BULGARIAN NATIONAL BANK

Fundamentals in Bulgarian Brady Bonds: Price Dynamics

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March 2000

DISCUSSION PAPERS

DP/12/2000

DISCUSSION PAPERS

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ISBN 954 – 9791 – 31 – 9

Printed in BNB Printing Center

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Summary: The objective of this paper is to analyze the main determinants of secondary market prices of Bulgarian Brady bonds. We investigate to what extent fluctuations in domestic fundamentals impact the secondary market prices of Bulgarian Brady bonds. In addition, we are interested to know whether external shocks impact Bulgarian Brady bond prices. We use cointegration techniques to estimate the long-term relationship between Brady bond market prices and domestic fundamentals. We also find contagion effects of the 1995 Mexican crisis on Bulgaria's Brady bond prices. Empirical results to a great extent confirm the view that so-called 'fundamentals approach' should be used to supplement the analysis of spillover effect for the case of Bulgarian Brady bonds.

JEL classification: F34, H63, E66

Keywords: external financing, foreign debt management and market-based restructuring, macroeconomic stabilization

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The authors would like to thank the European Commission for the financial support provided through the ACE Phare Research Project 1996 Programme. They are indebted to Lubomir Christov for his help with data. Special thanks are due to Sweder van Wijnbergen for his useful comments and suggestions.
All errors and omissions remain the full responsibility of the authors.
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I. Introduction

Little is known about the determinants that affect prices and hence yields of emerging markets Brady bond issues. The issue of price determination requires a closer investigation, taking into account the ongoing turmoil in emerging markets and the East European country prospects. This paper analyzes empirically the importance of domestic indicators for pricing the Bulgarian Brady bonds.

The purpose of this paper is to analyze the importance of some macroeconomic indicators in determining the secondary market price of Bulgarian Brady bonds after DDSR Agreement of the Bulgarian Government with the London Club in July 1994. Section two provides the theoretical background and surveys the empirical research in this area. Section three briefly discusses the DDSR Agreement, attempts at macroeconomic stabilization and potential candidates from macroeconomic variables that might affect the prices of Bulgarian Brady bonds. In section four we estimate an ECM model and a VAR system for DISC and IAB price determination and analyze the results. Tests for the stationarity of Bulgarian Brady bond movements are also provided. Finally, we present some concluding remarks.

II. Theoretical Background

The existing literature on Brady bonds suggests three alternative approaches to debt pricing: option pricing, spillover effect and 'fundamentals'.

The option theory is generally used to price the debt of corporate companies, but it is also applicable to pricing other risky debt. Claessens and Wijnbergen (1993) used option theory to price the bonds of Brady type agreement: the Mexican deal. Budina and van Wijnbergen (1998) use the same approach to value the effect of the Bulgarian Debt and Debt Service Reduction Agreement of 1994.

The approach based on the spillover effect simply states that different bond prices are interdependent and the level or variation of a particular bond price in the market depends on the behavior of similar bonds. The IMF (1995) reported the presence of Granger causality of the Mexican Brady bond prices on prices of other Latin American countries. Respectively, Calvo and Reinhart (1996) claimed for contagion effects on Brady bonds of shocks like the 1995 Mexican crisis.

Pricing a risky debt by using the so-called 'fundamentals approach' is considered complementary in the literature because it only adds to the

spillover effect in the explanation of bond price movement. It relates secondary market debt prices to a set of explanatory variables like inflation, foreign reserves, foreign reserves to imports ratio, exchange rates, debt, debt to exports ratio, GDP growth. Some of the important research in this area are Eaton and Gersovitz (1981), Sachs (1995), Edwards (1986), Cohen (1989), Olzer and Huizinga (1991), Haque, Kumar, Mark and Mathieson (1996). These analyses make the implicit assumption that bonds of different countries traded in the secondary market are directly compatible, although some of them do not use Brady prices.

Eaton and Gersovitz (1981) pointed out the complexity of lending to a sovereign country. They considered the probability of sovereign default as a function of macroeconomic sustainability of a given level of external debt. Through the econometric tests Cohen (1989) and Olzer and Huizinga (1991) identified the variables that best explain repayment capacity: debt to exports ratio, foreign reserves to imports ratio, inflation, *et al*. Sachs (1985) provided an empirical rationale for using certain economic indicators in determining the risk premium in international bond markets. He demonstrated the importance of exchange rate management and trade policies, emphasizing the role of the exchange rate and trade policy for a developing country performance. Edwards (1986) tested whether pricing of bonds and bank loans are significantly different and found out a positive effect of higher debt ratios on the risk premium testing the yields on low developing countries' bonds traded in the secondary market. Haque, Kumar, Mark and Mathieson (1996) investigated the importance of certain ratios: the ratio of foreign reserves (excluding gold) to imports, the ratio of current account to GDP, as well as of indicators like GDP growth and inflation, for the variation in credit ratings of developing countries. They tested data for 60 developing countries in their attempt to explain large variation in credit ratings.

III. DDSR Operation and Macroeconomic Stabilization in Bulgaria

The 1994 DDSR Agreement converted USD 8.3 billion, including original debt and interest arrears accumulated since the debt moratorium in 1991. The market-based debt and debt service reduction was estimated at about 46 percent in present value terms, or at 38 percent

[1] See Budina and van Wijnbergen (1998) for the evaluation of the benefits of the DDSR Agreement for Bulgaria and its commercial creditors.

when accounting for the up-front costs of this debt deal.[1] The menu of options available in this Agreement consisted of: cash buybacks, par bonds with lower interest payments in the first seven years, discount bonds issued at 50 percent discount but yielding market rates, and interest arrears bonds converting past-due interest. The impact of the DDSR Agreement consisted of lowering the face value of Bulgarian debt meant to alleviate the problems of 'debt overhang', thus raising the market price of the Bulgarian converted debt after the Agreement. Houben (1995) shows that the Bulgarian external debt was traded at deep discounts before the Agreement: the price varied between USD 0.20 and USD 0.30 per USD 1 face value debt. Budina and van Wijnbergen (1998) estimated the break-even price of the external debt (when the eligible debt was converted into the various options offered) at USD 0.50 per USD 1 face value converted debt (debt with guarantees) or USD 0.38 per USD 1 face value debt without guarantees. Thus the DDSR Agreement helps diminish uncertainty about future fiscal and exchange rate developments associated with debt overhang. It can increase the probability of success of economic reforms and restore access to the international capital markets and growth recovery prospects. These opportunities can be beneficial to the debtor country only in an environment of economic and political stability. The objective of this paper is to show that Bulgaria can benefit from the debt deal only if the country follows a consistent and credible macroeconomic stabilization policy. In addition, we will show that developments in Latin American markets play an important role in Bulgarian Brady bond price dynamics. An important implication of this finding is that any future fiscal projections should take these markets' developments into account. We also show that various types of instruments react differently to domestic and external fluctuations in macroeconomic fundamentals.

The Bulgarian DDSR Agreement proposed three different types of Brady bonds in the menu: discount bonds (DISCs), front-loaded interest reduction bonds (FLIRBs), and interest reduction bonds (IABs). Herewith, we will search the movement of Bulgarian DISC and IAB prices. The second group – FLIRBs – are somewhere between considering the safety and liquidity of Bulgarian Bradies. FLIRBs are convertible into equity, their interest is collateralized like DISCs, but the collateral is required only for the first seven years, and no principal collateral is required. FLIRBs are similar to IABs according to maturity and grace period.

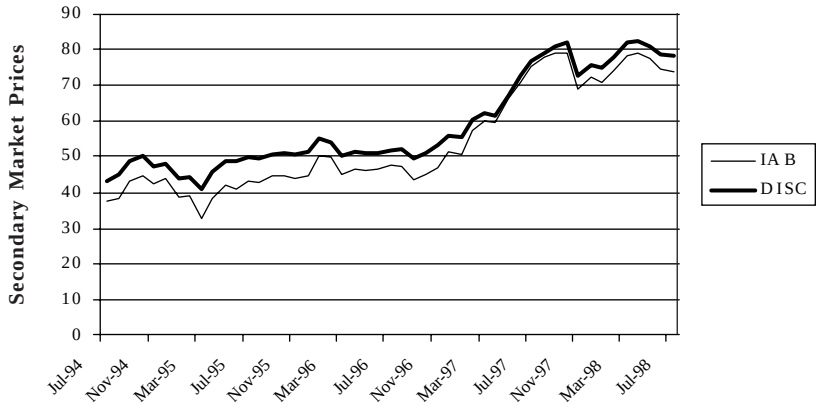
Discount bonds have a 30-year maturity, carry a floating market interest rate, and were issued at a discount to original face value of the

rescheduled loans, and do not involve market risk, so their prices are a good measure of country risk. We will focus on the prices of Bulgarian DISC Brady bonds for several reasons. First, DISCs are considered the safest and most tradable instrument: of all Bulgarian Brady instruments DISCs are the only one whose principal is secured by zero-coupon US bonds, 12-month interests are guaranteed, and they do not have any grace period. Second, DISC prices are published regularly and are usually used as a starting point to asses the risk of Brady bonds. Third, we also expect that US interest rates on 30-year treasury bonds were smoother than the risk premiums over the period of our study on Brady bonds, so they could not have much impact on Brady bond prices.

IABs are 17-year interest arrears bonds. A partial redemption on them must be made in 21 semiannual installments, beginning July 2001. Each installment is defined as a percentage of the original principal. Installments and percents agreed are graduated as follows: the first six installments at 1%, from seventh to 11th installment at 3%, from 12th to 16th installment at 6%, and from 17th to 21st at 9%. IABs pay the 6-month LIBOR plus 13/16% per annum. They are inconvertible into equity and are unsecured in terms of principal and interest. Thus, IABs can be considered as more risky and less liquid than DISCs.

Chart 1

BULGARIAN BRADY BOND PRICES



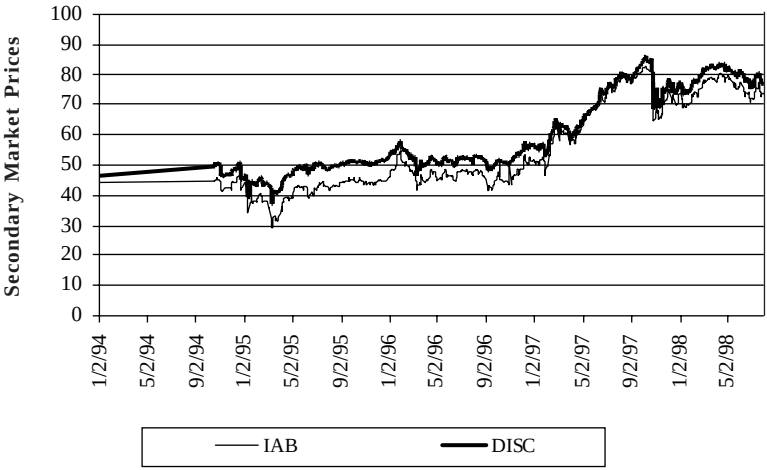
DISC and IAB price dynamics is shown on Chart 1. During almost the whole period of observation, DISC prices were higher, which is expected because the difference represents the value of the guarantees provided for DISC bonds. The period between March and October

1997 is the only exception: there is a jump in the prices of IABs and DISCs and two bonds were traded at a very small price differential. This implies a drop in the value of guarantees during that period. Since November 1997, however, IAB prices dropped down more significantly than the drop in DISC prices and the value of the guarantees increased respectively.

One explanation for the high value of IAB bonds could be enhanced investors' confidence in Bulgarian reforms. During March – July 1997, crucial political decisions were made – a one-year agreement with the IMF to support economic reforms was reached by the caretaker government, on 19 April 1997 Union of Democratic Forces right hand (a highly motivated to support both political and economic reforms political party) won the elections, soon after the decision on currency board introduction on 1 July 1997 was made. After this period IAB prices went down, though at much lower margin confirming investors' confidence in Bulgarian reforms, notwithstanding the serious shocks on international capital markets.

Chart 2

PRICES OF DISCS AND IABS (CLOSE PRICES)

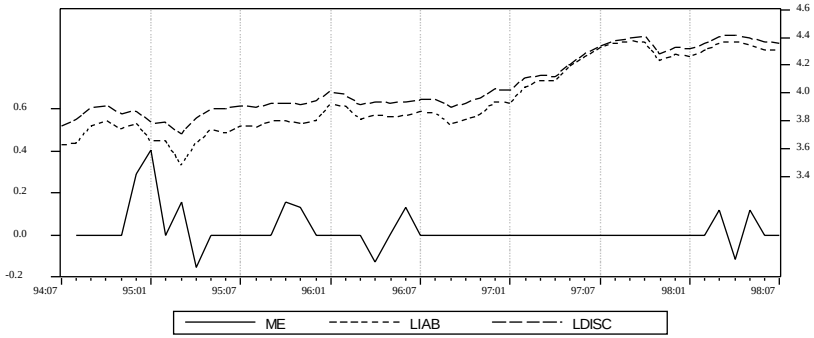


Three other shocks should be taken into account when we examine Bulgarian Brady bond price movements during the July 1994 – July 1998 period. The slowdown of Bulgarian Brady bond prices in the beginning of 1995 came together with the Mexican crisis (Chart 2). The downward trend in the second half of 1996 can be associated with the

banking crisis in the country, and a similar trend at the end of 1997 – with the beginning of the East Asian crisis.

Chart 3

MEXICAN NOMINAL EXCHANGE RATE DEPRECIATION AND BULGARIAN BRADY BONDS



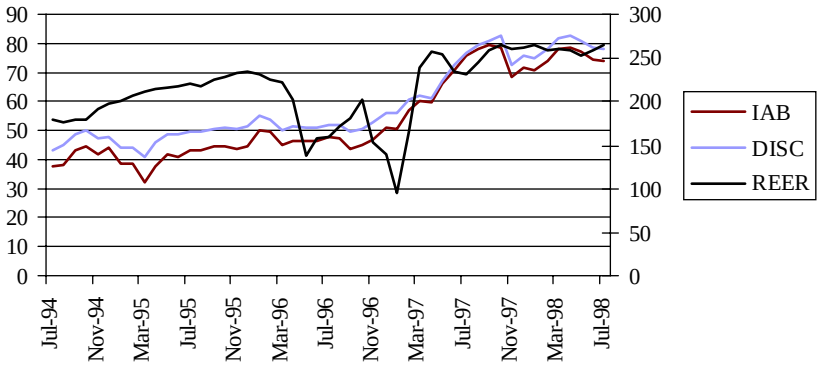
In our analysis we will focus on the real exchange rate, nominal exchange rate, gross foreign reserves and inflation as fundamental domestic factors influencing DISC and IAB prices because these macroeconomic indicators were officially reported on a regular basis for the whole period since the DDSR Agreement. Balance of payments data and GDP data, which the theory suggests to be used in the analysis, were published irregularly, mainly quarterly, and were revised many times during the observed period. No statistically significant interdependence was observed in our analysis of preliminary and final data for the balance of payments and GDP. Therefore, these data cannot be considered as reliable indicators for the analysis and decision-making when pricing Bulgarian Brady bonds. As information on Bulgarian foreign debt is released semiannually, it cannot serve the purpose of our analysis. The macroeconomic data set is summarized in Charts 3, 4, 5 and 6.

The real effective exchange rate (REER)[2] is considered as a measure of trade competitiveness of the economy. Sachs (1985)[3] demonstrated the importance of the exchange rate management for Latin America and East Asia. Especially in Latin American countries overvalued currencies caused substantial capital flights. A really appreciated exchange rate is expected to adversely affect prices.

[2] We use the real effective exchange rate indices as they are calculated by the BNB. The BNB calculates the real effective exchange rates using consumer price indices and a basket of three currencies distributed as follows: USD – 75%, DEM – 20%, and CHF – 5%.
[3] Sachs, J. D., "External Debt and Macroeconomic Performance in Latin America and East Asia", Brooking Papers on Economic Activities, 2, pp. 523 – 565.

Chart 4

REAL EXCHANGE RATE AND BRADY BOND PRICES

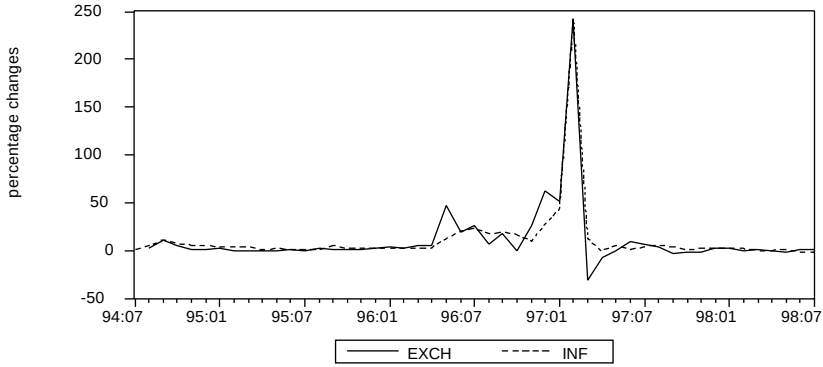


Since the issue of Brady bonds Bulgaria has been trying to maintain positive the exchange rate of the lev in real terms (Chart 3). Only two exceptions during the observed period can be traced: the banking crisis in mid-1996 and the economic crisis at the beginning of 1997, which knocked down the economy.

In the April 1996 – April 1997 period real exchange rate fluctuations in Bulgaria were caused primarily by dramatic changes in the nominal exchange rate (EXCH) and subsequent changes in domestic inflation rate (INF). Both variables seem to have strong correlation in their movements, which should be considered in econometric analyses (Chart 4).

Chart 5

BULGARIAN EXCHANGE RATE (BGL/USD) AND CONSUMER PRICE MOVEMENTS



The progressive real appreciation of the lev during almost the whole of 1995 and after January 1997 helped to increase imports significantly. This deteriorated the BOP current account especially in the first period considered when a sizeable budget deficit existed, and caused substantial imbalances in the real economy. The BNB, the central bank of Bulgaria, spent almost all its foreign reserves in the beginning of 1996 to keep the domestic currency afloat. At the same time, it injected huge liquidity through the financing of the budget deficit and banks. As a result, it was unable to fight the crisis that followed.

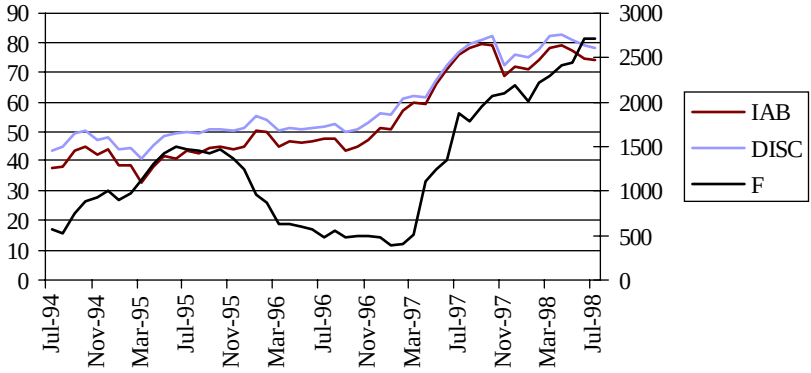
Gross foreign exchange reserves are considered to be of primary importance when discussing the possibility of a sudden liquidity crisis. Thus the lower the reserves are, the lower the country's risk rating should be, as well as Brady bond prices, and the greater the possibility of default.

During the transition period Bulgaria uses gross foreign exchange reserves (F) as the ultimate resource to balance payments on current account and foreign debt service. The BNB's participation in the domestic forex market is determined by the level and dynamics of foreign exchange reserves. At the beginning of the considered period the BNB succeeded to increase its foreign exchange reserves (to USD 1.5 billion at end-June 1995) due to prevalence of foreign currency supply over demand in the domestic interbank market and without any foreign financing (Chart 5). In the last quarter of 1995 BNB foreign reserves started to fall down due to a combination of internal speculative pressure following the reduction of the base interest rate and seasonal pressure on the BOP. During the first half of 1996 BNB forex reserves fell from USD 1.2 billion to USD 0.6 billion due to sizable foreign debt payments in January and intensive interventions in the domestic foreign exchange market to compensate eroded confidence in the lev and the banking system. During that period foreign debt was serviced without any foreign financing. The extremely low level of forex reserves coupled with the fast rate of their fall had an adverse effect on economic agents' expectations during the second half of the year.

The first tranche extended under the fourth standby agreement with the IMF in July 1996 and the funds extended in August 1996 by the EU compensated to a certain extent the sizable foreign debt payments and prevented temporarily a further depletion of BNB foreign reserves. This helped preserve the credibility and attractiveness of Bulgarian Bradies during the summer of 1996 (Chart 5).

Chart 6

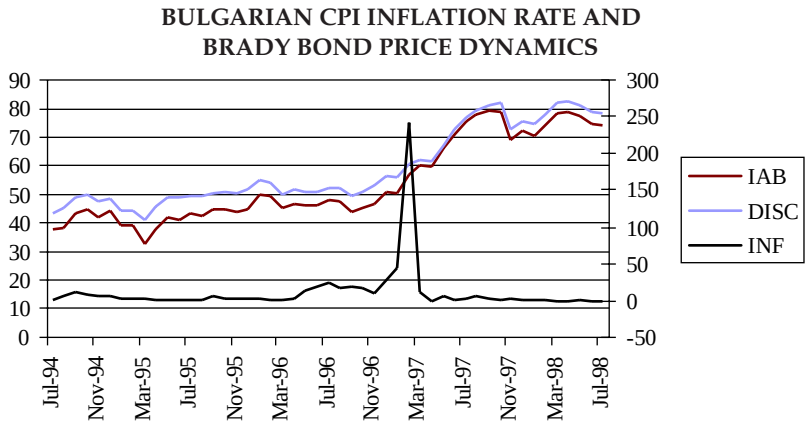
GROSS FOREIGN RESERVES AND BRADY BOND PRICES



The inflation rate (INF) is regarded here as a proxy for the quality of economic management of the country. As a result, the higher the inflation rate is, the lower the credibility in domestic policy-makers is, and hence the price of Bulgaria's Brady bonds.

Chart 6 shows the inflationary development in Bulgaria and Bradies' price movements. During the considered period monthly inflation was quite high. The only exception was 1995, where monthly movements in the consumer prices were not so strong, lacking dramatic price jumps. From the second quarter of 1996 inflation accelerated, reaching hyperinflation at the beginning of 1997. After introduction of the currency board arrangement in mid-1997 inflation steadily slowed down. Consumer price dynamics in 1997 diverged considerably from those displayed in the previous years. According to the BNB, this was due both to the shocks to which the economy was exposed and delayed effects of certain processes resulting from previous administrative decisions.

Chart 7



IV. Do Macroeconomic Fundamentals Matter for Bulgarian Brady Bond Prices: An Empirical Assessment

In this section we investigate the relationship between secondary market prices of Bulgarian Brady bonds and domestic macroeconomic fundamentals. The Bulgarian DDSR Agreement provided for three different types of Brady bonds: 50% discount bonds, DISCs, with full principal collateralization; front-loaded interest reduction bonds, FLIRBs, and interest arrears bonds, IABs. Both FLIRBs and DISCs had a one-year rolling interest guarantee. Despite the fact that prices of those bonds generally moved together, we are interested to find whether they reacted differently on various fluctuations in macroeconomic fundamentals as they imply different risk exposures for the commercial creditors. For example, we would expect the market price of a collateralized bond to be less sensitive to fluctuations in fundamentals than the market price of an uncollateralized bond. To check this hypothesis, we analyze separately market prices of fully collateralized DISC and IAB bonds, which are regarded as highly speculative instruments.

As already suggested in the previous sections, there are few obvious candidates that can be used in our regressions as indicators of macroeconomic stance which have some correlation with Brady bond prices. The most important and observable variables that reflect macroeconomic stance are the nominal exchange rate depreciation, REER, CPI

inflation, gross foreign reserves, the change in gross foreign reserves to imports ratio and the budget deficit.[4]

As suggested in our theoretical section, we would like to estimate the following econometric specifications:[5]

$$\mathbf{Log(DISC_t) = \alpha_0 + \alpha_1 Log(F_t) - \alpha_2 Log(EXP) - \alpha_3 Log(REER) + \varepsilon_t} \qquad (1)$$

$$\mathbf{Log(IAB_t) = \beta_0 + \beta_1 Log(F_t) - \beta_2 Log(EXP) - \beta_3 Log(REER) + \eta_t} \qquad (2)$$

If collateralization of DISCs matters, we would expect the prices of DISCs to be less sensitive to the impact of above indicators of macroeconomic stance. Thus the coefficients of the first equation should be different from the coefficients of the second equation.

1. ADF Unit Root Tests for Brady Prices and Macroeconomic Variables

The first step in our analysis is to check the order of integration of both dependent and independent variables used in our econometric model. If all variables are stationary, a simple OLS estimator will suffice. If they are nonstationary, however, estimation of equations for Brady bond prices by a simple OLS in levels can result in a spurious regression.

Table A.1 from Appendix 1 presents the ADF unit root tests for all the individual variables used in our econometric analysis. The ADF test results, including a constant term and a constant and a trend in the test equations, are also presented. The estimation period includes the July 1994 – July 1998 period. The results in Table A.1 suggest that the presence of a unit root in all the series in levels cannot be rejected. Furthermore, we are interested to know the order of integration of all the series. To find out the order of integration, we apply the same ADF test to first differences of all the variables. The results from these tests, presented in Table 1, reject the presence of unit roots in the differenced series. Thus we make the conclusion that all the variables are integrated of order 1.[6] Thus we have found that DISC and IAB bond log-prices, inflation, nominal exchange rate depreciation, REER, and gross foreign exchange reserves are all integrated of order one, which suggests that they may be cointegrated.

[4] Note that since we use monthly data, we had difficulties in selecting other important variables, such as debt service, which is available semiannually.
[5] Econometric specifications are tested with data for July 1994 – March 1998.
[6] For more details, see the ADF unit root tests for all the variables in Appendix 1.

To avoid spurious regression results that could arise if dependent and independent variables are nonstationary, we estimate the relationship between Bulgarian Brady bond prices and macroeconomic fundamentals in the form of an error correction model. Spurious regression[7] is one of the effects of the presence of unit roots in the econometric analysis of time series.

2. Results from the One-step Error Correction Method

In this section we apply the one-step error correction model for Bulgarian DISC and IAB bond prices. The tests for weak exogeneity of gross foreign reserves, inflation and exchange rate depreciation are made in the VAR analysis using the Johansen procedure. The conclusion is that these variables can be treated as weakly exogenous. Consequently, we can proceed with our econometric analysis in the form of a one-step error correction method in modeling the relationship between Bulgarian Brady bond prices and macroeconomic fundamentals. For this purpose we have to determine both the long-run relation and the short-term dynamics of this relationship. We can use the one-step error correction method to derive the error correction form of these functions. We regress the first difference of the dependent variable on the lagged dependent and independent variables, the differenced independent variables, and possibly on a constant and a time trend:

$$\Delta(\log(P_t) = \lambda\ (P_{t-1}) + \delta_j\ X_{j,t-1} + \gamma_j\ \Delta X_{j,t} + D_t + \eta_t \qquad (3)$$

where **X** is the vector of independent variables and ΔX_{jt} is the vector of short-term adjustment variables. The dependent variable is the log-difference of DISC and IAB bond market prices.[8] The **X** vector includes independent variables (macroeconomic fundamentals). Coefficients of the lagged dependent variables reflect the error correction mechanisms for these variables.

[7] Often, in the presence of unit root, we can find an apparently significant relationship between two variables despite the fact that the two processes are independent. This is a direct consequence of the presence of a serial correlation displayed by the disturbances of the OLS equation in levels if the variables are nonstationary.

[8] Market price of DISCs and IABs is calculated as average of offer and bid prices of the respective types of bonds. Data is obtained from Reuters.

Table 1

ONE-STEP ERROR CORRECTION ESTIMATES OF Log(DISC) AND Log(IAB)

Variables	**Δ(log(DISC))**	**Δ(log(IAB))**
(log(Brady))$_{-1}$ Log of bond's market price	-0.253 (-3.72)	-0.262 (-3.08)
Log(EXP)$_{-1}$ Log of export, f.o.b., USD	0.041 (1.32)	0.05 (1.03)
Log(REER)$_{-1}$ REER index	-0.06 (-1.92)	-0.09 (-1.89)
α Constant	1.09 (3.02)	1.22 (2.47)
Δ(log(F)) Growth of gross foreign reserves	0.046 (1.47)	0.06 (1.35)
DASIA Dummy for Asian crisis (1 in Nov 1997)	-0.13 (-3.42)	-0.135 (-2.395)
DCB Political and CB dummy (1 since April 1998)	0.13 (4.06)	0.154 (3.20)
ME(-1) Mexican exchange rate depreciation, lagged	-0.23 (-2.85)	-0.33 (-2.69)
Δ(ME) Change in Mexican exchange rate depreciation	-0.17 (-2.84)	-0.24 (-2.63)
R^2	0.56	0.47
DW	1.80	1.96

Sample period: July 1994 – July 1998.

The estimates for the long-run parameters can be calculated from equation (3)[9]. The $\mathbf{D_t}$ vector includes:

(a) a dummy for November 1997, DASIA, to account for the beginning of the financial crisis in East Asia,

(b) dummy, DCB, new political elections, introduction of the currency board agreement and Moody's credit rating for Bulgaria, or in

[9] They are equal to the minus of the coefficients of the lagged independent variables over the coefficient of the lagged dependent variable in every equation:
$(P_t) = -(\delta_j/\lambda)\, X_{j,t}$
The T-statistics for δ_j can be used as tests for significance of the long-run coefficients, θ_j. According to Boswijk (1994) and (1996), a sufficient condition for the t-statistics to be valid is that the explanatory variables are weakly exogenous.

general, reinforcing the process of political and economic stabilization since April 1997. Table 1 shows the econometric results using the one-step error correction procedure.

We present one of our econometric specifications of the market prices of DISCs and IABs. We have chosen these two bonds as we are interested to what extent domestic and external factors impact market price fluctuations. Since the characteristics of these two bonds are different (the most important being the absence of collateral for IAB bonds), we expect difference in their sensitivity with respect to various macro factors. In both regressions we found a positive impact of log of exports (in USD) on market prices, and a negative impact of the log of REER index on market prices. The difference, however, is in the fact that export coefficient is significant and REER index is insignificant in the DISC equation, whereas exports are insignificant and REER is significant in the IAB equation. In addition, the coefficient of REER is much bigger in the IAB equation than in the DISC equation. In addition, we find significantly greater negative effect of Mexican and Asian crises on the IAB equation than on the DISC equation. Furthermore, reinforcement of political and economic stabilization process and the decision for the introduction of a currency board as of May 1997, reflected by the dummy, DCB, had a greater positive effect on IAB as compared to DISC market prices. These differences may reflect different features of the two Brady bonds. The most important impact is the effect of collateralization, since holders of DISC bonds are less exposed to market risk, and less sensitive to both domestic and external shocks. IAB bonds, however, are more risky because they are unsecured and less liquid. Therefore, any news for a real appreciation at constant labor productivity increases the risk of future drop in foreign reserves and discrete depreciations. This drop in foreign reserves increases the risk of default that drives down the market prices of IABs due to lack of collateral.

Unit root tests for residuals are also made. Boswijk (1994) and (1996) suggests using the Wald test for 'noncointegration' hypothesis and provides tables for critical values of the Wald statistics. We have tested the hypothesis of 'noncointegration' as proposed by Boswijk (1996). We have made the Wald test for the joint hypothesis that coefficients of all lagged variables on the RHS are equal to zero. The 'noncointegration' hypothesis was rejected in all the equations.[10] Boswijk (1992, 1994) formulates the 'noncointegration' hypothesis as a

[10] See Appendix 2 for the Wald test statistics of the four equations and the critical values of this test.

joint test on the restrictions $\lambda = 0$ and $\delta = 0$. Wald statistics is calculated as $\xi = nF$, where **n** is the number of restrictions and **F** is the f-statistics from the test. He provides tables for the critical values of ξ, and ξ_μ, which allows for a constant term, and of ξ_μ, for a linear trend.

Table 2 displays long-run coefficients implied by the one-step ECM regression results presented in Table 1. Long-run equations for DISCs and IABs included a constant term, log of Bulgarian exports (in USD), log of REER index as calculated by the Bulgarian National Bank (BNB), and Mexican nominal exchange rate depreciation. It is of note that both domestic and foreign macroeconomic fundamentals are included. The reason behind the inclusion of Mexican exchange rate depreciation in long-run equations for Bulgarian DISC and IAB prices is the fact that Mexico is often used as a benchmark in pricing all Brady bonds as Mexican bonds have the biggest share in world trade in Brady bonds. Since Bulgaria's share is insignificant, we expect that Mexican fundamentals play an important role in determining Bulgarian Brady bonds. We also find that this effect is stronger on unsecured and less liquid bonds as IABs, than on collateralized, liquid bonds, such as DISCs (which can also play an important role in privatization).

Table 2

LONG-RUN ESTIMATES OF DISC AND IAB LOG-PRICES

Long-run coefficients	**Log(LDISC)**	**Log(LIAB)**
Constant	4.34	4.65
Log(EXP), Log of Exports	0.16	0.19
Log(REER), Log of REER index	-0.25	-0.36
Log(ME) – Mexican depreciation, nominal	-0.89	-1.24

It should be noted that we assume that the direct effect of the Asian crisis is temporary as these countries do not have Brady bonds. This effect is negative and significant in both equations and its impact is more significant in the IAB price equation. The indirect effect, however, is included in our long-term relation as to the extent to which the Asian crisis affects Mexican (Latin American) fundamentals.

3. VAR Analysis for Bulgarian Brady Bond Prices

We continue the empirical analysis of market prices of Bulgarian Brady bonds with formulation of unrestricted VAR system. The multivariate approach is more efficient when independent variables are not

weakly exogenous or it is necessary to check the number of cointegrating relationships. Johansen's (1988) procedure allows for determining the number of cointegration vectors by specifying an unrestricted VAR system (UVAR) of the following form:

$$x_t = \sum_{j=1}^{k} A_j x_{t-j} + \gamma D_t + \varepsilon_t$$

where $\mathbf{x_t}$ contains all endogenous variables (log(DISC), log(IAB), log(F), log(EXP), log(REER)), $\mathbf{D_t}$ contains exogenous variables: constant term, d(log(Mexexch)), DASIA, dummy equal to 1 in November 1997 to account for the Asian crisis and DCB, dummy equal to 1, starting from May 1997 until July 1998, political stabilization and currency board dummy. Finally, $\boldsymbol{\varepsilon_\tau}$ is a vector of normally distributed error terms. As our sample size is relatively small, the period between July 1994 and July 1998, we use two lags for setting up the conditional UVAR system.

After specifying the structure of the UVAR system, the Johansen's (1988) maximum eigenvalue ($\boldsymbol{\lambda_{max}}$) tests are used to determine the rank of $\mathbf{\Pi}$ matrix. The values of the $\boldsymbol{\lambda_{max}}$ statistics for estimated UVAR and critical values are given in Table 3.

First we show eigenvalue test-statistics for the unrestricted conditional UVAR system. We condition the UVAR system on ME, DASIA and DCB1.

Table 3

UVAR WITH TWO LAGS, CONDITIONAL ON EXOGENOUS VARIABLES, ME, DASIA, DCB1

Rank	λ_{max}	λ_{max} using T – nk	95%	λ_{trace}	λ_{trace} using T – nk	95%
0	62.44**	48.86**	34.4	137.4**	107.5**	76.1
1	33.72**	26.39	28.1	74.95**	58.66*	53.1
2	24.15*	18.9	22.0	41.23**	32.27	34.9
3	12.73	9.966	15.7	17.08	13.37	20.0
4	4.347	3.402	9.2	4.347	3.402	9.2

** denotes rejection at 1% critical value, * denotes rejection at 5% critical value

UNRESTRICTED STANDARDIZED EIGENVECTORS β'
(CONDITIONAL SYSTEM), VARIABLE

LDISC	LIAB	LF	LEX	LEER	Const	ME	DASIA	DCB1
1	-3.6291	0.13861	1.2865	-0.62436	4.4975	-0.20602	-1.1903	1.6399
-1.2723	1	0.21969	0.13558	-0.48487	1.4480	-0.016049	0.051739	-0.032652
-8.3705	5.9979	1	3.3797	1.9313	-27.518	2.0138	1.5786	-0.99031
17.640	-14.436	-0.09438	1	-0.26949	-18.182	-0.72741	0.25482	-0.32754
11.913	-5.4280	-1.1217	0.66894	1	-27.977	2.7927	-0.93419	-1.2756

UNRESTRICTED STANDARDIZED ADJUSTMENT COEFFICIENTS α
(CONDITIONAL SYSTEM)

LDISC	0.096607	-0.11181	-0.017440	0.026826	0.0030976
LIAB	0.10466	-0.16077	-0.026065	0.056644	0.0045503
LF	-0.013985	-0.52128	-0.045723	-0.043718	0.063333
LEX	-0.11845	-0.10957	-0.080212	-0.010791	-0.057215
LEER	0.019191	1.7995	-0.041989	0.015617	0.032557

The Likelihood ratio test indicates two cointegrating equations at a 5% significance level. It should be noted that we do impose restrictions on both β and α coefficients, as we would like to assume two different long-term relations: first for the LDISC, as a function of domestic fundamentals and external variables, and second, for the LIAB as a function of same parameters. This system can also be presented in the equivalent VECM (vector error correction) form:

$$\Delta x_t = \sum_{j=1}^{k-1} \Pi_j \Delta x_{t-j} + \Pi x_{t-1} + \gamma D_t + \varepsilon_t$$

where $\Pi = (\sum_{i=1}^{k} A_i - I)$ and $\Pi_j = (-\sum_{i=j+1}^{k} A_i)$ or j = 1,2,. . .(k-1). The **Π** matrix equals **αβ'**, where **α** represents the speed of adjustment to equilibrium and **β** long-run coefficients. Johansen's (1988) procedure determines the rank of the **Π** matrix which is equivalent to the number of cointegration vectors.

It is of note, that according to the theory, the only endogenous variables are LDISC and LIAB, so when constructing the ECM, we do assume that domestic fundamentals are weakly exogenous to the system (there is no causal relations from Bulgarian Bond prices to the fundamentals) which means that our ECM representation of the VAR system will have two equations: one for **Δ(LDISC)** and one for **Δ(LIAB)**, and

LDISC is weakly exogenous to second cointegrating vector, whereas LIAB is weakly exogenous to the first cointegrating vector.

First, we present restricted long-run **β'** vectors in Table 4. The first vector is the long-run dependence of **Log(P_{DISC})** on domestic fundamentals, Mexican nominal exchange rate depreciation and dummy for the Asian crisis. The second vector is the long-term equation for **Log(P_{IAB})** as a function of the same variables. Estimated coefficients have the expected signs: a positive impact of foreign exchange reserves and exports on Brady prices, and a negative impact of the real exchange rate depreciation index. In addition, there is a positive impact of DCB1, currency board dummy, and a negative impact of nominal Mexican exchange rate depreciation and Asian crisis on Bulgarian Brady prices. The effect of Mexican and Asian crisis, as well as the positive impact of currency board on the LIAB dummy is stronger than on LDISC, which is expected as LDISC are collateralized, whereas LIAB are not.

Table 4

RESTRICTED STANDARDIZED EIGENVECTORS β'
(CONDITIONAL SYSTEM), ECM VECTORS

LDISC	LIAB	LF	LEX	LEER	Const	ME	DASIA	DCB1
1	0	-0.10884	-0.38069	0.31201	-2.5849	0.63458	0.59605	-0.43753
0	1	-0.10364	-0.53852	0.38054	-1.9654	1.3465	0.98258	-0.50019

Next, we construct the ECM representation of the restricted VAR system. The results for the short-term adjustment to equilibrium are presented in Table 5:

Table 5

ECM SYSTEM FOR RESTRICTED VAR
(CONDITIONAL SYSTEM), VARIABLE

	$ECM_{i,-1}$	Δ(LF)	Δ(LEX)	Δ(LEER)	Δ(ME)
Δ(LDISC)	-0.15953	0.096556	0.027785	-0.049321	-0.11180
σ = 0.0468	(-3.699)	(2.029)	(0.55)	(-0.804)	(-1.89)
Δ(LIAB)	-0.12293	0.12267	0.044986	-0.079127	-0.17345
σ = 0.0644	(-3.583)	(1.87)	(0.651)	(-0.945)	(-2.108)

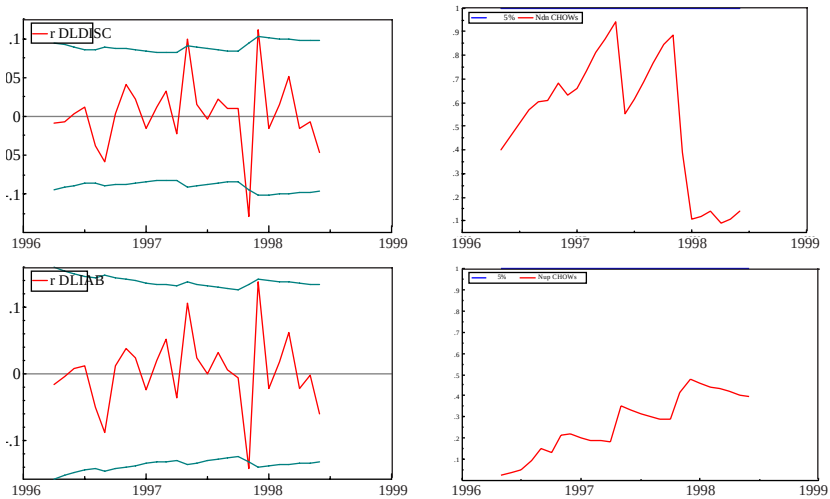
Numbers in brackets are the t-values of the estimated coefficients.
$ECM_{i,-1}$ is one lag of the error correction vectors shown in Table 4 (i = 1, 2).
loglik = 336.40341.

The ECM coefficients in both equations are negative and statistically significant, which confirms the fact that the series are cointegrated and there are long-term relations between Bulgarian Brady bond prices, domestic fundamentals and other international factors mentioned above. According to the estimated ECM coefficients, about 15.9 percent of adjustment towards the equilibrium occurs in one month for Brady discount bonds, and 12.3 percent for IAB bonds. In addition, any change in Bulgarian forex reserves or exports (insignificant but with the right sign) will increase prices of Bulgarian Brady bonds, whereas any real depreciation would tend to have a negative but insignificant effect on Brady prices. Any increase in the nominal exchange rate depreciation in Mexico, however, will have a negative and significant impact on Bulgarian Brady prices. As the theory and empirical evidence so far suggests, besides domestic fundamentals, external shocks (Mexican fundamentals) play an important role in Bulgarian Brady bond price movements.

Furthermore, we study how sensitive these estimates are to any potential structural changes.[11] For this purpose, we run recursive estimates by FIML procedure in PCFIML and we present several important tests for structural stability of the estimated equations.

Chart 8

RECURSIVE RESIDUALS AND CHOW BREAK-POINT AND FORECAST TESTS



[11] Please, note that we have already taken into account the change in the regime from a floating exchange rate to currency board in Bulgaria, and the change in the political regime as well.

Chart 8 plots recursive residuals and the boundaries consisting of +/- two standard errors, as well as Chow Break-point and Forecast tests scaled by their critical values at a 5 percent probability level. These tests show reasonable constancy of all equations.

Thus in this section we confirmed that there are two long-run cointegrating vectors: one for LDISC and the other, for LIAB, expressed as a function of a constant, domestic fundamentals, Mexican nominal exchange rate depreciation and two dummies: one for the Asian crisis, and the other for the introduction of a currency board and the change in political regime in Bulgaria. In addition, we found out that in the short run, price changes in DISCs and IABs account for about 15 and 12 percent of adjustment, respectively. Any increase in Bulgarian forex reserves pushes up DISC and IAB prices, whereas any increase in Mexican nominal exchange rate depreciation tends to lower Bulgarian DISC and IAB prices.

V. Conclusions

This paper focuses on the determinants of Bulgarian Brady bond prices. In particular, we are interested to study the impact of domestic fundamentals. In addition, we investigate the effect of international factors, such as nominal Mexican exchange rate depreciation and the Asian crisis on Bulgarian Brady prices.

We use the prices of two types of Brady bonds: DISC and IAB. The first type of bonds are issued at a discount of their face value but they have a principal collateral and one-year rolling-interest guarantee. The second type of bonds are issued at par, and unsecured. They are likely to have a more speculative nature and because of the value of the guarantee, DISC bonds are in general traded at higher prices than IABs. In addition, as domestic fundamentals we have used the Bulgarian gross foreign reserves and exports (in USD million), the real exchange rate index and a dummy that reflects the introduction of a currency board in Bulgaria and political changes. We took logs of all variables listed above. In addition, we used the Mexican nominal exchange rate depreciation and dummy for the Asian crisis, which indicates the impact of international factors on Bulgarian Brady bonds.

We apply an error-correction and cointegration analysis in both a single-equation framework and in VAR framework.

First, preliminary checks for unit root on variables show that log-prices of Bulgarian Brady bonds are integrated, I(1). Second, the empirical analysis suggests that domestic fundamentals, gross foreign re-

serves, exports and REER are important determinants of Bulgarian Brady bond price dynamics in the long run (they form the long-run cointegrating relationship).

We have established the positive impact of gross foreign reserves and exports and the negative impact of REER and Mexican nominal exchange rate depreciation on log prices of Brady bonds in the long run. In the short run, the Asian crisis has a negative impact, whereas the change in the political regime and the introduction of a currency board in Bulgaria have positively impacted log prices of Bulgarian Brady bonds.

Mexican fundamentals (in this case the nominal exchange rate depreciation) are important in the cointegrating relation that explains the dynamics of Bulgarian Brady bond prices in the long run. In addition, the Asian crisis dummy and the currency board dummy magnify the impact of such shocks.

Our findings squarely suggest that positive influence of the Debt and Debt Service Reduction Agreement is decisive for the pursuit of a credible and sustainable macroeconomic policy. However, external environment, primarily in Latin America, should be taken into account in macroeconomic policy.

Future decisions of buyback operations should consider estimates of both direct impact of such operations on the market price of converted foreign debt, and the indirect impact through the changes of foreign reserves, and consequently on the other macroeconomic variables.

Finally, empirical results to a great extent confirm the view that so-called 'fundamentals approach' should be used to supplement the analysis of spillover effect in the case of Bulgaria.

Appendix 1: Unit Root Test for Stationarity

Table A.1

ADF TEST FOR STATIONARITY

Levels	logDISC	LogIAB	INF	LogF	LogREER	LogEXRAV	DEF
w/o C	1.8846	1.2757	-2.2757	0.4015	0.5597	0.4845	-2.6916
C	-0.3696	-0.4461	-2.4921	-1.3035	-1.3827	-.04318	-3.1158
C and T	-2.0039	-2.5918	-2.4419	-1.6713	-1.5951	-1.8921	-3.3091

Critical values with 4 lags:

w/o C	1%	2.6155
	5%	1.9483
	10%	1.6197
C	1%	3.5850
	5%	2.9286
	10%	-2.6021
C and T	1%	4.1781
	5%	3.5136
	10%	3.1868

1st difference	logDISC	LogIAB	INF	LogF*	LogREER	LogEXRAV	DEF
w/o C	-2.5630	-2.9285	-4.6606	-2.2281	-4.0445	2.8110	-7.1922
C	-3.1383	-3.2284	-4.5999	-2.2479	-4.0569	-3.0781	-7.1088
C and T	-3.1142	-3.2391	-4.5609	-2.3485	-4.0225	-3.0548	-7.0155
Order of integration:							
	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)

Critical values with 4 lags:

w/o C	1%	-2.6168
	5%	-1.9486
	10%	- 1.6198
C	1%	3.5889
	5%	2.9303
	10%	2.6030
C and T	1%	4.1837
	5%	3.5162
	10%	3.1882

* Log(F) is I(1) integrated in 5% confidence interval with 2 lags when we include intercept, and with 1 lag, when we include intercept and trend.

ADF TEST FOR STATIONARITY (CONTINUED)

Levels		EX	E	ME
w/o C		0.2435	-1.9092	-3.1682
C	-1.6874	-2.2884	-3.3962	
C and T		--1.0689	-4.8024	-6.7017
Critical values with 4 lags:				
w/o C	1%	2.6168		
	5%	1.9486		
	10%	1.6198		
C	1%	3.5889		
	5%	2.9303		
	10%	2.6030		
C and T	1%	4.1837		
	5%	3.5162		
	10%	3.1882		

1st difference		EX	E	ME
w/o C		-3.8078	-4.9017	-6.3622
C		-3.7812	-4.8356	-6.4013
C and T		--1.0689	-4.8024	-6.7017
Order of integration:				
		I(1)	I(1)	I(1)
Critical values with 4 lags:				
w/o C	1%	2.6182		
	5%	1.9488		
	10%	1.6199		
C	1%	3.5930		
	5%	2.9320		
	10%	2.6039		
C and T	1%	4.1896		
	5%	3.5189		
	10%	3.1898		

Appendix 2: Wald Test

Table A.2

	D(Log(DISC))	D(Log(IAB))
n, # of restrictions	4	4
F-Statistics**	6.142	5.003
=nF	24.568	20.012
Critical values*	x = 19.69	x = 19.69

* The critical values are taken from Boswijk and van Dijk (1996) and are for a 0.05 level of significance.

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