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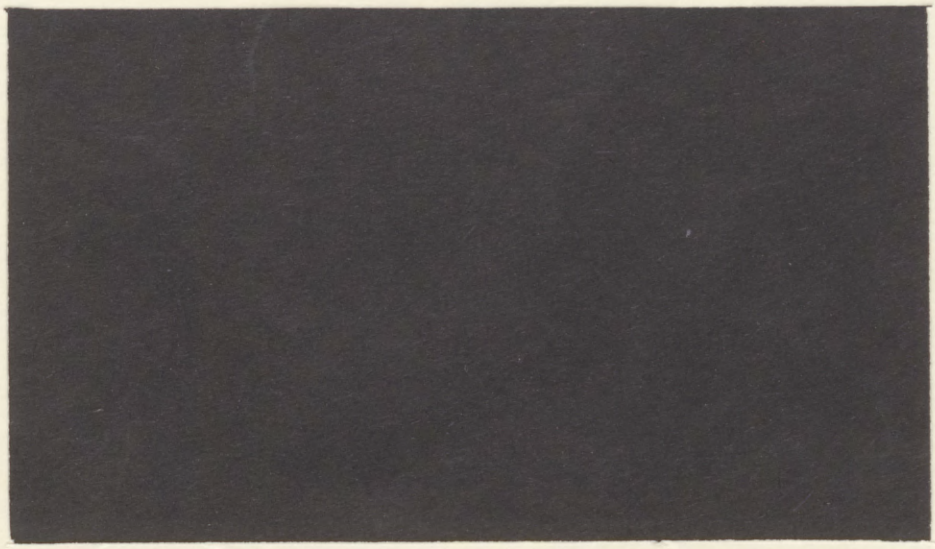

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DEBT FORGIVENESS AND CURRENCY SUBSTITUTION: MEXICO'S EXPERIENCE 1971–75 AND 1983–86

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MRG WORKING PAPER #M8738

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ABSTRACT

This paper explores the issue of debt forgiveness in the case of Mexico during the periods 1971–75 and 1983–86. An attempt is made to contrast the real costs of foreign borrowing over periods during which the degree of currency substitution implied by the differing economic regimes should have changed substantially. The analysis employs a statistical specification of the underlying macroeconomic relationships that is model-free and has proved to provide superior out-of-sample forecasts of macroeconomic variables. Also, due to the courseness of some of the time series for debt, a special procedure for the interpolation of monthly series from quarterly series is considered.

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I. INTRODUCTION

This paper explores the issue of debt forgiveness in the case of Mexico during the periods 1971-75 and 1983-86. An attempt is made to contrast the ability of the Mexican government to extract seignorage from its citizens in its efforts to meet its external debt obligations. This is of interest in the light of current models of small open economies in which it can be shown that if currency substitution prevails, the national government is not only limited in its ability to finance the debt through the issuance or sale of nominal bonds, but in its control of the rate of depreciation of the currency as well Thum ((1987)). In so far as the amount of debt the government can issue is constrained by the willingness of nationals to hold the bonds, it must resort either to paying a higher yield, to borrowing from abroad or to financing the debt through money creation. Given that the real rate of interest paid on bonds cannot exceed the growth rate of the economy indefinitely, the government is forced to finance its debt through foreign borrowing or money creation. To the extent that the government resorts to extracting seignorage from its nationals the domestic currency depreciates. The possibility then of capital flight

due to the substitutability of the national currencies forces the government to enforce a differential in the domestic and foreign rates of interest through the control of capital movements.

In view of the above theoretical considerations, the purpose of this paper is to contrast the tradeoff between the external foreign debt and the foreign-domestic interest rate differential in Mexico during the periods 1971-75 and 1983-86. These periods are of interest in that they represent significantly differing economic regimes. Whereas 1971-75 was characterized by relatively constant interest rates (a discount rate of 4.5%) and a fixed exchange rate of 12.50 Pesos/$US, the period 1983-86 witnessed extraordinarily high real interest rates and a continually devaluing Peso. Although current account deficits in the balance of payments were mounting in the 1970's as foreign borrowing financed the demand for goods necessary to promote the industrialization of Mexico, the external debt of Mexico during that period never approached its crisis proportions of the 1980's.

Specifically, in 1982 Mexico experienced a severe economic crisis. A sharp contraction in economic activity, an increase in unemployment and high rates of inflation were characteristic of that period. In contrast to increases of 60% and 14%, respectively, in the consumer and industrial production indices between the first quarters of 1980 and 1982, the CPI rose 109% and the industrial production index declined by 11% between the first quarters of 1982 and 1983. Mexico additionally experienced a severe balance of payments crisis at the end of 1982.[1]

On the heels of these crises the government subsequently implemented IMF fiscal austerity measures, as well as other measures to curb capital flight out of

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[1] Reserves dropped from a level of 161 million to a level of zero SDR's in the fourth quarter of 1981.

Mexico. The massive decline in international reserves associated with the balance of payments crisis resulted in a restructuring of the external debt and two- and three-tiered exchange rate structures were established whereby periods of controlled and free market rates were introduced into the 1980's.

Following the nationalization of private banks in September, 1982, fiscal authority was centralized in the Banco de Mexico in December, 1984. To control capital flight, capital controls were imposed and an interest rate policy designed to maintain interest rate parity was introduced. In addition the flexible interest rate policy that emerged enforced a positive differential between domestic and foreign interest rates. The latter was designed to encourage domestic savings.

II. METHODOLOGY

To constrast the tradeoff between the external foreign debt and the foreign-domestic interest rate differential during the periods in which Mexico experienced significant changes in economic structure, the time series relationship between long term foreign borrowing and the U.S.-Mexico interest rate differential is analyzed.[2] To diminish the chance that the estimated relationship is merely spurious, a monthly time series model of the interactions of real long term foreign borrowing, real net exports, the real foreign-domestic interest rate differential and a real industrial production index, is estimated.

The time series model formulated is particularly useful in that it allows the design of impulse response functions, which in turn can be employed to model the

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[2] The measure of debt employed is long-term foreign borrowing as it is available on the most consistent basis; its availability on a quarterly basis only in the 1970's, however, did necessitate an interpolation procedure that is elaborated upon later. The U.S.-Mexico interest rate differentials are employed as the U.S. constituted the largest single creditor to Mexico during the periods; although that role has diminished slightly in the 1980's.

changes in foreign borrowing in response to innovations in the rate of change of the interest rate differential. In so far as the values of the variables in this model can be expressed as linear combinations of the innovations or shocks to each series, the importance of a single variable in explaining movements in another series can be summarized by the magnitude and lag of the response of the latter to a shock in the first.[3] An innovation in one series is identified as important to another if the response of the latter is large and at a long lag.

The variables employed for each period such as net exports and debt are transformed into real peso terms through the use of a real exchange rate index as well as a consumer price index for Mexico based on real 1970 dollars.[4] The exchange rate index is constructed by deflating the exchange rate series by the relative consumer price indices of the U.S. and Mexico primarily because of the great volume of trade carried out with the United States.[5] Finally, the interest rate differential is derived according to the hypothesis of interest rate parity across countries (i.e. the proportionate differential between the forward and spot

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[3] The moving average representation of the system is perturbed by a unit shock to an orthogonalized innovation of the process. If var(u)= Σ =S'S, i.e., the orthogonal decomposition, such that u=Sv and var(v)=I, then the orthogonalized innovations are the v's.

[4] The 1971-75 monthly import, export series, as well as the quarterly figures for the same period comes from "Indicadores Economicas", Banco de Mexico, volumes 1972-77, while the 1983-86 monthly series for the same variables comes from the IMF's monthly International Financial Statistics, volumes 1983-1987. The monthly series for CPI and the industrial production index across both periods are drawn from the IMF's International Financial Statistics. Useful interpretation of some of the series was obtained in "Mexico Data Bank", by Sidney Wise and Hugo Ortiz, 1986.

[5] For example, given a 1970 base year value for the exchange rate of 12.5 Pesos/$US and 1970 base year values of CPI of 100 for both the U.S. and Mexico, the real exchange rate for any given month is given by 12.50 Pesos/$US multiplied by the ratio of the CPI for Mexico relative to that of the U.S. For an excellent discussion of the merits of this procedure, as well as comparisons of these real rates with actual realized rates, see "Mexico Data Bank".

exchange rates must equal the interest-rate differential over the same time interval). To avoid the confusion that often accompanies the consideration of this relationship in the literature, the interest rates employed are expressed in real terms. Although the ratio of forward to current spot rates in the 1970's does not appreciably differ from a value of unity during the period 1971–75, it does account substantially for the differential during 1983–86.[6]

The econometric methodology employed in the analysis is a vector autoregressive (VAR) specification of the interrelated time series (Sims (1980)). It confers the distinct advantage of providing a statistical analysis of the time series relationships between the variables that is free of any imposed structural form. The basic structure for the VAR model for the (mx1) vector of time series Y(t) is

$$(1) \qquad Y(t) = \sum_{j=1}^{p} Y(t-j)*B(j) + u(t)$$

where Y(t) is the vector of the variables in level terms and the B(j) are the (mxm) matrices of coefficients, u(t) is a (mx1) vector of normal white noise error terms and p is the order of the largest lag in the structure.

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[6] The interest rate parity relation essentially posits:

$$F/E \times (1+TUS-USINF) = (1+TMX-MXINF)$$

where F is the one month forward rate, E is the spot rate, and TUS, TMX respectively represent the one month T-bill rates for the U.S. and Mexico. Since all the variables studied are in real terms, the real rates of interest are employed, i.e. the rates adjusted for the rates of inflation in the U.S. and Mexico, USINF and MXINF, respectively. Over the period 1971–75 the discount rates are employed for both countries. F, E are in real terms, that is to say they account for the relative rates of inflation in both countries with respect to 1970 Pesos. It should be further noted that the assumption of the efficient markets hypothesis is invoked in this paper, whereby the forward rate is assumed to be an unbiased predictor of the future spot rate. This justifies the use of the one month-ahead future spot rate as the forward rate. Although this is a common practice in the literature, there is an abundant literature questioning its validity.

VAR's, despite their relatively simple dynamic structure have the further advantage of providing superior out-of-sample forecasts Litterman (1981), Nickelsburg and Thum (1986). A shortcoming of VAR's, however, manifests itself in a possible lack of parsimonious structure. That is to say, the specification might suffer from a lack of precision in the estimation of the model parameters due to the overparameterization of the model arising from long lag structures (Fair (1979)). This latter problem arose in the estimation of the above model only for the period 1971-75, the treatment of which is discussed below.

III. RESULTS

Several VAR specifications with varying lag structure were fitted to the 1983-86 data with first differences of the variables used instead of levels. Although the specification of VAR's is generally in level terms, first differences were required because of the nonstationarity of the various series.[7] The model selection criterion was based on the minimization of Akaike's information criterion. Employing this criterion, the superior fit was obtained with a specification which included only once lagged values of each of the endogenous variables as regressors. The fit is fortunate from the point of view that in studies such as this in which sample periods are small, precision is often lost in parameter estimation due to the exhaustion of degrees of freedom. The system estimated comprised a system of equations in which changes in the real variables- external debt (DBTR), net exports (NEXR), the foreign-domestic interest rate differential (IRDD) and the industrial production index (INDD) were regressed on their own once-lagged changes as well as the once-lagged changes in the other variables.

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[7] Dickey-Fuller unit root tests were employed to establish that first- differencing of the series was necessary to achieve stationarity of the various series.

As may be noted from the parameter values and their significance for 1983-86 (TABLE I), the own once-lagged value of DBTR, as well as the once-lagged values of NEXR and INDD are important in explaining changes in real debt (DBTR), while only the own once-lagged changes in real net exports (NEXR) enter in a significant fashion in the equation for changes in real net export values.[8] The once-lagged value for changes in real net exports NEXR enters in a significantly negative fashion in the equation for changes in the real interest rate differential (IRDD), and the own once- lagged value of the change in the industrial production index enters in a significantly negative fashion in the equation explaining changes in the industrial production index.

Fitting the VAR specification to the period 1971-75 was somewhat more problematic as first the issue of the unavailability of monthly values for real debt (DBTR) had to be resolved. In view of the dispersed distribution in the available quarterly debt series, simple interpolation from trend was inappropriate, consequently more sophisticated methods of interpolating monthly from quarterly series had to be considered. Chow and Lin (1971) have suggested methods that rely on the modelling of the serial correlation properties of the quarterly residuals. Their method proposes forecasting the monthly series of the variable in question from the quarterly GLS regression of the variable on other explanatory variables in the model. This procedure however is inappropriate in the case of a nonstationary error process, which the model considered here possesses.

A more general procedure that handles the case of nonstationary error processes is considered. Fernandez (1981) has suggested modelling the monthly error process as a random walk, i.e.,

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[8] At the 10% level of significance.

(3) $$u(t) = u(t-1) + e(t)$$

where u(t) is the monthly error term at time t and e(t) is a white noise process with variance σ^2 Given the flow nature of the debt variable, a suitable approximation for the monthly error is one-third of the quarterly error value. Applying this result yields for the most part adequate prediction results for the change in the real value of debt. The weakness of this approach is that it gives rise to step discontinuities at the beginning of each quarter in the monthly predictions of the change in debt. The step discontinuities disappear when the monthly error process is modelled with random drift as in (3).

Employing the Akaike criterion a superior fit is again obtained with a specification which includes only once-lagged values of each of the endogenous variables as regressors. The model estimated consists of a system of equations regressing the changes in the real variables- external debt (DBTR), net exports (NEXR), the foreign-domestic interest rate differential (IRDD) and the industrial production index (INDD) on their own once-lagged changes, as well the as the once-lagged changes of the other variables.

As may be noted from the parameter values and their significance, (TABLE II), the once-lagged values of changes in real external debt (DBTR) and real net exports (NEXR) enter significantly both in the equation for monthly changes in DBTR and NEXR. The own once-lagged values of changes in the real interest rate differential (IRDD) and the industrial production index (INDD) enter significantly in the equations for IRDD, INDD, respectively.

A salient feature of the results is that the VAR specifications do not differ significantly across the two periods 1971-75 and 1983-86. Both systems model the endogenous variables in terms of their own once-lagged values, as well as the

once-lagged values of the other variables. A primary reason for these results might well be that the use of the first differences of the variables, as opposed to their levels, might induce enough stationarity in the system. That is to say the VAR specification models the series as a second- order process in level terms. Some differences do emerge, however. Whereas the specification estimated across the earlier period models IRDD and INDD approximately as univariate autoregressions, its estimation across the later period models NEXR and IRDD as univariate autoregressions. Furthermore, the results suggest that changes in real debt and real net exports were more interrelated across the 1970's than in the 1980's.

The contrast in the patterns of the estimated relationships that emerge reflects the differences in the economic regimes. INDD was significantly univariate autoregressive across both the periods 1971-75 and 1983-86, whereas IRDD satisfied such a first order relationship only across the earlier period. Given the relatively fixed exchange rates and interest rates of the 1970's, the strong first order autoregressive relationship for IRDD reflects the lagged response of inflation in Mexico to that in the United States (see equation (2)), a fact which can be observed in the inflation series. On the other hand efforts in the 1980's on the part of the Mexican central government to establish interest rate parity amidst devaluations and increases in the real interest rate differential (Ruprah (1987)), apparently offset the tendancy of the inflationary trends to become manifest in such a pronounced first order effect.

The pattern of association among the variables in the equation for NEXR is particularly important as it highlights the tensions between international and domestic economic factors inherent in economic stabilization packages such as those of the IMF in the 1980's that promoted exports. In the 1970's the influence of both domestic and international factors are captured in the significant positive

coefficients on DBTR(T-1) and NEXR(T-1) in the equation for NEXR(T); the contribution of the debt was in the financing of the Mexico industrialization program. In contrast the strong univariate autoregressive relationship arising for NEXR in the 1980's emphasizes the dependence of NEXR on the prevailing international economic conditions. Efforts to finance exports through long term foreign borrowing or interest rate parity policies have not been consistently associated with changes in the levels of exports.

To address more closely the issue of the tradeoff between changes in real long term foreign borrowing and the real interest rate differential between the U.S. and Mexico, the pattern of impulse responses is analyzed. As the periods analyzed represent two distinct economic regimes--one characterized by fixed exchange rates, almost constant discount rates and free capital movements versus one characterzied by highly fluctuating exchange rates, interest rates and capital controls, the responses of both DBTR and IRDD to innovations in the other are considered. In this fashion the question of the tradeoff under currency substitution is more directly addressed. In particular in the case of a small open economy, increases in the debt can be financed not only through increased long term foreign borrowing, but through the enforcement of a higher, artificial real domestic-international interest rate differential. In view of Mexico's explicit policy in the 1980's to enforce interest rate parity such a consideration is especially important. If the latter policy enjoyed any measure of success, one would expect changes in long term foreign borrowing to be moderated somewhat due to offsets in the interest rate differential.

Table III presents the impulse responses for both DBTR and IRDD, while Figures I--IV plot the corresponding values. DI70, DI82, respectively represent the changes in long term foreign borrowing arising from innovations in the change of the

interest rate differential in the 1970's and 1980's. ID70, ID82 similarly reflect the changes in the real US-Mexico interest rate differential arising from changes in long term foreign borrowing in the 1970's, 1980's. Monthly changes are reported over an eighteen month horizon; responses beyond this horizon are only reported for two and three years after the shock. Values reported in Table III for DI70, DI82 are expressed in terms of 1970 Pesos; DI70 in millions and DI82 in billions of Pesos.

Following a zero response in the first period, DI70 changes by 211 million Pesos in the second period, 145 million Pesos in the third period, etc. The responses of DI70 diminish to changes of 50.6, 24.1 million after 2, 3 years respectively. The cumulative response of DI70 over a three year period is an increase of 2819 million Pesos. Viewed in percentage terms 50 percent of the three year response occurs within 11 months, 75 percent within 19 months. Similar to the case of DI70, there is no response of DI82 in the first period; the changes that do occur, occur in the subsequent periods and are of the same sign and of a larger magnitude. DI82 increases by 2.92, 2.42 billion Pesos in the second, third periods, respectively. Beyond those periods the response dies out to decreases of .07 and .03 billion after 24 and 36 months. The cumulative effect over a three year period is an increase in DBTR of 8.5 billion Pesos. In contrast to the 1970's, 50 percent of the three year response occurs by the third month and 75 percent of it by the fourth month following the shock.

In Table III the impulse responses of the U.S.-Mexico interest rate differential to innovations in DBTR are given in percentage terms, ID70 and ID82. ID70 alternates in sign beginning with a first period change of -5% , a second period change of 1%, followed by changes of .0004%, .0002% in periods 24 and 36. The cumulative response over the three year period is -4%. ID82 on the other hand

experiences a change of −1.3% in the first period, +.8% in the second period, followed by changes of −.03%, −.01% in periods 24, 36, respectively. The cumulative response over the three year period is −.008%.

Contrasting the impulse responses DI70 and DI82 one is led to conclude that the problem of currency substitution has posed a serious problem for Mexico in its economic development. The real tradeoff between long term foreign borrowing and the foreign-domestic interest rate differentials in these periods suggest that the associated costs of debt forgiveness are high. In the 1970's there is clear indication from the impulse response of DBTR to IRDD (FIGURE I) that real interest rate differentials between the U.S. and Mexico led to a substantial amount of substitution away from assets demoninated in Pesos to those denominated in U.S. dollars. Given the relatively constant interest rates and the fixed exchange rate characterizing that period, these differentials arose primarily from the prevailing inflation differentials between the U.S. and Mexico. These differentials were substantive enough to force an increase in long term foreign borrowing to compensate for the capital movements.

Similarly the positive tradeoff between changes in real interest rate differentials and long term foreign borrowing observed for the 1980's suggests the problem of currency substitution is no less severe. Despite capital controls and government policies aimed at achieving foreign-domestic interest rate parity there is strong evidence for the suspicion that capital flows still pose a serious problem. The results suggest that the real costs associated with the stabilization and capital controls policies have been extremely high in the face of the high rates of inflation during the period.[9] The latter point is best illustrated by the response of IRDD to

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[9] The cumulative change in prices over the period December 1982 thru June 1986 is on the order of 1,485%.

innovations in DBTR since in the 1980's a policy of flexible interest rates to support interest rate parity was in force, (FIGURES III & IV). It is clear from the data as well as these latter responses that the government has, in response to increases in the change of long term foreign borrowing, increased the real interest rate differential between the U.S. and Mexico drastically.[10] In the long run then the central authorities have been able to achieve interest rate parity in the 1980's, but only through continued devaluations of the currency, as well as continued increases in nominal interest rates.[11]

V. CONCLUSION

The approach in this paper to exploring the issue of debt forgiveness in the case of Mexico has been to analyze the tradeoffs between real long term foreign borrowing and the real interest rate differential between the U.S. and Mexico. Of particular interest was the contrast in the tradeoffs over the 1970's versus the 1980's as Mexico experienced two distinct economic regimes over those periods--one in which significant currency substitution would be expected to prevail versus another in which very little would be expected. Although sample sizes were small, an unrestricted VAR proved to provide a parsimonious structure for analyzing the interrelationships between changes in real debt, real net exports, the real foreign-domestic interest rate differential and a real industrial production index.

The results obtained suggest there is some empirical content to the theoretical notion that in models of small open economies under currency substitution a

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[10] Recall the contrast in the long run impulse response of ID82 and ID70 of -.008%, -4%, respectively.

[11] The nominal exchange rate depreciated in value from 150 Pesos/$US in 1983 to 632 Pesos/$US in 1986. From 1984 to 1986 the nominal interest rate increased from 60% to 94%.

country's effort to secure long term capital domestically can be severely constrained by levels of debt that outstrip its growth capacity. Support is found for the view that a national government is not only limited in its ability to finance debt through the issuance or sale of nominal bonds, but in its control of the rate of depreciation as well. In the face of currency substitution if the government desires to control the rate of depreciation it is forced to increase the nominal domestic-foreign interest rate differential.

These principles seemed to have ruled in the Mexican experience of the 1970's and 1980's. Mounting debt and positive interest rate differentials gave rise to capital flows, whereby more long term foreign borrowing became necessary. The results suggest that despite all of the measures taken to curb capital flight, currency substitution still poses a serious problem in any efforts to resolve the debt issue in Mexico.

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TABLE I *

	DBTR(T-1)	NEXR(T-1)	IRDD(T-1)	INDD(T-1)
DBTR(T)	0.6797 (5.07)	0.452 (1.67)	52.49 (0.80)	-1.1264 (-2.30)
NEXR(T)	0.0087 (0.39)	0.919 (20.3)	-4.99 (-0.46)	0.0789 (0.96)
IRDD(T)	0.0004 (1.29)	-0.002 (-2.76)	-0.01 (-0.07)	0.0018 (1.65)
INDD(T)	-0.0402 (-1.06)	0.031 (0.41)	-24.71 (-1.33)	-0.4680 (-3.37)

* T-statistics are enclosed by ().

TABLE II

	DBTR(T-1)	NEXR(T-1)	IRDD(T-1)	INDD(T-1)
DBTR(T)	0.5320 (3.82)	-0.293 (-2.59)	3717.3 (0.91)	-18.670 (-1.62)
NEXR(T)	0.2806 (2.26)	1.142 (11.27)	-5144.0 (-1.40)	7.165 (0.69)
IRDD(T)	0.0000 (0.05)	0.000 (0.03)	-0.233 (-1.74)	0.501 (0.13)
INDD(T)	-0.0014 (-1.18)	-0.001 (-1.03)	16.3 (0.46)	-0.615 (-6.17)

TABLE III

PERIOD (months)	DI70* (Pesos-millions)	DI82* (Pesos-billions)	ID70 (change in rate)	ID82 (change in rate)
1	0.000	0.00000	-0.050637	-0.013069
2	211.268	2.92174	0.012037	0.007893
3	145.525	2.42184	-0.002853	0.001840
4	162.950	1.35088	0.000802	0.001923
5	146.753	1.15220	-0.000208	0.001058
6	145.954	0.72725	0.000108	0.000614
7	135.936	0.52706	-0.000033	0.000263
8	131.226	0.33881	0.000030	0.000019
9	123.209	0.21670	-0.000013	-0.000152
10	117.421	0.12300	0.000009	-0.000269
11	110.501	0.05751	-0.000008	-0.000345
12	104.647	0.01033	0.000000	-0.000394
13	98.523	-0.02250	-0.000007	-0.000421
14	92.999	-0.04509	-0.000003	-0.000433
15	87.541	-0.06009	-0.000006	-0.000435
16	82.489	-0.06958	-0.000005	-0.000429
17	77.624	-0.07508	-0.000005	-0.000418
18	73.074	-0.07771	-0.000005	-0.000403
24	50.602	-0.06704	-0.000004	-0.000297
36	24.141	-0.03293	-0.000002	-0.000140

* real 1970 Pesos

IMPULSE RESPONSE OF LONG TERM FOREIGN BORROWING– 1970S

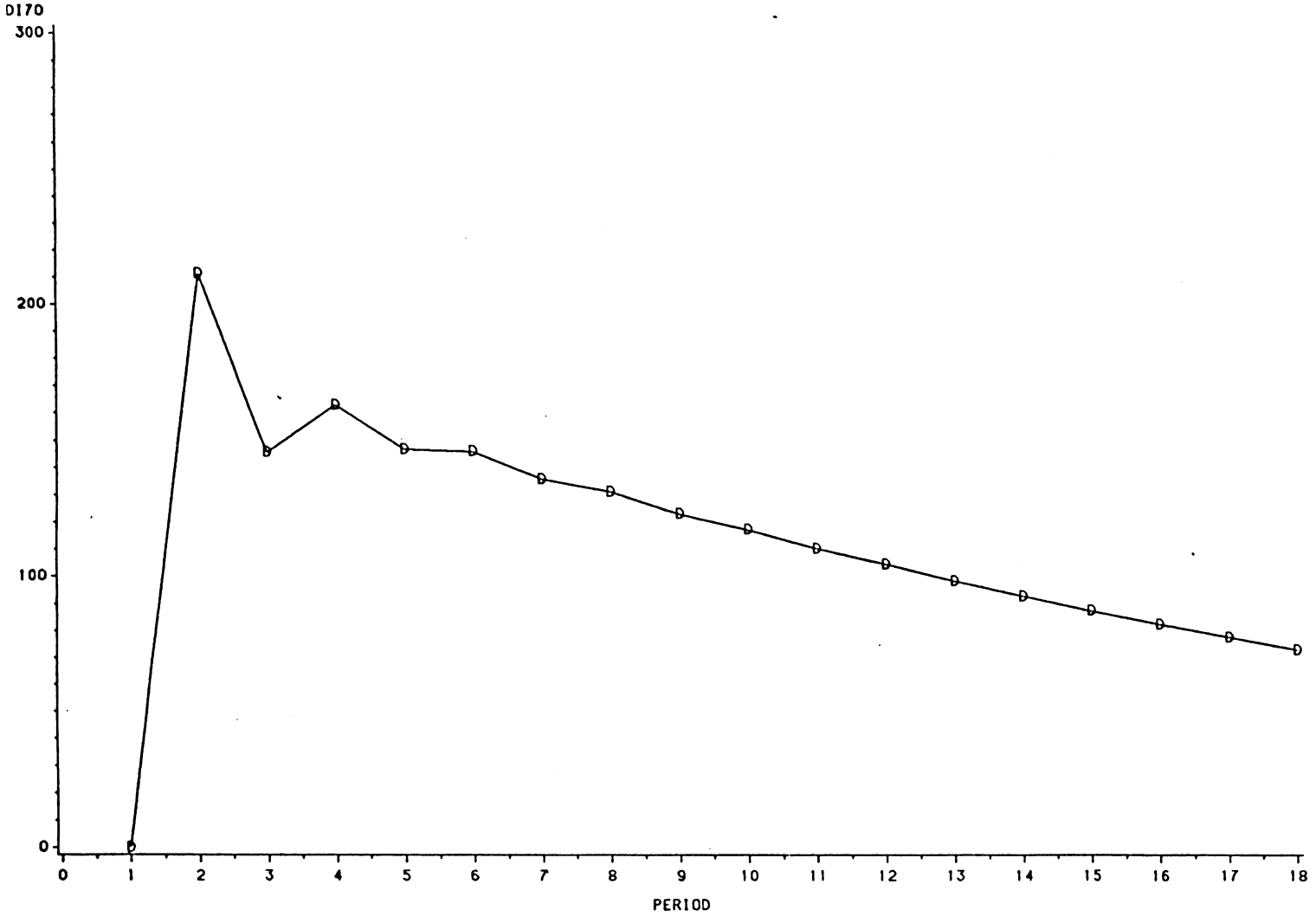

FIGURE I

IMPULSE RESPONSE OF LONG TERM FOREIGN BORROWING– 1980S

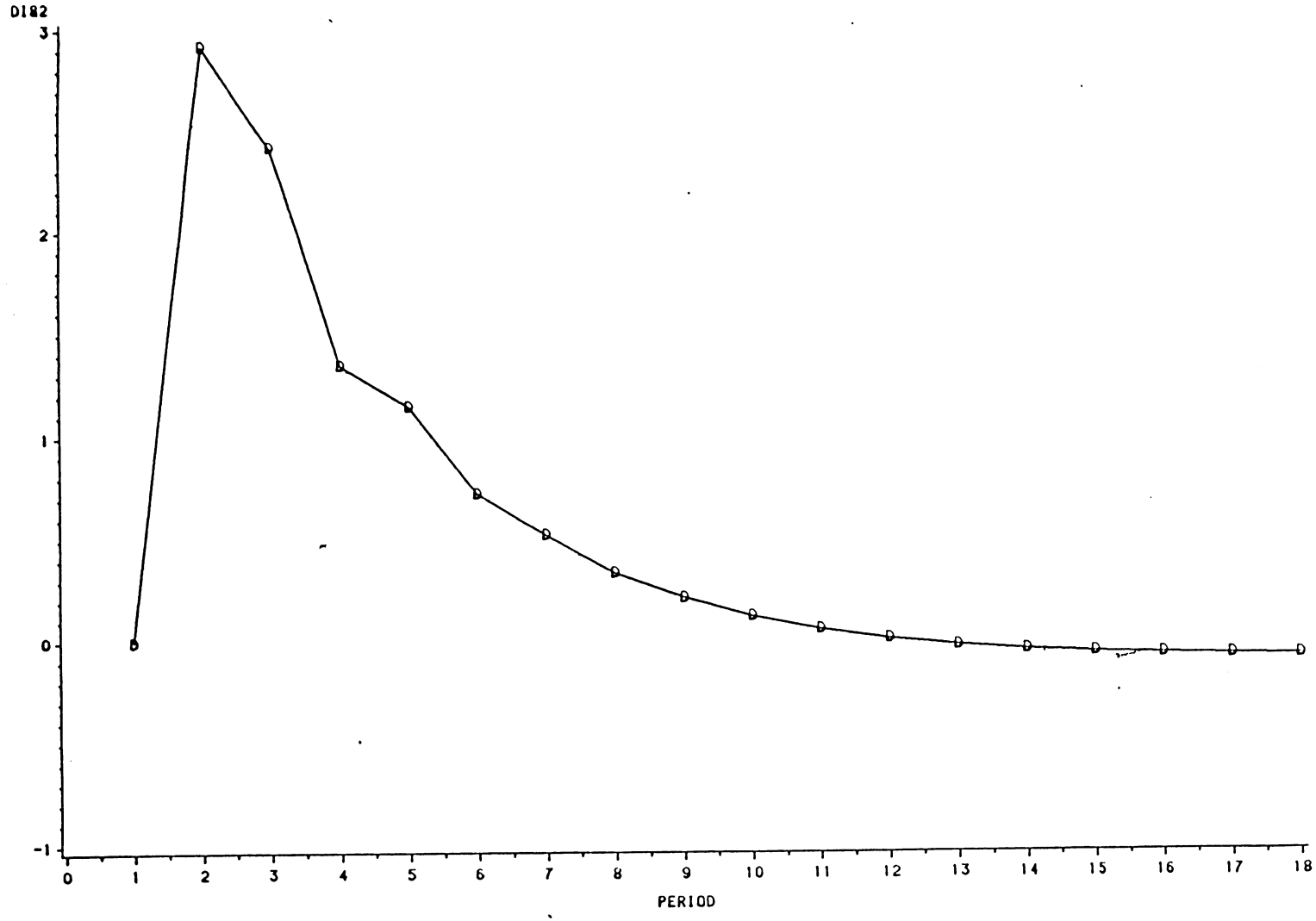

FIGURE II

IMPULSE RESPONSE OF US–MEXICO INTEREST RATE DIFFERENTIAL– 1970S

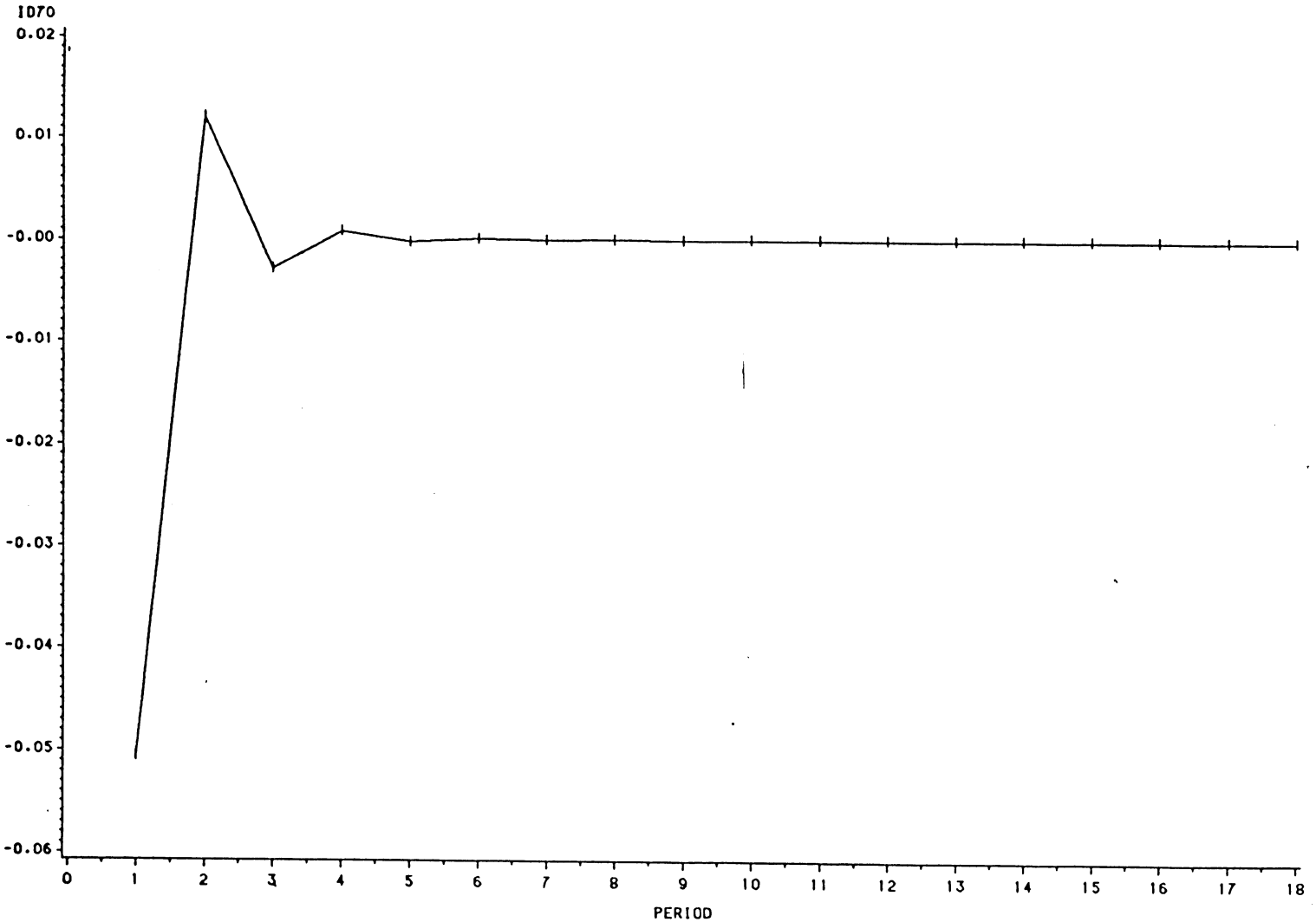

FIGURE III

IMPULSE RESPONSE OF US–MEXICO INTEREST RATE DIFFERENTIAL– 1980S

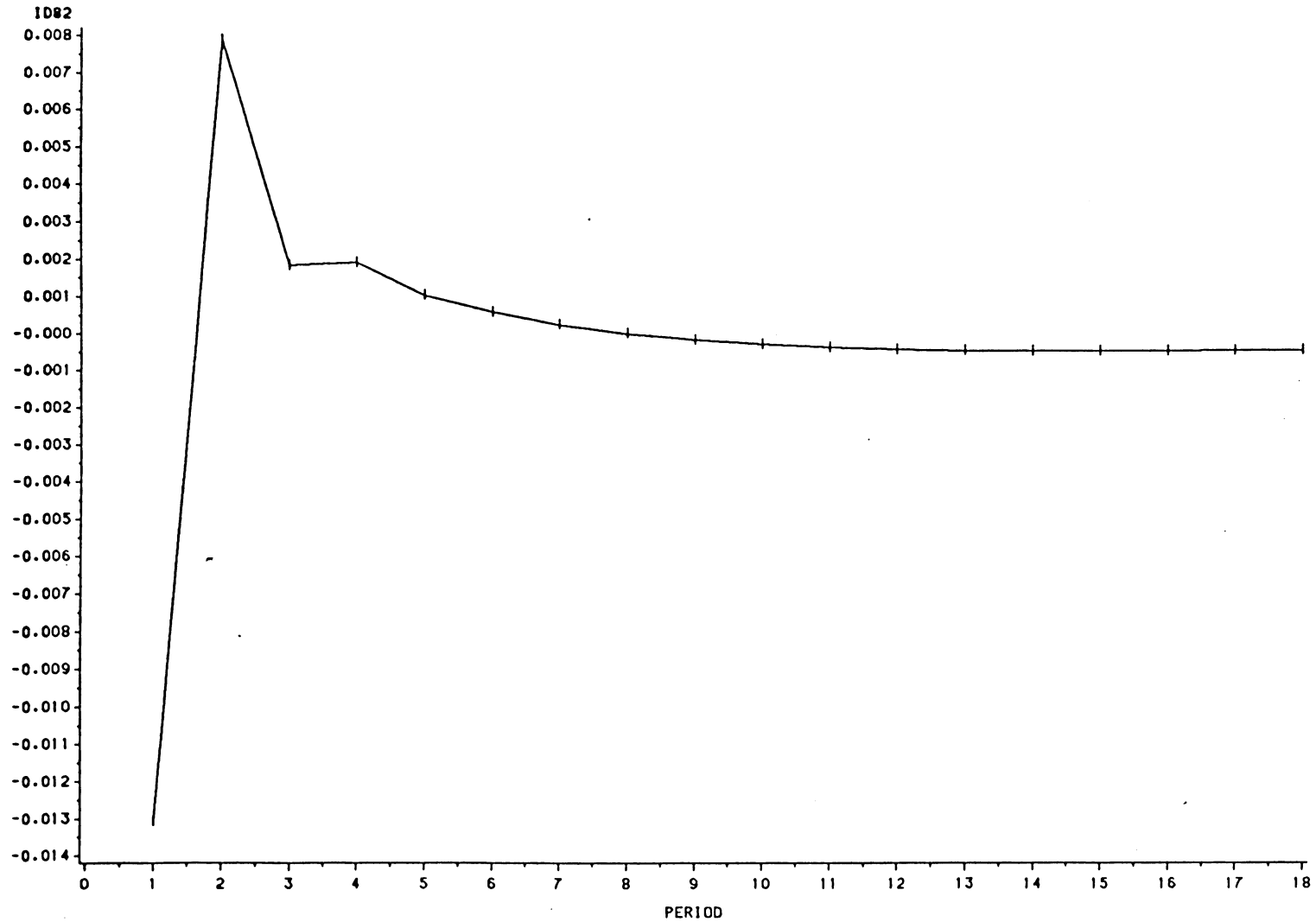

FIGURE IV

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