

Growth, exchange rates and trade in Brazil: a structuralist post-Keynesian approach

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Abstract

This paper presents a structuralist post-Keynesian analysis of trade adjustment in Brazil. Based on the concept of the balance-of-payments (BoP) constraint on growth, the paper investigates the relationship between income growth and real-exchange-rate devaluation necessary to adjust trade to a foreign-exchange constraint. The main result is that, with price-inelastic and income-elastic imports and based on its trade structure in 2002, Brazil may have to compensate an additional 1% of income growth with approximately 7% of real-exchange-rate devaluation in order to keep its trade balance stable in relation to GDP in the near future. Moreover, the trade parameters of Brazil seem to be unfavorable to growth with stable trade, that is, even moderate rates of GDP expansion lead to a substantial increase of imports and, therefore, require an also substantial devaluation of the real exchange rate to avoid a deterioration of the trade balance.

Resumo

Este artigo apresenta uma análise estruturalista e pós-keynesiana de ajustes comerciais no Brasil. Baseado no conceito de restrição do balanço de pagamentos (BoP) sobre o crescimento, o artigo investiga qual é a relação entre crescimento do PIB e desvalorização da taxa real de câmbio necessária para a obtenção de um ajuste comercial determinado pela restrição externa. O resultado principal é que, com importações preço-inelásticas e renda-elásticas e baseado em sua estrutura comercial em 2002, o Brasil pode ter que compensar 1% a mais de crescimento com aproximadamente 7% a mais de desvalorização cambial para manter seu saldo comercial estável em termos do PIB no futuro próximo. Além disso, os parâmetros do comércio do Brasil parecem desfavoráveis ao crescimento com estabilidade comercial, isto é, mesmo com crescimento moderado da renda, há um crescimento substancial das importações e, conseqüentemente, é necessária uma desvalorização também substancial da taxa real de câmbio para evitar uma deterioração do saldo comercial.

Introduction

The Brazilian economy experienced a quick and substantial depreciation of its currency in 2002. From 2.32 at the end of 2001, the Real/US dollar exchange rate reached 3.53 at the end of 2002, that is, a nominal devaluation of 52%. Discounting the difference between Brazilian and US inflation rates, the annual increase of the real exchange rate was 37% in consumers' prices, and 19% in producers' prices.¹ Such a "maxi-devaluation" was basically the result of two forces: the foreign financial fragility of the economy and the uncertainty associated with the Brazilian 2002 presidential election. On the one hand, in the past ten years Brazil has become highly dependent on large inflows of foreign capital to stabilize its exchange rate and finance its growth. On the other hand, the looming and effective victory of a left-wing candidate, Lula, in Brazil's 2002 presidential election made financial markets wary about the economic policy of the new administration.

The potential currency crisis was quickly disarmed after the inauguration of the new administration. Through a series of austere measures, Lula's

economic team adopted an orthodox economic policy to fight inflation and stabilize exchange rates. Interest rates were raised, fiscal policy was tightened and, driven by large arbitrage gains between Brazilian and foreign interest rates, short-term foreign capital returned *en masse* to Brazil.² The reduction of exchange rates followed soon after and, at the end of June, 2003, the Real/US dollar exchange rate was at 2.87. In relation to its value at the end of 2002, the nominal exchange rate fell 19%. Given Brazil's high inflation in the first semester of 2003, the reduction of the real exchange rate was even higher: 26% in consumers' prices and 24% in producers' prices.

As usual after periods of high exchange-rate volatility, the "appropriate" level of exchange rates became the object of high controversy and intense debate in Brazil. For many observers, the large devaluation of 2002 was useful to strengthen Brazil's balance of payments and should not have been reversed in the first half of 2003. In fact, because of a mix of high exchange rates and low economic growth, Brazil's annual trade surplus increased from US\$ 2.65 billion in 2001 to 13.1 billion in 2002.

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¹ Following the procedure adopted by the Central Bank of Brazil, the real exchange rate was calculated comparing Brazil's INPC and IPA-OG for industrial goods with the consumers' and producers' industrial price indexes of the US Bureau of Economic Analysis, respectively.

² In the first semester of 2003 Brazil obtained a total of US\$ 11.7 billion in bond and loan operations in foreign markets in comparison with just US\$ 3.8 billion in the second semester of 2002.

Despite a trade surplus of US\$ 10.4 billion in the first semester of 2003, many economic analysts became concerned that the recent appreciation of the Real would eventually bring a substantial deterioration of Brazil's trade surplus and lead the country once again into high current account deficits as soon as the economy resumes growth at higher rates than in recent years. Thus, rather than "letting" the exchange rate fall, the Brazilian government should have kept it at a level consistent with high trade surpluses, allowing the economy to build international competitiveness and gradually reduce its dependence on foreign capital.³

The hypothesis implicit in the BoP constraint is simple and intuitive: in a context of imperfect capital markets, a small open economy faces a

liquidity constraint and has to adjust its trade balance to the availability of foreign finance.⁴ If foreign finance is abundant, the economy may have a low trade balance without disruptive effects on exchange rates. If foreign finance is scarce, the economy must have a high trade balance to avoid a currency crisis. More importantly, fluctuations in foreign finance may lead to excessive fluctuations in growth and exchange rates when the economy has to adjust its trade balance to the changes in its liquidity constraint. One way to avoid the consequences of such exogenous shocks is for the economy to keep its trade balance at a sufficiently high level, so that it does not rely too much on foreign capital to maintain exchange-rate stability.⁵

In the operation of the BoP constraint, both growth and exchange

³ Since Brazil now has a floating-exchange-rate regime, the advocates of high trade surpluses argue that, by keeping its base interest rate too high, the Central Bank of Brazil induced an excessive appreciation of the *Real*.

⁴ In its original formulation (Thirlwall, 1979), the BoP constraint was associated with a zero trade balance.

The concept was later refined to incorporate a non-zero trade balance (Thirlwall and Hussain, 1982), as well as reformulated in terms of stock-flow (McCombie and Thirlwall, 1997; Moreno-Brid, 1998; and Barbosa-Filho, 2001a) and stock-stock (Barbosa-Filho, 2001b) financial ratios. In general terms the basic idea is that

the trade balance, and consequentially the current account, of a small open economy has to be adjusted to the availability of foreign finance through changes in its growth and real-exchange rates. Causation runs from the capital to the current account, which in its turn represents the existence of liquidity constraints on the economy in question.

⁵ Another way would be some sort of control or taxation of capital flows to reduce the volatility of the exchange rate and foreign reserves and, in this way, distribute the trade adjustment over a longer period of time than what would prevail with liberalized capital markets.

rates are residually determined by the trade surplus necessary to avoid a deterioration of the balance of payments and a currency crisis. Given the structural parameters of the economy in question, one can derive the combination of exchange-rate devaluation and growth necessary to achieve the trade balance consistent with the BoP constraint in the short run.⁶ In fact, in a way similar to the Phillips Curve, the “target” trade balance may impose a short-run trade-off between growth and real-exchange-rate devaluation. For instance, to keep the trade surplus stable in terms of GDP, more income growth may have to be compensated by currency depreciation and vice versa.

What are the implications for Brazil? The recent debate about Brazilian exchange rates should be framed in terms of the trade structure of the economy. Depending on which price indexes and initial conditions one chooses, there are many “appropriate” levels for the trade balance and the exchange rate. However, regardless of the levels one chooses, the adjustment of the trade balance to some pre-specified target imposes some well-defined relationships between

real-exchange-rate devaluation and income growth. In the short run, there may be a trade-off between both variables. In the long run, there may be just a few combinations of both variables consistent with stable trade, which in its turn is not necessarily consistent with a stable real exchange rate. Given the structural parameters of the economy, the determination of exchange rate has therefore to be analyzed in relation to the growth rate and the evolution of the trade balance.

Following the approach of structuralist and post-Keynesian models (Taylor, 1991; McCombie and Thirlwall, 1994 and 1999; Moreno-Brid, 1998; Blecker, 1999), this paper analyzes the implications of the BoP constraint for trade, growth and exchange rates in Brazil. The aim is to obtain the short-run trade off between growth and real-exchange-rate devaluation implicit in any trade adjustment, as well as the combinations of growth and real-exchange-rate devaluation consistent with a stable, increasing or decreasing trade balance. Based on the recent estimates of the income and price elasticities of Brazilian exports and imports by Cavalcanti and Frischtak (2002), the paper also analyses what may be the appropriate

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⁶ In this paper “short run” means the period during which the price and income elasticities of exports and imports can be considered as constant. In the long run these parameters may vary to accommodate differences in the trends of GDP and real exchange rates, along the lines proposed by Krugman (1989) and analyzed by Caporale and Chui (1999).

path of real exchange rates in relation to alternative target values for the trade balance and the growth rate of Brazil.

The text is in four sections in addition to this introduction. Section one presents the basic assumptions of the model and derives the relation between growth and real-exchange-rate devaluation necessary to obtain a given trade adjustment in the short run. Section two presents the dynamics of the export-income and import-income ratios and analyses for which combinations of growth and real-exchange-rate devaluation the trade balance is stable, increasing or decreasing in terms of GDP. Section three applies the model of sections one and two to Brazil using recent estimates of the price and income elasticities of Brazilian exports and imports as a guide. Section four concludes with some comments of the implications of the BoP constraint for trade in Brazil.

1_ The growth-devaluation trade-off

The impact of exchange rates on income and trade is a classic topic of international finance and is at the center of the so-known “elasticity vs. absorption” debate. The standard

conclusion in the literature is that the impact of exchange rates on trade occurs through two channels: a direct impact through price effects and an indirect impact through income and wealth effects.⁷ Overall the evidence indicates that, for small open economies, exchange rates tend to have a positive impact on trade (a devaluation increases the trade balance) because the Marshall-Lerner-Robinson condition is usually satisfied and because of the negative impact of exchange rates on income and wealth (a devaluation reduces real income and wealth).⁸

For the purpose of this paper we are only interested in the relation between growth and real-exchange-rate devaluation necessary to obtain a pre-specified change of the trade balance. Following the standard approach of structuralist and post-Keynesian models, this can be investigated through three simplifying assumptions that do not violate the main features of the real phenomenon in question. First, assume that the world economy can be divided into a large “foreign” country and a small “home” country, with the latter being BoP constrained. Second, for simplicity, assume that the supply curves of world exports and imports are

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⁷ For a summary of the literature on the topic see, for instance, Gandolfo (1994) and Isard (1995).

⁸ However, immediately after devaluation, the price and income elasticities of exports and imports are usually not favorable to trade surpluses, so that devaluation may initially have a negative impact on the trade balance (the “J” curve) in home currency.

horizontal, so that trade can be modeled just from the demand side.⁹ Third, assume that the real demand for imports and exports of the home country can be represented by standard multiplicative functions of the real exchange rate and the home and foreign real income levels. Formally:

$$Q_m = A \left(\frac{EP_f}{P_b} \right)^{-\alpha} Q_b^\beta \quad (1)$$

and

$$Q_x = B \left(\frac{EP_f}{P_b} \right)^\gamma Q_f^\delta, \quad (2)$$

where E is the nominal exchange rate (the price of foreign currency in terms of the home currency), P_f the foreign price, P_b the home price, Q_b the home real income, Q_f the foreign real income. The non-negative parameters α , β , γ , δ , A and B represent respectively the price and income elasticity of imports (α and β), the price and income elasticity of exports (γ and δ), and fixed effects of other variables than exchange rate, price and income (A and B). To simplify notation, let $Z = EP_f/P_b$ represent the real exchange rate (the amount of the home good exchanged for one unit of the foreign good).

Also following structuralist and post-Keynesian models, let us set the analysis in terms of the home GDP,¹⁰ that is, let $m = ZQ_m/Q_b$ and $x = Q_x/Q_b$ represent respectively the import-income and export-income ratios of the home country. The dynamics of these ratios are given by

$$\frac{dm}{dt} = m[(1-\alpha)z + (\beta-1)q_b] \quad (3)$$

and

$$\frac{dx}{dt} = x(\gamma z + \delta q_f - q_b) \quad (4)$$

where z , q_b and q_f are respectively the exponential growth rates of Z , Q_b and Q_f .

Translating (3) into words, an increase in the real exchange rate has a positive impact on the import-income ratio when the price elasticity of imports is smaller than one, that is, a real-exchange-rate devaluation increases imports in terms of GDP when imports are price inelastic ($\alpha < 1$). In the same vein, an increase in the home growth rate has positive impact on the import-income ratio when the income elasticity of imports is greater than one, that is, growth increases imports in terms of GDP when imports are income-elastic ($\beta > 1$). As we shall see in section

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⁹ In the general case the formulation would be more complex but the idea would be the same, namely: exchange rates and growth are adjusted to obtain a pre-specified trade adjustment, which in its turn is determined by the BoP constraint on the economy in question. For the starting functions of the general case, see, for instance, Gandolfo (1994, ch. 14).

¹⁰ It is common practice in the literature to normalize the flow variables by income when analyzing trade and current account adjustments, so that one can have a better idea of the wealth gains or losses involved.

three, the empirical evidence indicates that Brazil falls into these two cases.

The economic interpretation of (4) is simple and intuitive. Provided that the corresponding elasticity is not zero, an increase in the real exchange rate increases the export-income ratio, as well as an increase in the foreign growth rate. Conversely, an increase in the home growth rate reduces the export-income ratio independently of the values of the price and income elasticities of exports.

Moving to the dynamics of the trade balance, from (3) and (4) we have:

$$\frac{dx}{dt} - \frac{dm}{dt} = x(\gamma z + q_f - q_b) - m[(1 - \alpha)z + (\beta - 1)q_b] \tag{5}$$

The economic interpretation of (5) is not as intuitive as of (3) and (4) because, in addition to the value of the elasticity parameters, we now have to take into consideration the values of the export and import ratios. To facilitate the analysis and having in mind the implications of the BoP constraint for trade, it is easier to analyze (5) for a given value of the trade adjustment.

More formally, let $\chi = (dx/dt) - (dm/dt)$ be the change of the trade balance in terms of GDP necessary to satisfy the BoP constraint.

For each value of χ we have a set of points on the $q_b \times z$ plane that are consistent with the same trade adjustment, that is, we have an infinite combination of income and real-exchange-rate devaluations capable of producing the same adjustment of the trade balance in terms of GDP. To see this, solve (5) for the home growth rate, that is:

$$q_b = \left[\frac{x\delta q_f - \chi}{x - m(1 - \beta)} \right] + \left[\frac{x\gamma - m(1 - \alpha)}{x - m(1 - \beta)} \right] z \tag{6}$$

Given the desired trade adjustment (χ), the initial trade ratios (x and m), the foreign growth rate (q_f) and the elasticity parameters (α , β , γ , and δ), (6) represents the short-run relationship between growth and devaluation¹¹ in the home country. For each value of the trade adjustment we have a different line, so that (6) can be used to obtain a map of level curves, each of which represent a different short-run adjustment of the trade balance.

To illustrate the growth-devaluation trade off and with the Brazilian case in mind, assume that the home country has the following structural features: income-elastic

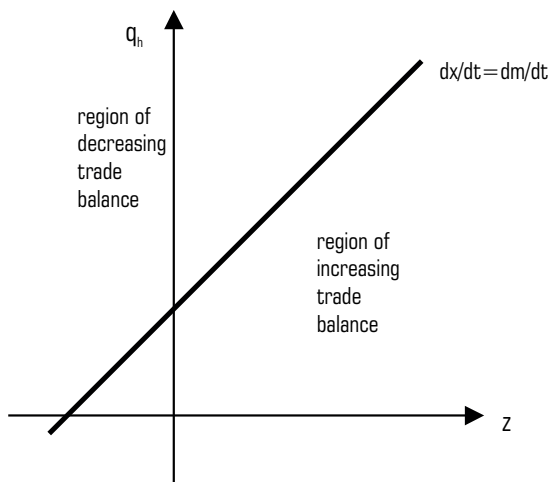
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¹¹ Unless stated otherwise, devaluation means real-exchange-rate devaluation.

imports ($\beta > 1$); import and export price elasticities that satisfy the Marshall-Lerner-Robinson condition ($\alpha + \gamma > 1$); and a trade surplus ($x > m$).

The first assumption implies that $x - m(1 - \beta) > 0$, whereas the second and third assumptions imply that $x\gamma - m(1 - \alpha) > 0$. Altogether, the three assumptions imply that (6) has a positive slope coefficient, that is, to obtain the aimed trade adjustment, more growth has to be compensated with more devaluation and vice versa.

To illustrate the point, Figure 1 shows the growth-devaluation trade off necessary to obtain a stable trade balance ($dx/dt = dm/dt$) under the above assumptions. Points above the curve are associated with a reduction of the trade balance and, conversely, points below the curve are associated with an increase of the trade balance. The intuition is that above the curve the growth rate is too high to keep the trade balance stable, whereas below the curve it is too low.

Figure 1_ The growth-devaluation trade off



It should be noted that both the intercept and slope coefficients of (6) depend on the magnitude of imports and exports in relation to GDP.

Focusing on the trade off between growth and real-exchange-rate devaluation, let

$$\phi = \frac{x\gamma - m(1-\alpha)}{x - m(1-\beta)}$$

be the slope coefficient of (6).

The partial derivatives of ϕ in relation to the trade ratios are:

$$\frac{\partial \phi}{\partial x} = \left[\frac{1}{x - m(1-\beta)} \right]^2 m[1-\alpha + \gamma(\beta-1)] \quad (7)$$

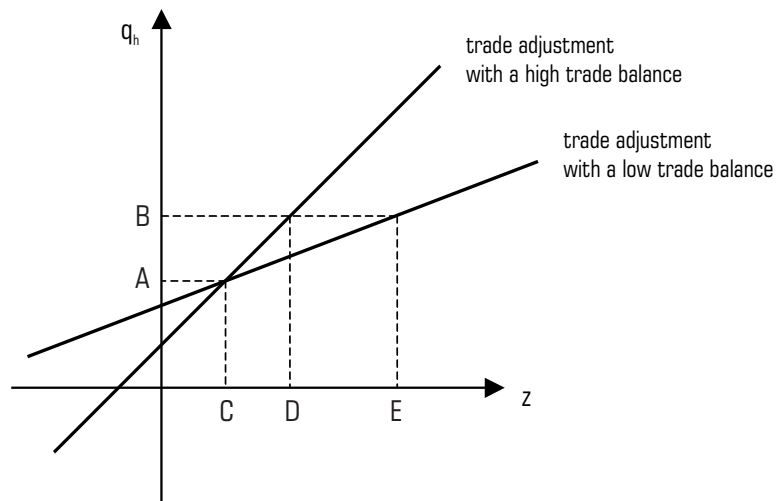
and

$$\frac{\partial \phi}{\partial m} = - \left[\frac{1}{x - m(1-\beta)} \right]^2 x[1-\alpha + \gamma(\beta-1)] \quad (8)$$

So, if imports are price-inelastic ($\alpha < 1$) and income-elastic ($\beta > 1$) as we assumed, then $\partial\phi/\partial x$ is positive and $\partial\phi/\partial m$ is negative. In words, the higher the export-income ratio, the lower the devaluation necessary to compensate an increase in the home growth rate in order to keep the trade balance stable. Conversely, the higher the import-income ratio, the higher the devaluation necessary to offset the increase in the home growth rate.

To illustrate the point, Figure 2 presents two lines of trade adjustment with different slopes. The steeper line represents the situation of a high trade balance (high x and low m) and the flatter line represents the situation of a low trade balance (low x and high m). Given the same increase of the income growth rate (distance AB), the required increase of the real-exchange-rate devaluation is higher with a low trade balance (distance CE) than with a high trade balance (distance CD).

Figure 2_ The growth-devaluation trade-off with different trade balances



Although there are many parameters behind Figure 2, the intuition is rather simple, with price-inelastic and income-elastic imports, a high trade balance in terms of GDP facilitates the trade adjustment because it reduces the devaluation or revaluation necessary to compensate growth fluctuations.¹²

2_ The impact of exchange rates and growth on the trade ratios

So far we have analyzed the relationship between devaluation and growth necessary to adjust trade given the initial values of the export-income and import-income ratios. However, both the intercept and the slope of the growth-devaluation trade off given by (6) depend on the values of the export-income and import-income ratios. If these ratios change, so does the trade off. We therefore have to analyze the determinants of export and import dynamics to extend the analysis to moving trade ratios.

From (3) it is straightforward that the import-income ratio is stable if

$$q_b = \left(\frac{1 - \alpha}{1 - \beta} \right) \bar{\zeta} \quad (9)$$

In the same vein, the export income ratio is stable if

$$q_b = \gamma \bar{\zeta} + \delta q_f \quad (10)$$

Put together, (9) and (10) can be interpreted as a system of two equations for two variables: growth and devaluation. In line with the BoP constraint, the exogenous variables are the elasticity parameters and the foreign growth rate, and the solution of the system is given by

$$q_b = \left(\frac{1 - \alpha}{1 - \alpha - \gamma + \gamma\beta} \right) \delta q_f \quad (11)$$

and

$$\bar{\zeta} = \left(\frac{1 - \beta}{1 - \alpha - \gamma + \gamma\beta} \right) \delta q_f \quad (12)$$

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¹² In a recent paper, Pastore and Pinotti (2001) argued that Brazil needed to increase its trade openness (measured by the sum of exports and imports) to ease the burden of trade adjustments on the exchange rate. Their analysis was done in nominal terms and was later incorporated by Brazil's Ministry of Finance (Ministério da Fazenda, 2003). According to (7) and (8), an increase of the trade openness eases the burden of the trade

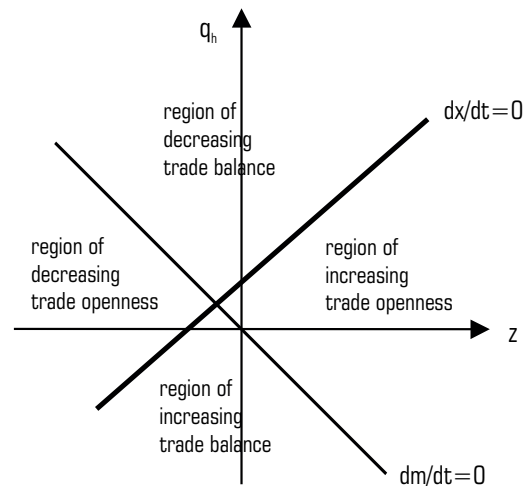
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 adjustment in terms of GDP only if it is also accompanied by an increase of the trade balance. In fact, considered in isolation, an increase of the import-income ratio ends up making the trade adjustment harder, provided that the analysis is made in terms of GDP, which is standard procedure in the literature because the severity of trade adjustments is usually analyzed in relation to the size of the economy in question.

In other words, if income growth and real-exchange-rate devaluation satisfy (11) and (12), both the export-income and the import-income ratios are stable.

In the previous section we analyzed what values of growth and devaluation were necessary to adjust trade to the BoP. However, the values derived there are not necessarily consistent with stable trade ratios, that is, the trade adjustment itself may imply a change of the export-income and import-income ratios and, through this, alter the growth-devaluation trade off.

How can we know if and what change will occur? The import and export equilibrium-lines given by (9) and (10) give us two sets of points to evaluate the direction of the trade adjustment. To illustrate the point let us plot both equilibrium lines on the $z \times q_h$ plane. Assuming as before that the economy in question has price-inelastic and income-elastic imports, Figure 3 shows the export and import “equilibrium” lines when there is positive income growth in the foreign country.¹³

Figure 3_ Direction of the trade adjustment



¹³ For the other possible configurations, see Barbosa-Filho (2001a).

The two lines cut each other at a point with positive income growth and negative devaluation, that is, in order for both exports and imports to be stable in terms of the GDP, it would be necessary for the home country to combine growth with a reduction of its real exchange rate. The fact that the latter cannot go on indefinitely indicates that there will be some change of the trade elasticities or fluctuation of the trade ratios of the home country.¹⁴

Despite its counterintuitive implication, the result portrayed in Figure 3 is easy to explain. Since the home country has price-inelastic imports, an increase of the real exchange rate ends up increasing imports in relation to GDP. Thus, to stabilize its import-income ratio, the home country has to combine income growth with a decreasing real exchange rate.¹⁵

Returning to the long-run direction of the trade adjustment, notice that the import-income ratio is decreasing at points above and decreasing at points below (9). By analogy, the export-income-ratio is increasing at points below and decreasing at points above (10). Thus, given the foreign growth rate and the elasticity parameters, the export and

import equilibrium lines divide the $z \times q$ plane into four trade-adjustment regions, as shown in Figure 3.

Translating the regions in Figure 3 into words, for points above both the equilibrium export and import lines we have $dx/dt < 0$ and $dm/dt > 0$ and, therefore, a decreasing trade surplus. The opposite holds for points below both the equilibrium export and import lines. For points below the export line and above the import line we have $dx/dt > 0$ and $dm/dt > 0$, that is, an increasing trade openness (exports plus imports). Conversely, for points above the export line and below the import line the trade openness is decreasing. Thus, plotting the effective income growth and real-exchange-rate devaluation on Figure 3, one can obtain the long-run direction of the trade adjustment of the home country.

Finally, what if we want to know whether the trade balance is increasing or decreasing in the regions where we know only the sign of the change in trade openness? Just set $dx/dt = dm/dt = 0$ as in the previous section to obtain the line for which the trade balance is constant. It can be easily proved that, for the case of price-inelastic and income-elastic imports, the slope of

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¹⁴ A permanent increase of the real exchange rate is not logically possible because it implies that the foreign good will become infinitely cheap and the home good infinitely expensive, that is, a mathematical possibility with no economic sense. To avoid this case the trade parameters change or the trade ratios fluctuate.

¹⁵ If imports were price-elastic, the equilibrium import line would have a positive slope and the solution will occur with positive income growth and an increasing real exchange rate.

such a line is positive and smaller than the slope of the equilibrium export line.¹⁶ Figure 4 shows the diagram with the three lines and, as we already derived in the previous section, the trade balance is increasing below and decreasing above the trade-adjustment line.

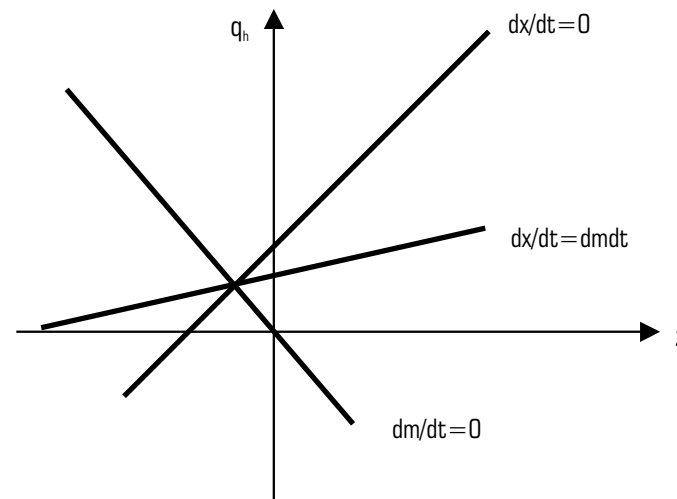
3_ An Application to Brazil

The model of the previous sections allows us to analyze the relation between trade, exchange rates and growth, provided that we know the value of the price and income

elasticities of exports and imports. Based on the elasticity parameters estimated by Cavalcanti and Frischtak (2002) for Brazil in 1980-2000, this section presents some numerical exercises in that direction.¹⁷

Using quarterly data, Cavalcanti and Frischtak estimated import and export equations for Brazil as an autoregressive process with distributed lags and an error correction mechanism. The independent variables in the import equation were Brazil's real GDP and real exchange rate, which was calculated for producers' prices.

Figure 4_ Direction of the trade adjustment and the growth-devaluation trade-off



¹⁶ Formally, note that $\frac{x\gamma - m(1-\alpha)}{x - m(1-\beta)} < \gamma$ implies

$(1-\alpha) > \gamma(1-\beta)$, which is true since $0 < \alpha < 1, \beta > 1$ and $\gamma > 0$.

¹⁷ We chose to use the study by Cavalcanti and Frischtak because it contains estimates for both exports and imports for 1980-2000 and adopts a functional specification very similar to the one used in this paper.

The independent variables in the export equation were the real exchange rate, world real imports, and productive capacity and capacity utilization in manufacturing. The last two variables were introduced to capture the influence of supply factors on Brazil exports and, in terms of the export equation presented in section one, they can be interpreted as being implicit in the fixed-effect parameter of (2).

From the coefficients in error correction mechanisms for exports and imports, Cavalcanti and Frischtak obtained their estimates of price and income elasticities. Table 1 presents their estimates and, as we assumed in the previous section, they indicate that Brazil has price-inelastic and income-elastic imports. The high income-elasticity of imports estimated

by the authors is basically due to Brazil's recent trade liberalization. In fact, when Cavalcanti and Frischtak test their results for structural breaks, they find evidence of one break exactly at the beginning of trade liberalization (1991). As also shown in Table 1, the estimated income elasticity of imports was just 0.45 in 1980-1991, but 5.53 in 1991-2000. The price elasticity of imports was also higher in the latter period but the difference is not substantial. As for exports, Cavalcanti and Frischtak found no evidence of structural breaks and their estimates indicate that Brazil has price-inelastic and income-elastic exports. The estimates of price elasticities also indicate that the MLR condition is satisfied during the whole period, but for 1980-1991 their sum is just 1.15.¹⁸

Table 1_ Brazil's trade elasticities, 1980-2000

	1980-2000	1980-1991	1991-2000
Price-elasticity of imports	0.74	0.54	0.65
Income-elasticity of imports	3.39	0.45	5.53
Price-elasticity of exports	0.61		
Income-elasticity of exports	1.01		

Source: Cavalcanti and Frischtak (2002).

¹⁸ Cavalcanti and Frischtak (2002) do not present the standard deviation of the estimated parameters. In a more recent study by Paiva (2003), the sum of the price elasticities is slightly below one (0.91), but still sufficiently high so that the hypothesis $1 - \alpha - \gamma + \beta\gamma > 0$ is still valid.

Before we use the econometric estimates as a guide in some numerical exercises a word of caution is necessary. Since the model of the previous sections was specified in continuous time and the estimates in Table 1 were obtained in discrete time, they involve different time definitions. Is a theoretical-empirical correspondence still valid? Absolutely, it is common practice in economics to specify theoretical models in continuous time to facilitate the analysis and investigate the empirical implications of such models in discrete time. In the specific case in question, because the estimates in Table 1 are cointegrating parameters, they can be interpreted as representing the final impact of their corresponding variables on exports and imports, which is exactly what the theoretical parameters of the previous section aim to capture. More formally, the impact of the real exchange rate and growth on trade varies according to the dynamic multiplier implicit in the lag structures of the export and import equations, but as the fluctuations die out, the final impact converges to the numbers in Table 1. The numerical accuracy of the estimates have obviously to be

interpreted with caution but, nevertheless, the estimated numbers give us valuable information about the order of magnitude of Brazil's trade elasticities.

Moving to the numerical exercises, let us start with the short-run analysis of trade adjustments. Given Brazil's export-income and import-income ratios in 2002 (approximately and respectively 13 and 10%) and Cavalcanti's and Frischtak's estimates for 1980-2000,¹⁹ the trade-adjustment line for a stable trade balance ($dx/dt = dm/dt$) in Brazil is given by:

$$q_b = 0.356q_f + 0.144z \tag{13}$$

In words, given the foreign growth rate, to keep its trade balance stable in terms of GDP, Brazil has to compensate an additional 1% of income growth with an additional $(0.01/0.144) \cong 6.9\%$ devaluation of its real exchange rate.

To illustrate how sensitive the slope of (13) is in relation to the export-income and import-income ratios, Table 2 presents what would be the real-exchange-rate devaluation necessary to compensate an additional 1% of income growth under different trade configurations.

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¹⁹ The estimates for 1980-2000 were used to obtain (13) because the income elasticity parameter estimated for 1991-2000 seems too high in relation to other studies on Brazil (Paiva, 2003; Resende, 2001) and other developing countries (Caporale and Chui, 1999), whose estimates range between 2.5 and 3.5, depending on the specification of the equation. In fact, even Cavalcanti and Frischtak consider their estimate for 1991-2002 too high, indicating that it was probably the result of a temporary phenomenon and should not be used for forecasting and simulations. Following their recommendation, we focus on the estimates for the whole period and present the implications of the structural break in 1991 in the appendix. The initial export-income and import-income ratios were calculated from the annual data of the Central Bank of Brazil.

Table 2_ Annual real-exchange-rate devaluation necessary to compensate an additional 1% of income growth and keep Brazil's trade balance stable in terms of its GDP

		Import-GDP ratio					
		9	10	11	12	13	14
Export-GDP ratio	10	8.4	9.7	11.2	13.0	15.1	17.7
	11	7.4	8.5	9.7	11.1	12.6	14.5
	12	6.7	7.6	8.6	9.7	10.9	12.4
	13	6.2	6.9	7.7	8.7	9.7	10.8
	14	5.7	6.4	7.1	7.9	8.7	9.7
	15	5.4	5.9	6.6	7.2	8.0	8.8

Source: Own estimates based on the elasticity parameters estimated by Cavalcanti and Frischtak (2002).

As we proved theoretically in the previous section, the higher the trade balance in relation to GDP, the lower the real-exchange-rate devaluation necessary to keep trade stable. However, the numbers in Table 2 also show that, given Brazil's unfavorable elasticity parameters, even with a trade surplus of 6% of GDP ($\alpha = 15\%$ and $m = 9\%$), 1% of income growth would "cost" approximately 5.4% of real-exchange-rate devaluation to keep the trade balance stable in terms of GDP.

Given the intention of the Brazilian government to increase Brazil's GDP growth in the near

future, it is worthy to investigate what would be the growth rates consistent with stable trade. Assuming that the world economy will grow 4% in 2004 (IMF, 2003), Table 3 presents the growth-devaluation trade off implicit in (13). To keep both its real exchange rate and trade balance-GDP ratio stable, Brazil should grow approximately 1.4% when the world economy grows 4%. If we plot the target growth rate of 3.5% set by the Brazilian government for 2004, then the real-exchange-rate devaluation necessary to keep the trade balance stable in terms of GDP rises to approximately 14.4%.

Table 3_ Trade off between annual income growth and real-exchange-rate devaluation in Brazil necessary to keep the trade balance stable in terms of GDP (estimates obtained for a 4% annual income growth of the world economy)

GDP annual growth rate	Real-exchange-rate devaluation
1.00	-2.9
1.50	0.5
2.00	4.0
2.50	7.5
3.00	10.9
3.50	14.4

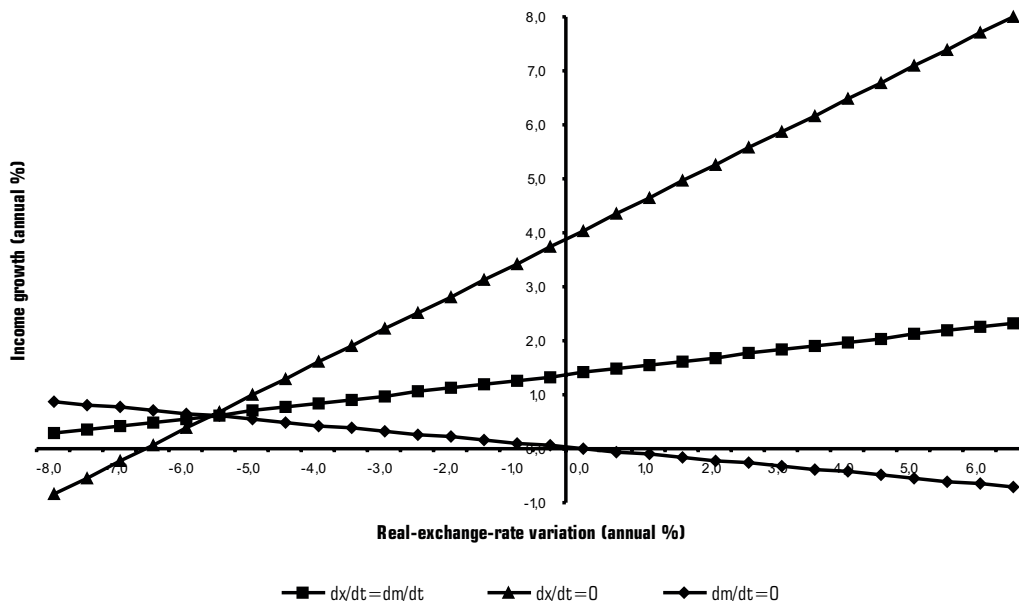
Source: Own estimates based on the elasticity parameters estimated by Cavalcanti and Frischtak (2002).

Moving to the long-run direction of the trade adjustment, the numbers in Table 1 indicate that, for Brazil's export-income and import-income ratios to be stable, we must have $q_b = 0.15q_f$ and $\xi = -1.41q_f$. So, given a foreign annual growth rate of 4%, Brazil would have to combine a GDP growth of just 0.6% with a real-exchange-rate revaluation of 5.6% to keep both its export-income and import-income ratios stable! Such an unfavorable situation reveals why such ratios have shown wide variations in recent years, it would be too costly in terms of income and relative prices to stabilize them. Nevertheless, the combination of low growth and currency appreciation revealed by the

elasticity parameters indicates that the very own structure of the Brazilian economy is biased towards a poor trade and growth performance.

Finally, to illustrate the relation between the trade, exchange rates and growth in Brazil, Figure 5 presents the trade-adjustment line (representing $dx/dt = dm/dt$) and the export ($dx/dt = 0$) and import ($dm/dt = 0$) equilibrium lines derived from the elasticity parameters in Table 1, a foreign growth rate of 4% and Brazil's export-income and import-income ratios of 2002. Interpreting the latter as the initial conditions of the numerical exercise, the lines portrayed in Figure 5 offer us a simple way to analyze the trade structure of Brazil.

Figure 5_ Brazil's trade structure based on the estimates of price and income elasticities of exports and imports of Cavalcanti and Frischtak (2002) and the export-income and import-income ratios observed in 2002



Two issues should be noted in Figure 5. First, as we derived above, the three lines intersect at a point with positive growth and negative devaluation (increase of the real exchange rate). Second, since points below the trade-adjustment line are associated with an increasing trade surplus, Figure 5 shows that income growth must be low for Brazil

to increase its trade balance in terms of GDP at moderate devaluations of the real exchange rate. In fact, given a stable real exchange rate ($\varepsilon = 0$), annual income growth would have to be between zero and 1.4% for the trade balance to grow in terms of GDP under the current trade structure of the Brazilian economy.

4 Conclusion

Brazil's current trade structure does not seem to be favorable to growth. According to the theoretical model of Sections 1 and 2 and the evidence analyzed in Section 3, the growth-devaluation trade off is highly unfavorable. Given a BoP constraint on growth, an additional 1% of GDP growth requires a substantial increase of the real-exchange-rate in order for Brazil to keep its trade balance stable in relation to GDP. Even if Brazil had a higher trade surplus the situation would not be substantially different. In fact, the roots of the problem lay deeper, namely: on the price and income elasticities of Brazilian exports and imports.

The numerical exercise of section three shows that Brazil has such an unfavorable trade-elasticity configuration that, if the world economy grows at a annual rate of 4%, its GDP would have to grow at 1.4% in order to keep its trade balance stable in terms of GDP at a constant real exchange rate. Any higher growth rate with a stable real exchange rate would reduce the trade balance in terms of GDP.

Of all elasticity parameters considered in the analysis, the main problem seems to be the high

income-elasticity of Brazil's imports. Even a moderate growth rate domestically tends to lead to a substantial growth of imports and, therefore, has to be compensated with an equally high real-exchange-rate devaluation.²⁰ To worsen the situation, the low price elasticities of exports and imports indicate that a large devaluation is usually needed to obtain the necessary trade adjustment.

If we combine the import and export elasticity parameters, the result is that Brazil would have to combine a low annual growth rate with a continuous increase of its real exchange rate to keep both its export-income and import-income ratios stable under the current growth prospects for the world economy. This is obviously an unsustainable situation because no country is able to appreciate its currency indefinitely against the rest of the world. The fact that Brazil's trade structure requires low growth and appreciation to be stable just indicates how fragile the current situation is. So far the solution has been wide fluctuation of the real exchange rate.

Is there a way out of such an unfavorable situation? The answer is yes, provided that Brazil's elasticity

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²⁰ The same conclusion was reached by Paiva (2003, p. 17): "*(...) to avoid a deterioration of the trade balance as Brazil grows faster than its trading partners, the real effective exchange rate (...) would have to come under renewed pressure to depreciate.*" According to Paiva the solution is to deepen structural reforms that improve international competitiveness and increase the access to foreign finance.

parameters change in the right direction. Throughout the analysis we have been working under the assumption of constant elasticities. This is a common and sensible assumption when one is analyzing trade issues in short intervals of time, say, up to 4 years. However, the longer the time interval considered, the higher the probability of structural changes in the economy.²¹

The recent economic history of Brazil is marked by such changes. After the 1980 debt crisis Brazil had to produce high trade surpluses to finance its balance of payments. In the 1990s the wave of international capital from advanced countries to emerging markets allowed Brazil to liberalize its trade and appreciate its currency to fight inflation. During both periods the structure of the economy adjusted to the new situation after some years. The same may probably happen again.

In fact, a structural adjustment may already be under way now that more than four years have passed since Brazil's 1999 currency crisis and the end of the period of low real exchange rates. As a result of the devaluation and exchange-rate volatility since 1999, Brazil's trade elasticity parameters may

be expected to change in the near future, provided that the foreign and domestic signs point to the right direction.

As any aggregate parameter, the price and income elasticities analyzed in this paper depend on a mix of institutional, technological and behavioral factors. Given that Brazil's current trade structure is biased toward low growth rates, its trade elasticities will probably change as new policy measures are adopted to stimulate growth and economic agents respond to it. The trade structure inherited from the 1990s is unfavorable but not immutable. Much can be gained by government incentives to export promotion and import substitution. Rather than a political choice, such a strategy is an economic necessity for Brazil to increase its growth rate in a sustainable way.

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²¹ Following Krugman (1989), a possible way to summarize the point is to say that real exchange rates and income growth vary to accommodate differences of elasticities in the short run, whereas, the elasticities change to accommodate differences in growth and a stable real exchange rate in the long run.

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This appendix presents the growth-devaluation trade-off based on the elasticity parameters estimated by Cavalcanti and Frischtak (2002) for 1980-1991 and 1991-2000. In both periods the trade-off confirms the theoretical conclusions of the paper

(more growth needs more devaluation to keep the trade balance stable in terms of GDP), but the magnitude of the trade-off is obviously different. In short, the higher income elasticity of imports in 1991-2000 makes the trade-off much more unfavorable in that period.

Table A1_ Annual real-exchange-rate devaluation necessary to compensate an additional 1% of income growth and keep Brazil's trade balance stable in terms of its GDP based on the 1980-1991 parameters

		(%)					
		Imports-GDP ratio					
		9	10	11	12	13	14
Exports-GDP ratio	10	2.6	3.0	3.8	5.9	23.8	-6.8
	11	2.4	2.6	3.0	3.7	5.3	12.2
	12	2.2	2.4	2.6	3.0	3.6	4.9
	13	2.1	2.3	2.4	2.7	3.0	3.6
	14	2.1	2.2	2.3	2.5	2.7	3.0
	15	2.0	2.1	2.2	2.3	2.5	2.7

Source: Own estimates based on the elasticity parameters estimated by Cavalcanti and Frischtak (2002).

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