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The role of foreign and domestic factors in the evolution of the Brazilian EMBI spread and debt dynamics.

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This paper examines the relative importance of global and domestic factors as a source of macroeconomic fluctuations in Brazil from 1995 to 2004. US and Brazilian credit spreads are encompassed in a near-VAR model, including the main debt-related domestic variables. The US corporate bond spread is used as a measure of international risk aversion. The relative importance of global factors to the volatility of Brazilian domestic series is singled out by means of a partial identification strategy, whereby foreign variables are treated as block exogenous. The estimates reveal that foreign investors' appetite for risk is an important determinant of the volatility of the macroeconomic Brazilian series and affects the monetary policy transmission channel, as recently suggested by Olivier Blanchard.

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Keywords: External factors, Credit spreads, External debt, Fiscal dominance.

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1. Introduction.

The evolution of emerging market credit spreads has attracted a great deal of attention throughout the last ten years. Most of the empirical literature on this issue has focused on the relationship between credit spreads (of different debt instruments), credit ratings and macroeconomic variables. The rationale behind the consideration of the way in which credit spreads relate to these variables has been threefold: (i) to test the significance of the predictions coming from theoretical models studying such relationships; (ii) to improve the forecasts of debt-related financial variables; (iii) and to check the truthfulness of market commentary and widespread beliefs (such as the idea that appetite for risk grows in low interest rate environments). A significant part of the literature - among which Eichengreen and Mody (1997) and Kamin and Kleist (1999) represent two of the most prominent works - has taken the form of panel data analysis. While sharing similar goals, the various papers differed in the techniques they adopted, in the samples they investigated (i.e. either countries or time periods) and in the variables on which they focused. However, these works shared one weakness: they neglected the fact that sovereign credit spreads are important determinants of debt service and, therefore, of debt sustainability.

More recently, the endogenous role of credit spreads in macroeconomic volatility has attracted the attention of researchers, and credit spreads have started being treated as endogenous variables in a growing number of papers. However, since most of the authors draw on the assumption that credit spreads move together with domestic business cycles, they have studied the interaction of credit spreads with those factors that are commonly considered to affect the business cycle, but not with those relating to debt sustainability. As a consequence, limited attention has been devoted to the study of the interaction in emerging market economies between credit spreads, foreign investors' risk aversion and sovereign debt dynamics[1]. Ignoring the fact that foreign investors are risk averse and that their degree of risk aversion can change over time has potentially serious consequences on the validity of the results of such empirical investigations. Therefore, while studying the determinants of emerging market credit spreads, the contribution of global risk aversion should not be neglected. On this basis, this work jointly attempts to take seriously the endogeneity of the credit spreads, and to relate them to the degree

[1] One exception is represented by Arora and Cerisola (2001), where the authors consider, among the regressors, US interest rates and measures of market sentiment. However, as the authors resort to a one-equation estimation method, the endogeneity issue is not fully taken into account. The same holds for Gonzales-Rozada and Levy (2005)

of risk aversion of international investors, as well as to traditional domestic and international macroeconomic factors.

In particular, in this work I analyse the determinants of Brazilian credit spreads (from January 1995 to January 2004), taking into consideration both of the observations made above, in terms of the endogeneity of credit spreads and the role of foreign variables. In Section 2, I shall propose a brief review of the literature. In Section 3 I shall illustrate the theoretical reasons that lie behind the choice of the model to estimate and of the variables to encompass. The data will be described in Section 4, and in Section 5 I will estimate a VAR model including foreign variables (US federal funds rates, US production, and US_BAA spread) as well as domestic Brazilian variables (external debt, primary deficit, EMBI spread, and other macro variables). The main goal of the paper is to appraise the historical contribution of the internal and external factors to the evolution of the Brazilian domestic variables under scrutiny, and to analyse the relative importance of the internal and external factors once i) credits spreads are treated as endogenous, and ii) a measure of global appetite for risk is included among their determinants. By exploiting the fact that the foreign factors are presumably only marginally affected by Brazilian macroeconomic variables, in Section 6 I shall disentangle and quantify the historical relative impact of the foreign factors on the Brazilian domestic variables[2]. In Section 7, I shall take on a second task: assuming a recursive causality order between the endogenous variables, I shall calculate the impulse response functions of the endogenous variables in the system, so as to better understand the potential contributions of the diverse shocks to the evolution of the endogenous variables. At the end of the analysis, I shall discuss briefly the robustness of the results.

2. Review of the literature on credit risk spreads and debt dynamics.

In the last few years, a growing number of researchers have recognised that the previous literature failed to treat credit spreads as endogenous variables, affecting and affected by domestic and international macroeconomic conditions.

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[2] Other works exploit block exogeneity in VAR systems to study the contribution of foreign variables on the domestic ones. Let me recall here Genberg, Salemi and Swoboda (1987), Cushman and Zha (1997) and Genberg (2003). In what follows, I will stick to the structure and strategy used in these analyses. Other authors employ different techniques to gauge the relative importance of internal and external factors, as, for instance, restricted Structural VARs (see, for instance, Gerlach-Kristen (2006) for the case of Hong Kong). Calvo *et a.l* (1993), instead, use a principal component analysis to create two proxies of external impulses and insert them in a block exogenous SVAR to evaluate their relative contribution to the forecast error variance of international reserves and real exchange rates. Canova (2005) first identifies supply, real demand and monetary US disturbances, then exploits a prior specification with cross-sectional information to estimate the response of some Latin American countries.

Uribe and Yue (2006) clearly realize this issue and, by focusing on seven emerging market economies, estimate a VAR model encompassing foreign and domestic interest rates, trade balance to output ratio, real gross domestic investment, and real gross domestic output. These variables are chosen among those that most commonly appear in classical IRBC models. Despite these authors improving on previous analyses, as they take into account the simultaneous relationship between credit spreads and macro-variables, they do not include those domestic factors which are indeed important for debt sustainability (namely, debt/gdp ratio, fiscal primary balance/gdp ratio and nominal variables), nor do they consider all relevant foreign variables (such as measures of appetite for risk). In other words, despite tackling the issue of the simultaneity of credit spreads, they do not encompass those factors which are reasonably connected to credit spreads, but not to real business cycles. Their choice of neglecting these variables is consistent with their interest in the determinants of the real business cycles, and not in those of the credit risk premia *per se*. However, the risk is that, failing to recognise that credit spreads do not exclusively depend on business cycles but also on other debt-related macroeconomic factors, their model is misspecified and relevant variables are omitted.

Garcia and Rigobon (2005) abandon the panel data approach and focus their investigation on Brazil alone. They estimate a large VAR model for the Brazilian economy (over the period 1994-July 2003) where debt, deficit and other nominal and real variables are included. The authors do not utilise EMBI spreads or other credit spread measures in their model, but, rather, they set up a VAR system including many of the alleged determinants of credit risk premia. Their choice follows a two-step strategy: first, they estimate a VAR model able to forecast the stochastic evolution of sovereign debt in the future, and, afterwards, they relate such predictions to the credit spreads actually recorded in the markets. Unfortunately, since they do not encompass any foreign factors among the variables of the VAR model, the latter loses the ability to explain the variance of credit spreads and debt which is instead attributable to such foreign factors. Following an approach which is similar in spirit to Garcia and Rigobon (2005), Hostland and Karam (2005) propose a framework to assess debt sustainability in emerging market economies based on stochastic simulation methods. The authors take into account the interaction among economic variables and, in particular, the endogeneity of risk premia (p. 6). Their contribution, however, differs from the present work in two main aspects. First, Hostland and Karam aim at highlighting the key factors influencing prospective debt sustainability in a stochastic framework where the joint likelihood of several adverse shocks is considered, whereas I am interested in explaining the data and the relationship among the series over a historical period. Second, they do not consider the role played by external factors in the evolution of emerging market fluctuations, while this is one of the main themes of this work. Tanner and Samake (2006) address the first of the two observations above, and assess debt sustainability (in a stochastic simulation model) not only prospectively but also retrospectively. Tanner and Samake, however, do not tackle the second point, since they do not embed external factors in their study (expect for the growth in oil prices). In addition, they neglect the endogeneity of risk premia and credit spreads which is, instead, extremely important for the development of external debt .

Focusing on the consequences of limited enforcement constraints in sovereign debt markets, Neumeyer and Perri (2005) build a theoretical general equilibrium model for a small open economy to account for a series of stylised facts, namely that, in emerging economies, i) business cycles are more volatile than in developed nations, ii) real interest rates are counter cyclical and lead the cycle, iii) consumption is more volatile than output, and iv) net exports are strongly counter cyclical. These authors decompose the real interest rate into two independent determinants, that are an international interest rate and a country risk component. In the words of the authors,

> "Because fluctuations in country risk spreads are large, we consider two simple polar (non-mutually exclusive) approaches to their determination. The first is that factors that are largely independent of domestic conditions (like foreign rates, contagion, or political factors) drive country risk. In the second approach changes in country risk are induced by the fundamental shocks to a country's economy (productivity shocks in our model). In this case, these shocks drive, at the same time, business cycles and fluctuations in country risk." (Neumeyer and Perri 2005 p 347).

It is clear from the excerpt above that the authors recognise that domestic interest rates are affected by three different sources of uncertainty: foreign "risky" interest rates (in their turn determined by foreign short term interest rates and foreign investors' appetite for risk), external shocks (such as contagion, political factors, foreign crises), and domestic determinants (such as inflation, exchange rates, unemployment, debt levels, debt currency composition, volatility of the tax base, and the like). The authors, however, decide not to model the default process; they assume that the probability of default is inversely related to domestic productivity shocks. In so doing, however, foreign risk aversion does not come to play that crucial role it actually has in generating or amplifying the fluctuations of domestic credit spreads, debt level and other macroeconomic variables. The authors do highlight the fact that domestic risk premia affect domestic interest rates and amplify the volatility of the business cycles, yet they do not model domestic risk premia and thus, fail to take into account that the interest rates themselves affect the premia. Accordingly, the issue I empirically address in this work is acknowledged, yet not fully treated in their theoretical contribution.

In their paper on debt "intolerance", Reinhart, Rogoff and Savastano (2003) recognise that the "interest rate a country must pay on its debt is an endogenous variable, which depends, among other things, on the country debt-to-output ratio." (p. 41). Also in this case, although the authors acknowledge the endogeneity of credit risk spreads, they neither directly tackle the issue, nor do they try to formalise it in a proper model, probably because this task would have gone beyond the scope of their analysis and interests.

Building on Neumeyer and Perri (2005) and others, Arellano (2005) proposes a theoretical RBC model in which she endogenises interest rates by linking spreads to default probabilities. The novelty is that default is optimally decided, and it is neither exogenous nor rule-determined. In a nutshell, the fluctuations of output affect the incentives to default, the changes in the incentives to default determine the volatility of bond prices, and the latter is mirrored in the interest rate volatility. It follows that real shocks in the tradable and non-tradable sectors cause counter-cyclical and highly volatile interest rates[3]. Domestic interest rates are affected by the probability of default because investors require an adjustment to the expected payoffs of defaultable bonds (i.e. the payoff of a defaultable bond is lower than an identical but safer one as long as the probability of default is positive). Following the literature, Arellano assumes investors to be risk neutral. It follows that no risk premia are in the model. In fact, credit spreads merely reflect the differences in the expected rates of return of defaultable and risk-free instruments, yet not those 'additional' premia that investors typically require to undertake the risk. As a consequence, the domestic interest rate volatility does depend on the changes in the expected probability of default due to output fluctuations, yet not on foreign lenders' risk aversion. In addition, the feedback of domestic interest rates on the other macroeconomic variables is not fully endogenised.

A contribution that is very much in line with the idea underlying this investigation is represented by Fiees (2003). Starting from the observation that "it has been widely recognized that both country-specific and global factors matter in explaining capital flows" (p. 1), and following the approach by Calvo *et al.* (1993), Fiees uses a principal component analysis to "disentangle the relative weight of country-specific and global factors in determining capital flows" (p. 1). He starts by separating the common component of emerging country spreads from the country-specific ones. Then, he uses the pure country-specific risk and two global

[3] It is interesting to note that, in Arellano's work, the optimal level of debt is endogenously determined in equilibrium. The debt level does not imply default alone. In fact, it is not the level of debt *per se*, but, rather, its interaction with i) real shocks, ii) exchange rate volatility and iii) default probabilities that makes a certain level of debt sustainable or not. I am sympathetic with this approach because it treats the choice to default and the credit spreads as endogenous stochastic variables, interacting with other variables in the economy.

components (i.e. "contagion" and U.S. long-term interest rates) as "explanatory variables to account for the observed pattern of capital flows using multivariate cointegration analyses" (p. 1). Doing so, he identifies the relative weight of global and country-specific factors in explaining capital flows to Argentina, Brazil, Mexico and Venezuela in the 1990s. In a nutshell, Fiees decomposes country risk and disentangles its main determinants. He finds that the determinants of capital flows and sovereign bond spreads can be jointly identified in a small system. He claims that capital flows are driven by country risk and global factors (i.e. "contagion" and U.S. long-term interest rates), while the primary balance-to- GDP ratio (-) and the ratio of public debt to GDP (+) determine country risk. This implies that capital flows are determined by country risk, and not, as often argued in the literature, vice versa. Such conclusions support the idea that capital flows are driven by the changes in the (demanded and actual) risk premia: I shall return to this point in Section 3. While tackling the issue of credit spreads in a way that is very close to the one I shall develop in this work, Fiees does not address debt dynamics, which are, instead, part of this investigation[4]. In addition, he does not include foreign investors' appetite for risk as one of the global factors involved: this, I believe, is something to improve upon.

It is also worth considering the contribution by Agenor, Hoffmaister and Medeiros (2002). These authors examine the behaviour of the capital flows and the real exchange rate in Brazil during the period 1988-1995. They resort to a near-VAR model where capital flows, changes in domestic and foreign interest rates, changes in the expected depreciation rate, the government spending-output ratio and changes in the real exchange rate are all linked. Using a generalized VAR framework (as proposed in Koop, Pesaran and Potter 1996), the authors show that the impact of a change in the world interest rate explains only a small proportion of fluctuations in capital flows. This work is close in spirit to my contribution because it focuses only on one country (that is, by coincidence, the same); in addition, Agenor and his co-authors treat foreign interest rates as block exogenous, as I will do afterwards. However, since the authors tackle capital flows and exchange rate, their contribution can be distinguished from mine in light of two of its main features: first, sovereign debt dynamics are not considered, and, second, foreign risk aversion is not included among the foreign factors.

Since this work started, a few other analyses have dealt with the endogeneity of debt dynamics and credit spreads, as well as with the relative importance of foreign factors. Garcia-Herrero and Ortiz (2005) empirically assess the relative importance of global factors (such as global risk aversion, US interest rates and US economic growth) to explain the evolution of

[4] The same observation is valid for Calvo *et al.* (1993). With respect to Fiees, however, Calvo and co-authors explicitly focus on capital flows, real exchange rate fluctuations, and accumulation of international reserves.

sovereign credit spreads in Latin America (hereafter LA). They use a small 4 variables SVAR model (the actual identification strategy is, in fact, a Choleski decomposition without any block exogeneity assumption) to identify the underlying foreign determinants of LA sovereign spreads. Following the intuition of the principal component analysis by McGuire and Schrijvers (2003), they end up distinguishing a direct and an indirect channel of influence of US growth and long term interest rates on LA sovereign spreads[5]. Their approach does not encompass domestic LA variables and so, interestingly, neither deficit nor debt variables enter the specification of the domestic factors affecting credit spreads. Thus, the authors fail to fully take into account the endogeneity of credit spreads and debt dynamics. In addition, as mentioned, they do not adopt a block exogeneity assumption and produce impulse response functions for the US variables to the Brazilian innovations. In this work I will try to improve on this and to test the robustness of their findings.

Favero and Giavazzi (2005) argue that the way EMBI spreads respond to international shocks depends on the fiscal policy regime in force[6]. In particular, they find that the correlation between US BAA corporate high yield and EMBI spreads is nonlinear and the nonlinearity depends on the state of domestic fiscal policy. They conclude that the effectiveness of monetary policy in a country whose fiscal policy is judged as unsustainable by financial markets, is significantly reduced. Even a serious inflation targeting policy can be at jeopardy and it can, under certain circumstances, even turn out to be counterproductive. I shall come back to this issue again in Section 3 where I shall illustrate the work of Blanchard (2005), as the assumptions and conclusions in Favero and Giavazzi (2005) are in line with it. With respect to these two contributions, in this work I focus on and quantify the forecast and historical relative contribution of global factors on the fluctuations of several Brazilian domestic variables.

To conclude this concise review of the literature, it is worth mentioning the recent work by Goretti (2005). Using high frequency data, she employs a Markov-Switching regime with Gibb sampling model to disentangle the relative importance of several sources of instability (such as political factors, global risk aversion, IMF news, and Argentine contagion) in Brazil, during the currency and financial distress episode in 2002. As she focuses on a specific episode, the investigation covers a rather restricted span of time and offers interesting empirical insights only on the validity of some interpretations of the Brazilian turmoil. The author argues there is evidence in favour of a regime switch, that is a jump in equilibria during this delicate political

[5] The indirect channel is the one that refers to the impact that US growth and interest rates have on the global risk aversion and, via the latter, on the LA credit spreads.
[6] The latter can be, following Woodford (1994) terminology, either Ricardian or Non Ricardian.

and economic period[7]. Credit spreads seem to be remarkably affected both by international factors and by the developments of the peculiar political situation in Brazil during 2002 (namely, the distinctive features of the candidates to the Presidential elections in October 2002). The main policy implication one can draw from this is that developing countries' financial markets, currencies and debt instruments are very sensitive to the fluctuations in global risk aversion and pre-electoral political instability. Admittedly, this conclusion does not provide general, all-time-valid suggestions about how to better predict the impact of the individual variables on credit spreads. I believe the main contribution of the paper is, rather, in distinguishing and assessing the theoretical explanations of what happened in Brazil on that specific occasion. In this work, instead, the emphasis will be placed on the "normal time" links between foreign and domestic, macroeconomic and financial variables affecting debt and credit spreads.

3. Credit risk spreads as a channel of transmission.

In broad terms, a traditional general equilibrium macroeconomic model assumes that international investors are risk neutral. This tenet excludes the possibilities of modelling risk premia and including the degree of risk aversion among the determinants of the equilibrium. To my knowledge, the only macroeconomic model where credit spreads and the degree of risk aversion are encompassed to explain the evolution of other macroeconomic variables is Blanchard (2005). Blanchard puts forward the idea that foreign investors, being more risk averse than domestic investors, demand a risk premium to hold their funds in emerging, risky countries. Such a risk premium depends on two main components, that are the investors' degree of risk aversion[8] and the probability that the issuer defaults on its obligations. As the actual risk premium is determined by the average investor's behaviour, and being foreign investors more risk averse than the domestic ones, unexpected changes in the degree of risk aversion of a few (either foreign or domestic) investors may cause sudden capital flow reversals. Similarly, abrupt changes in the perceived probability of default are able to trigger sudden capital stop (or, vice versa, inflows). Changes both in foreign risk aversion and in the probability of default make the risk premia required by investors grow beyond the actual premia. Such a gap between the actual and the required interest rates leads international investors to withhold their loans until the former reaches the latter. The capital reversals, that result as a by-product of this interaction, tend, in

[7] It is worth mentioning that the author imposes a regime switch on the constant terms, not on the coefficients of the estimated regressions.
[8] In financial jargon, this is also called the investors' appetite for risk.

their turn, to depreciate the domestic currency, increase imported inflation, and worsen debt prospects. In such a situation, a peculiar form of fiscal dominance occurs: inflation is spurred by the change in the required credit risk premia and not by a lax monetary policy conduct[9]. This peculiar channel of transmission of the shocks represents a self-enforcing process: it helps explaining some economic phenomena that are hard to justify by means of more classical models (i.e. models with risk neutral international investors).

From an analytical point of view, the relationship between the domestic bond yields r and the foreign risk-free government debt yields r^f in the presence of risk-averse international investors can be written as follows:

$$(1-p)(1+r)+pRV=(1+r^{f})+\varphi$$

In this formula, p is the expected probability of default, r is the domestic government bond yields, r^f is the risk-free international interest rate, RV is the recovery value after the default and, φ is the risk premium demanded by foreign investors. As said, the risk premium φ depends on the foreign degree of risk aversion and the probability of default p. The probability of default p depends on a large number of domestic and international factors, such as the level of external debt, the conduct of domestic monetary and fiscal authorities, the domestic vulnerability to foreign shocks, the political climate, the global liquidity conditions, the intervention of the IMF (or its lack) in temporary episodes of financial distress, past credit history, and the like. The probability of default p, in other words, is endogenous: on the one hand, it changes because of the fluctuations in the international (exogenous) lending conditions and in the domestic conditions and, on the other hand, it affects the required risk premium and, thus, the equilibrium values of the interest rate, the exchange rate and inflation. This creates a complicated equilibrium relationship between the foreign degree of risk aversion, the domestic monetary and fiscal policies, and any other domestic and foreign shock. It is worth noting that, although this idea may sound familiar and almost intuitive, in fact, most macroeconomic models studying debt and default in the literature build on the assumption of risk neutral investors and complete markets. In the formula above this assumption corresponds to setting the value of φ equal to 0.

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[9] I qualify this form of fiscal dominance as "peculiar" because it differs from the famous fiscal dominance phenomenon illustrated by Sargent and Wallace (1981) and developed afterwards by Leeper (1991), and, more in general, by the so-called fiscal theory of the price level, first introduced by Woodford (1994), further developed by Uribe (2006), and applied to Brazil by Loyo (2000). In a nutshell, the classical dominance theory builds on the idea that when the fiscal policy is unrestricted, and debt grows without constraints, the monetary authorities eventually have to inflate the debt away, so as to guarantee that the intertemporal budget constraint holds in the long run. The "peculiar" fiscal dominance theory illustrated by Blanchard, instead, is based on the channel of transmission linking actual and required interest rates, capital flows, exchange rate and inflation.

Working on the formula above and leaving φ and p unspecified, the government bonds' spread can be calculated as the difference between the domestic and the foreign risk free rate, that is $spread = r - r^f = [\varphi + (1 + r^f) - RV][p/(1-p)]$.

Clearly, the credit spread is a complicated function of the probability of default, the risk premium and the international risk-free interest rate. The risk premium is determined by some international factors (such as foreign investors' appetite for risk, global liquidity and global financial distress conditions) and also by the perceived probability of default, which is, in turn, influenced by domestic and international macroeconomic conditions. Notably, credit spreads affect the cost of servicing debt and domestic interest rates; therefore, they influence both the vulnerability of the country and the future incentives to default. Since the latter are, as said, an important determinant of the credit spreads themselves, it follows that significant current fluctuations of credit spreads tend to affect their own evolution in the future. All this suggests that credit spreads are not only affected by the shocks hitting most macroeconomic and financial variables, but also affect some of them in return. The recognition of this issue indicates that, while studying the interaction between credit spreads and macroeconomic variables, it is appropriate to adopt a systemic approach. A single equation approach (where credit spreads are the dependent variable and external factors the independent ones) fails to take into account the centrality of credit spreads in their own evolution and in that of the economy. This constitutes the main motivation for resorting to a VAR model which encompasses most the of the abovementioned variables.

Before going to illustrate the empirical model to estimate and the data, I shall make a short digression to better qualify the idea proposed by Blanchard, and, in relation to it, the goals and scope of my empirical work. As outlined above, the idea that changes in the required risk premia may cause inflationary pressures even in a country where monetary policy is conducted in an orthodox way has not been much exploited in the past. Such "new" fiscal dominance theory, however, is helpful to explain peculiar economic phenomena that find no clear explanation in the traditional "risk neutral" literature. An example of this is represented by what happened to inflation and credit spreads in Brazil in 2002. At the time of the Presidential elections (eventually won by Mr. Lula), inflation spiked up despite the central bank maintaining its firm and truthful commitment to conduct a tight monetary policy. The fact that a spike in the Brazilian EMBI spread occurred at the same time as that in inflation has attracted the attention of many economists who have tried to uncover the connections between these phenomena. Although I focus on this very same country and period, and will base many choices and comments on Blanchard's intuition, I shall not try to establish here whether such a peculiar form of fiscal dominance occurred in that period in Brazil or not[10]. Rather, I intend to show that credit spreads, once their endogeneity is taken into account seriously, are extremely important in explaining the developments and the fluctuations of the Brazilian economy. In particular, I shall show that the degree of risk aversion of foreign investors is a crucial determinant of the macroeconomic volatility in Brazil. Insofar as these conclusions can be generalised to other emerging markets holding external debt, some general policy implications can be drawn. While governments and central banks can more or less directly affect (and control) the course and the fluctuations of the main domestic macroeconomic variables, they cannot influence foreign investors' degree of risk aversion[11]. The exogeneity of this important global factor suggests two policy recommendations for emerging markets. First, fiscal and monetary authorities should follow with care the developments in the international appetite for risk, being ready to intervene not to try to influence it, but, rather, to moderate the impact of its shocks on the domestic economy. Secondly, while assessing the political and economic responsibility of bizarre economic outcomes, domestic and foreign observers should use great caution. As it will appear more clearly in what follows, the blame for the upsurge of inflation in Brazil in 2002 has been probably thrown too hastily on monetary and fiscal authorities, which might indeed have reacted too little and too late, yet do not seem to be the origin of such a problematic situation.

4. The data.

According to what argued so far, in order to disentangle the contribution of domestic and external factors to the development of the Brazilian economy, I shall employ both foreign variables (i.e. the US industrial production cycle, US Federal Funds Rate, US-BAA corporate high yield spread) and Brazilian domestic series (i.e. the inflation rate, the real depreciation of the Real with respect to the US dollar, the cyclical component of the industrial production, the primary deficit cumulated over the 12 months, net external debt over GDP, and the EMBI credit

[10] Accordingly, although I shall highlight those results that can be interpreted as supporting the existence of such a channel, this is not to be intended as the ultimate goal of the paper. For direct empirical tests, see Blanchard (2005), Favero and Giavazzi (2005), Loyo (2005), and Tanner and Ramos (2002).

[11] Admittedly, this general statement is only partially true. In fact, US investors' appetite for risk could depend (in a very small measure) on Brazil's political, military, and economic conditions. For instance, if US investors were to believe that Brazil was going to invade Argentina, US spreads would be certainly affected by Brazil's conduct. Yet there are no events of such a kind in the period of time under consideration. The objection remains however valid for those emerging market countries that are able to affect investors' sentiment worldwide. It is easy to think of the long lasting repercussions that events occurring in the Middle East or in Venezuela have on the price of oil and, as a consequence, on US investors' appetite for risk. Similarly, Russian default in 1998 had huge repercussions on US monetary policy – as admitted by Chairman Greenspan – and on the international markets (see Dungey *et al.* 2003); events of this kind can hardly be treated as exogenous to the US and US investors.

spread[12]). Since I will look at the period of time spanning from January 1995 to January 2004, the series have been collected over this time lapse. All the data have a monthly frequency. I employ Giavazzi and Favero's dataset (see Giavazzi and Favero (2005))[13] and I add a few series which come from the IFS Statistics 2004 and from the Banco Central do Brasil. In this section, I shall briefly illustrate the most relevant variables employed in the empirical investigation; in particular, I shall focus on the EMBI spread, the US-BAA corporate high yield spread (BAA spread hereafter), and on Brazilian external debt. Following the literature, I shall employ the BAA spread as a measure of the international investors' appetite for risk (or risk aversion)[14]. The Brazilian EMBI spread (which refers to external dollar-denominated Brady bonds and to other non-local currency-denominated bonds), instead, serves as a measure of the Brazilian sovereign credit spreads. The ratio of the external debt over the domestic GDP is chosen to account for the Brazilian sovereign external liabilities. These three variables are plotted in Figure 1 below[15].

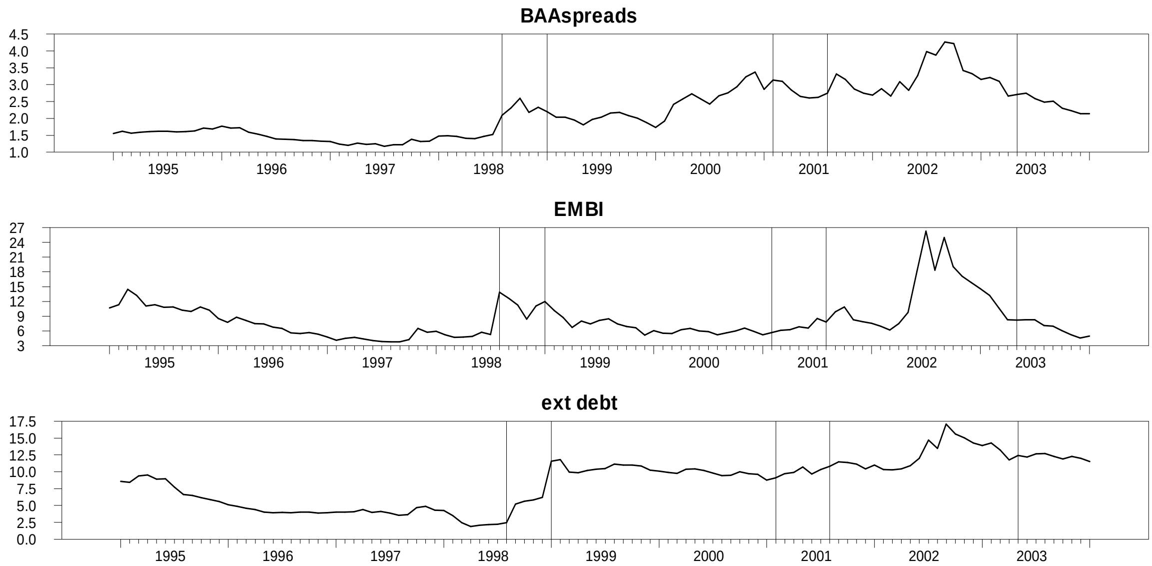

Figure 1. US_BAA spread, EMBI spread and external debt (as % of GDP).

[12] More precisely, the Brazilian inflation rate and the real depreciation rate of the Real with respect to the US dollar are calculated as monthly % rates of change expressed in annual terms. The cyclical component of Brazilian industrial production is obtained by HP filtering (with a smoothing parameter set equal to 14400) the Brazilian industrial production index. The primary deficit cumulated over the 12 months and the external debt are expressed as % ratio over Brazilian GDP. All the interest rates are expressed as hundreds basis points. The reasons for choosing these series will be spelt out and discussed in section 5.

[13] The series have been extended where necessary.

[14] Arguably, these spreads depend both on international investors' risk appetite and on the actual default risk of US corporate high yield assets. Nonetheless, being both of them exogenous to Brazil, I will take the shortcut of using them as a proxy of international risk appetite *tout court*.

[15] The vertical lines coincide respectively with the inception of the crisis in Russia (August 1998), the Brazilian devaluation (January 1999), the turmoil in Turkey (February 2001), the crisis in Argentina (August 2001), and the crisis in Uruguay (May 2003).

These three series move in a very similar way over the period of time considered: they fall and remain low from 1995 to 1998, rise afterwards (after the Russian crisis), climb again in 2002 and, finally, drop at the end of the sample. This common pattern suggests that the series might be relatively highly correlated. This similarity is curious in the case of the external debt because its evolution depends on a wider series of factors – namely, fiscal deficits, exchange rate fluctuations, interest rates and inflation - which are not plotted in Figure 1. Accordingly, to better assess the relative contribution of BAA and EMBI spreads to the evolution of Brazilian net external debt, a more systematic analysis is warranted and, indeed, this will be one of the main goals pursued in sections 5 and 6[16]. Here, I shall continue with the visual inspection of the relationship of EMBI and BAA spreads with other variables of interest. In particular, in the following figures, I will plot the EMBI and BAA spreads against the US 10 year Treasury bond yield, the US Federal Fund Rate (FFR hereafter), and the de-seasonalised domestic industrial production cycle.

I start presenting two graphs plotting the EMBI and BAA credit spreads, and the US 10 year Treasury bond yield (US_10y hereafter). The reason for looking at the US_10y is that this series is often used in the literature as a proxy of international liquidity. Furthermore, since it differs from the short-term FFR, it will be considered in Section 6 to test the robustness of the baseline VAR findings. Starting from Figure 2, a pattern characterised by high US_10y (scale on the right hand) and low EMBI spreads (scale on the left hand) and a negative correlation between the two can be observed. After the first quarter of 2002, the behaviour of the series changes but the correlation remains negative[17]: the EMBI spread jumps while the US_10 yield falls to an all-time low. The pattern of the series over 2002 is certainly peculiar and it is likely to depend on the contemporaneous presence of the presidential elections in Brazil, on the one hand, and of the stock market collapse and the very accommodative US monetary policy in 2001-2002, on the

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[16] Giavazzi and Favero (2005) discuss the time-varying nature of the correlation between these two credit spreads series. They argue that the fiscal policy regime in force affects the impact of foreign shocks on the evolution of the EMBI spreads, and this makes the relationship time-varying and nonlinear. Despite acknowledging the possible presence of nonlinear relationships, this issue will not be addressed in this work.

[17] It should be noted that, from a theoretical point of view, an increase in US long term government yields may be either positively or negatively correlated with the EMBI spread. If a portfolio substitution effect prevails, the correlation will be positive. The rationale is that an increase in the US long term yields reduces the amount of funds available to emerging markets and increases the spread. On the contrary, if a flight-to-quality effect occurs, any major increase in the spread tends to lead to an increased demand for US bonds and a decrease in their yields. Accordingly, the correlation between the two is negative. The second channel of transmission is more plausible if the movements in the spread are global, not only related to a single country. (Note that, if the capital outflows from an individual country are so large as to affect US treasury bond yields, the latter caveat does not apply). This seems to be confirmed by the actual negative correlation (-0.35) in the sample and supports the idea that the EMBI spread is strongly affected by international investors' risk aversion.

other. This hypothesis seems corroborated by the spike in US_BAA spread and the drop in US_10y in 2002 (in Figure 3).

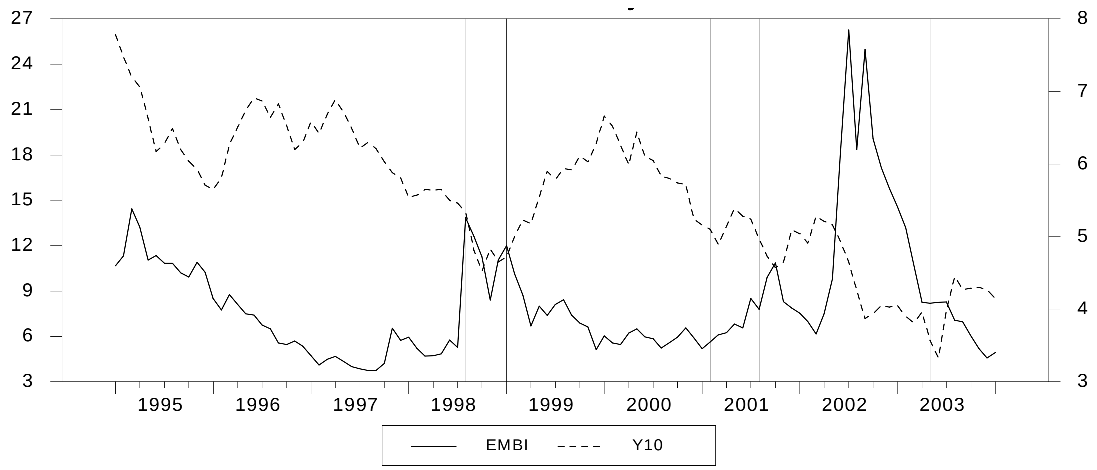

Figure 2. EMBI spread (% left hand scale) and US_10y (% right hand scale).

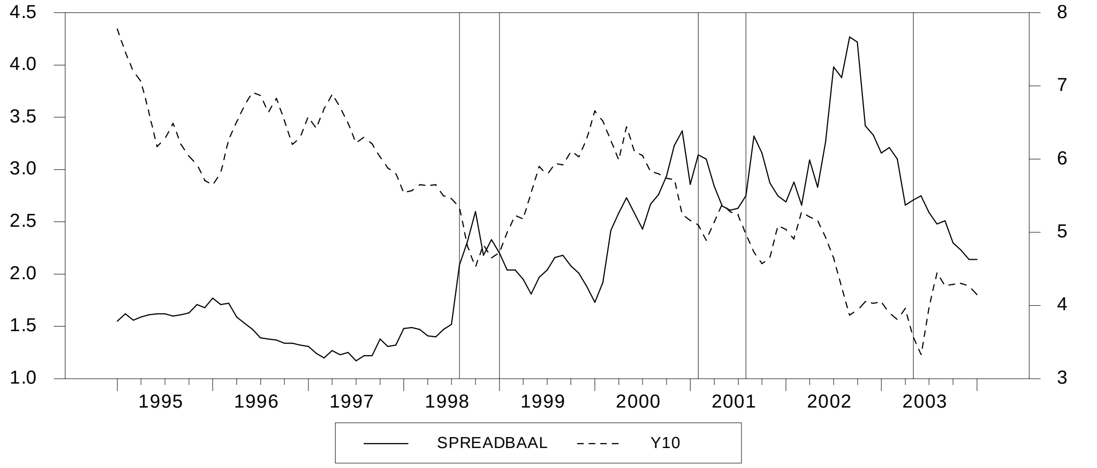

Figure 3. US_BAA spread (% left hand scale) and US_10y (% right hand scale).

In Figure 4, the EMBI spread and the Federal Fund Rate are plotted. There does not seem to be one single relationship between the two series over the whole period[18]. Overall, however, their correlation results negative (about -0.36 in the whole sample). This could be due to several factors. For instance, falling levels of the FFR may be associated with the slowing of US economic activity and, often, to dollar depreciations: these, in turn, are usually transmitted to

[18] One could argue that short and long term interest rates are leading indicators of the US cycle and, therefore, that this is sufficient to guarantee a negative correlation between the BAA spread and both short and long term interest rates. Still, current and prospective inflation seems to play the lion share in the determination of current short term interest rates in most developed countries (US included). Also, the current and past US cycle situations play a more important role in the determination of short-term interest rates than in long ones. It follows that short and long-term interest rates do not necessarily have to exhibit similar relationships with the BAA spread.

Brazil via reduced exports, which result in a worsening of Brazilian growth prospects, debt sustainability and, hence, in a rise of risk premia.

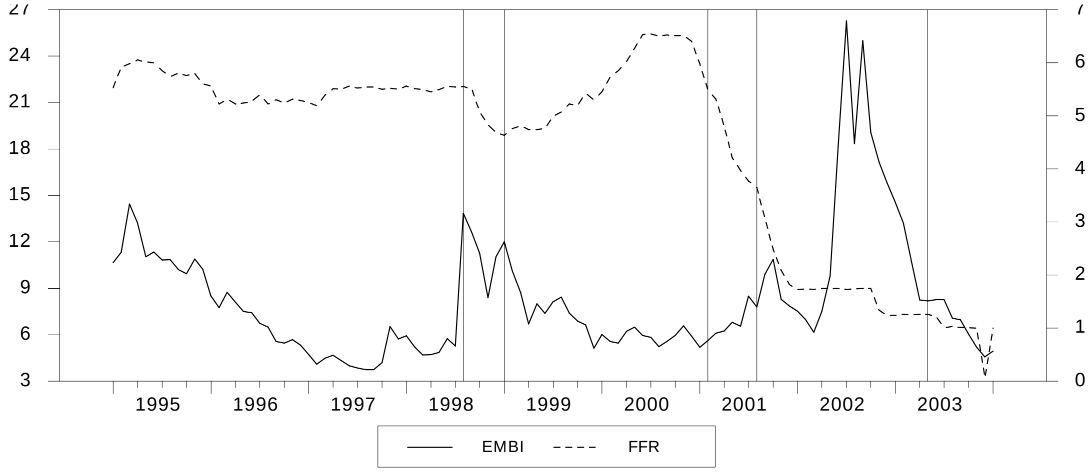

Figure 4. EMBI spread (%left hand scale) and FFR (% right hand scale).

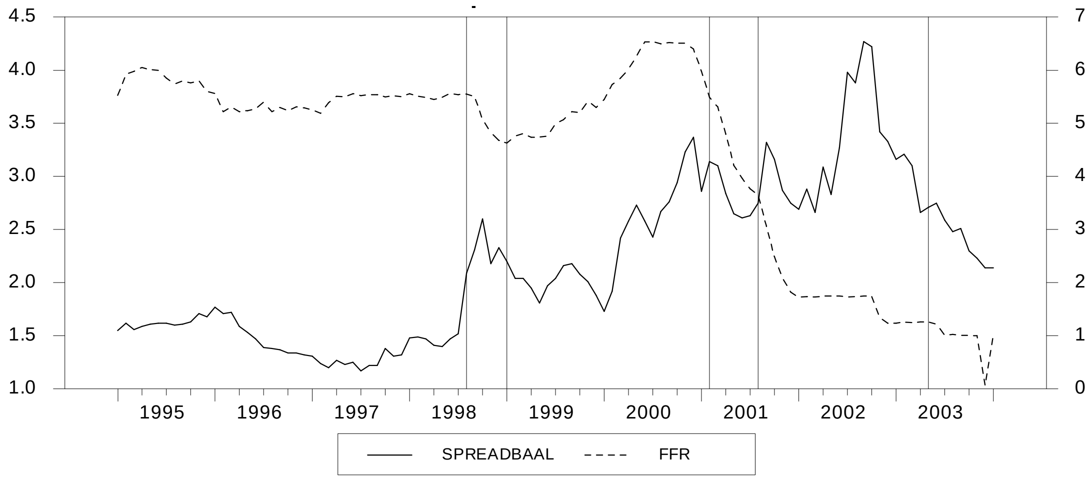

Figure 5. US_BAA spread (%left hand scale) and FFR (% right hand scale).

To conclude, I plot the EMBI spread and the Brazilian cyclical component of the production index in Figure 6. The series seem negatively correlated, as economic logic would indicate. When Brazilian production slows down, the debt-GDP ratio tends to grow and this raises the EMBI spread. The latter, in turn, increases the cost of servicing the debt, and therefore contributes to augmenting its riskiness, and after a few lags, its level too. This relationship, however, seems to hold less clearly in 2002.

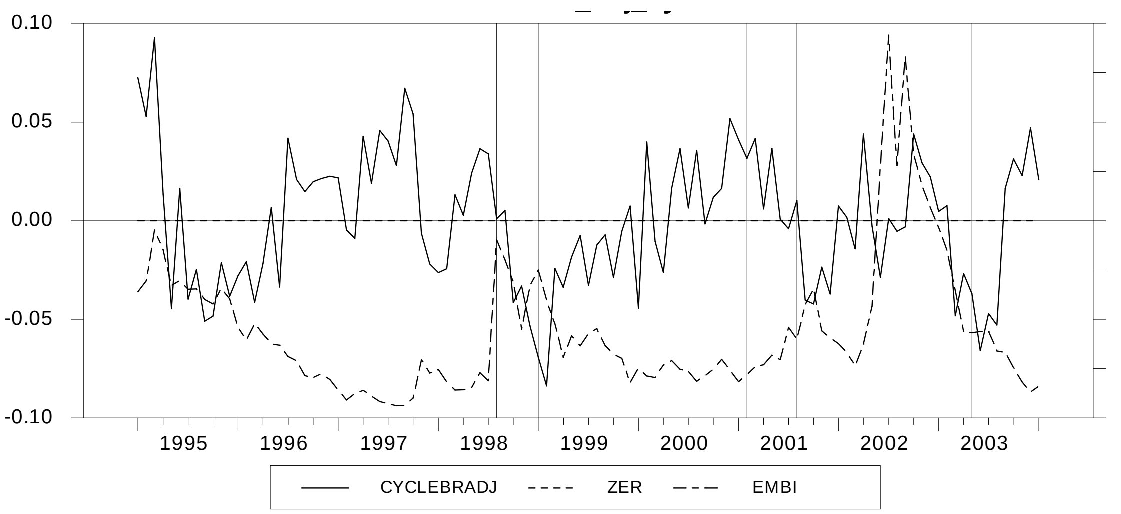

Figure 6. Brazilian cycle (%left hand scale) and EMBI spread (% right hand scale).

Since the visual inspection of the figures above does not permit to draw much more than suggestions about the relationships between the Brazilian EMBI spread and the international factors considered here, they will be the object of a more analytical investigation in the following sections.

To conclude, before moving on to illustrate the model to estimate, it is worth evaluating whether the mere inspection of the series provides any evidence in favour of or against the abovementioned "new" fiscal dominance channel postulated by Blanchard (2005). Interestingly, while the sample correlation of US_BAA spread with US inflation is not significantly different from 0 at all leads and lags, the correlation between EMBI spread and Brazilian inflation is significantly different from 0 and positive up to 6 lags of the EMBI spread[19]. When the sample is restricted to the period before the turmoil in 2002, instead, such correlation index turns out to be insignificantly different from 0. This change in the correlation over time seems to provide some evidence that the "new" fiscal dominance effect *à la* Blanchard might have actually occurred in Brazil in 2002. This is consistent with the idea that it is the EMBI spread-related shocks (namely, pure EMBI spread shocks, risk aversion shocks, and liquidity shocks) that remarkably affect the Brazilian rate of inflation (through the indirect channel identified by Blanchard and described above), and not their level *per se*[20]. In Section 7, I will provide further evidence on this intuition. Clearly, this result is just one piece of evidence in favour of this hypothetical channel; however, as explicitly stated in Section 3, proving its existence is not the ultimate goal of this work. Here,

[19] The results, calculated for the sample employed in the estimation of the VAR model, are available on request.

[20] This is also consistent with Goretti (2005)'s approach and findings for, even in the short period of time considered, she models a regime switch to distinguish normal and "abnormal" periods in which peculiar shocks occur.

and in the following sections, I shall limit myself to call the attention of the reader to those findings which, I believe, either support or contradict this appealing theory.

5. The VAR model, the estimation technique and the *minimal* identifying assumptions.

In Section 3, I illustrated the reasons why credit spreads should be treated as endogenous variables which both react to the shocks of many macroeconomic and financial determinants and also affect some of them in return. This requires that a systemic approach be used when studying the interaction between credit spreads and macroeconomic variables. Accordingly, I resort to a VAR system to study the relative contribution of external and internal variables to the volatility of macroeconomic and debt-related variables in Brazil.

As pointed out while describing the theoretical underpinnings of this empirical work, in order to properly determine how external and internal macroeconomic variables influence the external debt and credit risk premia in Brazil, it is important to encompass as many relevant variables as possible. In order to do so, I shall consider in the VAR both foreign variables – i.e. US industrial production cycle, US FFR, US_BAA spread - and Brazilian domestic variables – i.e. the Brazilian inflation rate, the real depreciation of the Real with respect to US dollar, the cyclical component of the Brazilian industrial production, the primary deficit cumulated over the 12 months, the level of external debt, and the EMBI spread[21]. The period under scrutiny goes from January 1995 to January 2004, and the series have a monthly frequency.

Arguably, in addition to six such domestic variables, it would have been plausible to include either other sources of macroeconomic volatility, or trade related variables, or even measures of capital flows. However, having only 9 years of monthly observations at disposal, six domestic variables represent a relatively large number and it would not be advisable to further enlarge the list. Moreover, it is quite difficult to drop most of the chosen series without cutting the linkages of the empirical estimation from the theoretical underpinnings illustrated in Section 3: first, EMBI spread, external debt and inflation are the main variables of interest; second, the cycle and exchange rate depreciations are crucial ingredients in the channel of transmission suggested by Blanchard; and, finally, the primary deficit is an important determinant of the dynamics of debt. In Section 6, as tests of robustness, I shall estimate a VAR model after having

[21] The data are described in greater detail in Section 4. Following most of the authors who have investigated Brazilian economic policy, I employ the net external debt and the primary fiscal deficit cumulated over the last 12 month. (See, among the others, Goldfajn (2002 pp.11-12), Favero and Giavazzi (2005))

replaced two of the abovementioned variables with another relevant domestic factor, namely the Brazilian short-term interest rate (i.e. the Selic). As the results of this modified model are not significantly different from those obtained by the VAR specification described in this section, I shall come back to this only in Section 6.

As said, this work aims at finding the relative (forecast and historical) contribution of external global factors to the fluctuations of Brazilian series, in particular debt and country spreads (see Section 2). The issue to address is how to properly disentangle the impact of the external factors from that of the domestic ones. In order to tackle this problem, the strategy I choose is to encompass (some of) the foreign variables which affect, but are not affected by, the domestic ones. As anticipated in the previous sections, I implicitly assume that the considered US variables proxy such unobservable global factors. Although it is a shortcut, this solution is widely adopted in the literature, given the central role played by the US dollar and US investors in the international financial markets. Arguably, there is a long list of US nominal and real variables standing as possible candidates, namely US inflation, US_FFR, US GDP growth, US_BAA spread, US industrial production cyclical component, and the like. In order to keep the number of variables to a treatable level, I include only three of them, namely US deseasonalised industrial production cycle (US_cycle), US FFR (or, alternatively, US 10 year Treasury bond yield), and US_BAA spread. The choice of these variables is driven by economic reasoning: i) the FFR provides the basis rate, on the top of which a risk premium is to be added in foreign (less safe) countries[22], ii) the US_cycle is an important determinant of US trade patterns and affects both the US_BAA spread and the short-term interest rate, and iii) the US_BAA spread provides a good measure of global risk aversion (or appetite for risk)[23]. All these variables are truly exogenous from the Brazilian viewpoint and, therefore, respect the necessary requirements to be encompassed as block exogenous in the VAR model to estimate.

Since this modelling choice is at the heart of this empirical investigation, it requires a few comments. As the US is an integrated financial centre and a big economy (in the usual meaning economists use the expression “big country”), it is rather unlikely that Brazilian macroeconomic conditions can significantly affect the Fed’s decisions and private investors’ appetite for risk. It follows that assuming US_cycle, US_FFR and US_BAA spread to be block exogenous is, to say

[22] In addition, embedding the FFR helps determine how the Brazilian economy reacts to changes in the monetary conditions in the US.

[23] See Blanchard (2005 p.63) as to the use of the US_BAA spread as a proxy of global risk aversion. Dungey *et al.* (2003) study the relative importance of three different components of global risk, that is liquidity, volatility and credit shocks. Admittedly, the US_BAA spread reflects only credit shocks; however, as pointed out by Dungey *et al.* (2003 pp. 20-21) these are the most relevant innovations in Brazil.

the least, a plausible presumption[24,25]. While this presumption is not too demanding, its implications on the estimation are noteworthy. First, since imposing a block exogeneity restriction on the foreign variables is equivalent to assuming that neither current nor lagged values of domestic Brazilian variables affect the US ones, the number of parameters to estimate (and the complexity of the impulse response functions) are reduced[26,27]. Second, it permits a reasonable causal ordering of foreign and domestic variables. Third, it allows looking at the historical contribution of foreign shocks to the variance of domestic variables (see next section) without having to identify each and every individual shock. This latter is the advantage of this (relatively simple) technique with respect to those methods which ground their conclusions on the relative contribution of internal and external factors on a specific identification strategy for the entire VAR model.

In order to take into account seasonal patterns and peculiar periods of time within the span 1995:01-2004:01, I add a number of deterministic components to the analysis. I include a set of monthly dummies and 2 other dummies[28]. The first dummy takes value one in the period of Russian debt crises (August to December 1998). The second dummy takes value one in the three months after Brazilian authorities de-pegged the *Real* from the US Dollar and the currency officially started floating (January – March 1999). In this period, the Brazilian exchange rate market went through a serious turmoil[29]. Finally, I encompass also 2 lags of the US inflation rate

[24] See footnote 11 for a minor caveat to this assumption.

[25] Note that block exogeneity is stronger than block causality. A block causality restriction in a VAR system is a mere generalization of a Granger causality restriction; a variable does not Granger cause another variable if lagged values of the former do not significantly affect current values of the latter. This restriction still allows the former variable to contemporaneously affect the second one. Similarly, in a VAR framework, block causality imposes that past values of a group of variables do not affect current values of another group. Block exogeneity in a VAR system, instead, implies that both current and past values of a group of variables do not affect current values of another group. This is why the variables of the first group are (block) exogenous to the second ones.

[26] This choice basically entails a triangularisation of domestic and foreign variables. It should be noted that once I assume the block exogeneity of the foreign variables the VAR system becomes a near-VAR system since not all the equations of the model have the same number of regressors. For instance, the equation for the US_BAA spread has only lagged values of the FFR and the US_BAAspread, while the EMBI equation encompasses the lagged values of all the foreign and the domestic variables. From a theoretical point of view, a gain in efficiency can be obtained using a SUR estimation, yet, in practice, SUR and OLS estimations provide almost identical results in this sample.

[27] See Genberg (2003) and Genberg, Salemi and Swoboda (1987) as valuable references on the technical details regarding the exploitation of such an assumption for identification purposes. Chusman and Zha (1997) offer a different application of the same techniques.

[28] I do not include either a dummy for controlling for the *Real* Plan for its implementation goes back to July 1994 (that is 6 months before the beginning of the sample under scrutiny), or dummies in correspondence to international financial turmoil, other than the Russian crisis and the Brazilian distress. The latter have turned out to be insignificant in some preliminary estimations including them.

[29] The dates chosen are an approximation of the real timing of the crises. For purposes of the estimation, they do not strictly coincide with the anecdotal public information disclosure for some movements occur both earlier than and after the announcements of the beginning and the end of a crisis. Dungey *et al.* (2003) operate a similar cautious choice.

in the equation of the FFR. This improves the fit of the model, since it mimics the classical Taylor type rule which fits well the broad contours of US monetary policy[30].

Given the relatively limited number of observations (108) and their monthly frequency, tests for the presence of unit roots in the series are not fully reliable. While neglecting the possible presence of unit roots in the series risks undermining a single equation estimation, a VAR system is less sensitive to the such a problem because near unit-roots VARs produce, anyway, consistent estimates. Several authors suggest concentrating on the estimation stage without questioning the stationarity of the series (see Enders (2003) p.301, Garcia and Rigobon 2004 p.10. For a detailed analysis, see Rothenberg and Stock (1997)). I follow such an indication and estimate the model with the series as described earlier.

The structural model looks like the second-order system[31] below:

$$\mathrm{A}y_t = \mathrm{B}(L)y_{t-1} + Cz_t + \varepsilon_t \qquad (1).$$

y_t is the vector of foreign and domestic variables at time t (namely: US_cycle, US FFR, US_BAA spread, Brazilian cycle, Brazilian primary deficit, real depreciation of the *Real*, Brazilian inflation rate, external debt (as % of GDP), and Brazilian EMBI spread). The matrix *A* represents the structure of simultaneous determination in the economy, B(L) is the matrix of the parameters for the lagged values of the variables, z_t is a vector of other exogenous variables (namely 1 constant, 11 seasonal dummies, 2 dummies for the Russian and the Brazilian turmoil, and 2 lags of US inflation which enter only in the equation of the US FFR) and ε_t is the vector of the innovations, assumed to be independent and normally distributed with mean zero and variance **Ω**. The system is block-triangular because the foreign variables are assumed to be block exogenous. To make more evident the implications of this assumption, system (1) can be rewritten, splitting domestic and foreign variables, as follows[32]:

$$\begin{pmatrix} \Lambda & 0 \\ -\Gamma & \Phi \end{pmatrix}\begin{pmatrix} f_t \\ d_t \end{pmatrix} = \begin{pmatrix} \Lambda(L) & 0 \\ \Gamma(L) & \Phi(L) \end{pmatrix}\begin{pmatrix} f_{t-1} \\ d_{t-1} \end{pmatrix} + \begin{pmatrix} C_f \\ C_d \end{pmatrix} z_t + \begin{pmatrix} \varepsilon^f{}_t \\ \varepsilon^d{}_t \end{pmatrix} \qquad (2),$$

where f_t represents the vector of foreign variables, d_t stands for the vector of domestic variables, and $\varepsilon^f{}_t$ and $\varepsilon^d{}_t$ are the foreign and domestic structural innovations.

The model to estimate is the reduced form of (1) and (2). This takes the typical VAR structure:

$$y_t = D(L)y_{t-1} + Fz_t + u_t \qquad (3)$$

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[30] Estimating a Taylor rule for the US by adopting monthly observations usually leads to estimated coefficients that are very different from those obtained with quarterly series. Nonetheless, the rule encompassed in this VAR has a discrete fit and behaves quite satisfactorily, probably because of the 2 recursive components.

[31] The estimated VAR system encompasses 2 lags of all variables, as suggested by AIC and SIC indices.

[32] In what follows I draw on Genberg (2003) and Genberg *et al* (1987).

where D(L) is the matrix of propagation of the shocks, and u_t is the vector of the reduced-formed residuals. It is worth making explicit that $D(L)=A^{-1}B(L)$, $F=A^{-1}C$, and $u_t= A^{-1}\varepsilon_t$. By construction, the residuals u_t are correlated according to the characteristics of matrix A^{-1}. Because of this correlation, the residuals of each estimated equation cannot be treated as independent innovations. In order to show that block triangularisation of A and B(L) is maintained also in the vector autoregressive representation, (3) can be rewritten as follows:

$$\begin{pmatrix} f_t \\ d_t \end{pmatrix} = \begin{pmatrix} D_{11}(L) & 0 \\ D_{21}(L) & D_{22}(L) \end{pmatrix} \begin{pmatrix} f_{t-1} \\ d_{t-1} \end{pmatrix} + \begin{pmatrix} F_f \\ F_d \end{pmatrix} z_t + \begin{pmatrix} u^f{}_t \\ u^d{}_t \end{pmatrix} \quad (4)$$

After having estimated the reduced form of system (4)[33], it is possible to perform a series of experiments, such as deriving the forecast error variance decompositions, the impulse response functions (IRFs hereafter) of the endogenous variables to the various shocks affecting the system, and the historical decomposition of the endogenous variables. All these procedures require disentangling the feedbacks inherent in the system and, therefore, adopting an identification strategy for the whole system. Unfortunately, any identification strategy is questionable and controversial, and it leads to conclusions conditional on the identifying assumptions[34]. Bearing this in mind, in Section 7, I shall propose an identification strategy for the whole system, and provide and discuss the relative impulse response functions. This exercise, however, is not the main goal of this work. In fact, as anticipated earlier, I estimate this VAR system to recover information mainly about two aspects. First, I am interested in the relative contribution of foreign variables to the forecast volatility of the Brazilian domestic macroeconomic variables. Second, I calculate the relative historical contribution of global factors on the actual behaviour of external debt and EMBI credit spread over a specific period of time, namely January 2001- January 2004. Achieving these two objectives does not require endorsing any specific identification strategy on the interaction between the domestic Brazilian variables, but only a block exogeneity assumption for the foreign global factors. As said, this assumption is not too demanding and allows

[33] I report the results of the estimation in Appendix C.

[34] To understand why, it must be remembered that economists resort to VAR systems in order to overcome the problem of simultaneity between the endogenous variables of interest. Being unable to decide on theoretical grounds about the exact contemporaneous interaction between the variables, it is convenient to estimate reduced-form models (i.e. autoregressive representations of the system) that i) are free from the simultaneity problem, and, usually, ii) fit the data well. To develop forecast error variance decompositions, impulse response functions, and historical decompositions, however, an identification strategy needs be chosen, that is a set of restrictions on the way the variables are supposed to interact. It is clear how controversial this technique intrinsically is. The problem to solve is the lack of certain knowledge on the contemporaneous relationships between the variables, and the solution (i.e. the identification strategy) consists in imposing subjective, *a priori* restrictions on their interaction. Any solution of this kind is subject to some criticism. Nonetheless, an identification strategy requires imposing only N(N-1)/2 restrictions in order to obtain the estimates of N^2 contemporaneous coefficients (where N is the number of endogenous variables in the VAR system). This entails that identifying a VAR system does not require imposing restrictions on *all* the contemporaneous interactions under scrutiny, but, rather, on few of them.

distinguishing the contributions of external and internal factors, without imposing any *a priori* restriction on the rest of the model[35].

5.1 The block exogeneity assumption and the contribution of foreign factors to the volatility of the domestic Brazilian series.

The relative importance of the foreign variables for the forecast error variance of the domestic Brazilian variables and the historical contribution of the former to the development of the latter can be investigated by exploiting the block exogeneity restriction on the foreign variables. Once such an assumption is imposed on the system, the structure of the residuals can be written as:

$$\begin{pmatrix} u^f{}_t \\ u^d{}_t \end{pmatrix} = \begin{pmatrix} \Lambda^{-1} & 0 \\ \Phi^{-1}\Lambda^{-1}\Gamma & \Phi^{-1} \end{pmatrix} \begin{pmatrix} \varepsilon^f{}_t \\ \varepsilon^d{}_t \end{pmatrix} \quad (5)$$

The formula above shows that the disturbances of the foreign block (i.e. $u^f{}_t$) are exclusively determined by the structural innovations of the foreign variables, without having to identify the whole system. The internal and external contribution to the volatility of the Brazilian series can be calculated simply assuming that US_cycle, US_FFR and BAA spread are block exogenous.

It could be argued that US_cycle, US_FFR and BAA spread could have been embedded in the deterministic vector z_t and not included as block exogenous variables in the VAR system. In fact, having them in the recursive part of the near-VAR allows encompassing their dynamics in the determination of the evolution of the whole system: this would not have been possible if they had been included in z_t rather than in y_t. In subsection 5.4, I shall consider a case in which US_BAA spread is encompassed as a deterministic factor. By comparing these diverse specifications, I shall point out the implications of including such variables in the model. This will help grasping the importance and the novelty of this work, that is the inclusion of both domestic and foreign credit spreads in the VAR system.

5.2 The contribution of foreign factors to the forecast error variance of the domestic Brazilian variables.

In this subsection, I shall focus on the contribution of global factors to the forecast error variance of the Brazilian variables of interest[36]. The block exogeneity assumption allows distinguishing the source of the forecast fluctuations of the domestic variables at different time

[35] The lack of an identification strategy for the whole system prevents from discriminating the relative contribution of each *individual* factor to the volatility of the others. This is the inherent limitation of the block exogeneity assumption.
[36] In general, the FEV decomposition shows how much of the unanticipated changes of variables are explained by different shocks.

horizons. On the basis of the forecast error variance decomposition, the contribution of the foreign factors at different horizons is reported in Table 1.

Horizon	**Industrial cycle**	**Primary deficit**	**Real depreciation**	**Inflation**	**External debt**	**EMBI Spread**
1	3.31	3.79	0.61	3.47	17.78	31.56
3	18.68	7.43	9.29	9.14	35.28	36.31
6	22.84	12.35	10.76	18.82	47.45	43.52
9	23.30	20.17	11.52	25.13	56.68	48.94
12	25.17	27.81	11.83	29.38	63.51	52.91
16	28.53	36.59	11.98	32.64	69.89	56.25
24	33.57	49.31	12.17	35.28	77.27	59.15

Table 1. Contribution of foreign variables to the forecast error variance of Brazilian domestic variables.
Note: Foreign variables are US_cycle, US_BAA spread and US_FFR.

Table 1 shows that the longer the horizon, the more important foreign variables are for the unanticipated volatility of inflation, primary deficit-gdp ratio, external debt-gdp ratio, EMBI spreads, and cyclical component of the industrial production. The real depreciation of the *Real* is less sensitive to foreign shocks. Overall, the impact of foreign variables on the credit risk spread is notable. Even at very short horizons, almost one third of the EMBI forecast variation is amenable to foreign shocks. In the long run, this ratio goes up to two-thirds. This finding is very much in line with the idea that unexpected shocks to global factors matter a lot to the evolution of credit risk premia, both in the short and in the long run. To return to the theory outlined in Section 3, these outcomes support the claim that credit risk premia do depend on the evolution of domestic variables, but are also importantly affected by changes in global factors, such as foreign short-term interest rates and global risk aversion. It follows that, if one wants to understand emerging market economies, it is crucial to take into account the impact that global factors have on the various domestic macroeconomic and financial variables. The proportion of unexpected debt fluctuations which are amenable to foreign shocks is noticeable; the policy implication of this finding is that fiscal and monetary policymakers should remain vigilant and actively counteract unexpected changes in foreign factors if determined to maintain the evolution of debt under control[37].

Furthermore, it is worth noticing that external factors seem to matter to the volatility of inflation; the impact is indeed important even after few lags. Although this finding does not

[37] This is in line with the conclusions Canova draws from the analysis on a group of LA countries.(2005 p. 231).

inform about how much external shocks actually affected Brazilian inflation in the period under scrutiny, it confirms that it would be erroneous not to take them into account while judging the overall performance of monetary authorities. In fact, this is exactly what a certain number of economists, some sections of the press and politicians did after inflation spiked in 2002.

5.2.1 A note of caution on the methodology.

The estimated contribution of foreign shocks to the forecast variance of Brazilian series is striking. To assess such findings properly, I believe that some caution is warranted and a few additional considerations are in order. An important technicality to have in mind is that the block exogeneity assumption entails that the exogenous variables Granger-cause the endogenous ones. Accordingly, any change to the domestic Brazilian variables that is potentially (directly and indirectly) amenable to foreign shocks is accounted for in the contribution of foreign factors. Under certain circumstances, the risk is over-estimating the impact of the latter on the former. Imagine, for instance, that two contemporaneous, similar, but independent, shocks hit the EMBI and the US_BAA spreads. (As an example, the shock to the US_BAA spread could be an increase in the riskiness of US corporate bonds and not a shock to the degree of global risk aversion.) In a VAR model like this one, the impact of the Brazilian-specific shock (simultaneous to the US one) would be partially (and erroneously) attributed to the latter. Evaluating the importance of such a caveat in this analysis is counterfactual: nonetheless, I shall offer a few considerations in which I argue the results do not suffer much. The first consideration is that it is very unlikely that many shocks occur simultaneously in the whole sample without being correlated. Moreover, the contribution of foreign variables to the fluctuations of domestic series varies remarkably across the latter and the different magnitudes follow economic intuition.

Admittedly, it could be contended that while the absence of an identification scheme does not condition the results, the latter are in fact conditioned by its lack. For instance, had it been possible to find an uncontroversial identification strategy restricting the impact of foreign variables on only some of the domestic ones so as to reproduce the actual channels of transmission in Brazil, the results might have been slightly different. Unfortunately, however, an uncontroversial identification strategy is not available.

These two considerations show that the pros and cons of imposing a block exogeneity assumption (instead of a more structured identification strategy) are subtle. On the one hand, imposing a block exogeneity restriction provides a certain degree of generality to the results and makes the findings less subject to the criticisms regarding the identification strategy. On the other hand, avoiding imposing specific restrictions on the contemporaneous correlation of all foreign and domestic variables might lead to over-estimating the actual contribution of the foreign factors to the fluctuations of some of the domestic ones.

5.3 The historical decomposition of the Brazilian domestic variables.

By exclusively imposing the block exogeneity assumption on the foreign factors, it is possible to decompose the 'historical values of a set series into a base projection and the accumulated effects of current and past innovations' (Rats User's Guide p.307). This exercise allows using the residuals from the VAR estimation to obtain the structural shocks and reconstruct their impact on the actual paths of the variables in the system. In this section I shall focus on the Brazilian EMBI spread, the net external debt ratio, and inflation. Notice that, while in subsection 5.2 I show how the forecast error variance of such variables is affected (*ceteris paribus*) by the innovations in the foreign variables, here, by means of a historical decomposition of the VAR residuals, I analyse the relative importance of such global factors for the domestic variables in a specific period of time. Since a historical decomposition analysis must refer to a period of time that is shorter than the total length of the sample of observations, I choose to concentrate on the period from January 2001 to January 2004. The reason is that I want the base projection to start prior the turmoil and the Presidential elections in 2002, which characterise the period under scrutiny and motivate its choice.

Below, I report the graphs of the historical decomposition of EMBI spread, external debt and inflation[38]. The solid line is the actual series of data, the long dashed (LD) line is the base projection from January 2001 to January 2004, and the short dashed (SD) line is the sum of the base projection and the impact of foreign innovations on the Brazilian domestic variables. The inspection of Figures 7 to 10 reveals that much of the difference between the actual series and the base projection is indeed conducible to foreign shocks. These results go hand in hand with the forecast error variance decompositions in subsection 5.2, and strongly support the idea that global factors were important for the actual evolution of the Brazilian economy in those years.

Looking at Figure 7 for the EMBI spread, it can be noticed that the difference between the solid and the SD lines is very narrow, if compared to that between the solid and the LD line. This suggests that, between January 2001 and January 2004, most of the difference between actual data and the base forecast is due to foreign shocks. Accordingly, global factors seem to have played a really important part in leading the ups and downs of the Brazilian EMBI spread.

[38] The graphs for all the other variables are available on request.

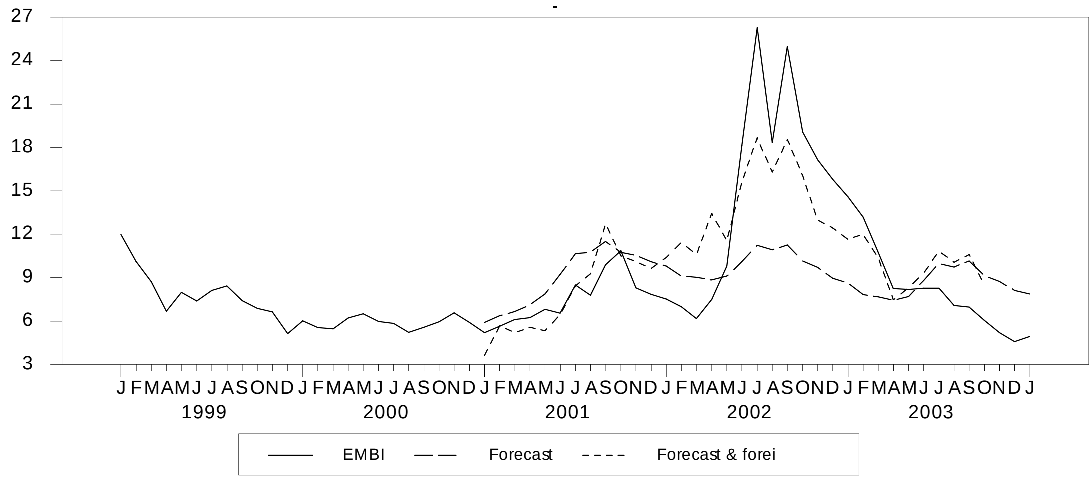

Figure 7. The historical decomposition of EMBI. 2001:01 – 2004:01

As revealed in Figures 8 and 9, similar considerations can be drawn for Brazilian external debt and inflation. In the case of external debt, the SD line gets very close to the solid one while the LD one is far from it in 2002. This suggests that most of the fluctuations in the external debt to GDP ratio in that period can be imputed to unexpected innovations to foreign factors: fiscal policy seems not to have promptly changed so as to limit the growth of debt. In the case of inflation, while the relative weight of foreign shocks is much smaller than in the previous two cases, it is apparent that, particularly in mid-2002, the role of foreign shocks is considerable. This seems another piece of evidence in favour of the idea that the impact of global factors on inflation is significantly large once US_BAA and EMBI spreads are encompassed in the system.

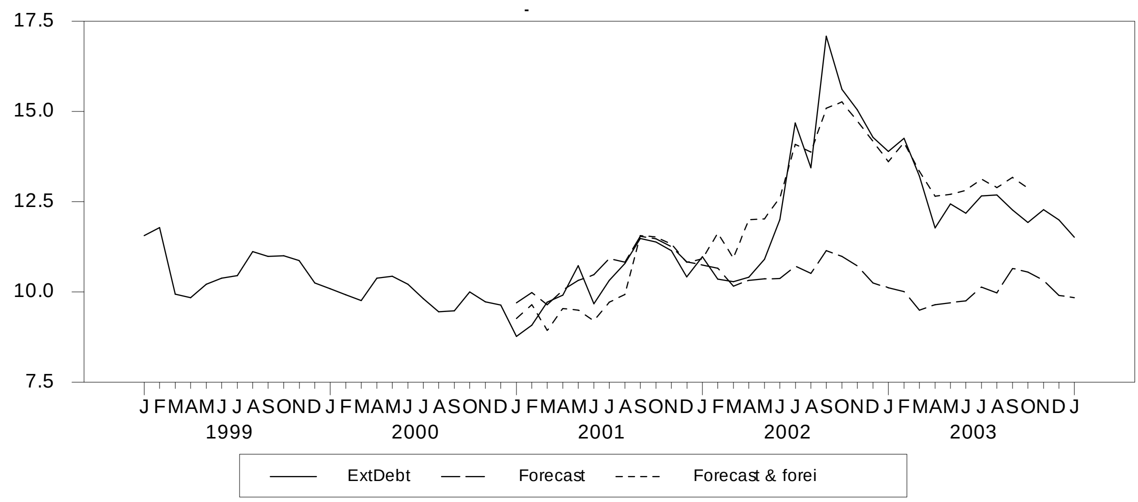

Figure 8. The historical decomposition of the external debt over GDP. 2001:01 – 2004:01

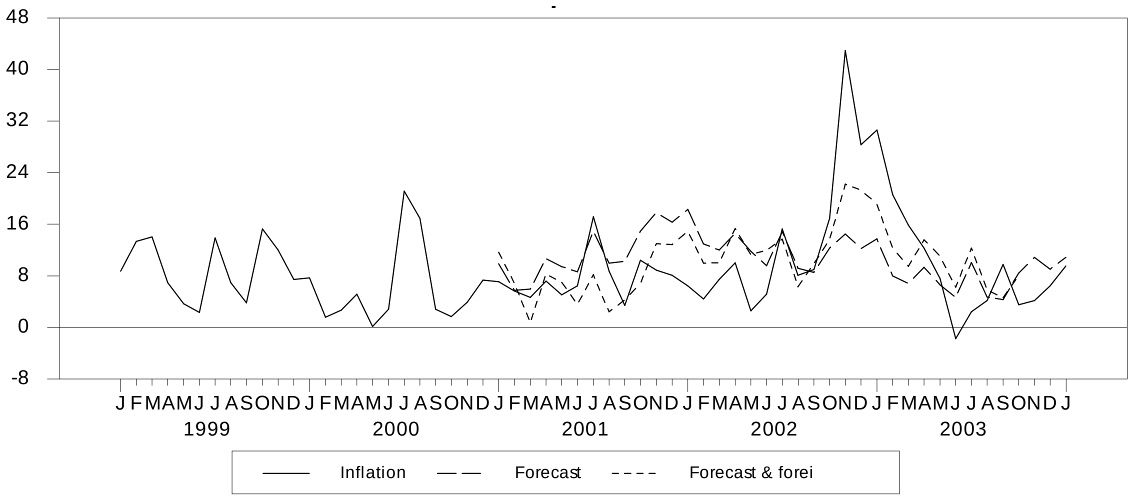

Figure 9. The historical decomposition of the inflation rate. 2001:01 – 2004:01

Although it is not the focus of the investigation, it is worth showing the historical decomposition also for the primary deficit, reported in Figure 10. As can be noticed, it is only taking into account foreign factors that one is able to produce predictions that are closer to the actual behaviour of the primary deficit. The base projection alone is, in fact, far from actual data. This suggests that the fiscal authorities did not take into account the potential influence of innovations in the global factors and this worsened the surplus which otherwise would have been achieved: this implies that the fiscal policy stance should be modelled so as to promptly react to foreign factors and, in particular, to changes in the appetite for risk.

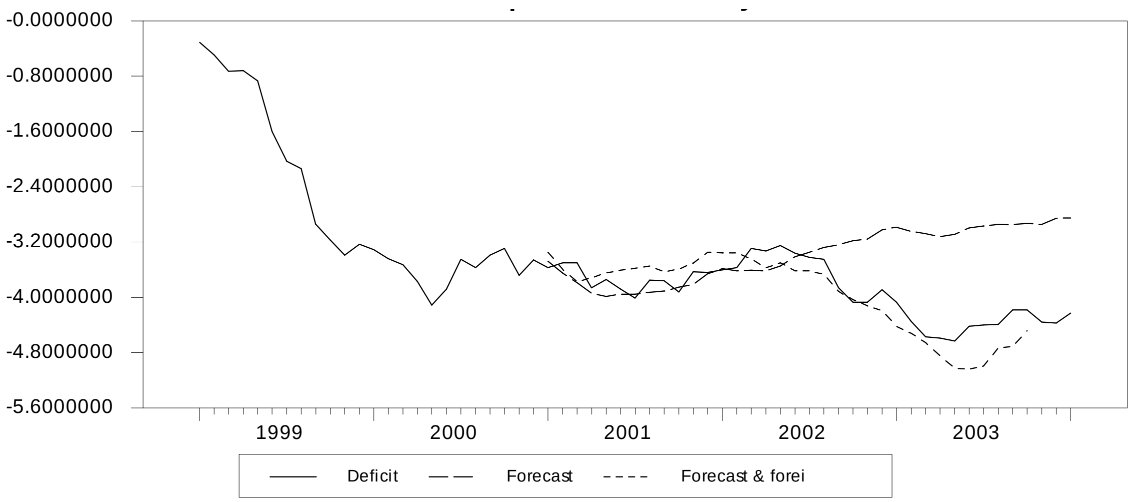

Figure 10. The historical decomposition of the primary deficit. 2001:01 – 2004:01

As mentioned above, this work aims to show that i) the endogeneity of credit risk premia and ii) the inclusion of (a measure of) global appetite for risk among the explanatory variables of emerging market credit spreads are important features that a model directed to capture the macroeconomic and financial dynamics should present. The results presented in this sub-section provide, at least for Brazil, some evidence in favour of this hypothesis.

5.4 Assessing the importance of including the BAA spread in the VAR system.

The historical decomposition exercise allows grasping quite easily the relative importance of foreign shocks in the actual path followed by domestic variables: one need only compare the difference between the base projection and the base projection plus the impact of foreign shocks. In particular, an intuitive way to assess the importance of the BAA spread is to compare the results above with those that would have been obtained by omitting the BAA spread from the system. In Table 2, I report the relative importance of the (remaining) foreign variables in the FEV decomposition once the BAA spread variable is omitted.

Table 2 shows that the impact of foreign variables is modest once the BAA spread is excluded from the VAR. In particular, note that the impact of foreign shocks on i) the variance of Brazilian inflation is reduced to 10%, and on ii) the variance of the EMBI spread falls to 27%. The forecast variance of the external debt remains, in the long run, affected by the shocks to the included foreign variables, yet just up to 30%. This outcome suggests that the shocks to the BAA spread have a relatively large influence on the volatility of Brazilian variables, and, in particular, on that of EMBI spread, debt and inflation; its inclusion, I believe, is crucial in exercises whose objective is to disentangle the contributions of external and internal factors to the volatility of an economy.

Horizon	**Industrial cycle**	**Primary deficit**	**Real depreciation**	**Inflation**	**External debt**	**EMBI**
1	1.07	2.24	0.20	0.20	1.43	2.35
3	4.14	6.60	3.42	6.02	2.31	3.04
6	6.67	5.24	4.24	9.26	1.33	2.55
9	8.39	3.31	4.42	9.93	2.76	4.51
12	9.78	2.52	4.52	10.54	6.25	8.96
16	11.00	2.89	4.66	10.90	12.78	15.89
24	11.55	7.99	4.92	11.00	28.73	27.63

Table 2. Contribution of foreign variables to the forecast error variance of domestic variables
Note: Foreign variables are US_cycle and US_FFR. US_BAA spread is excluded.

Figures 11 to 13 reproduce the historical decomposition of the Brazilian series obtained from estimating a near VAR system where the BAA spread is omitted, and US_cyle and US_FFR are the only foreign variables included.

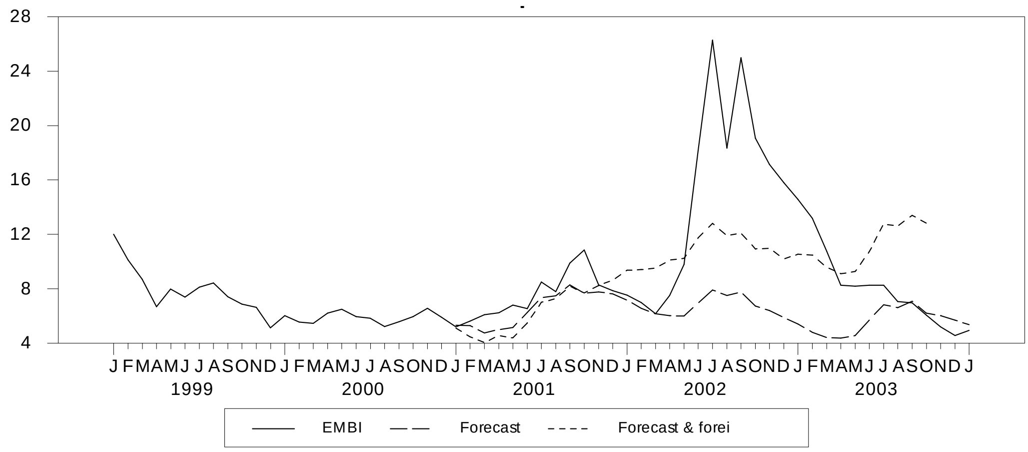

Figure 11. The historical decomposition of the EMBI spread. 2001:01 – 2004:01
Note: US_BAA spread is excluded from the system.

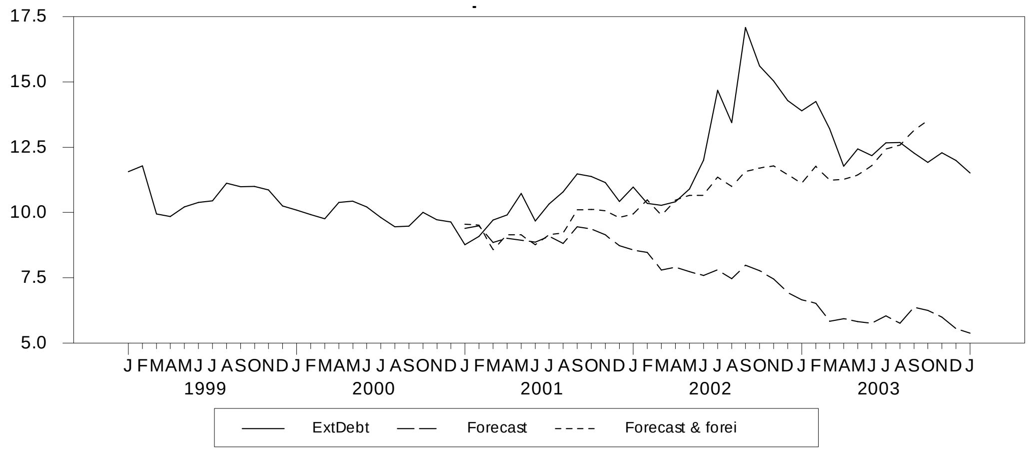

Figure 12. The historical decomposition of the external debt over GDP. 2001:01 – 2004:01
Note: US_BAA spread is excluded from the system.

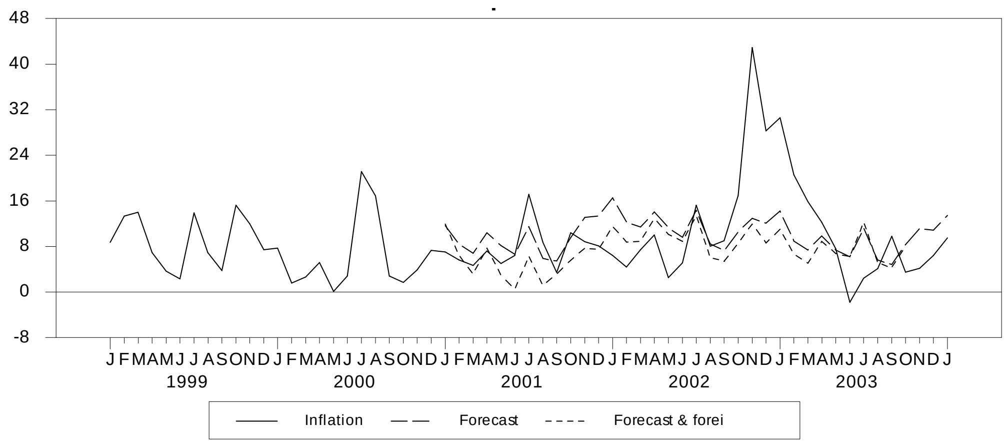

Figure 13. The historical decomposition of the inflation rate. 2001:01 – 2004:01
Note: US_BBA spread is excluded from the system.

From the comparison of Figures 7, 8 and 9, with 11, 12 and 13, two considerations can be made. First, the base projection realized with the VAR system without the BAA spread is worse than that obtained with the BAA spread among the variables. Second, foreign shocks appear far less important when the BAA spread is omitted than when it is included. The reason for these two results is, probably, that when the BAA spread is excluded, the EMBI spread moves autonomously; on the contrary, when the BAA spread enters the model, the EMBI spread strongly depends on the evolution of the former. This is the misspecification error one would commit by omitting a measure of global risk aversion from the model. Put another way, when the BAA spread is left out, all the shocks hitting the EMBI spread are treated as idiosyncratic; instead, when the BAA spread is included, global shocks to the appetite for risk can be distinguished from idiosyncratic Brazilian shocks to the EMBI spread. Furthermore, Figure 13 corroborates the hypothesis that the BAA spread shocks had a relatively large impact on the volatility of Brazilian inflation in 2002; most probably, this happened through the theoretical channel identified by Blanchard. I do not claim this amounts to proof that this channel exists and mattered in that period; but this appears to be, nonetheless, an additional piece of empirical evidence in its favour.

Admittedly, omitting the BAA spread from the VAR system is an extreme choice. It could be argued this is not the most appropriate solution to assess the importance of encompassing it in a larger VAR system. For instance, it is reasonable to consider an alternative system where the BAA spread is in fact included, but treated as a purely deterministic component. It becomes possible then to compare (on a pairwise basis) the results of the VAR models where the BAA spread is i) treated as an endogenous variable (subsection 5.1), ii) included as an exogenous factor (this subsection, below), and iii) excluded (this subsection, above). Such a comparison could help shedding some light on both of the issues at the core of this analysis: i.e. the endogeneity of credit spreads and the importance of global appetite for risk to emerging markets' domestic fluctuations.

In a nutshell, encompassing the BAA spread as a deterministic variable importantly changes the outcomes of the estimation, the FEV analysis and the historical decomposition. The relative contribution of foreign factors in the variance decomposition is reported in Table 3 below. The values in Table 3 fall, in general, between those in Tables 1 and 2. The impact of the two foreign variables on the variance of the domestic Brazilian series is, in 4 out of 6 cases, around 20%. The reason why the insertion of the BAA spread among the deterministic factors increases the relative importance of foreign factors in the FEV analysis is, I believe, that the estimated innovations of the EMBI spread get smaller once the BAA spread is included, even though only as a deterministic term. The logic is the same as that illustrated above. When the BAA spread enters the estimation as a deterministic factor, it a) improves the base projection (as can be seen in the historical decomposition graphs) and b) slightly reduces the estimated idiosyncratic innovations of the EMBI spread.

horizon	Industrial cycle	Primary deficit	Real depreciation	Inflation	External debt	EMBI
1	2.03	1.23	0.58	1.88	0.38	3.78
3	16.94	5.57	3.08	6.13	6.31	9.55
6	18.39	7.52	3.70	15.89	7.25	11.81
9	18.39	7.00	3.95	18.85	7.85	13.61
12	19.59	5.83	3.98	20.25	10.53	16.59
16	21.37	4.93	4.00	21.17	14.39	19.24
24	22.80	4.83	4.20	22.01	18.52	20.56

Table 3. Contribution of foreign variables to the forecast error variance of domestic variables
Note: Foreign variables are US_cycle and US_FFR. US_BAA spread is included as deterministic.

Figures 14 to 16, below, are drawn by encompassing the BAA spread in the VAR model as a deterministic factor. The base projection improves considerably with respect to that reproduced in Figures 11 to 13 (when the BAA spread is completely excluded). The relative contribution of the two remaining foreign shocks has relatively minor importance. It can be concluded that the BAA spreads has here only a level effect on the Brazilian variables (in particular, EMBI spread, external debt, and inflation) and, therefore, that this specification misses the fact that the innovations to the BAA spread remarkably influence the behaviour of the Brazilian series.

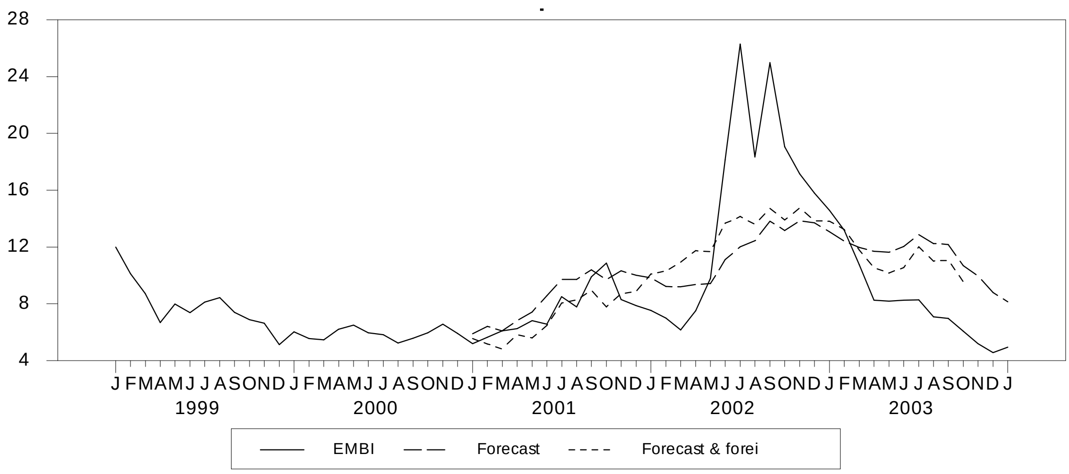

Figure 14. The historical decomposition of the EMBI spread. 2001:01 – 2004:01
Note: Foreign variables are US_cycle and US_FFR. US_BAA spread is included as deterministic.

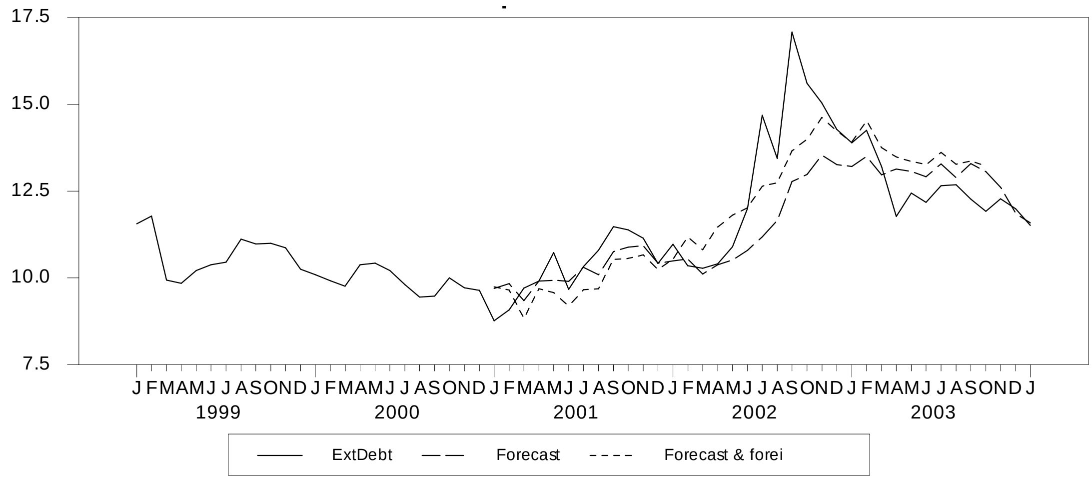

Figura 15. The historical decomposition of the external debt over GDP. 2001:01 – 2004:01
Note: Foreign variables are US_cycle and US_FFR. US_BAA spread is included as deterministic.

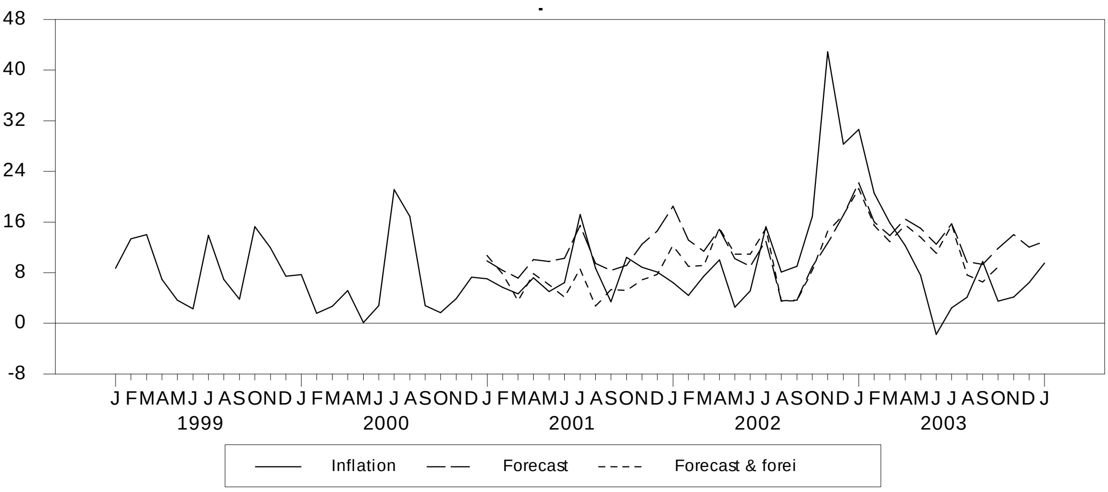

Figure 16. The historical decomposition of the inflation rate. 2001:01 – 2004:01
Note: Foreign variables are US_cycle and US_FFR. US_BAA spread is included as deterministic.

Admittedly, any comparison between these three series of graphs has to be made with caution. Being built on the basis of different assumptions, the models necessarily differ in their predicting performance, and the decomposition of the historical series varies accordingly. The interpretation I propose above takes this consideration into account and, I believe, is quite conservative. Rather than stressing the exact quantitative results I come up with, I limit myself to highlight that both VAR models where a measure of global risk aversion is excluded or included, but not endogenised, do not allow to fully grasp the importance of global factors in the dynamics of credit risk spreads, external debt and inflation. This is an important finding and distinguishes this work from those empirical contributions studying credit spreads and debt by means of single equations with few (global and domestic) determinants, all treated as exogenous.

6. Alternative specifications: testing the robustness of these findings.

Before proceeding to the proposal of an identification strategy for the whole system and producing the resultant IRFs, I devote this section to some modifications of the model considered earlier[39]. These serve as tests for the robustness of the previous findings, and, also, enlarge the scope of the investigation.

The first extension I analyse consists in swapping the US_FFR with the US_10y. Long term yields tend to reflect both liquidity in the market and, according to the expectation hypothesis, the expected changes in monetary policy over the medium/long term horizon. Since the results of this extension follow those presented earlier, for the sake of brevity, I shall limit the discussion to their main differences. The contribution of foreign factors to the forecast error variances of the domestic variables are reported in Table 4 below, while the historical decomposition of these series is plotted in the composite Figure 17.

Horizon	**Industrial cycle**	**Primary deficit**	**Real depreciation**	**Inflation**	**External debt**	**EMBI**
1	1.09	2.38	0.04	2.01	16.78	31.47
3	8.07	6.90	7.12	11.77	33.20	33.25
6	15.10	9.13	8.79	11.76	44.14	40.79
9	18.32	16.65	9.82	14.83	54.66	48.70
12	20.51	25.75	10.39	19.64	62.79	54.49
16	22.99	37.52	10.78	25.08	70.26	59.12
24	27.39	55.29	11.14	31.15	78.46	63.04

Table 4. Contribution of foreign variables to the forecast error variance of domestic variables
Note: Foreign variables are US_cycle, US 10y and US_BAA spread.

The relative contributions of foreign factors are not too different from those in Table 1, and the interpretation does not change either. Only two differences, in fact, deserve being mentioned: these concern the growth in the relative importance of foreign factors in the decomposition of the forecast volatility of the EMBI spread and the primary deficit. The first finding is probably due to

39 In Appendix A I reduce the model to a very small scale and repeat the same exercises carried out above. Since this extension is undertaken exclusively to test the robustness of these findings it is used a smaller VAR model that continues to encompass the main features introduced in this work, I will skip commenting the results here. It suffices to say that the main abovementioned conclusions are robust also to this extension.

the fact that the US_10y seems to be more strongly negatively correlated to the EMBI spread than the FFR, in particular in the years preceding 1999[40].

The second extension stems from the contention that monthly primary fiscal deficit is not too important a domestic variable and needs not be included. Although, on the one hand, the performance of the fiscal authorities is constantly monitored by international investors and institutions, on the other hand, monthly data do not provide a sufficiently broad and comprehensive yardstick of the fiscal policy stance. It is therefore possible that including this variable in the VAR system might not improve it. It is worth noticing that this is a plausible caveat for attention is focused on external debt, and not on overall (domestic and external) debt. According to such reasoning, the primary deficit series is omitted and the results compared with those of the baseline model. Since it could be appropriate to encompass in the VAR system the Brazilian short run policy interest rate, i.e. the Selic, in what follows I shall replace first the primary deficit and then the real depreciation rate with the Selic interest rate. These two additional extensions serve also to countercheck the robustness of the previous findings[41].

I start by dropping the primary fiscal deficit and encompassing the Selic interest rate. The comparison of Table 5 below with table 1 reveals that the main conclusions do not vary once such a change is operated. Foreign factors continue to significantly contribute to the forecast variance of the Brazilian domestic variables: nonetheless, the volatility of the Selic seems not to be significantly influenced by foreign factors.

[40] What happens in the subsequent period, instead, is more difficult to judge. The change between the periods may be due to the fact that the *ceteris paribus* requirement does not actually hold (because of the depreciation of the Real in 1999, the adoption of inflation targeting in Brazil, the Presidential elections in 2002, the various crises in Argentina, Uruguay and Turkey, and the burst of the US stock market bubble in 2001). However, the change might have also to do with the fact that the impact of the US_10y yield on Brazilian long term yields is non linear. I am aware that the adoption of a VAR linear estimation technique is implicitly imposing on the coefficients the restriction that they are constant over time and state uncontingent. However, the investigation of the possible nonlinearity of the parameters goes beyond the goals of this work. Giavazzi and Favero (2005) discuss possible nonlinearity in the relationship between EMBI spread and domestic and international factors.

[41] It could be argued that since the foreign variables do not change, it is not surprising that their relative contribution to the forecast error variance of the domestic series does not change. The historical decompositions, instead, depend on the base projection and on the estimated innovations in the system: both are affected by which variables are encompassed.

Historical decomposition : use US_10y instead of US_FFRs

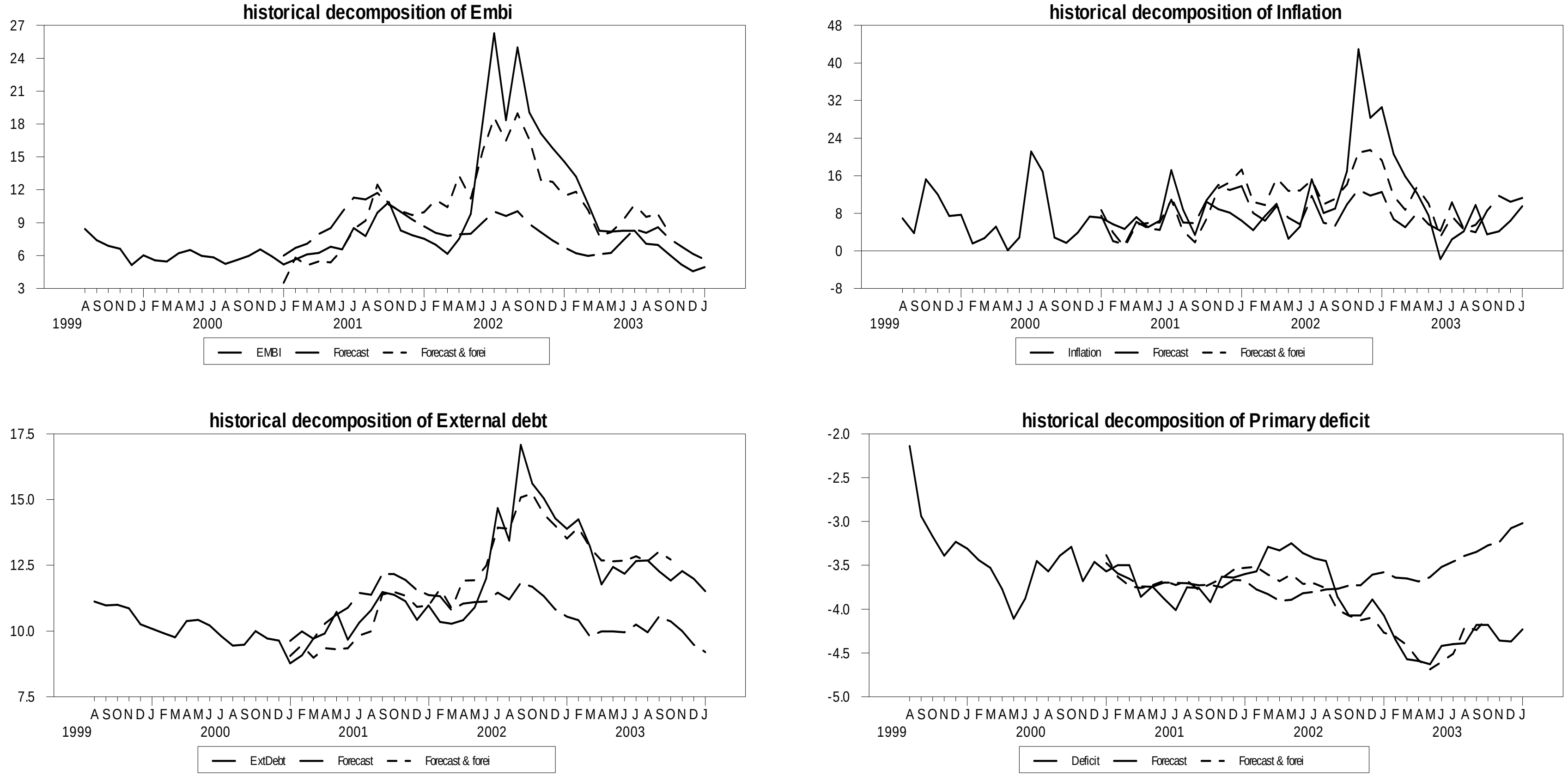

Figure 17. Historical decomposition of the Brazilian series when US_10y is encompassed in the VAR system. 2001:1 2004:01

Horizon	Industrial cycle	Real depreciation	Inflation	Selic	External debt	EMBI
1	3.03	0.79	2.84	1.05	18.48	32.71
3	18.89	9.71	11.28	4.60	34.02	39.51
6	23.55	10.62	26.87	12.85	43.17	48.67
9	24.20	11.29	33.50	14.99	58.90	54.16
12	25.96	11.62	36.54	14.93	58.90	56.98
16	29.25	11.89	38.10	14.61	64.60	58.52
24	34.02	12.25	38.70	14.31	69.92	58.20

Table 5. Contribution of foreign variables to the forecast error variance of domestic variables
Note: Foreign variables are US_cycle, US_BAA spread and US_FFR.

The historical decomposition of the Brazilian series for this alternative model is reported in Figure 18. The substitution of the primary deficit with the Selic rate has not significantly changed the results of the exercise. The relative importance of foreign innovations for the historical evolution of the EMBI spread, the external debt and the Brazilian inflation is notable.

A similar reasoning is also valid for the depreciation of the real exchange rate. Consequently, the third extension I undertake consists in swapping the real depreciation with the Selic interest rate. From Table 6, in which the results of the FEV are reported, we can reach conclusions which are similar to those illustrated above for inflation, external debt, primary deficit, and EMBI spread. This time, however, the forecast error volatility of the Selic rate seems to be more importantly affected by the innovation of foreign factors than in the previous extension. Plausibly, this is the by-product of having excluded the real devaluation variable; notably, there are no similar effects on the other Brazilian series.

Horizon	Industrial cycle	Primary deficit	Inflation	Selic	External debt	EMBI
1	2.62	3.14	3.89	2.10	12.57	31.14
3	15.53	6.91	12.30	9.65	29.33	36.36
6	19.18	10.19	20.97	23.44	40.58	42.85
9	20.04	16.56	25.13	31.35	50.16	47.15
12	21.59	24.11	27.80	36.03	57.80	50.16
16	24.33	33.75	30.06	39.87	73.74	52.77
24	29.38	47.72	31.10	39.87	73.74	55.27

Table 6. Contribution of foreign variables to the forecast error variance of domestic variables
Note: Foreign variables are US_cycle, US_BAA spread and US_FFR.

As regards the historical decomposition of the variables, I refer to the combined Figure 19.

The fourth extension consists in using the monthly change (in annual terms) of Brazilian real GDP and the monthly change (in annual terms) of US industrial production index[42]. The following Table reports the relative contribution of foreign factors to the forecast variance of the Brazilian domestic series. Comparing these values with those in Table 1, a few results turn out to be different. In the first place, the foreign contribution to the fluctuations of external debt and the EMBI spread falls by about 11%. Moreover, the volatility of inflation due to foreign factors is reduced dramatically.

Horizon	**Monthly real GDP growth**	**Primary deficit**	**Real depreciation**	**Inflation**	**External debt**	**EMBI**
1	1.93	2.54	1.06	5.56	19.17	32.18
3	11.60	5.67	9.76	8.77	31.45	30.61
6	12.99	10.92	10.55	11.63	40.83	33.37
9	13.48	18.35	11.05	12.14	47.37	35.77
12	13.74	25.13	11.45	12.33	52.94	38.35
16	13.91	32.51	11.72	12.77	59.32	41.67
24	14.07	44.25	11.84	14.01	69.02	46.83

Table 7. Contribution of foreign variables to the forecast error variance of domestic variables
Note: Foreign variables are US_indus_gr, US_BAA spread and US_FFR.

This does not amount to saying that monthly changes in the real GDP growth are more important than the output gap in determining the forecast volatility of inflation; rather, this is the joint effect of different estimated residuals and diverse VAR projections. The inspection of the historical decompositions, in effect, reveals that the base projection of inflation in the basic model (see Figure 9) tends to exceed the actual values of inflation in 2001 and first half of 2002: foreign shocks are important because they contribute to closing this gap. Such an effect does not occur when the rates of growth are encompassed in the model. Besides this important change, the main results of the exercise remain unaffected by the adoption of these different output measures.

To conclude this section, I address an objection that might be raised with respect to the modelling choices I have made for the US. Arguably, the peculiar situation the US went through after the terrorist attacks of 9/11 makes the sample under scrutiny quite delicate. As claimed by

[42] Growth rates of change have been used by Garcia and Rigobon (2005), and Garcia-Herrero and Ortiz (2005), among the others. Since Brazil has monthly data on GDP while the US does not, I use the industrial production index for the US.

Chairman Greenspan and other members of the FOMC, the US monetary authorities kept the interest rates at unusually low levels during 2002, for they feared the consequences of a prospective deflationary process. According to this reasoning, the VAR model should be adjusted in the US block so that the peculiarity of such a period is duly taken into account. Failing this, there is the risk of taking the abrupt change in the levels of the BAA spread and FFR for a series of different shocks. In order to tackle this concern, I re-estimate the VAR system illustrated in Section 4, including in the equations of the US exogenous block a dummy variable, taking value 1 in the period from 2001:09 to 2003:1[43]. To briefly summarise the more important outcomes that will be reported below, let me point out the three main results of this extension. The first is that it confirms that foreign factors importantly contribute to determine the (forecast) error variance of Brazilian domestic variables. The second is that, in the historical decomposition, the base projection of the model improves remarkably for all variables. The third and last result is that foreign factors remain important determinants of the historical decomposition of the Brazilian domestic variables even after this dummy is encompassed in the system.

Horizon	**Industrial cycle**	**Primary deficit**	**Real depreciation**	**Inflation**	**External debt**	**EMBI**
1	3.35	4.54	0.55	2.88	20.90	27.10
3	18.91	8.35	9.47	8.83	36.16	31.79
6	23.10	14.23	10.49	20.17	46.52	38.51
9	23.96	21.75	10.84	28.00	53.23	42.38
12	27.25	27.59	11.17	32.57	57.36	44.11
16	31.71	33.31	11.74	35.30	60.53	44.83
24	35.75	40.22	12.52	38.56	63.91	45.56

Table 8. Contribution of foreign variables to the forecast error variance of domestic variables
Note: Foreign variables are US_cycle, US_BAA spread and FFR.

The contribution of foreign factors to the forecast error variance of the Brazilian domestic variables reported in Table 8 is self-explanatory. With the exception of the real depreciation, foreign factors count at least for 1/3 of the overall forecast volatility of the domestic variables. With respect to the results for the benchmark model (Table 1), the main differences reside in their relative contributions to the external debt and the EMBI spread. Despite remaining considerably

[43] It is worth noticing that, while Goretti (2005) allows for a temporary structural change in the constant of the Brazilian domestic equations, I consider here a similar extension for the US (i.e. foreign) block. Admittedly, while her switch is endogenously identified, here it is imposed on *a priori* basis. Focusing on the US block, however, is in line with trying to disentangle correctly the effects of foreign and domestic factors, as it is well-known that 9/11 and the stock market crash are both US and global shocks.

high, the relative importance of the foreign factors falls by about 13%. This finding does not entail that foreign factors are not important for the Brazilian economy as a whole. In fact, as it can be derived from the observation of the historical decomposition, the foreign variables, besides their impact on the forecast volatility, also have an important level effect on the base projections which, as anticipated above, are closer to the actual data[44]. It follows that, although relevant, this extension does not alter the main conclusions drawn from the exercises above.

[44] This is also valid for each of the other extensions considered in this section.

Historical decomposition when Selic is included and Deficit excluded

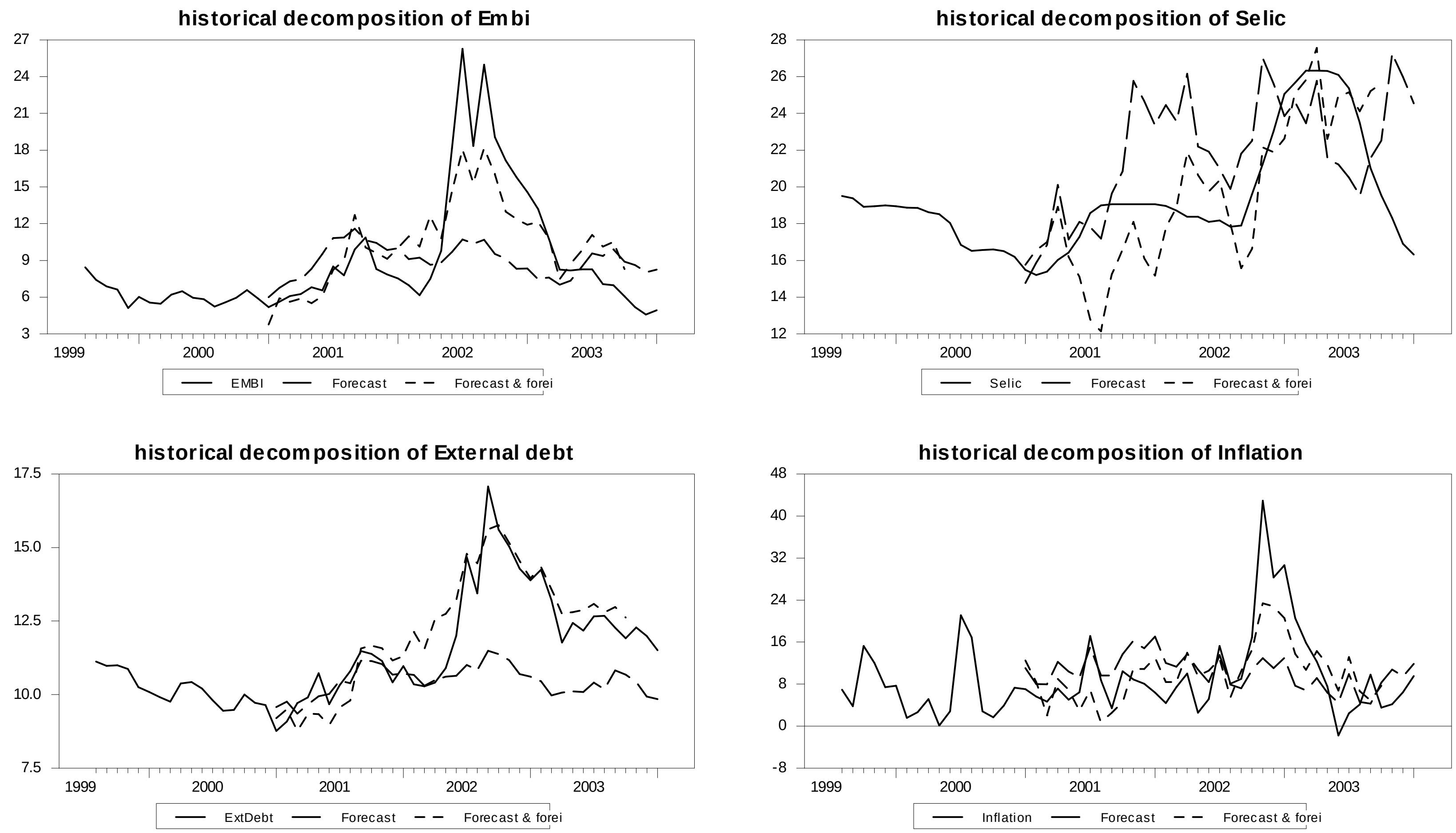

Figure 18. Historical decomposition (2001:1 2004:01) of the Brazilian series.

Historical decomposition (Selic included & Real depreciation excluded)

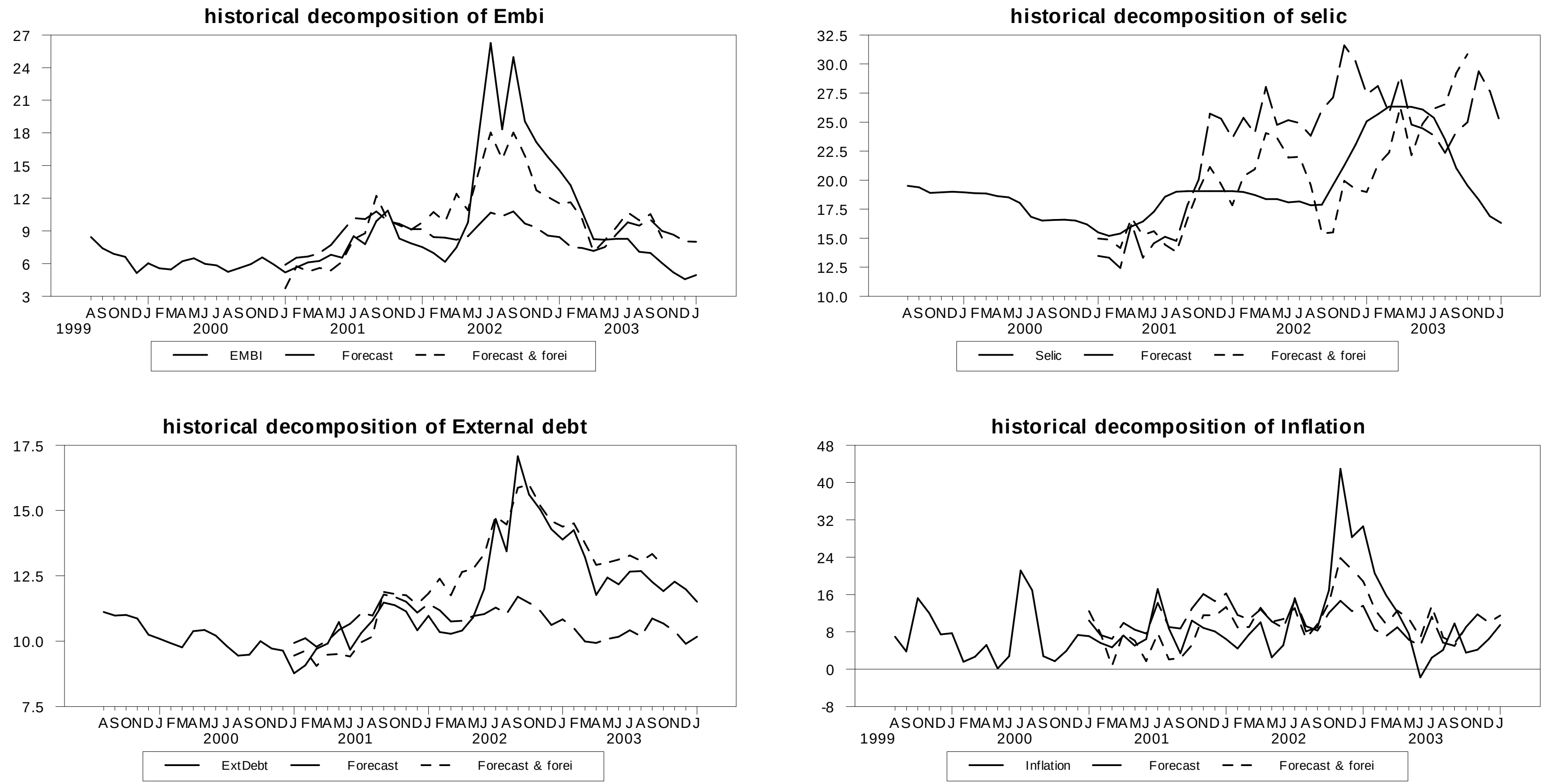

Figure 19. Historical decomposition (2001:1 2004:01) of the Brazilian series.

Historical decomposition using rates of growth

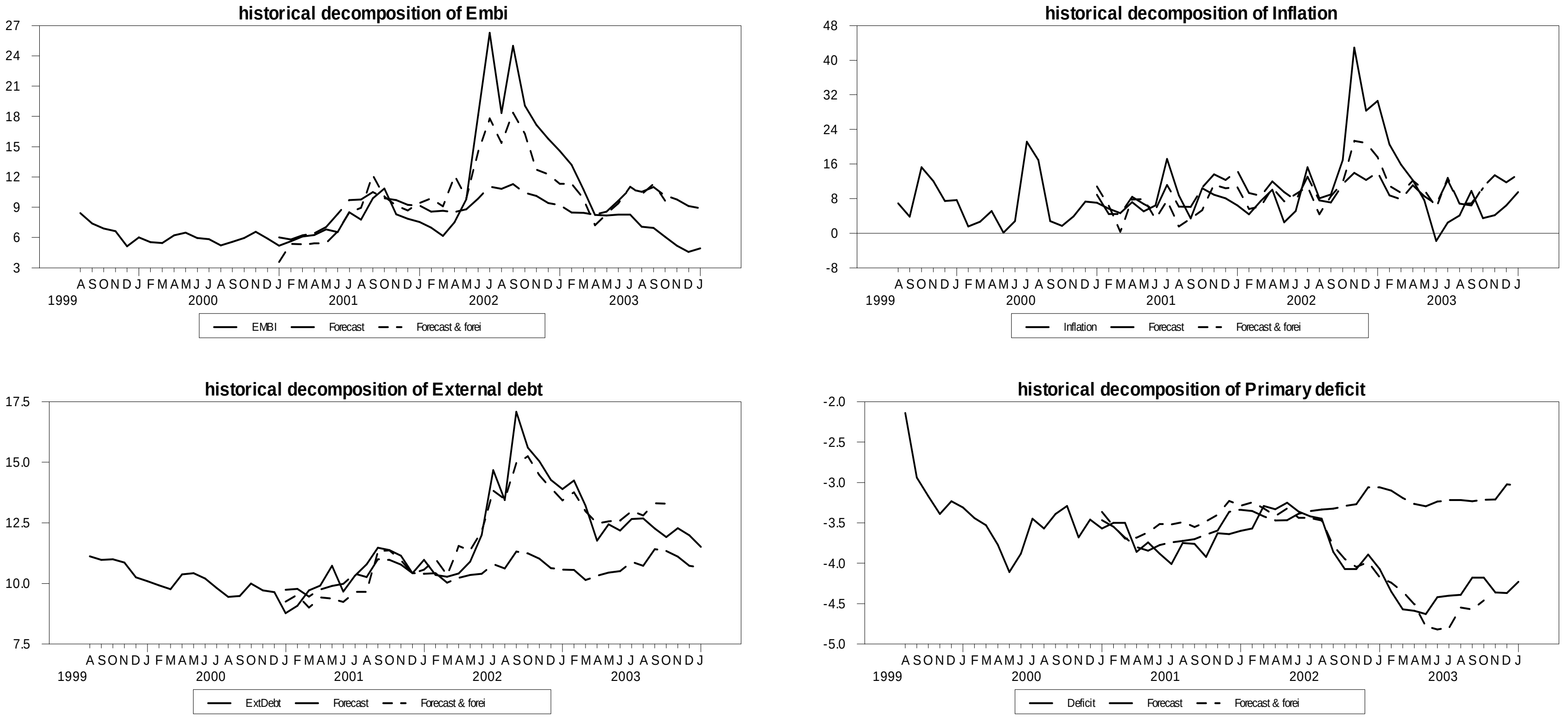

Figure 20. Historical decomposition (2001:1 2004:01) of the Brazilian series using the rate of growth rather than the cyclical components of output.

Historical decomposition with a dummy for US in 2001:09-2003:1

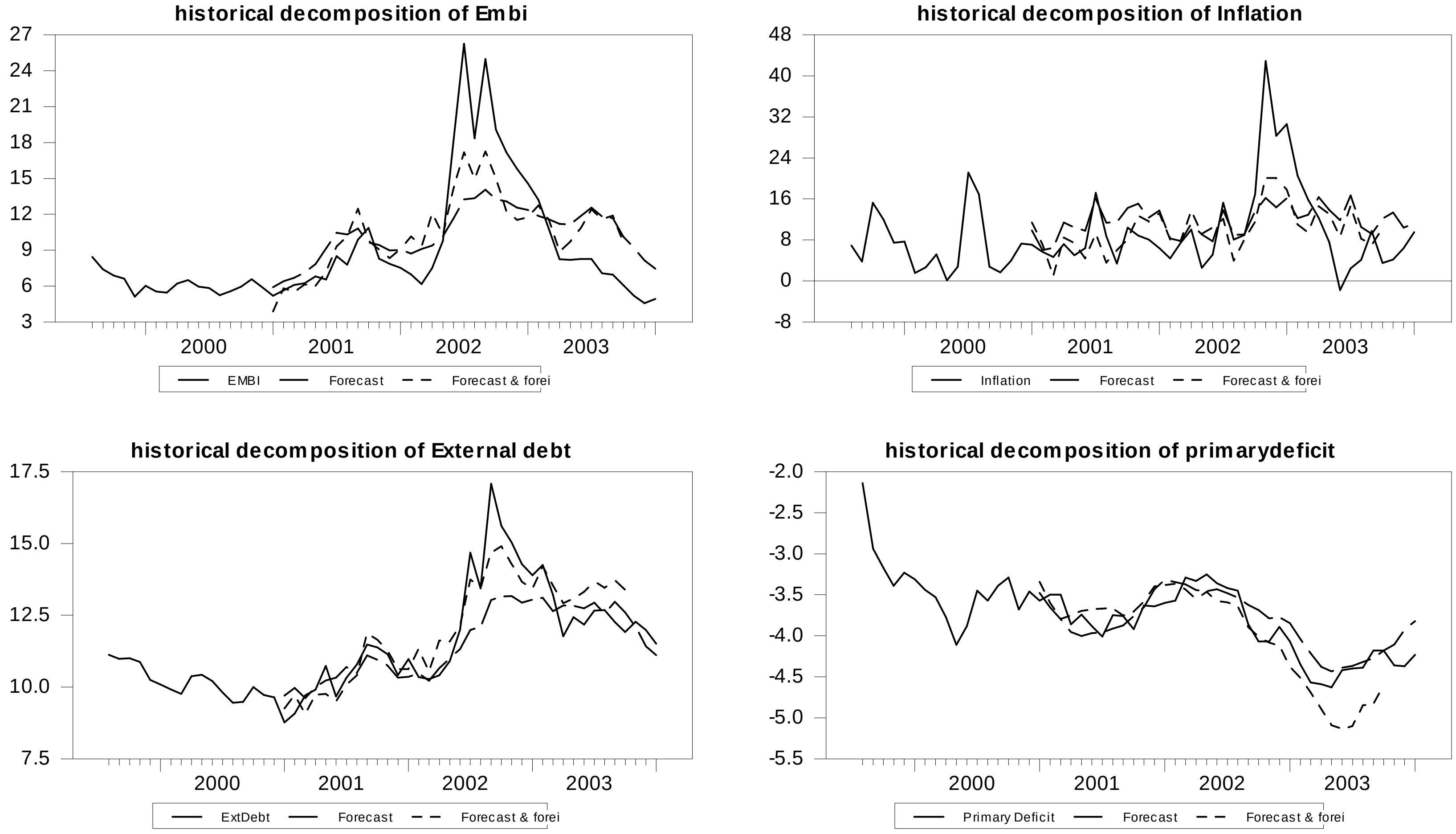

Figure 21. Historical decomposition (2001:1 2004:01) of the Brazilian series using a dummy variable for the period 2001:09 – 2003:01

7. Identifying the model : suggestions from the impulse response functions.

7.1 The identification strategy.

Once the VAR model (4) is estimated, it is possible to obtain the impulse response functions (IRFs) of each endogenous variable to the various innovations in the system. In order to do so, it is necessary to identify the entire structural model, that is all the parameters of matrix A[45]. In the literature, at least to my knowledge, four kinds of identification strategies have been developed. The first consists in ordering the variables according to the lags that, presumably, characterise the transmission of the shocks across the variables. (This is obtained by means of a triangular Choleski decomposition). The second one is based on the choice of definite values (mainly ±1 and 0) for some parameters of matrix *A*, and on the imposition of some specific relationships between the parameters. The third technique rests on the exploitation of sign restrictions; this technique is similar to the previous one but for the imposition of signs, rather than values, to the parameters of matrix *A*. The fourth method consists in setting restrictions on the long run interactions of the variables (i.e. imposing restrictions on B(1)), such as the long run separation between nominal and real variables. For the reasons illustrated in the previous sections, any of these strategies is subject to qualms and reservations, and the IRFs of each variable depend on the identification strategy adopted. Since I shall resort to the first of the abovementioned techniques, I shall briefly describe its main features here. The Choleski decomposition is a rather mechanical method to impose a triangular form to matrix *A*. If matrix *A* is upper triangular, the first variable of the vector y_t is not contemporaneously affected by the other variables, yet it has a contemporaneous impact on all the others. Conversely, the last variable in vector y_t is contemporaneously affected by all the other variables and does not simultaneously influence any of them. Adopting a Choleski decomposition is equivalent to imposing a recursive structure to the system (that is, to matrix *A*). Clearly, the imposition of a recursive structure to the system is often a questionable choice since the researcher has to decide upon the order of the contemporaneous effects of the variables without a well-grounded *a priori* knowledge. Nonetheless, there are some theoretical intuitions that help order the variables. For instance, it is usually accepted that real variables immediately affect nominal variables, while the latter affect the former with one or

[45] To be precise, if I were to use generalized FEV and IRFs, this would not be necessary. However, generalized FEV and IRFs do not allow disentangling the impact of individual shocks. See Agenor *et al*. (2002) for a description of this method.

more lags. Crucially, "the importance of the ordering depends on the magnitude of the correlation coefficient between" (Enders 2003 p.309) the residuals of the system. As a rule of thumb, if the correlation between two series of residuals is larger than 0.2 (in absolute value), the ordering is likely to be relevant. If it is lower, the ordering is immaterial. (Enders 2003 p. 309). In Appendix B, I apply the criterion suggested by Enders to the VAR residuals obtained with the identification scheme I shall use in the remaining of the work.

In what follows, I shall produce and comment upon the results one can draw from imposing a recursive order to the system. Although it is not the main goal of the paper, I have decided to undertake this additional exercise because I intend to offer some insights on external debt, inflation and EMBI spread dynamics, and on their relationships with foreign external factors. The ordering I adopt for the recursive identification model (4), is US_cycle→ US_FFR (or US_10y) → US_BAA spread → Br_Cycle→ Br_Primary Deficit→ Br_Real Depreciation→ Br_Inflation→ Br_extdebt-over-gdp → Br_EMBI spread. This identification strategy is based on the idea that i) foreign variables are block exogenous and ii) nominal variables affect the real ones only with a lag. The ordering of Brazilian cycle, primary deficit, real depreciation and inflation is followed also by Garcia and Rigobon (2005) and Minella (2003). External debt comes after the nominal variables because its value (when it is denominated in foreign currency) adjusts immediately after a change in the exchange rate. Since the EMBI spread is a financial variable, volatile and depending on a very large set of factors, it is ordered last.[46]

7.2 The impulse response functions.

Having applied the abovementioned ordering of the variables, it is possible to decompose the variance/covariance matrix of the residuals of the VAR model and simulate the impulse responses of the various series to the shocks hitting the system. I report the results of such an exercise in Figure 22 when the FFR is included, and in Figure 23 when the US_10y yield is embedded[47]. In what follows, I will shortly discuss these figures in relation to the economic intuitions proposed in Section 3. In particular, as it has been repeated several times that the BAA spread plays a central role in explaining the evolution of most of Brazilian domestic variables, the discussion will focus on the impact of innovations to the BAA spread on the variables of interest, namely Brazilian inflation and EMBI spread.

[46] On the basis of the correlation indices of the VAR residuals, I consider an alternative ordering so as to make the EMBI spread coming before the real depreciation and after the deficit. This extension will be discussed in Appendix B.
[47] The confidence intervals are calculated by means of 4000 MonteCarlo simulations. The technique, employed by Sims and Zha (1999), is necessary for the model is near-VAR.

Let me start with looking first at Figure 22. The impulse response function of the EMBI spread to a shock to the BAA spread follows economic intuition. The Brazilian EMBI spread increases more than proportionally and, absent any intervention, remain affected also in the medium term. Brazilian inflation reacts negatively on impact – I shall come back to this at the end of the section - but it is permanently positively affected thereafter, probably because of the real depreciation lasting a few periods. This suggests that, *ceteris paribus*, positive shocks to global appetite for risk tend to have an inflationary impact on the Brazilian economy. The primary deficit improves in correspondence to a positive shock to the US_BAA spread: this seems to indicate that, in times of low appetite for risk, Brazilian authorities increase the fiscal discipline (and vice versa). This is a recommendable policy stance which goes hand in hand with prudential considerations.

If the impact of innovations to the EMBI spread is considered, it turns out that they, and their effects, are quite persistent. According to the predictions of the new "fiscal dominance" approach, they tend to generate temporary domestic inflation and a real depreciation of the currency. In light of these findings, one could conclude that the shocks to both global appetite for risk and Brazil EMBI spread tend to boost Brazilian inflation. They differ, however, in that only the former leads to an increase in the external debt. It is also worth noticing that, while domestic inflationary shocks lead to an increase in the cyclical components of the Brazilian production index, the inflationary burst caused by changes in both spreads is associated with a contraction in the production. Finally, a US monetary shock leads to a temporary increase in the EMBI spread[48].

Admittedly, a close inspection of figure 22 also reveals some odd results, which may cast some doubts on the validity of the identification strategy. On the one hand, a positive shock to Brazilian inflation causes a real appreciation of the exchange rate and a small improvement in GDP, as one would have expected; on the other hand, however, the EMBI spread reacts oddly to such a shock, since it tends to fall when inflation spikes up. This is probably due to the fact that the debt-GDP ratio falls after the increase in the nominal GDP level and the real appreciation. If the EMBI spread is mainly affected by the level of debt, this conclusion makes sense: the inflationary shock reduces the ratio of debt over GDP in the very short run. It could be argued, however, that the fact that a spike in inflation causes a negative response in the EMBI spread does not follow common sense, and this is particularly the case in a country where the ability to keep inflation under control is a rough measure of the political commitment to stabilise the economy. One possible explanation is that shocks to Brazilian inflation are not persistent and,

[48] Most of the results, where comparable, are consistent with those in Garcia-Herrero and Ortiz (2005). The impact of the US_FFR on the EMBI spread, in particular, is similar to that in Uribe and Yue (2006).

since they do not jeopardize the overall ability of the central bank to keep inflation under control, they are not directly mirrored by a spike in the EMBI spread.

Let me move on now to Figure 23; there I report the IRFs for one of the extensions considered earlier, that is the swap between US_10y and FFR. Most of the results are not different from those discussed above, but let me briefly mention only a few peculiar ones. First, the US_10y yield is negatively related on impact and positively related afterwards with BAA and EMBI credit spreads[49]. Second, since a shock to US_10y is associated with a spike in inflation and no real depreciation, there must be a nominal depreciation which is almost equal to the difference between domestic and US inflation rates.

Although many of the IRFs follow economic intuition over the medium/long run, in general, the immediate impact of the innovations on the variables seems, in same cases, counter-intuitive. This is particularly true in the case of foreign shocks. My hunch is that this depends on the identification strategy proposed above: since using a Choleski decomposition is equivalent to imposing a unique ordering on the variables, this might be suboptimal in the case of foreign financial variables. The reasoning goes as follows. In the real world, any innovation to the BAA spread is likely to be immediately transmitted to the EMBI spread and, only after a few lags, to the other (nominal and real) macroeconomic variables. This supposition hinges on the observation that shocks are in general transmitted faster across financial than macroeconomic variables. The choice of leaving both BAA and EMBI spreads as the last variable in each (foreign and domestic) block hinges on this principle. However, this very same idea is contradicted by the overall ordering of the foreign and domestic variables, with the domestic Brazilian variables coming after the BAA spread and before the EMBI spread. Accordingly, the BAA spread affects all domestic Brazilian variables immediately, and the EMBI spread is not the first to be influenced. Such ordering of the variables, however, cannot be modified since the foreign block needs be separate from the domestic one if one wants to exploit the block exogeneity assumption[50]. If the innovations to the BAA spread affect all domestic Brazilian variables, and each of these has an impact on the EMBI spread, there is some interference in the direct impact of BAA spread shocks on the latter. As said, unfortunately, there is no way to solve such a problem without resorting to a structural identification strategy which imposes extra lags in the transmission mechanism of BAA spread shocks to the Brazilian series. This extension, however, goes far beyond the scope of this model and, therefore, it is left for future research.

[49] Most of the results, where comparable, are consistent with those in Garcia-Herrero and Ortiz (2005).

[50] In Appendix B I shall amend the model so as to anticipate the EMBI spread in the ordering. Such a move changes very few results, in particular between EMBI and real depreciation. The discussion of such extension is left to the appendix.

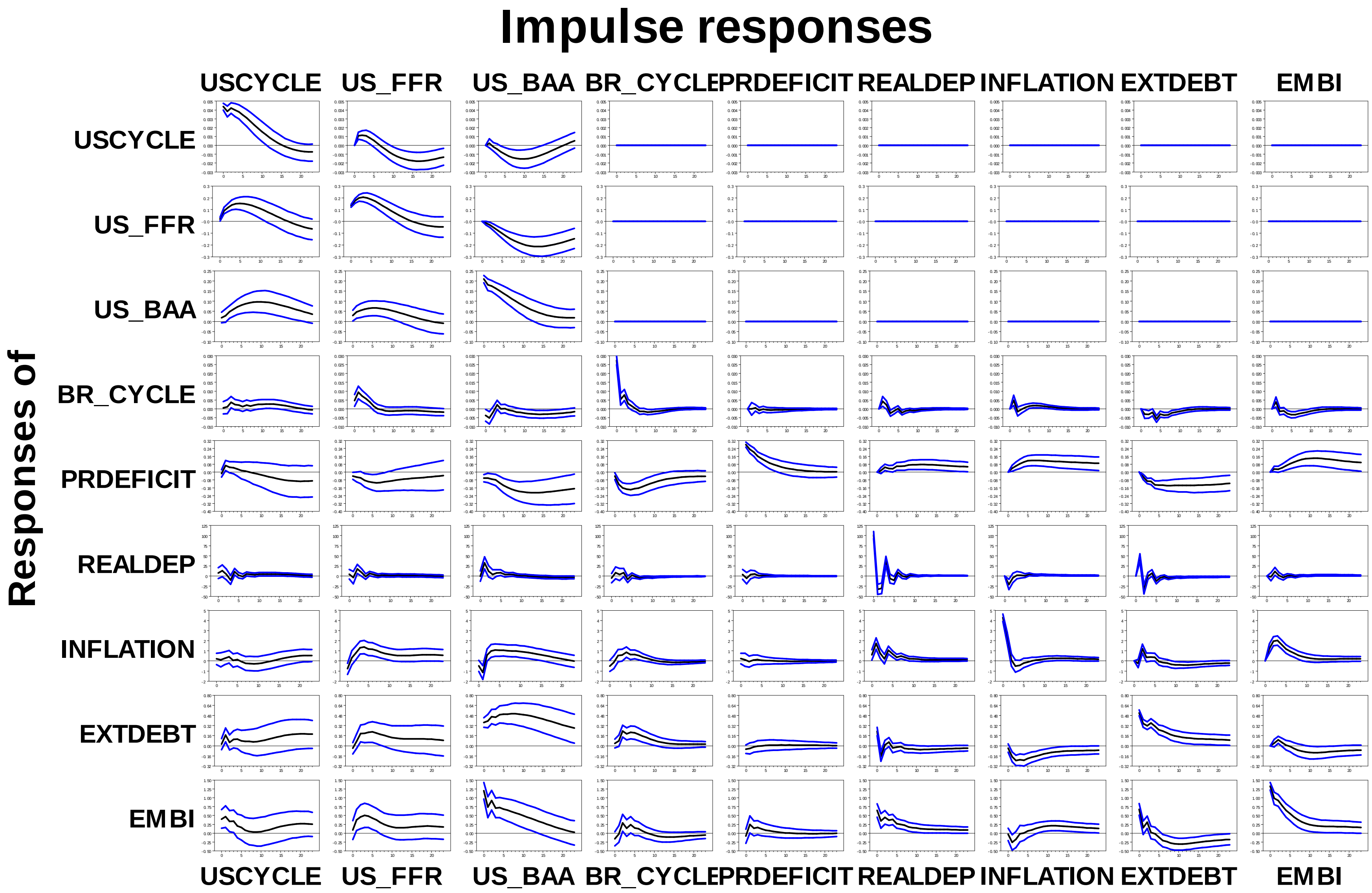

Figure 22. The Impulse response functions of the variables to various shocks. Baseline model (table 1).

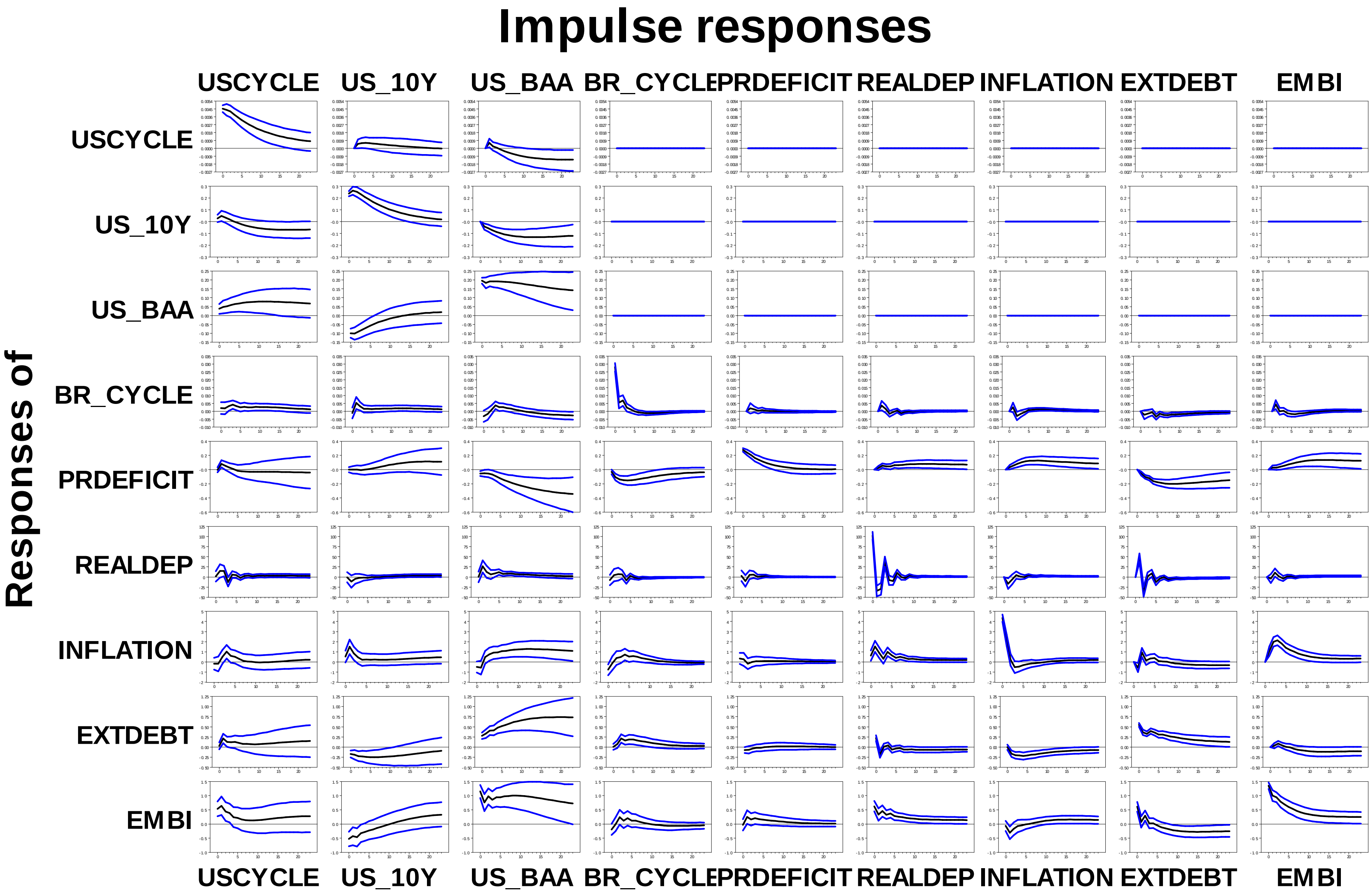

Figure 23. The Impulse response functions of the variables to various shocks. Baseline model with US_10y (table 4).

8. Closing remarks.

This work focuses on the impact of foreign global shocks on the behaviour of domestic macroeconomic variables (in particular external debt and EMBI spread), in Brazil. A VAR system encompassing 6 domestic and 3 foreign variables, which proxy global factors, is estimated for Brazil from January 1999 to January 2004. In order to fully grasp the contribution of credit risk premia and foreign investors' appetite for risk to the overall macroeconomic volatility, EMBI and US_BAA corporate spreads are included among the variables of the system.

A partial identification strategy, which exploits the block exogeneity of foreign variables with respect to the domestic ones, allows i) deriving the contribution of foreign variables to the forecast error variance of the domestic ones and ii) performing the historical decomposition of the series under investigation. The results of these two analyses suggest that almost all the Brazilian series, in particular EMBI spread and external debt, are strongly affected by foreign exogenous innovations.

In the last section, a full identification of the system allows studying the implied IRFs of the system. Conditional on the identification strategy adopted, most of the IRFs for each of the variables confirm the importance of the innovations of the foreign factors.

Several findings support the existence of the unconventional channel of transmission suggested by Blanchard, whereby changes either in foreign appetite for risk or in the domestic determinants of debt sustainability can bring about domestic inflation without monetary policy being expansionary. The policy recommendation that can be drawn from this observation is that the innovations in the foreign degree of risk aversion, and in other global factors, have to be taken into account by fiscal and monetary authorities. The inflationary pressures stemming from such external sources of volatility have to be treated with care.

All in all, the findings and observations reported in the main text and the appendices provide support to the hypothesis that foreign factors are important determinants of the development of the domestic Brazilian variables. In particular, global appetite for risk (and its counterpart, i.e. global risk aversion) turns out to be a very important factor to consider. It follows that researchers and policymakers interested in the evolution of credit risk premia and external debt in an open emerging market economy, should take global risk aversion into due account.

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Appendix A. Small scale model

It could be argued that 9 variables risk overfitting the model. In this section, I shall present the results obtained by estimating a near-VAR model where only US_cycle, US_FFR, US_BAA spread, Brazilian external debt and Brazilian EMBI spread are included. In light of the extensions considered in the main text, I report the results of this model when the dummy for the US in 2001:09-2003:01 is both included and excluded. The results of interest do not change with the exclusion of the other domestic Brazilian variables. This is not surprising since the decomposition moves around the identification of foreign innovations, not of the domestic ones.

	Without dummy for US in 2001:09 – 2003:01			**With dummy for US in 2001:09 – 2003:01**	
horizon	**External debt**	**EMBI**		**External debt**	**EM BI**
1	13.16	32.72		14.62	27.48
3	34.25	36.98		34.63	32.21
6	52.28	45.36		50.47	40.05
9	63.13	51		58.90	44.26
12	70.24	54.88		63.99	46.31
16	76.29	58.08		68.08	47.29
24	82.38	60.67		71.73	47.73

Table A.1. Contribution of foreign variables to the forecast error variance of domestic variables
Note: Foreign variables are US_cycle, US_FFR and US_BAA spread.

As already mentioned in the other extensions in the text, omitting relevant variables from the system tends to affect the estimated contribution to the forecast variance. Although the omission of the domestic variables alters the quantitative results, the main conclusions of the paper remain valid.

Appendix B. Correlations of the VAR residuals

The correlations of the VAR residuals help understand if the ordering of the variables is either immaterial or, rather, crucial. As said in the text, Enders suggests considering the ordering as immaterial if the correlation between two variables is, in absolute value, smaller than 0.2. In Table B.1, which represents the correlations matrix of the VAR residuals, I highlight those correlation indices exceeding such a "rule-of-thumb" critical level. I shall then discuss the chosen ordering and the plausibility of an alternative one.

Correlation of the VAR residuals	**US_CYCLE**	**US_FFR**	**BAA_ spread**	**Br_ind cycle**	**Primary deficit**	**Real deprec.**	**Inflation**	**External debt**	**Embi**
US_cycle	1.000								
US_FFRs	0.145	1.000							
BAAspread	0.013	0.114	1.000						
Br_cycle	0.018	0.143	-0.096	1.000					
Primary deficit	-0.035	-0.109	-0.171	-0.134	1.000				
Real depreciation	0.066	0.047	0.022	-0.041	0.041	1.000			
Inflation	0.028	-0.129	-0.140	-0.116	0.097	0.125	1.000		
External debt	0.033	-0.047	0.409	-0.028	-0.192	0.319	-0.063	1.000	
Embi	0.186	0.080	0.532	-0.145	-0.135	0.330	-0.061	0.622	1.00000

Table B.1. Correlations of the residuals from VAR (4).

Correlation indices are larger (in absolute value) than 0.2 only for the equations relative to external debt and EMBI spread. Let me now discuss briefly to what extent these findings can cast doubts on the identification strategy adopted in the work. To begin with, the correlation 0.622 between the residuals of the last two variables can hardly lead to inverting the order of the variables. In fact, there are good economic reasons to believe that while changes in the external debt level immediately affect the EMBI spread, the latter has an impact on the former only after some lags. Reverting the order would not make economic sense. The other high correlation indices regard BAA and EMBI spreads. Once the exogenous block assumption is accepted, the correlation between US_BAA spread residuals and those of the other endogenous domestic variables does not represent an issue. Again, reverting the ordering would entail dropping the block exogeneity assumption altogether.

Some attention should also be devoted to the correlation indices between the residuals of the real depreciation equation, on the one hand, and the external debt and EMBI spread on the other. There is no reason to doubt that the direction of causality goes from the real depreciation to the external debt. Conversely, the relationship between the real depreciation and the EMBI spread is not uncontroversial. The ordering adopted in the text ensures that innovations to the EMBI spread perculate into the other domestic variables with one lag; moving the EMBI spread before depreciation would revert the lag. To see whether the choice of setting the EMBI spread as following the real depreciation in the ordering strongly affects the results. Let me propose the following alternative ordering: US-cycle→ US_FFR → US_BAA spread → Brazilian_Cycle→ Br_PrimaryDeficit→ Br_EMBI spread → Br_RealDepreciation→ Br_Inflation→ Br_ext_debt over GDP. The IRFs are represented in Figure B.1. When the EMBI spread is moved before real depreciation and inflation, only a few results change. In particular, it turns out that innovations to the real depreciations do not affect the EMBI spread at any lag, whereas the influence of EMBI spread shocks on the depreciation of the exchange rate is amplified. As a consequence, on impact the external debt grows. Note that the criterion that the real variables come before the nominal ones is immaterial in this setting.

Finally, the ordering between the real depreciation and inflation is subject to possible criticism. Yet, three arguments indicate that it is not an unreasonable assumption. First, the correlation indices support the ordering or, at least, downplay its importance. Second, this ordering is maintained in most of the works applying VAR models on the Brazilian series[51]. Third, such sequencing follows the theoretical reasoning (*à la* Blanchard) illustrated in Section 3. In practice, *ceteris paribus*, nominal depreciations (which lead to real depreciations if inflation follows) cause an increase in the imported inflation and, therefore, in the domestic rate of inflation. According to Blanchard's theory, abrupt changes in the nominal exchange rate are often caused by harsh reversals of capital flows, which in their turn can be determined by shifts in the appetite for risk of foreign investors (i.e. US_BAA spread). This chain of causation is respected here since the US_BAA spread precedes real depreciation in the ordering, and real depreciation comes before inflation.

[51] See, for instance, Garcia and Rigobon (2005) and Minella (2003)

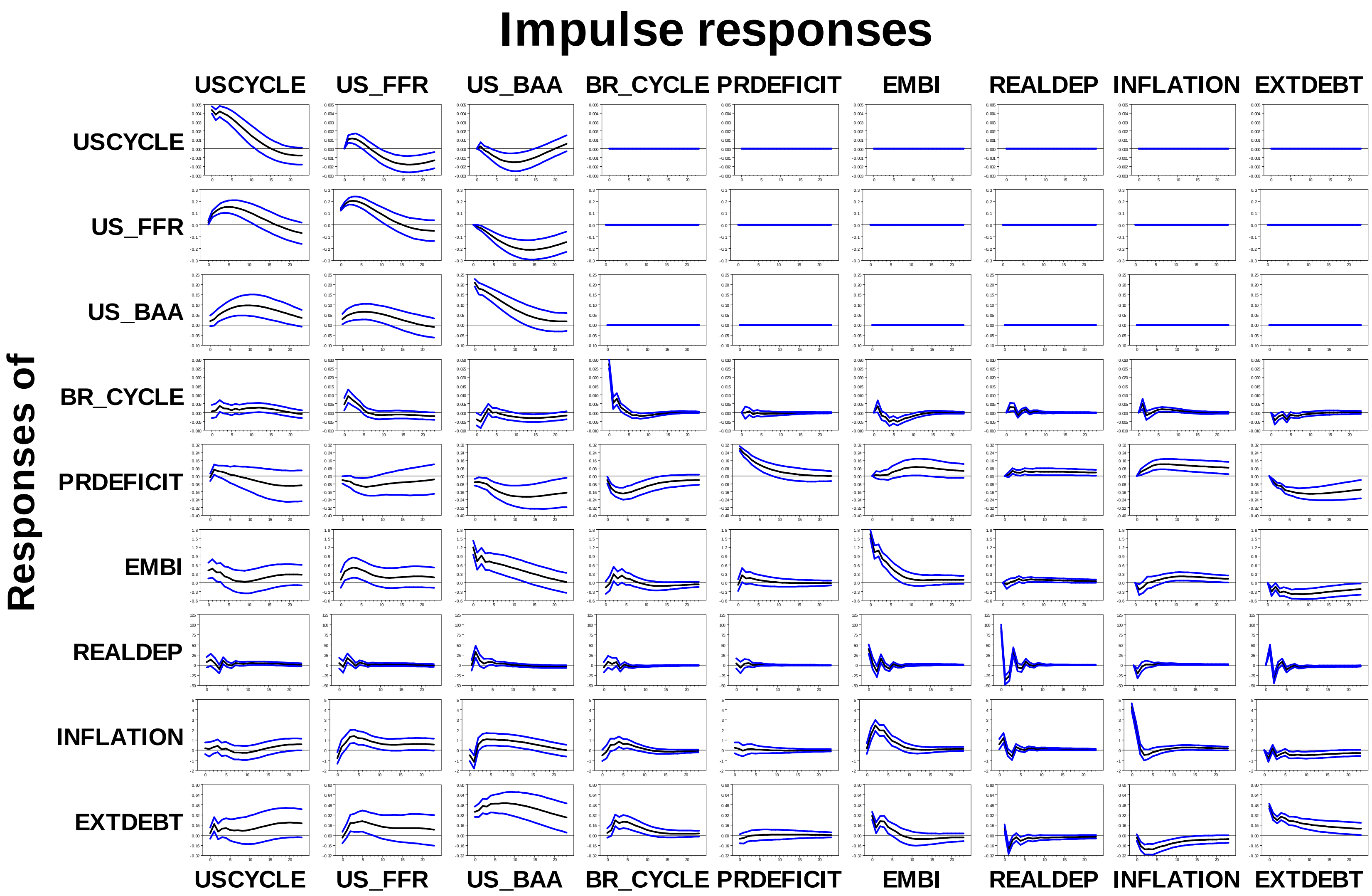

Figure B.1. The Impulse response functions of the variables to various shocks. Baseline model with EMBI preceding other nominal variables.

Appendix C. Near-VAR estimates and tests.

In what follows I reproduce the results of the VAR estimation and a few statistical tests on each of the equations of the near VAR system. The estimates in table C.1 refer to the specification of the model discussed in section 6 which includes a dummy variable so as to capture the unusually low US interest rates during 2002.

Not surprisingly, the empirical fit of the various equations looks quite good. This is certainly due to the number of relevant regressors included in the estimations and the relatively high importance of the autoregressive terms in explaining the dynamics of current values.

The values of the coefficients are as expected. In general the lagged values of each dependent variable are highly significant whereas the significance of the lagged values of the other variables varies across the equations. In a few equations, the two lagged values of some variables turn out to be insignificant. This is the case, for instance, of the BAA_spread in the EMBI equation. This finding does not entail that the former variable, at all leads and lags, is an unimportant determinant of the latter. In fact, as it appears clearly from the IRFs in section 7, the contemporaneous impact of the BAA_spread fluctuations on the Brazilian domestic variables is significant and often large. Both EMBI and BAA spread measures are financial variables: the strength of their contemporaneous relationship is not surprisingly higher than that of lagged values and the scant significance of lagged BAA spread in the EMBI equation is likely due to this reason.

Even though the significance of the various regressors differs considerably across equations, there is no variable whose lagged values are insignificant in all equations. This supports the inclusion of these 9 variables in the VAR system and corroborates the results of the model selection statistics calculated on the whole system. It should also be noted that the dummy variables included in the model help improving the estimates even though they are not significant in each and every equation.

	US Cycle	US FFR	US BAA	Br_ cycle	BR_ deficit	BR_ deprec	BR_ Inflation	BR_ Ext debt	BR_ EMBI
US Cycle _1	0.860 ***	14.83 ***	1.21	-0.30	16.58 ***	3657 *	-83.76	32.49 **	31.27
……_2	0.066	-12.36 ***	1.91	0.28	-12.26 **	-4560 **	-32.41	-51.48 ***	-78.92 *
US FFR _1	0.006 ***	1.344 ***	0.19	0.062 ***	-0.05	-10.61	4.786	0.58	2.07
……_2	-0.007 ***	-0.364 ***	-0.18	-0.061 ***	0.02	27.51	-3.32	-0.49	-2.05
US BAA _ 1	0.0006	-0.046	0.886 ***	-0.018	0.01	0.20	-6.23 ***	0.46	0.52
……_2	-0.0015	-0.005	0.040	0.0455 ***	0.07	60.80	4.03 *	-0.05	0.51
Br_ Cycle _1				0.244 ***	-2.71 ***	13.66	16.30	0.65	3.64
……_2				0.183 **	-1.17	221.36	12.86	7.03 ***	15.85 ***
Br_ Deficit _1				-0.002	0.800 ***	7.68	-0.24	0.06	1.06 *
…… _2				0.001	-0.01	-0.166	-0.35	-0.003	-0.94*
Br_ Deprec _1				0.00003 *	0.002	-0.488 ***	0.011 ***	-0.003 ***	0.0003
…… _2				0.00000	0.0002 *	-0.111 *	-0.009 ***	-0.0003	-0.0007
Br_ Inflation_1				0.0010 **	0.0008	-4.135 ***	0.528 ***	-0.035 ***	-0.062 *
……_2				-0.011 **	0.002	1.416	-0.224 ***	-0.02 *	0.006
Br_ Extdebt_1				-0.009 **	-0.127 ***	88.53 ***	-1.74 ***	0.655 ***	-0.61 **
……_2				0.004	-0.04	-93.11 ***	2.10 ***	0.33 ***	0.56 *
Br_ EMBI_1				0.002 *	0.021	-1.44	0.89 ***	0.04	0.76 ***
……_2				-0.004 ***	-0.006	9.60	0.34	0.037	0.14
D_:rus	0.0003	-0.112 ***	0.213 **	-0.030 **	-0.24 *	-163.31 **	-3.49	0.055	1.26
D_us	-0.0006	-0.089	0.20 ***						
D_floating				-0.07 ***	-0.267	1317.2 ***	-3.91	5.322 ***	2.64 *
US_Infl		-0.357							
US_Infl _1		-0.0075							
US_Infl _2		0.0111							
R^2	0.96	0.99	0.97	0.84	0.98	0.94	0.93	0.99	0.93
Jarque-Bera	0.68	4.30	56.01 (Kurt)	0.36	16.01 (kurt)	300.87 ***	1.13	34.41 ***	300 ***
Ljung Box test	8.27	16.28	18.17	31.63 ***	29.28 ***	46.54 ***	13.21	21.00 *	7.14
BP LM	22.98	23.47**	25.04**	35.94 ***	45.09 ***	45.54 ***	25.93 **	34.89 ***	26.79 ***
Arch LM	1.14	4.12	10.22 *	2.35	2.95	33.94 ***	5.37	17.57 ***	19.27 ***

Table C.1. Near VAR estimates and equation-by-equation test statistics.

The test statistics reported at the bottom of the table refer to the usual test for the normality of the errors (Jacque Bera test), the remaining serial correlation of the errors (Ljung-Box and Breush-Pagan test) and the homoskedasticity of the errors (Arch LM test). The US equations appear to be well defined, even though there is some inconsistency between the Ljung-Box and the BP LM tests. The residuals of the Brazilian equations, instead, are less satisfactory. With the exception of the Inflation and Industrial Cycle equations, the residuals do not look normal and are, probably, partially correlated. This would suggest to increase the number of lagged values of the variables in the model. However, the addition of few lags does not considerably change the results while the inclusion of 1 to 12 lags erodes degrees of freedom. Admittedly, these findings cast some doubts on the overall fit of the model. In commenting upon these test statistics, however, it is worth recalling that while the VAR specification is chosen on the ground of some model selection statistics which regard the whole near-VAR system, the statistics reported below are drawn on an equation-by-equation basis. This suggests that while the system can hardly be improved by means of an extension of the number of lagged values common to all equations, it might be improved on the basis of an equation-by-equation selection procedure. The latter, however, implies the imposition of additional restrictions to the overall system which implicitly makes the system over-identified. This is the reason why, in the VAR literature, it is uncommon to apply an equation-by-equation specification procedure and the model selection is usually run on the basis of tests on the whole system. In this work, while acknowledging that improvements coming from a different modelling strategy are possible, I follow the literature and refer to the complete-model selection criteria.