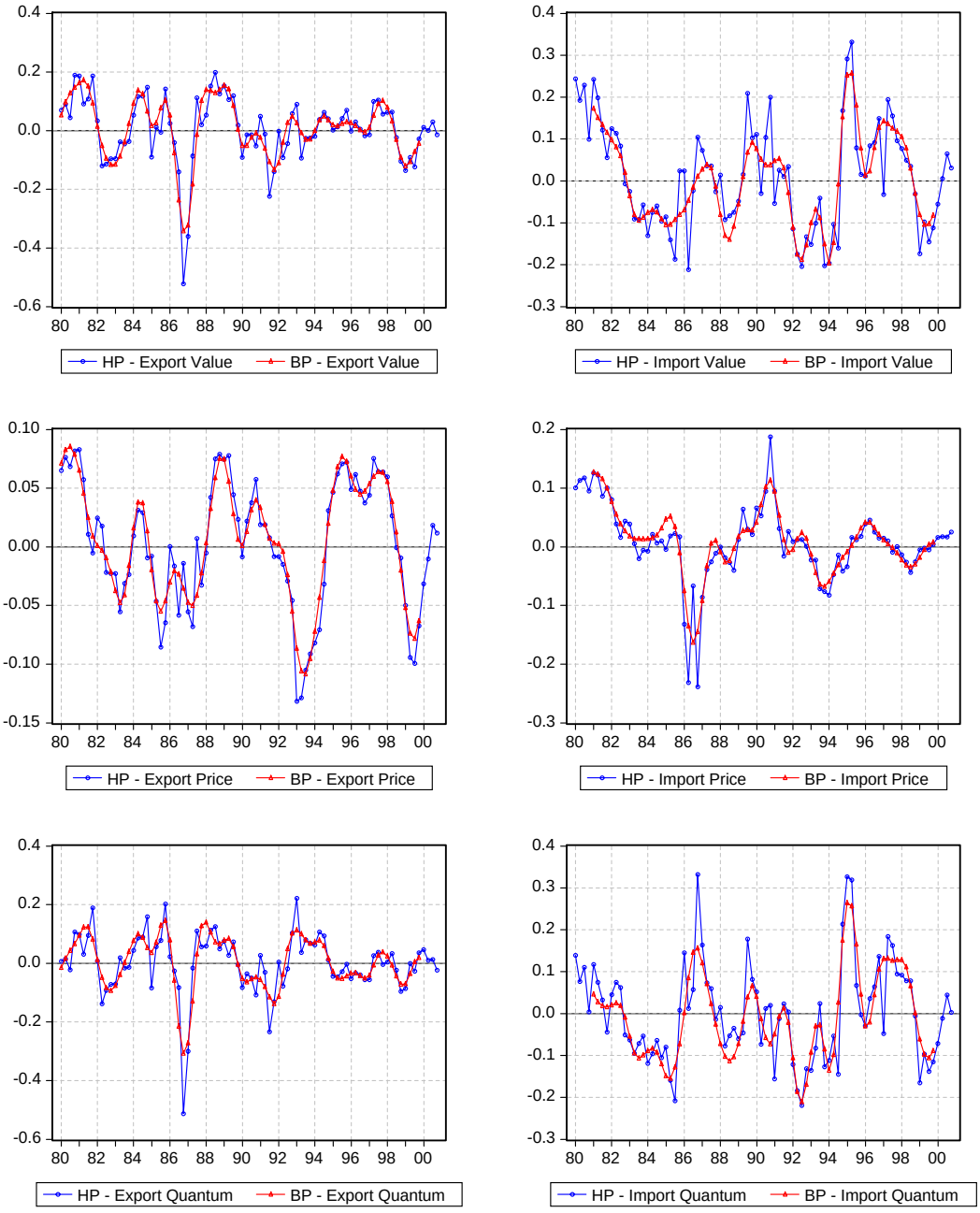


Figure 4: Business fluctuations of Argentine exports and imports obtained through the Hodrick-Prescott (HP) and Band-Pass (BP) filters.

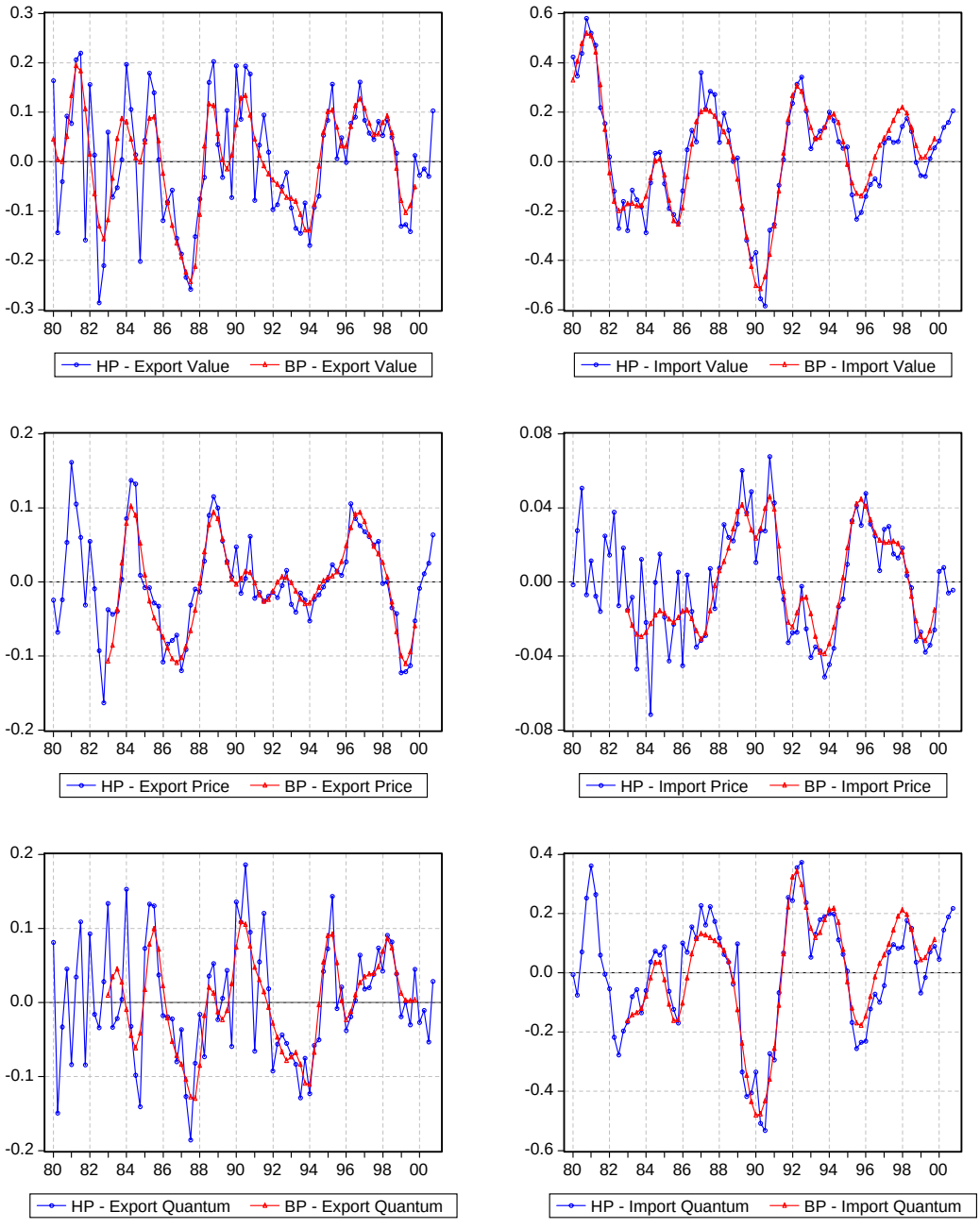


Figure 5: Long-run Hodrick-Prescott trends of the export price, import price and terms-of-trade indexes of Brazil and Argentina.

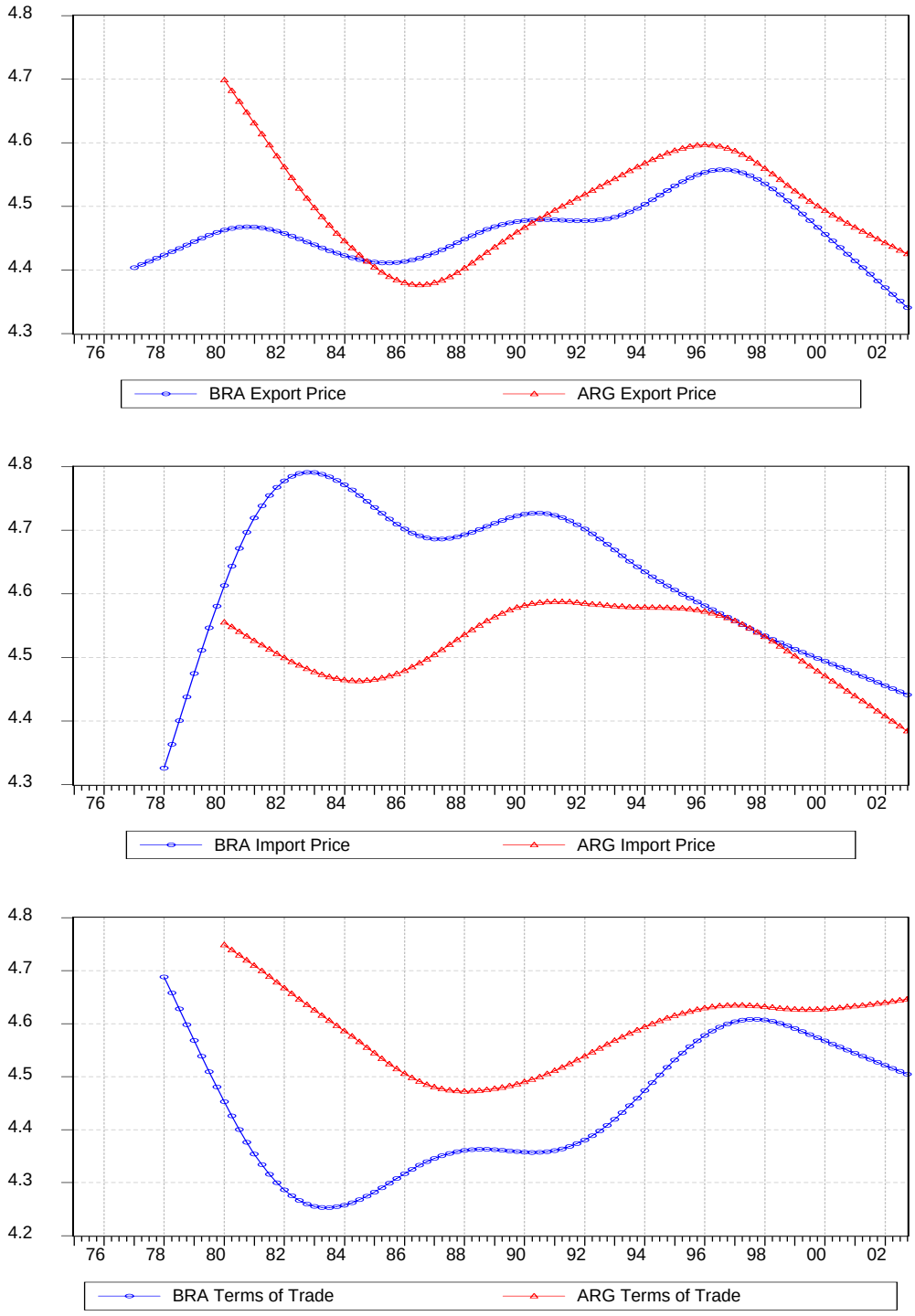
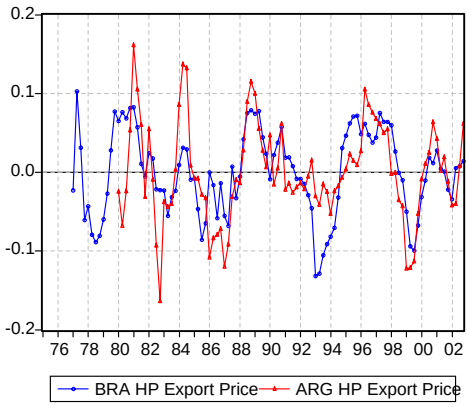
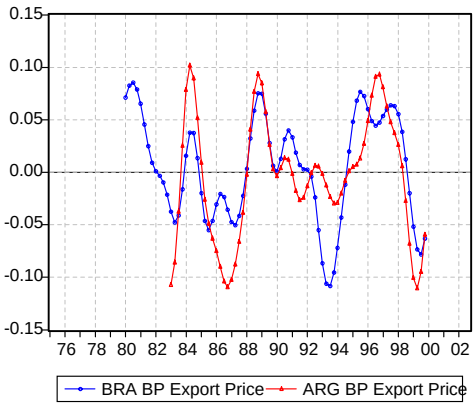
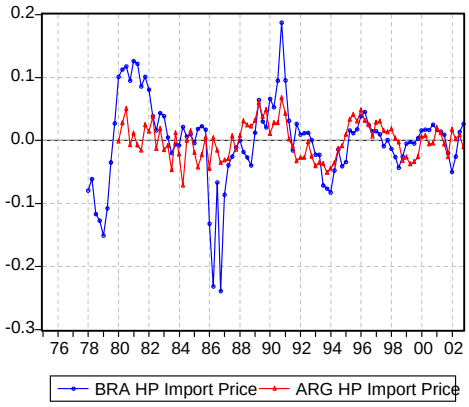
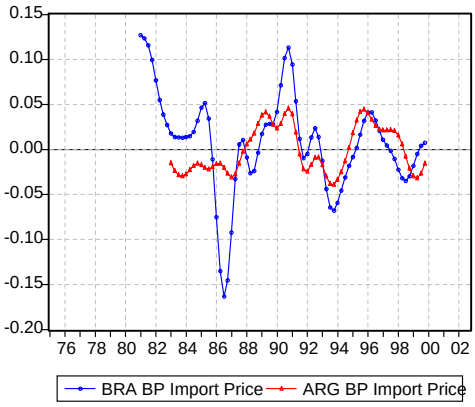


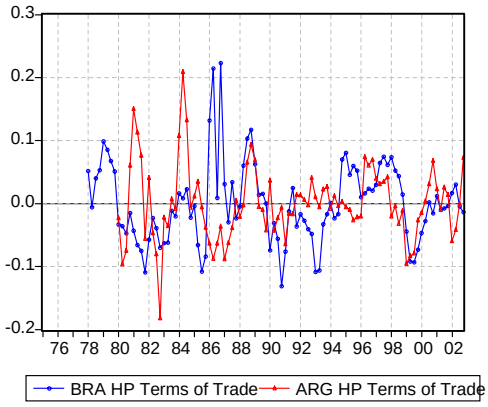
Figure 6: Fluctuations of the export price, import price, and terms-of-trade indexes of Brazil and Argentina. Fluctuations estimated through the Hodrick-Prescott (HP) and Band-Pass (BP) filters.


0.2
0.1
0.0
-0.1
-0.2
76 78 80 82 84 86 88 90 92 94 96 98 00 02
BRA HP Export Price
ARG HP Export Price


0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
76 78 80 82 84 86 88 90 92 94 96 98 00 02
BRA BP Export Price
ARG BP Export Price


0.2
0.1
0.0
-0.1
-0.2
-0.3
76 78 80 82 84 86 88 90 92 94 96 98 00 02
BRA HP Import Price
ARG HP Import Price


0.15
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
76 78 80 82 84 86 88 90 92 94 96 98 00 02
BRA BP Import Price
ARG BP Import Price


0.3
0.2
0.1
0.0
-0.1
-0.2
76 78 80 82 84 86 88 90 92 94 96 98 00 02
BRA HP Terms of Trade
ARG HP Terms of Trade

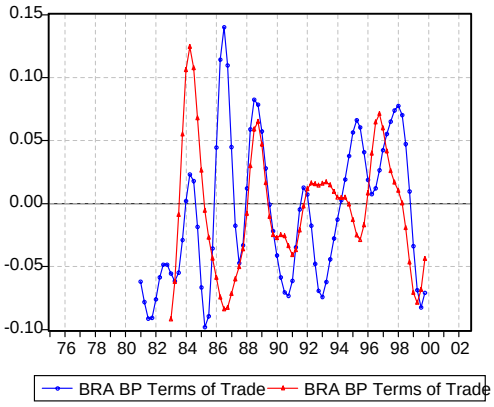
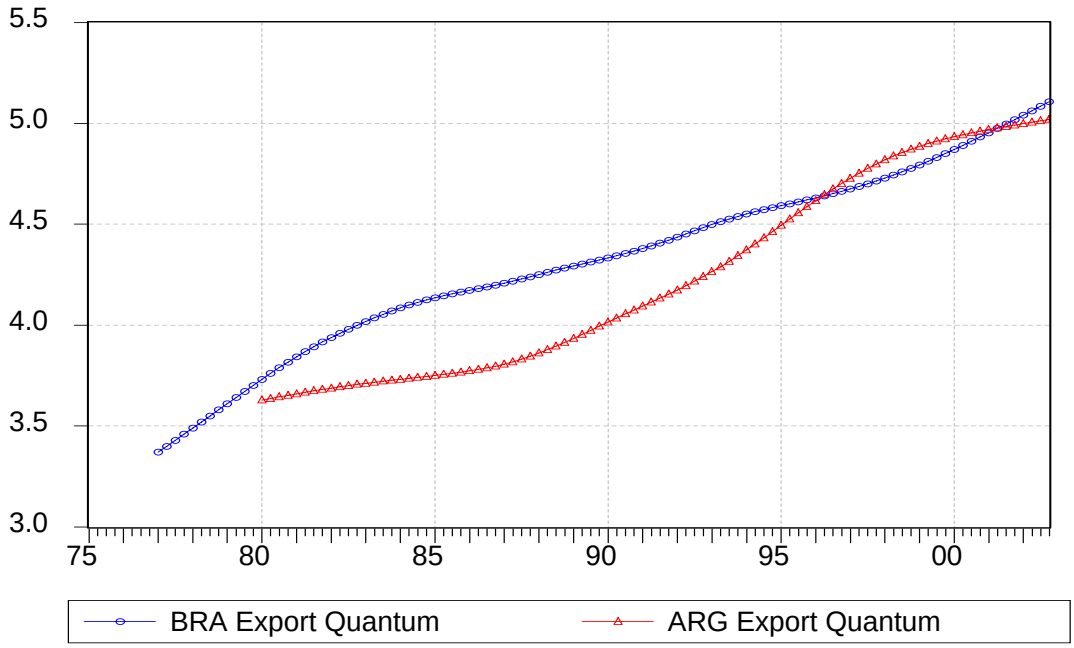

0.15
0.10
0.05
0.00
-0.05
-0.10
76 78 80 82 84 86 88 90 92 94 96 98 00 02
BRA BP Terms of Trade
BRA BP Terms of Trade

Figure 7: Long-run trends of the export and import quantum indexes of Brazil and Argentina. Trends estimated through the Hodrick-Prescott filter.



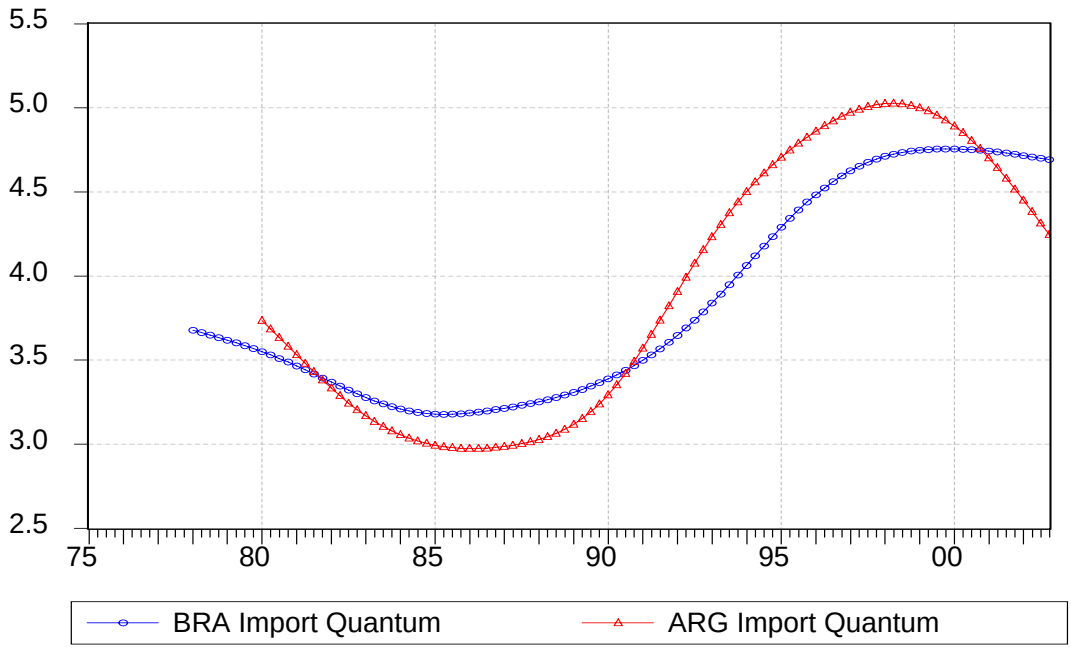
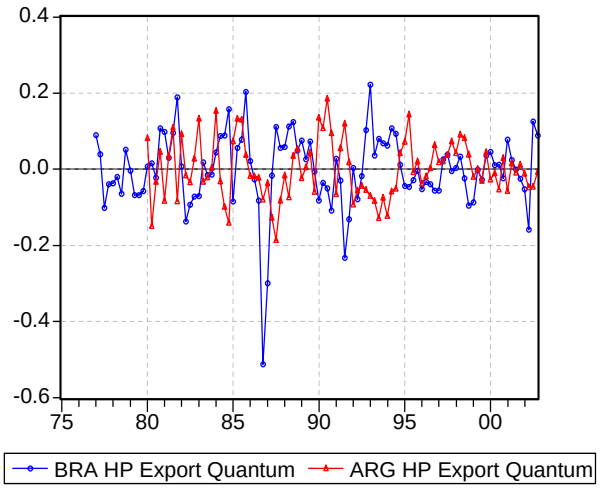
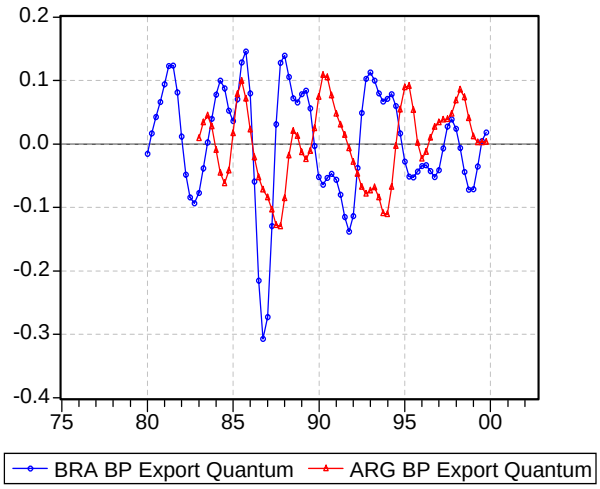
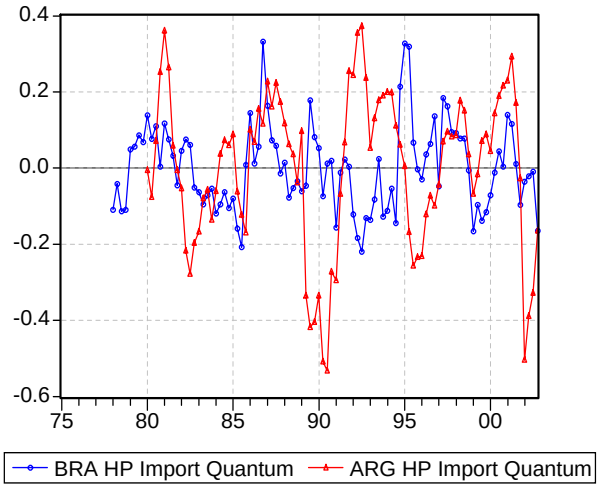


Figure 8: Fluctuations of the export and import price quantum indexes of Brazil and Argentina according to the Hodrick-Prescott (HP) and Band-Pass (BP) filters.







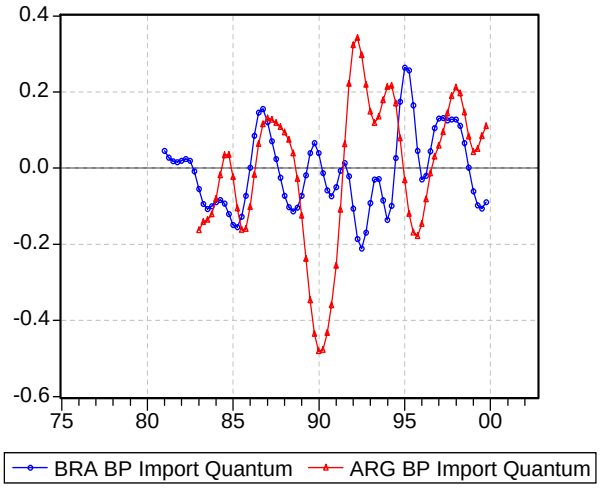


Figure 9: Fluctuations of real income, real exports and real imports of Brazil according to the Hodrick-Prescott (HP) and Band-Pass (BP) filters.

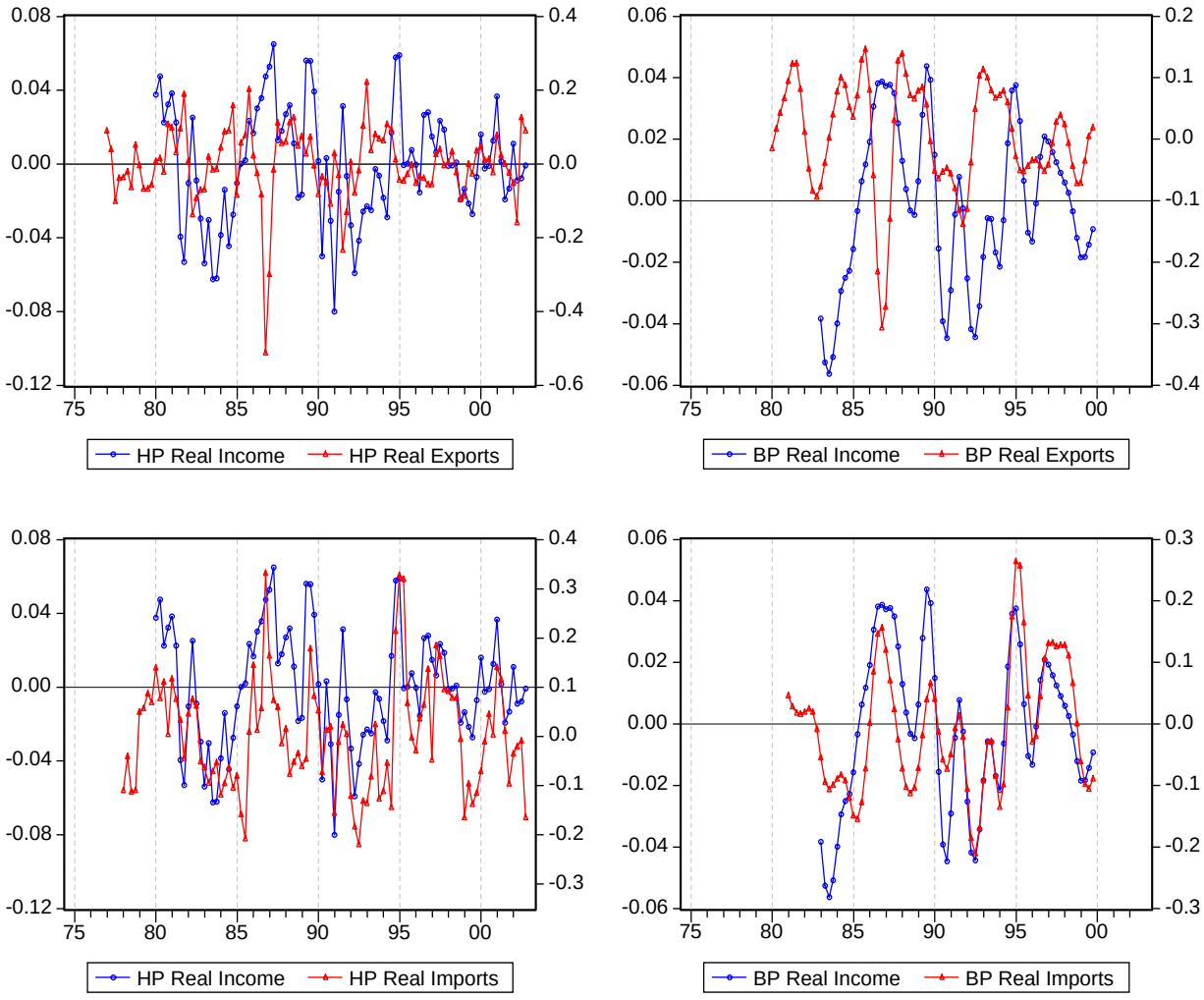


Figure 10: Fluctuations of real income, real exports and real imports of Argentina according to the Hodrick-Prescott (HP) and Band-Pass (BP) filters.

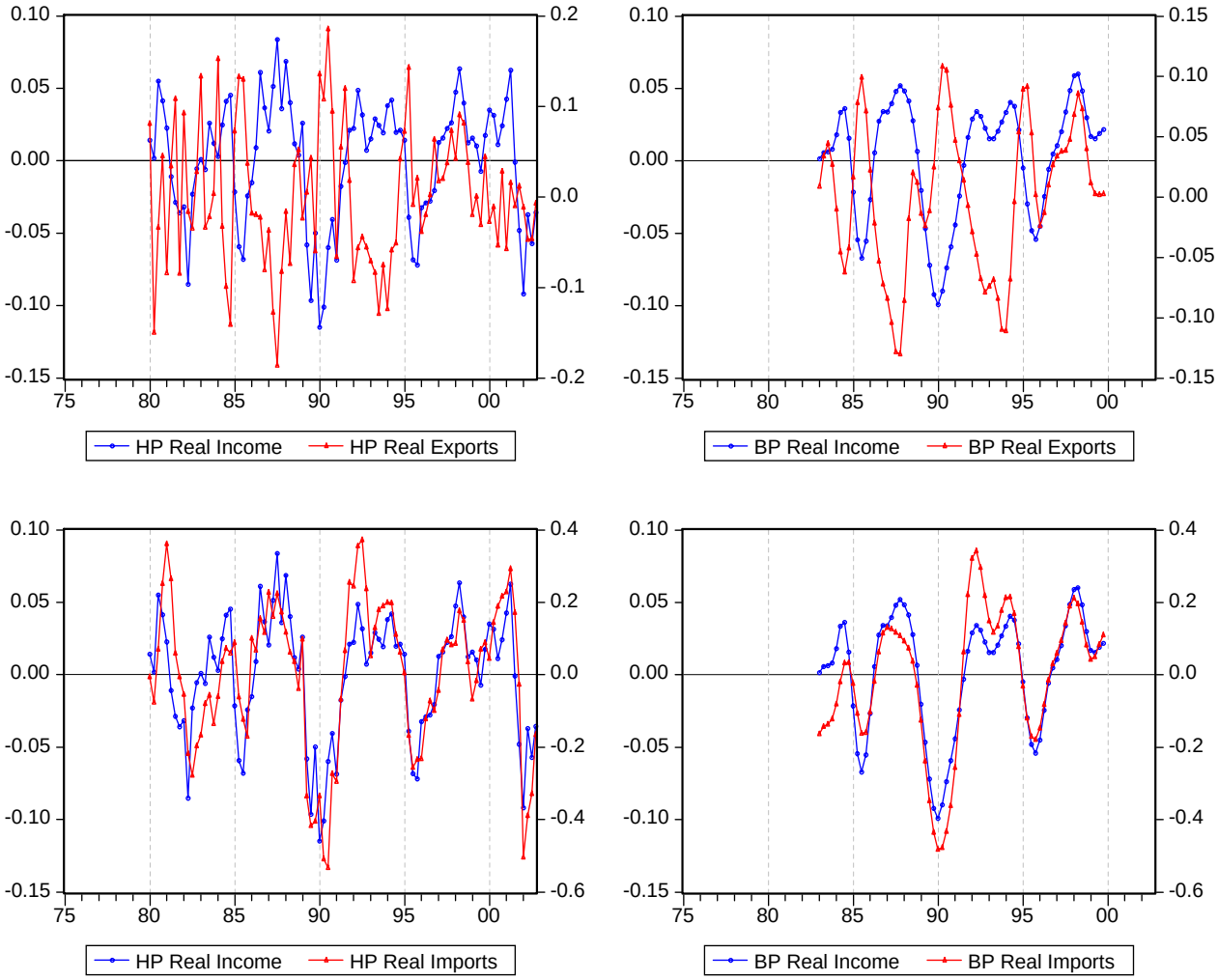


Table 1: Contemporaneous correlation between the Hodrick-Prescott (HP) and Band-Pass (BP) estimates of trends and fluctuations. The HP estimates were obtained by applying a Hodrick-Prescott filter, with smoothing parameter equal to 1600, to the quarterly seasonally adjusted series. The BP estimates were obtained by applying a Band-Pass filter, for periodicity between 6 and 32 quarters, to the quarterly series.

Variables	Brazil	Argentina
Trends of Export Values	1.000	1.000
Trends of Export Prices	0.982	0.995
Trends of Real Exports	1.000	1.000
Fluctuations of Export Values	0.884	0.830
Fluctuations of Export Prices	0.960	0.927
Fluctuations of Real Exports	0.841	0.785
Trends of Import Values	0.999	0.999
Trends of Import Prices	0.991	0.994
Trends of Real Imports	1.000	0.999
Fluctuations of Import Values	0.869	0.945
Fluctuations of Import Prices	0.906	0.882
Fluctuations of Real Imports	0.852	0.930

Table 2: variance and autocorrelation of the fluctuations of Brazilian and Argentine trade flows according to the Hodrick-Prescott filter (smoothing parameters equal to 1600).

Variable*	Variance	Autocorrelation of order J			
		J=-1	J=-2	J=-3	J=-4
BRA XP	0.0029	0.815	0.618	0.437	0.203
BRA MP	0.0044	0.770	0.615	0.447	0.252
ARG XP	0.0038	0.736	0.438	0.205	0.066
ARG MP	0.0008	0.606	0.486	0.406	0.360
BRA XQ	0.0093	0.489	0.104	0.004	-0.107
BRA MQ	0.0124	0.597	0.321	0.172	0.070
ARG XQ	0.0055	0.355	0.155	0.099	0.092
ARG MQ	0.0420	0.830	0.607	0.362	0.160
BRA TOT	0.0039	0.614	0.406	0.271	0.034
ARG TOT	0.0034	0.586	0.252	-0.011	-0.021
BRA Y	0.0009	0.641	0.271	0.230	0.290
ARG Y	0.0018	0.752	0.518	0.344	0.145

* BRA=Brazil, ARG=Argentina, XP=export price, MP=import price, XQ=real exports, MQ=real imports, TOT=terms of trade.

Table 3: variance and autocorrelation of the fluctuations of Brazilian and Argentine trade flows according to the Band-Pass filter (periodicity between 1.5 and 8 years).

Variable*	Variance	Autocorrelation of order J			
		J=-1	J=-2	J=-3	J=-4
BRA XP	0.0025	0.937	0.763	0.522	0.273
BRA MP	0.0030	0.922	0.714	0.450	0.219
ARG XP	0.0034	0.922	0.706	0.415	0.129
ARG MP	0.0007	0.945	0.806	0.628	0.457
BRA XQ	0.0079	0.852	0.484	0.072	-0.231
BRA MQ	0.0103	0.882	0.587	0.259	0.034
ARG XQ	0.0037	0.884	0.602	0.290	0.059
ARG MQ	0.0357	0.943	0.785	0.563	0.323
BRA TOT	0.0033	0.887	0.593	0.234	-0.046
ARG TOT	0.0023	0.902	0.637	0.297	-0.017
BRA Y	0.0007	0.893	0.631	0.345	0.163
ARG Y	0.0016	0.927	0.732	0.474	0.212

* BRA=Brazil, ARG=Argentina, XP=export price, MP=import price, XQ=real exports, MQ=real imports, TOT=terms of trade.

Table 4: correlation between the cyclical components of the export price, import price and terms of trade of Brazil and Argentina. The cyclical components were estimated by applying a Hodrick-Prescott filter, with smoothing parameter equal to 1600, to the quarterly seasonally adjusted series.

Variable 1*	Variable 2*	Correlation Between Variable 1 at period t and Variable 2 at period t+J								
		J=-4	J=-3	J=-2	J=-1	J=0	J=+1	J=+2	J=+3	J=4
BRA XP	ARG XP	0.145	0.300	0.431	0.549	**0.624**	0.543	0.399	0.270	0.178
BRA MP	ARG MP	0.398	0.438	0.334	0.425	**0.464**	0.395	0.305	0.164	0.036
BRA XP	ARG MP	0.311	0.394	0.569	0.670	**0.692**	0.648	0.565	0.452	0.287
BRA MP	ARG XP	0.202	0.299	0.297	0.355	**0.391**	0.351	0.269	0.229	0.180
BRA XP	BRA MP	0.044	0.129	0.284	0.428	0.474	0.555	**0.564**	0.472	0.401
ARG XP	ARG MP	0.150	0.258	0.330	0.368	0.349	0.381	0.366	**0.399**	0.200
BRA TOT	ARG TOT	-0.017	0.003	-0.001	0.043	0.081	0.039	-0.013	-0.108	**-0.136**

* BRA = Brazil, ARG = Argentina, XP=export price, MP = import price, and TOT = terms of trade.

Table 5: Correlation between the cyclical components of the export price, import price and terms of trade of Brazil and Argentina. The cyclical components were estimated by applying a Band-Pass filter, for periodicity between 6 and 32 quarters, to the quarterly series.

Variable 1*	Variable 2*	Correlation Between Variable 1 at period t and Variable 2 at period t+J								
		J=-4	J=-3	J=-2	J=-1	J=0	J=+1	J=+2	J=+3	J=4
BRA XP	ARG XP	0.153	0.356	0.554	0.687	**0.719**	0.644	0.498	0.323	0.163
BRA MP	ARG MP	0.400	0.419	0.457	0.505	**0.528**	0.488	0.371	0.196	0.004
BRA XP	ARG MP	0.382	0.510	0.645	0.760	**0.821**	0.804	0.706	0.545	0.363
BRA MP	ARG XP	0.292	0.362	0.410	0.442	**0.451**	0.428	0.366	0.266	0.135
BRA XP	BRA MP	0.077	0.168	0.244	0.317	0.389	0.461	0.522	**0.556**	0.546
ARG XP	ARG MP	0.244	0.329	0.428	0.520	0.577	**0.581**	0.523	0.412	0.273
BRA TOT	ARG TOT	-0.139	-0.052	0.063	0.143	**0.149**	0.080	-0.025	-0.114	-0.148

* BRA = Brazil, ARG = Argentina, XP=export price, MP = import price, and TOT = terms of trade.

Table 6: results of Granger causality tests on a VAR model, with four lags, for the export and import prices and terms of trade of Brazil and Argentina (period=1981-2002).

Null hypothesis*	F statistic	Probability**
BRA XP does not Granger cause ARG XP	4.246	37.4%
ARG XP does not Granger cause BRA XP	3.711	49.7%
BRA XP does not Granger cause ARG MP	**13.491**	**0.9%**
ARG MP does not Granger cause BRA MP	**8.851**	**6.5%**
BRA XP does not Granger cause BRA MP	**7.813**	**9.7%**
BRA MP does not Granger cause BRA XP	6.635	15.6%
ARG XP does not Granger cause BRA MP	**10.594**	**3.1%**
BRA MP does not Granger cause ARG XP	3.744	44.2%
ARG XP does not Granger cause ARG MP	**15.267**	**0.4%**
ARG MP does not Granger cause ARG XP	1.029	90.5%
BRA MP does not Granger cause ARG MP	**9.952**	**4.1%**
ARG MP does not Granger cause BRA MP	**12.323**	**1.5%**
BRA TOT does not Granger cause ARG TOT	0.063	99.3%
ARG TOT does not Granger cause BRA TOT	0.153	96.1%

* BRA = Brazil, ARG = Argentina, XP=export price, MP = import price, and TOT = terms of trade.
**Significance level at which we can reject the null hypothesis.

Table 7: correlation between the cyclical component of real exports and real imports of Brazil and Argentina. The cyclical components were estimated by applying a Hodrick-Prescott filter, with smoothing parameter equal to 1600, to the quarterly seasonally adjusted series.

Variable 1*	Variable 2*	Correlation Between Variable 1 at period t and Variable 2 at period t+J								
		J=-4	J=-3	J=-2	J=-1	J=0	J=+1	J=+2	J=+3	J=4
BRA XQ	ARG XQ	**-0.382**	-0.237	-0.112	-0.085	-0.186	-0.016	0.173	0.197	0.178
BRA MQ	ARG MQ	0.020	0.041	0.007	-0.028	-0.001	-0.028	-0.084	-0.119	**-0.127**
BRA XQ	ARG MQ	**0.313**	0.232	0.209	0.187	0.123	0.094	0.000	-0.156	-0.275
BRA MQ	ARG XQ	-0.043	-0.008	0.076	0.067	**0.146**	0.079	0.092	0.015	0.089
BRA XQ	BRA MQ	-0.150	-0.180	-0.166	-0.320	**-0.339**	-0.103	0.091	0.073	0.166
ARG XQ	ARG MQ	-0.260	-0.299	-0.276	-0.318	-0.341	**-0.382**	-0.297	-0.216	-0.036

* BRA = Brazil, ARG = Argentina, XQ=real exports and MQ = real imports.

Table 8: correlation between the cyclical component of real exports and real imports of Brazil and Argentina. The cyclical components were estimated by applying a Band-Pass filter, for periodicity between 6 and 32 quarters, to the quarterly series.

Variable 1*	Variable 2*	Correlation Between Variable 1 at period t and Variable 2 at period t+J								
		J=-4	J=-3	J=-2	J=-1	J=0	J=+1	J=+2	J=+3	J=4
BRA XQ	ARG XQ	**-0.557**	-0.452	-0.333	-0.219	-0.098	0.041	0.185	0.287	0.311
BRA MQ	ARG MQ	0.005	-0.020	-0.042	-0.057	-0.061	-0.045	-0.015	0.023	**0.060**
BRA XQ	ARG MQ	**0.474**	0.408	0.287	0.150	0.027	-0.073	-0.154	-0.228	-0.304
BRA MQ	ARG XQ	0.059	0.138	0.218	0.275	**0.278**	0.225	0.144	0.083	0.074
BRA XQ	BRA MQ	-0.163	-0.352	-0.496	**-0.523**	-0.417	-0.219	-0.009	0.144	0.221
ARG XQ	ARG MQ	-0.230	-0.314	-0.407	-0.485	**-0.519**	-0.494	-0.392	-0.225	-0.024

* BRA = Brazil, ARG = Argentina, XQ=real exports and MQ = real imports.

Table 9: correlation between the cyclical component of real income and real exports and real imports of Brazil and Argentina. The cyclical components were estimated by applying a Hodrick-Prescott filter, with smoothing parameter equal to 1600, to the quarterly seasonally adjusted series.

Variable 1*	Variable 2*	Correlation Between Variable 1 at period t and Variable 2 at period t+J								
		J=-4	J=-3	J=-2	J=-1	J=0	J=+1	J=+2	J=+3	J=4
BRA Y	BRA XQ	0.125	0.119	0.040	-0.048	-0.161	**-0.170**	-0.015	-0.048	-0.121
BRA Y	BRA MQ	0.020	0.079	0.167	0.375	0.619	**0.652**	0.395	0.264	0.206
ARG Y	ARG XQ	-0.056	-0.180	-0.230	-0.376	**-0.396**	-0.313	-0.226	-0.202	-0.151
ARG Y	ARG MQ	0.066	0.285	0.467	0.620	**0.810**	0.795	0.616	0.364	0.168

* BRA = Brazil, ARG = Argentina, XQ=real exports, MQ=real imports and Y=real income.

Table 10: correlation between the cyclical component of real income and real exports and real imports of Brazil and Argentina. The cyclical components were estimated by applying a Band-Pass filter, for periodicity between 6 and 32 quarters, to the quarterly series.

Variable 1*	Variable 2*	Correlation Between Variable 1 at period t and Variable 2 at period t+J								
		J=-4	J=-3	J=-2	J=-1	J=0	J=+1	J=+2	J=+3	J=4
BRA Y	BRA XQ	0.214	0.182	0.105	-0.028	-0.188	-0.314	**-0.352**	-0.296	-0.196
BRA Y	BRA MQ	-0.120	0.001	0.245	0.525	0.715	**0.725**	0.568	0.348	0.187
ARG Y	ARG XQ	-0.059	-0.236	-0.394	-0.491	**-0.510**	-0.456	-0.353	-0.235	-0.129
ARG Y	ARG MQ	0.304	0.500	0.691	0.834	**0.889**	0.836	0.675	0.444	0.187

* BRA = Brazil, ARG = Argentina, XQ=real exports, MQ=real imports and Y=real income.

Table 11: results of Granger causality tests on a VAR model, with four lags, for the real exports, real imports and real income of Brazil and Argentina (period=1981-2002).

Null hypothesis*	F statistic	Probability**
BRA XQ does not Granger cause BRA MQ	6.986	13.7%
BRA MQ does not Granger cause BRA XQ	3.988	40.8%
BRA XQ does not Granger cause BRA Y	1.800	77.2%
BRA Y does not Granger cause BRA XQ	6.392	17.2%
BRA XQ does not Granger cause ARG XQ	**8.377**	**7.9%**
ARG XQ does not Granger cause BRA XQ	7.434	11.5%
BRA XQ does not Granger cause ARG MQ	3.848	42.6%
ARG MQ does not Granger cause BRA XQ	4.436	35.0%
BRA XQ does not Granger cause ARG Y	5.001	28.7%
ARG Y does not Granger cause BRA XQ	5.426	24.6%
BRA MQ does not Granger cause BRA Y	2.211	69.7%
BRA Y does not Granger cause BRA MQ	**31.670**	**0.0%**
BRA MQ does not Granger cause ARG XQ	**8.328**	**8.0%**
ARG XQ does not Granger cause BRA MQ	1.866	76.0%
BRA MQ does not Granger cause ARG MQ	2.843	58.4%
ARG MQ does not Granger cause BRA MQ	5.378	25.1%
BRA MQ does not Granger cause ARG Y	1.286	86.5%
ARG Y does not Granger cause BRA MQ	**10.212**	**3.7%**
BRA Y does not Granger cause ARG XQ	**21.827**	**0.0%**
ARG XQ does not Granger cause BRA Y	2.725	60.5%
BRA Y does not Granger cause ARG MQ	7.699	10.5%
ARG MQ does not Granger cause BRA Y	1.073	89.9%
BRA Y does not Granger cause ARG Y	2.476	64.9%
ARG Y does not Granger cause BRA Y	6.209	18.4%
ARG XQ does not Granger cause ARG MQ	5.453	24.4%
ARG MQ does not Granger cause ARG XQ	6.996	13.8%
ARG XQ does not Granger cause ARG Y	1.191	88.0%
ARG Y does not Granger cause ARG XQ	2.024	73.1%
ARG MQ does not Granger cause ARG Y	2.511	64.3%
ARG Y does not Granger cause ARG MQ	**10.338**	**0.0%**

*BRA=Brazil, ARG=Argentina, XQ=real exports, MQ=real imports, and Y=real income. **Significance level at which we can reject the null hypothesis.