Order Number 9510714

The effects of commercial policies on the trade balance in a general equilibrium model. (A case study of Jamaica, Trinidad, Barbados, and Guyana)

Sangster, Donald B., Ph.D.

City University of New York, 1994

U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

THE EFFECTS OF COMMERCIAL POLICIES ON THE TRADE BALANCE IN A GENERAL EQUILIBRIUM MODEL (A CASE STUDY OF JAMAICA, TRINIDAD, BARBADOS AND GUYANA)

by

DONALD B. SANGSTER

A dissertation submitted to the Graduate Faculty in Economics in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

1994

This manuscript has been read and accepted for the Graduate Faculty in Economics in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

September 29, 1994
Date

Michael Grossman
Chair of Examining Committee

September 29, 1994
Date

Michael Grossman
Executive Officer

Ronald Anderson

Salih N. Neftci

Michael Grossman
Supervisory Committee

THE CITY UNIVERSITY OF NEW YORK

Abstract

THE EFFECTS OF COMMERCIAL POLICIES ON THE TRADE BALANCE IN A GENERAL EQUILIBRIUM MODEL (A CASE STUDY OF JAMAICA, TRINIDAD, BARBADOS AND GUYANA)

by

DONALD B. SANGSTER

Adviser: Professor Michael Grossman

This dissertation uses a model developed by Kenneth W. Clements(1977) to test the effects of such policies as devaluation of the local curriencies, tariffs on imports, and money creation policies on various model endogenous variables such as exports, imports, the average price level and the trade balance. The model was first estimated using data for four small Caribbean countries, Jamaica, Trinidad, Barbados and Guyana. The model was then used to simulate policy experiments, initiated by changes in relevant exogenous variables.

The model was found to be reasonably accurate in capturing the main trends for endogenous variables but there were

problems. It appeared to be more accurate predicting the demand side of the model rather than supply , with the exception of absorption. Secondly, it appears that the existence in all four countries, of trade rigidities such as quotas and import restrictions further impair the model's prediction of the trade balance. Lastly since aggregate resource endowment (the model's employment variable) was designated as an exogenous variable, the effect of policy experiments on employment was indeterminate and will be explored in future research.

ACKNOWLEDGEMENTS

The writing of this dissertation would not at all have been possible without the patience, guidance and support of my thesis committee, Michael Grossman (Chairman), Salih Neftci and Ronald Anderson.

I would also like to thank my old teachers Alvin Marty and Richard Lipsey for contributing on a broad intellectual level and also for encouraging my research in the field of International Macroeconomics.

Denise Johnson typed the draft and Wanda Knox typed the final version. Both did a first rate job, and provided valuable editorial assistance.

Finally I would like to thank my wife Janet for encouragement through fairly rough times.

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Chapter 1

Introduction

This dissertation is intended as a contribution to applied international trade theory. Specifically it uses as its base a multisector general equilibrium model developed by Kenneth W. Clements [1] and tested on U.S. data and estimates the model using data from four Caribbean countries; Barbados, Trinidad, Guyana and Jamaica. Secondly, it simulates the effects of changes in policy variables on specified macroeconomic aggregates.

Clements' model (hereafter referred to as "the model") was developed using the classical assumption of the pure theory of trade [2]. This means the model starts with a specification of technology (supply side) and preferences (demand side). The supply side is represented by a quadratic transformation function and supply side equations have been generated by the solution to a producer maximization problem. That is to say, producers (individually and in the aggregate) choose the composition of output subject to the quadratic transformation function for the purposes of maximizing the value of output. This generates domestic supply equations for three commodities defined in the model as "exportables", "importables" and "non-traded goods".

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[1] See Clements (1978)

[2] See e.g. Johnson (1971)

The development of consumer demand equations is the second building block of the model. This is accomplished by solving an intertemporal utility maximization consumer problem. As such closed forms for the consumption function and demand equations were obtained.

The process of deriving behavioral equations rather than explicitly stating equations convenient for analysis and estimations accomplishes two important feats in the model. First of all, certain restrictions from economic theory are automatically imposed on the model. These restrictions are [3]:

(i) homogeneity of degree zero in all nominal variables

(ii) symmetry for both own price elasticity and compensated price response matrices

(iii) a consumption point which satisfies the budget constraint and which must lie on the transformation surface

As such, these restrictions are implicit in the model and do not have to be explicitly set. Secondly, restrictions are imposed on model parameters, as well as income, own price and

---

[3] See Clements (1978) page 194

cross price elasticities. This is especially important as our time series data set was small, subject to common trends, yielding little informational content. This method of deriving behavioral equations, implicitly supplies us with the required restrictions for our parameter and related estimates.

The third component of the model is the income (budget) constraint which explicitly links the demand and supply equations. The income constraint implies for example that if a trade deficit exists, income is less than expenditure. There is, therefore, an explicit link between imports and exports on the one hand and income and expenditure on the other; but this is not all. It is via this route that money enters the system.

An expansion in the domestic credit component of high powered money via direct transfers (i.e. "the helicopter drop") [4] raises income directly. This is further defined on the model by an income identity and an absorption equation. As such, income is defined as the sum of the value of output plus the change in the domestic credit component of high powered money and the increase in the nominal value of wealth due to inflation.

---

[4] Here we assume that this type of new money enters the system via government spending and in the absence of explicit government consideration, it is treated as an exogenous variable.

The model has some other interesting features. First of all, government is omitted from explicit consideration. Government expenditure is broken down into government consumption expenditure and government investment expenditure and added to private consumption and private investment respectively. When this is done, taxation also drops out. This limits the model in terms of exploring certain aspects of fiscal policy simulation experiments. However, some analysis is possible (e.g. expansionary policy along with a budget deficit is implicitly assumed to be financed by money creation rather than increased borrowing (or taxation) and has a direct positive effect on nominal income).

Also representing the explicit link between the demand and supply side of the model is the later [5] specification of a wealth constraint. Here wealth is defined as a scalar and the constraint is expressed as a difference between nominal incomes and expenditures take place here. So the wealth constraint really defines the link between income and expenditures, savings (also defined as adjustable in the wealth constraint) and the price level (as wealth is defined nominally and, therefore, is affected by inflation).

---

[5] The wealth constraint replaces the earlier income constraint and links exports,imports,savings,income,expenditures and the price level together.

It should be pointed out that because wealth is defined as a scalar, there is no portfolio theory [6]. That is to say, it is the aggregate rather than the compositional effect of wealth that is at work in the model and this is also the case with the trade balance.

There is no separation between capital and current accounts when considering the trade balance. It is the effect of policy variable experiments on the overall trade balance that concerns us.

Finally the model uses a Divisia Index of the prices of exportables, importables and non-traded goods for the Aggregate Price Index when simulating the model. For initial estimation purposes, the GDP deflator was used.

The model is set out below in table 1 with definitions of symbols representing endogenous and predetermined variables as well as restrictions on parameters defined in tables 2 through 5.

Wealth has been defined and used somewhat differently from Clements. Holdings of local bonds have excluded, Nominal wealth has been included in income, and no adjustment in the wealth identity has been made to take account of population changes. [6]

TABLE 1 THE MODEL *1

```
Absorp  = g1*expprie + g2*impprie +g3*notraprie +a*(wealth -
          g4*aggprie)
Consexp = g1*expprie +t1*(consump -(g2*impprie +g3*notraprie))
Consimp = g2*impprie +t2*(consump -(g1*expprie +g3*notraprie))
Consnotra=g3*notraprie+t3*(consump-(g2*impprie+g1*expprie))
Aggprie =  t0 + t1*expprie +t2*impprie +t3*notraprie
Outexp  = b0 +b1*zbare*expprie +b2*zbare*impprie
          +b3*zbare*notraprie +(zbare/kbar)*aggresend
Outimp = bi +b2*zbari*impprie +b1*zbari*expprie
         +b3*zbari*notraprie +(zbari/kbar)*aggresend
Outnotrad =bn + b3*zbarn*notraprie +b1*zbarn*expprie
           +b2*zbarn*impprie +(zbarn/kbar)*aggresend
Consump   = absorp - todominv
Wealth    = lawealth +income -consump
Income    = k0 +outexp +(zbare*expprie) +outimp
            +(zbari*impprie) + outnotrad +(zbarn*notraprie)
            +domcred +todebtser +(lawealbar*chagpr)
            +(chapbar*lawealth)
Expdomexp = hinvexp + consexp
Impdomexp = hinvimp + consimp
Notdomexp = hinvnotrd + consnotra
Exports   = ki +outexp +(zbare*expprie) -consexp
Imports   = kn +outimp +(zbari*impprie) - consimp
Trabal    = exports - imports
```

1 Here "" means multiplication and "/" implies division.

TABLE 2

MODEL ENDOGENOUS VARIABLES

Variable	Description
Absorp	Absorption
Consump	Consumption
Wealth	Wealth
Consexp	Domestic Consumption Expenditure on Exportables
Consimp	Domestic Consumption Expenditure on Importables
Consnotra	Domestic Consumption Expenditure on Non-traded*
Aggprie	Aggregate Price Index
Outexp	Output of Exportables
Outimp	Output of Importables
Outnotrad	Output of Non-traded*
Income	Income
Expdomexp	Total Domestic Expenditure on Exportables
Impdomexp	Total Domestic Expenditure on Importables
Notdomexp	Total Domestic Expenditure on Non-traded*
Exports	Value of the Trade Flow in Exportables
Imports	Value of the Trade Flow in Importables
Notraprie	Price Index of Non-traded*
Trabal	Trade Balance

* means Non-Traded Goods

TABLE 3

MODEL PREDETERMINED VARIABLES

Variable	Description
Todominiv	Total Domestic Investment
Lawealth	Lagged Wealth
Aggresend	Aggregate Resource Endowment
Domcred	Change in Domestic Credit Component of the Monetary Base
Todebtser	Total Debt Service (Deficit)
Hinvexp	Domestic Investment Expenditure on Exports
Hinvimp	Domestic Investment Expenditure on Imports
Hinvnotrd	Domestic Investment Expenditure on Non-Traded Goods
Expprie	Price Index of Exportables
Impprie	Price Index of Importables

TABLE 4

MEANS OF ENDOGENOUS VARIABLES USED FOR ESTIMATION

Variable	Description
Zbare	Mean , Output of Exportables
Zbari	Mean , Output of Importables
Zbarn	Mean , Output of Nontraded Goods
Kbar	Mean , Aggregate Resource Endowment
Lawealbar	Mean , Lagged Wealth
Chagpr	Change in the Aggregate Price Index
Chapbar	Mean , Change in the Aggregate Price Index

TABLE 5

RESTRICTIONS ON PARAMETERS

Restriction	Description
t1+t2+t3 = 1.0	where the "t's" represent marginal income budget shares for the three commodities*
b1+b2+b3 = 1.0	required supply parameter restriction as normalization required for estimation purposes

*the commodities are exportables , importables and non-traded goods

Chapter 2

Data Modifications and Estimation procedures.

To estimate this model, certain adjustments were made primarily due to data inadequacies. Wherever possible, data from international sources were used. Since such data was not sufficiently disaggregated for our purposes, local data provided apriori information which assisted in disaggregating data to retrieve sectoral consumption, investment and output.

This, however, was not possible for prices. Export and import deflators were used as the prices of exportables and importables respectively. However, as there existed no "deflator for non-traded goods", the domestic absorption deflator was used as a "proxy" for the price of non-traded goods. This has somewhat compromised the predictive power of our model as movements in the price of the traded goods (both designated as predetermined variables - small country assumption) directly and indirectly introduces variability into the price of the non-traded goods.

Lastly, the change in debt service did not reflect debt generated by I.M.F. stabilization regimes presently in existence in two of the countries (Jamaica and Guyana).

All data, except prices, are expressed in each countries currencies and per capita data is used for model estimation purposes. The model is linear in variables but is non-linear in parameters. In addition, there are within and across equations restrictions on parameters. As such, the best most convenient estimator is full information maximum likelihood. The procedure we use is GARCH (Bollerslev 1986) multivariate estimation techniques. The GARCH multivariate normal log likelihood element at time "t" is defined as follows:

$$-0.5 \log|\Sigma_{it}| - 0.5\ v_t \Sigma_{it}^{-1} v_t'$$

Where Σ_{it} is an nxn matrix of lagged variances and v_t is an (n x 1) vector of lagged residuals, n = number of equations.

The GARCH formulation allows the variance term to depend on both lagged residuals and lagged variances. This implies that the variance matrix changes over (or depends on) time. In order to model this, elements of Σ_{it} would have to be estimated using model residuals and lagged residuals. We have simplified this in a rather pragmatic way, by allowing the variance matrix to depend on model estimated parameters instead of time and this allows us to define Σ_{it} somewhat less rigid as follows:

Σ is a nxn matrix of variances

Where the ij^{th} term is $\Sigma ij = 0.01**(i-j))$ which prevents the variances from exploding a problem sometimes exhibited in GARCH estimation [1] .

The "u_t" residual vector is defined as follows:

$$u_t = \Theta y_t - \alpha x_t$$

Where "y_t" = vector of endogenous variables.

"x_t" = vector of predetermined variables.

Θ, α are coefficient matrices.

The "u's" also are assumed to follow a first order autoregressive process:

i.e. $u_t = \rho u_{t-1} + v_t$

where ρ is the matrix of 1st order autocorrelation parameters and :

v's are assumed to have zero mean, are serially uncorrelated, contemporaneously correlated, have constant variances and are drawn from a multivariate normal distribution.

---

[1] See Bollerslev (1986) and Doan (1992) for a discussion of exploding variances in GARCH model estimation techniques.

The model (and hence the GARCH log likelihood element) is estimated by transforming the model such that its disturbance becomes a white noise by the usual lagging of the model by one period and subtracting it yielding.

$$\Theta(y_t - \rho y_{t-1}) - \alpha(x_t - \rho x_{t-1}) = vt$$

It is this "v_t " that is estimated in the GARCH log-likelihood element.

Finally, the parameter restrictions in the model deserve some brief comments. The restrictions are imposed in order to make the model identifiable through a normalization process. As was stated above " ρ ", the 1st order autocorrelation parameter matrix is diagonal so that:

$\rho_{ii} = \rho_{JJ}$ when i = consumption of importables equation
when j = consumption of non-traded goods equation

$\rho_{ii} \neq \rho_{JJ}$ when i,j are otherwise i.e. refer to other model equations

and ρ_{IJ} is zero .

The supply parameter matrix is diagonal with off diagonal elements are zero. Since supply equations are homogenous of

degree zero in parameters, identification requires normalization. The diagonal elements are set equal to unity.

Lastly, the utility function wealth parameter is numerically much larger than the rest of the other parameters. As such, to preserve the same order magnitude in parameter values, we constrain the utility function parameter as follows:

$$g4 = (1000 * Sin2(g5)) / Sin(g5)$$

where "g5" is also estimated as a parameter. This has the effect of constraining "g4".

Data Base

For purposes of model estimation, we use annual data 1969 - 1990 for all four countries. The data from both international and local sources was not sufficiently disaggregated and considerable effort was made with some apriori information to construct a data base consistent with requirements of the model.

The primary sources for most of the data are [2] International Financial Statistics 1969 - 1990 published by the International Monetary Fund and World Tables 1988 - 1990 published by the International Bank for Reconstruction (World Bank). Other sources include United Nations and International Labor Office publications.

Local publications provided some apriori information on consumption patterns and sectorial output which helped in the process of disaggregating the data. Sectoral Output was obtained by disaggregation of GNP into exportables, importables, non-traded and debt services (deficit). Sectoral consumption and investment was obtained by similarly disaggregating consumption and gross fixed capital formation respectively.

Wherever data was not available "proxies" [3] were used. The domestic absorption deflator was used for the price index of non-traded goods. Export and import deflators were used as the price index for exportables and importables respectively.

Our wealth variable was constructed somewhat differently from that of Clements. Wealth for us was the sum of Net

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[2] For a complete list of data sources see Appendix.

[3] By proxies here we mean time series data which approximate the variables we need in trying to estimate Clements Model.

Foreign Assets and the holdings of outside money. We excluded explicitly local claims on real capital, preferring to accept the view that in the aggregate the holdings of local bonds does not constitute a component of aggregate real wealth [4]. In other words we have treated wealth as the local economies holdings of only outside financial assets.

Following Clements, we also used per capita data for estimation. However unlike Clements, because of the view of wealth that we have taken, real wealth is not adjusted to take account of population changes. It follows that if accumulated holdings of local bonds does not constitute wealth, the increased population's holdings of local bonds also does not constitute wealth and their holdings of outside financial assets is negligible.

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[4] See Chapter 1, footnote 5 for a description of wealth as defined in this application of Clements' model.

Chapter 3

Empirical Results

In tables 6 - 9, we present the GARCH model estimates and their asymptotic standard errors. The model was estimated and simulated using RATS [1] written by Thomas S. Doan (March '92). This program uses the Simplex Algorithm to get initial estimates of parameters, then uses the algorithm developed by Berndt, Hall, Hall and Hausman [2] to refine initial estimates and produce asymptotic standard errors.

The following notation is used for estimated parameters:

g1 , g2 & g3	are utility function parameters for exportables, importables and non-traded goods, respectively
g4	is the utility function parameter for wealth

---

[1] See RATS 4.0 (Regression Analysis of Time Series) by Thomas A. Doan, March 1992 ; Estima , Evanston Illinois.

[2] See "Estimation and Inference in Nonlinear Structural Models" by Berndt,E.K.,Hall,R.E.,Hall,B.H., and Hausmann, J.A., in Annals of Economic and Social Measurement, Vol. 3 pages 653-665.

t1 ,t2 & t3	are the marginal budget shares for the three commodities
b1 , b2 & b3	are diagonal elements of the supply parameter matrix
a	is the speed of adjustment in the absorption equation
d1 , d2 , d3 , d4 d5 , d6 & d7	are first order auto-correlation coefficients for the behavioral equations (defined such that d1=d2=d3 for LES disturbances).
b0 , bi , bn , k0 ki , kn & t0	These are constant terms:

where

"b0 ,bi & bn" refer to supply equations for exports , imports and non-traded goods, respectively.

"k0 , ki , kn" refer to income and wealth equations , and non-traded goods requirement, respectively.

"t0" refer to aggregate price index equation

Table 6 Jamaica

MAXIMUM LIKELIHOOD PARAMETER ESTIMATES

Parameter	g1	g2	g3	g4
Estimate	209.62	419.07	836.08	13700.41
s.e.(asymp.)	14.64	32.21	102.74	1021.17
Parameter	a	t1	t2	t3
Estimate	0.5739	0.2125	0.34	0.4475
s.e.(asymp.)	0.87	0.043	0.017	0.181
Parameter	b1	b2	b3	d1
Estimate	0.1067	0.4296	0.4637	1.200
s.e.(asymp.)	0.03278	0.0674	0.0121	0.0049
Parameter	d2	d3	d4	d5
Estimate	1.200	1.200	0.833	0.9218
s.e.(asymp.)	0.0049	0.0049	0.0261	0.2142
Parameter	d6	d7	b0	bi
Estimate	0.9403	0.8612	-28.2	-36.1
s.e.(asymp.)	0.0087	0.1294	4.61	3.94
Parameter	bn	t0	k0	ki
Estimate	-44.61	40.34	31.90	2127.21
s.e.(asymp.)	4.71			
Parameter	kn			
Estimate	1831.6			

Table 7 Barbados

MAXIMUM LIKELIHOOD PARAMETER ESTIMATES

Parameter	g1	g2	g3	g4
Estimates	228.21	682.8	1146.8	5000.2
s.e.(asymp.)	8.963	55.86	76.51	348.7
Parameter	a	t1	t2	t3
Estimates	0.6637	0.285	0.484	0.231
s.e.(asymp.)	0.2213	0.0176	0.0285	0.0118
Parameter	b1	b2	b3	d1
Estimates	0.437	0.410	0.153	0.8412
s.e.(asymp.)	0.197	0.212	0.0231	0.1761
Parameter	d2	d3	d4	d5
Estimates	0.8412	0.8412	0.7125	0.9384
s.e.(asymp.)	0.1761	0.1761	0.0389	0.2621
Parameter	d6	d7	b0	bi
Estimates	0.7759	0.8693	29.35	31.96
s.e.(asymp.)	0.1473	0.2181	4.76	5.19
Parameter	bn	t0	k0	ki
Estimates	261.3	0.0061	2661.5	1726.1
s.e.(asymp.)	16.31			
Parameter	kn			
Estimates	294.7			

Table 8 Guyana

MAXIMUM LIKELIHOOD PARAMETER ESTIMATES

Parameters	g1	g2	g3	g4
Estimates	244.43	582.68	946.68	1637.44
s.e.(asymp.)	12.70	41.33	81.31	349.77
Parameters	a	t1	t2	t3
Estimates	0.4637	0.1285	0.344	0.5275
s.e.(asymp.)	0.0324	0.0087	0.1014	0.0298
Parameters	b1	b2	b3	d1
Estimates	0.5337	0.3151	0.1512	0.9121
s.e.(asymp.)	0.0426	0.0137	0.0063	0.1637
Parameters	d2	d3	d4	d5
Estimates	0.9121	0.9121	0.8726	0.7875
s.e.(asymp.)	0.1637	0.1637	0.0432	0.1147
Parameters	d6	d7	b0	bi
Estimates	0.8321	0.7694	24.71	28.31
s.e.(asymp.)	0.1439	0.1572	6.86	9.32
Parameters	bn	t0	k0	ki
Estimates	125.72	40.86	0.07621	2836.8
s.e.(asymp.)	41.34			
Parameters	kn			
Estimates	2139.4			

Table 9 Trinidad

MAXIMUM LIKELIHOOD PARAMETER ESTIMATES

Parameters	g1	g2	g3	g4
Estimates	227.24	799.06	969.33	2368.85
s.e.(asymp.)	12.6	56.31	101.31	126.31
Parameters	a	t1	t2	t3
Estimates	0.6105	0.2961	0.340	0.3639
s.e.(asymp.)	0.1063	0.047	0.021	0.136
Parameters	b1	b2	b3	d1
Estimates	0.6601	0.2159	0.124	1.2311
s.e.(asymp.)	0.0721	0.0181	0.0064	0.0049
Parameters	d2	d3	d4	d5
Estimates	0.7321	0.6472	0.9371	0.8641
s.e.(asymp.)	0.0023	0.0041	0.0052	0.1137
Parameters	d6	d7	b0	bi
Estimates	1.2311	1.2311	-26.21	-17.46
s.e.(asymp.)	0.0049	0.0049	5.94	3.38
Parameters	bn	t0	k0	ki
Estimates	107.3	16.23	0.0047	2638.3
s.e.(asymp.)	26.31			
Parameters	kn			
Estimates	2132.9			

For all four countries, we have found that estimates of "g1" ," g2", "g3" & "g4" are extremely large and violate utility function requirements as well as their subsistence interpretation [3]. This suggests a weakness in the demand side of the model.

However the estimated marginal budget shares 't1' , "t2" & "t3" are reasonably well determined. So, for example, in Barbados of an increase in overall (total) consumption expenditure of $100, $28.50 will to exportables, $48.40 will go to importables and $23.10 will go to non-traded. This pattern is somewhat different for the other countries. In Jamaica, it appears that non-traded goods dominate; (exportables $21.25, importables $34.00 and non-traded is $44.75). This is also the case in Trinidad ($29.61 exportables, $34.00 importables, $36.39 non-traded) and Guyana ($12.85 exportables, $34.40 importables and $52.75 for non-traded).

The speed of adjustment parameter "a" is estimated to lie between 0.46 and 0.66 for the four countries. This suggests that the difference between income and spending only partially closes the gap between actual and long run desired wealth. If

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[3] See Clements Op.Cit pgs. 207-209.

viewed as an adjustment to long run equilibrium, this is consistent with Clements results [4].

The estimates of "b1" , "b2" & "b3" have no meaning by themselves due to normalization procedures. They, however, can be used to determine supply elasticities, which will be done later.

Lastly, the first order autoregressive parameters in the main, lie inside the unit circle as required for stability conditions. There are, however, exceptions (for "d1" in Trinidad and Jamaica) and this may be due to variability in sampling.

Below is table 10 showing the Quasi- R^2 values for all stochastic equations in the truncated model [5] including the equation for consumption of exportables.

---

[4] See Clements Op. Cit. pgs. 198 -200.

[5] The truncated model drops certain identities such as domestic expenditures on exportables, importables and nontraded goods as well as the consumption expenditures on exportables equation because either they appear only once in the model and their component parts are determined during estimation or they are redundant. The truncated model is identical to the entire model.

Table 10

QUASI - R^2 (All Countries)

Quasi - R^2 Values

Endogenous Variables	Jamaica	Barbados	Trinidad	Guyana
Absorption	0.7935	0.8971	0.8643	0.7268
Consumption Expenditure on Exportables	0.9947	0.9229	0.9126	0.9731
Consumption Expenditure on Importables	0.9631	0.9741	0.9731	0.9248
Consumption Expenditure on Non-Traded	0.9725	0.9146	0.9947	0.8751
Supply of Exportables	0.9635	0.8647	0.9082	0.8134
Supply of Importables	0.9439	0.7779	0.8976	0.7677
Supply of Non-Traded	0.9621	0.8641	0.8641	0.7834

Table 10 suggest that the demand equations (except for absorption) tend to fit the data better than the supply equations do.

The structural demand elasticities are presented in table 11 below. These elasticities(evaluated at sample means) are calculated with the implicit assumption [6] that all goods are normal, gross compliments and net substitutes and uncompensated own price elasticities are less than unity in absolute value: Given the level of aggregation (i.e. exportables) price elasticities are low and it appears income effects explain a large proportion of uncompensated price responses.

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[6] These are the Stone's LES (linear expenditure system) characteristics for all three goods in our model.

Table 11

STRUCTURAL DEMAND ELASTICITIES

	Expenditure		Price		
Jamaica	Exportables	0.4472	-0.1321	-0.2657	-0.1597
			-0.0368	0.0213	0.0266
	Importables	1.0026	-0.1769	-0.4135	-0.3262
			0.0077	-0.0859	0.0527
	Non-traded	0.7857	-0.1459	-0.7976	0.3381
	Goods		0.0161	0.0584	-0.0327
Barbados	Exportables	0.5278	-0.1265	-0.2735	-0.1621
			-0.0327	0.0881	0.0417
	Importables	1.1367	-0.1973	-0.5263	-0.2176
			0.0084	-0.0384	0.0198
	Non-traded	0.8125	-0.1637	-0.4876	-0.362
	Goods		0.0026	0.0497	-0.0027
Guyana	Exportables	0.4729	-0.2136	-0.6005	-0.3263
			-0.0089	0.0137	0.0203
	Importables	1.0134	-0.3168	-0.7302	-0.1782
			0.0187	-0.0217	0.0163
	Non-traded	0.8629	-0.4725	-0.6326	-0.3896
	Goods		0.0176	0.0323	-0.0159

	Expenditure	Price		
Trinidad	Exportables 0.6137	-0.3627	-0.5864	-0.4211
		-0.0213	0.0119	0.0224
	Importables 1.1467	-0.4633	-0.6821	-0.3372
		0.0138	-0.0264	0.0321
	Non-traded 0.8931	-0.2639	-0.4721	-0.2374
	Goods	0.0218	0.0187	-0.0168

(a) Line 1 uncompensated

Line 2 compensated

The structural supply elasticities are presented in table 12 below. These are also evaluated at sample means. Since the supply system parameter matrix is assumed to be diagonal, off-diagonal elements of each column take the same value. This diagonal restriction implies all goods are gross substitutes and all own price elasticities being less than unity.

TABLE 12

Structural Supply Elasticities

Elasticity of Supply of Good I

with Respect to Price of Good J

			1	2	3
Jamaica	1)	Exportables	0.893	-0.430	-0.463
	2)	Importables	-0.107	0.570	-0.463
	3)	Non-traded Goods	-0.107	-0.430	0.537
Barbados	1)	Exportables	0.563	-0.410	-0.153
	2)	Importables	-0.437	0.590	-0.153
	3)	Non-traded Goods	-0.437	-0.410	0.847
Guyana	1)	Exportables	0.466	-0.316	-0.151
	2)	Importables	-0.534	0.684	-0.151
	3)	Non-traded Goods	-0.534	-0.316	0.849
Trinidad	1)	Exportables	0.340	-0.216	-0.124
	2)	Importables	-0.660	0.784	-0.124
	3)	Non-traded Goods	-0.660	-0.216	0.876

In order to determine how well the estimated model predicts the paths of the endogenous variables over the sample period, we simulate it dynamically. That is to say, we use the previous period's simulated values of endogenous variables for the current periods lagged endogenous variables.

The model varies in its ability to predict or track endogenous variables for all of the countries. Clements found that with the exception of the trade balance, the model captured the main characteristics of the rest of the endogenous variables when applied to U.S. data [7]. This result is not apparent when applied to our data. In all cases, the trade balance was fairly well predicted. However, in all cases (except Barbados), the model was unable to predict absorption and supply of the three commodities exportables, importables and non-traded goods (except for Trinidad where the model only performed badly for supply of the non-traded goods). In addition, it was unable to capture the main characteristics of imports for all countries (except Barbados) and was also unable to accurately represent exports (in the case of Barbados). It did not accurately predict wealth (for Jamaica and Trinidad) nor consumption expenditure on exports (for Barbados) nor consumption expenditure on non-traded (for Guyana).

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[7] See Clements Op. Cit. pg.194

Several factors explain this apparent lack of performance of the model. First of all, the data is characterized by massive swings instead of smooth trends. This in turn is due to problems in getting sectorial data which, as was stated above, was obtained with apriori knowledge from local publications. However, government policies over the sample period have been erratic and has had significant effects on the whole array of macro-economic aggregates.

Secondly, it appears that as far as the trade balance is concerned, errors in component endogenous variables such as exports and imports, have compensated giving us a reasonably accurate simulation result. This is not true for absorption. Here the component errors have been more additive, resulting in a rather disappointing simulation result for absorption.

Below in tables 13 through 16 are the Mean Percentage Errors , Root Mean Square Percentage Errors and Theil -U Statistics for all four countries.

Table 13 Jamaica

Mean Percentage Errors, Root Mean Square Percentage Errors & Theil - U Statistics: Dynamic Simulation over Sample Period.

Endogenous Variable	MPE(a)	RMSPE(b)	T.U.(c)
Consump = Consumption Exp = Expenditure			
Absorption	48.73	142.91	6.48
Total Consump Exp	0.0276	0.0342	0.0691
Wealth	6.79	12.47	3.91
Consump Exp on Exports	0.0068	0.0135	0.591
Consump Exp on Imports	0.0326	0.0687	0.473
Consump Exp on Non-traded	0.0417	0.0829	0.589
Aggregated Price Index	0.0086	0.0317	0.282
Supply of Exportables	33.89	111.74	4.89
Supply of Importables	24.31	86.49	6.31
Supply of Non-traded	38.76	124.71	8.98
Income	0.0363	0.07467	0.563
Value of Exports	0.0437	0.3121	0.486
Value of Imports	57.39	181.27	11.69
Price of Non-traded	0.0163	0.0427	0.426
Trade Balance	0.0467	0.0932	0.573

(a) MPE = Mean Percentage Errors

$$= 1/T \sum_{t=1}^{T} (y_{it}^{s} - y_{it})/y_{it}$$

y_i^s = simulated value of endogenous variable i

y_i = actual value of endogenous variable i

(b) RMSPE = Root Mean Square Percentage Error

$$= (1/T ((\Sigma_t y_{it}^{s} - y_{it})/y_{it})^2)^{1/2}$$

(c) TU = Thiel U Statistic

Calculated as an average of Thiel U Statistic estimates over 5 iterations with 22, 21, 20, 19, 18 observations respectively

Table 14 Barbados

Mean Percentage Errors, Root Mean Square Percentage Errors & Theil - U Statistics: Dynamic Simulation over Sample Period

Endogenous Variable	MPE	RMSPE	T.U.
Consump = Consumption Exp = Expenditure			
Absorption	0.0632	0.0971	0.6872
Total Consump Exp	0.0284	0.0437	0.5873
Wealth	0.0483	0.0962	0.6831
Consump Exp on Exports	0.4327	1.7861	1.8932
Consump Exp on Imports	0.0269	0.0531	0.4278
Consump Exp on Non-traded	0.0537	0.0983	0.6847
Aggregate Price Index	0.0742	0.1321	0.873
Supply of Exportables	0.8632	1.5742	1.0321
Supply of Importables	11.2463	27.9138	3.647
Supply of Non-traded	36.93	121.68	14.31
Income	0.0876	0.1349	4.3121
Value of Exports	46.41	127.29	7.61
Value of Imports	33.7	86.4	9.48
Price of Non-traded	0.0263	0.0521	0.4374
Trade Balance	0.0437	0.0649	0.5403

Table 15 Guyana

Mean Percentage Errors, Root Mean Square Percentage Errors & Theil - U Statistics: Dynamic Simulation over Sample Period

Endogenous Variable	MPE	RMSPE	T.U.
Consump = Consumption Exp = Expenditure			
Absorption	43.69	97.31	4.67
Total Consump Exp	0.0304	0.0521	0.564
Wealth	0.216	0.978	0.934
Consump Exp on Exports	0.0289	0.0581	0.621
Consump Exp on Imports	0.837	1.6321	0.864
Consump Exp on Non-traded	36.47	107.31	7.48
Aggregate Price Index	0.0427	0.0631	0.476
Supply of Exportables	22.61	63.74	6.21
Supply of Importables	17.39	52.64	4.79
Supply of Non-traded	38.47	86.96	7.21
Income	37.36	125.84	6.37
Value of Exports	0.0386	0.0861	0.579
Value of Imports	47.43	134.31	8.71
Price of Non-traded	0.0687	0.0927	0.337
Trade Balance	0.0327	0.0721	0.632

Table 16 Trinidad

Mean Percentage Errors, Root Mean Square Percentage Errors & Theil - U Statistics: Dynamic Simulation over Sample Period

Endogenous Variable	MPE	RMSPE	T.U.
Consump = Consumption Exp = Expenditure			
Absorption	37.48	76.31	7.71
Total Consump Exp	0.0326	0.0746	0.583
Wealth	14.76	31.37	2.74
Consump Exp on Exports	0.4643	0.7361	0.624
Consump Exp on Imports	0.2567	0.4831	0.488
Consump Exp on Non-traded	0.3641	0.5127	0.426
Aggregate Price Index	0.0467	0.0783	0.521
Supply of Exportables	0.2173	0.6449	0.823
Supply of Importables	0.5846	0.9734	0.949
Supply of Non-traded	0.7329	1.1648	3.674
Income	0.2981	0.5535	0.6527
Value of Exports	24.31	48.61	4.61
Value of Imports	34.95	59.83	5.89
Price of Non-Traded	0.0381	0.0721	0.557
Trade Balance	0.0447	0.0626	0.548

The figures 1 - 68 below show for all four countries, the actual and simulated values of relevant endogenous variables (except the price of non-traded goods). Actual values is represented by heavy line and simulated values by a broken line.

Concluding Comments

In this chapter we have generated empirical results which, as was stated above, are only partially encouraging.

We have found problems both common with Clements' results and unique ones. As far as common problems are concerned, the estimated parameters "g1", "g2", "g3" & "g4" tend to be too large for subsistence interpretation. Secondly, the restrictions imposed to make the model identifiable and capable of being estimated makes the fitted supply system very rigid. Thirdly, the model does not perform sufficiently well in tracking some endogenous variables in particular absorption over the sample period. We should note that tracking the trade balance, not absorption, is the main deficiency in the model noted by Clements.

We should note that overall, however, the results are encouraging. We should also note that various rigidities

Fig. 1

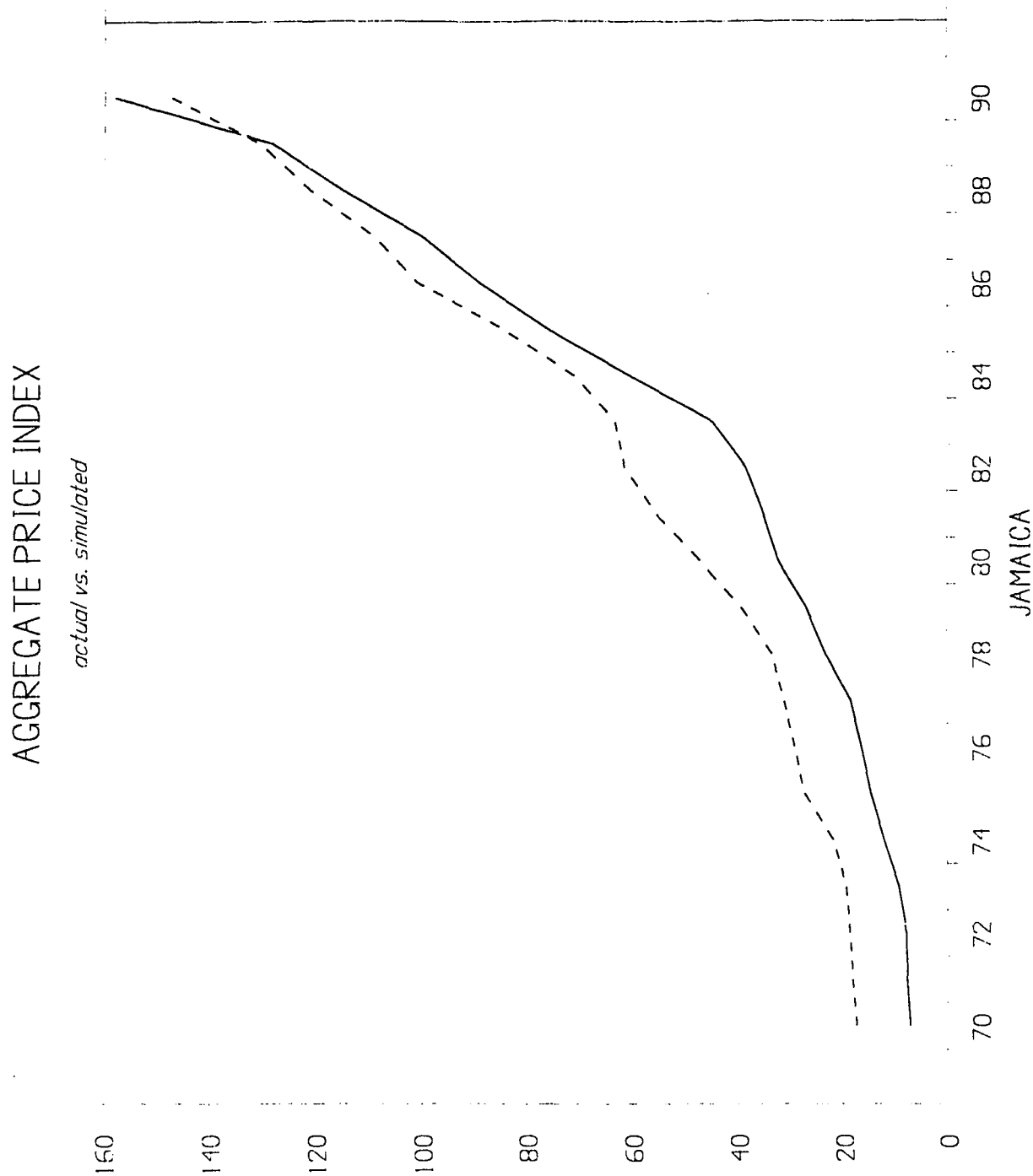

AGGREGATE PRICE INDEX
actual vs. simulated
JAMAICA
160
140
120
100
80
60
40
20
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 2


OUTPUT OF EXPORTABLES
actual vs. simulated
4500
4000
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 3

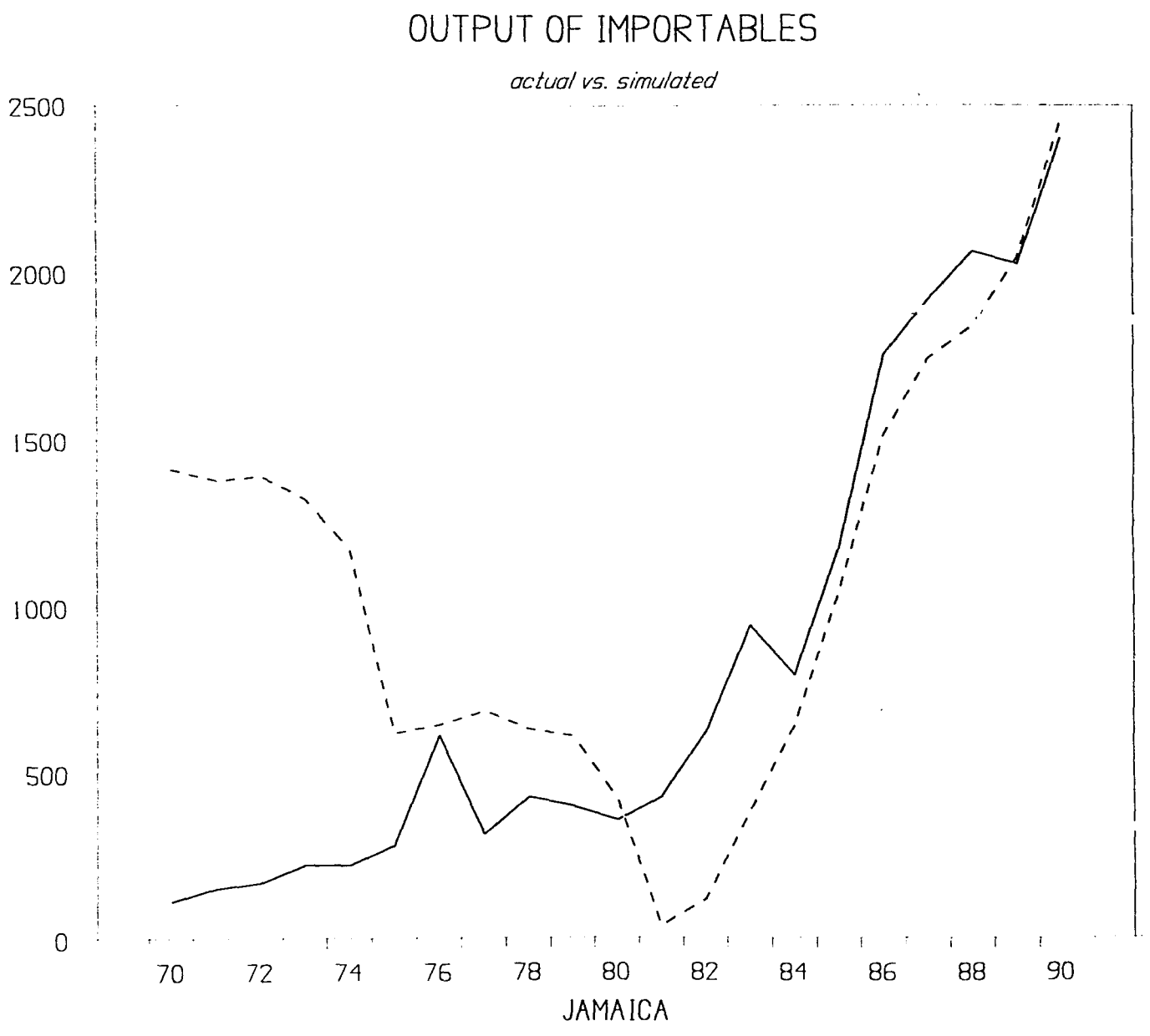

OUTPUT OF IMPORTABLES
actual vs. simulated
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 4

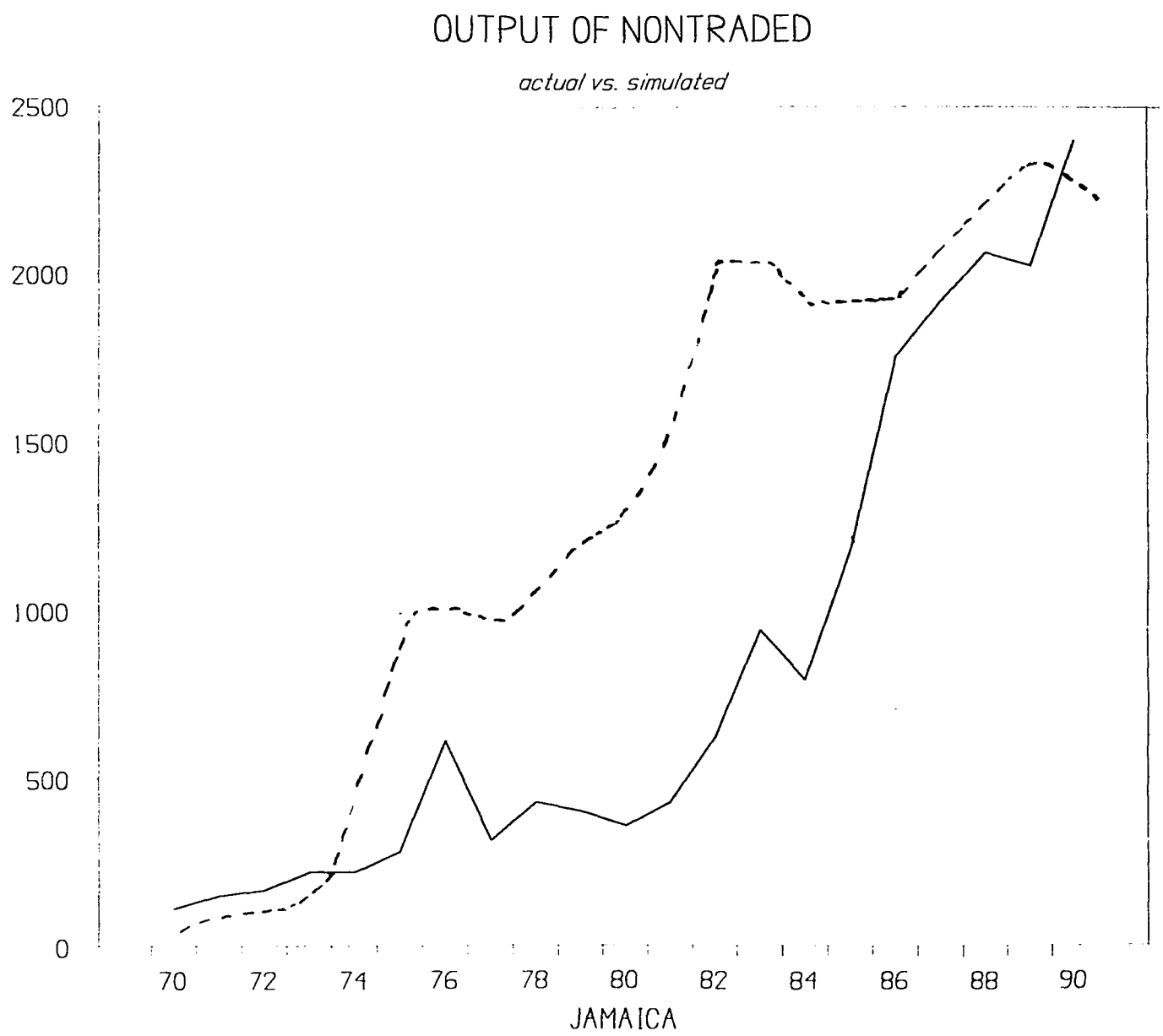

OUTPUT OF NONTRADED
actual vs. simulated
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 5

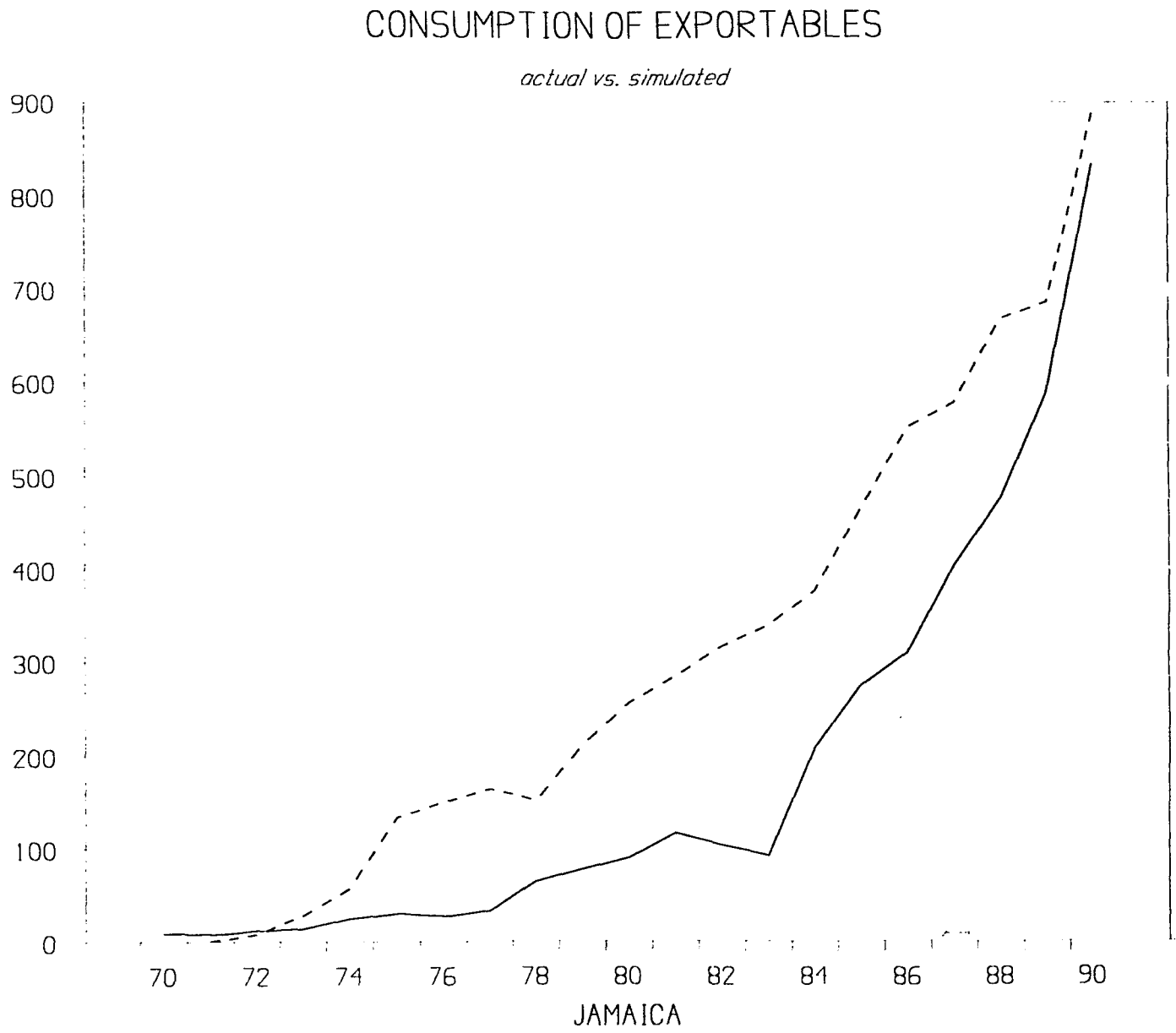

CONSUMPTION OF EXPORTABLES
actual vs. simulated
900
800
700
600
500
400
300
200
100
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 6

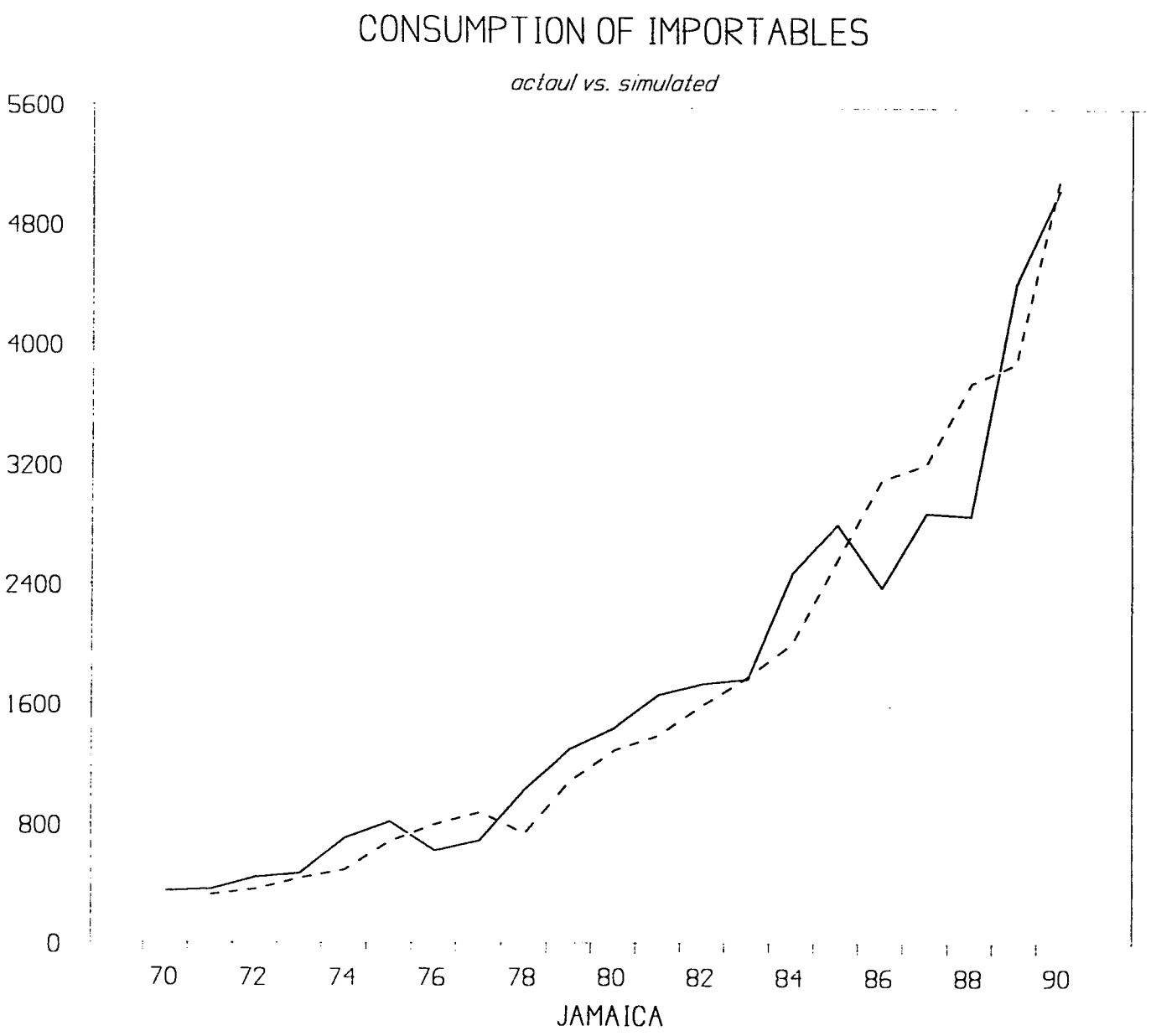

CONSUMPTION OF IMPORTABLES
actaul vs. simulated
5600
4800
4000
3200
2400
1600
800
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 7

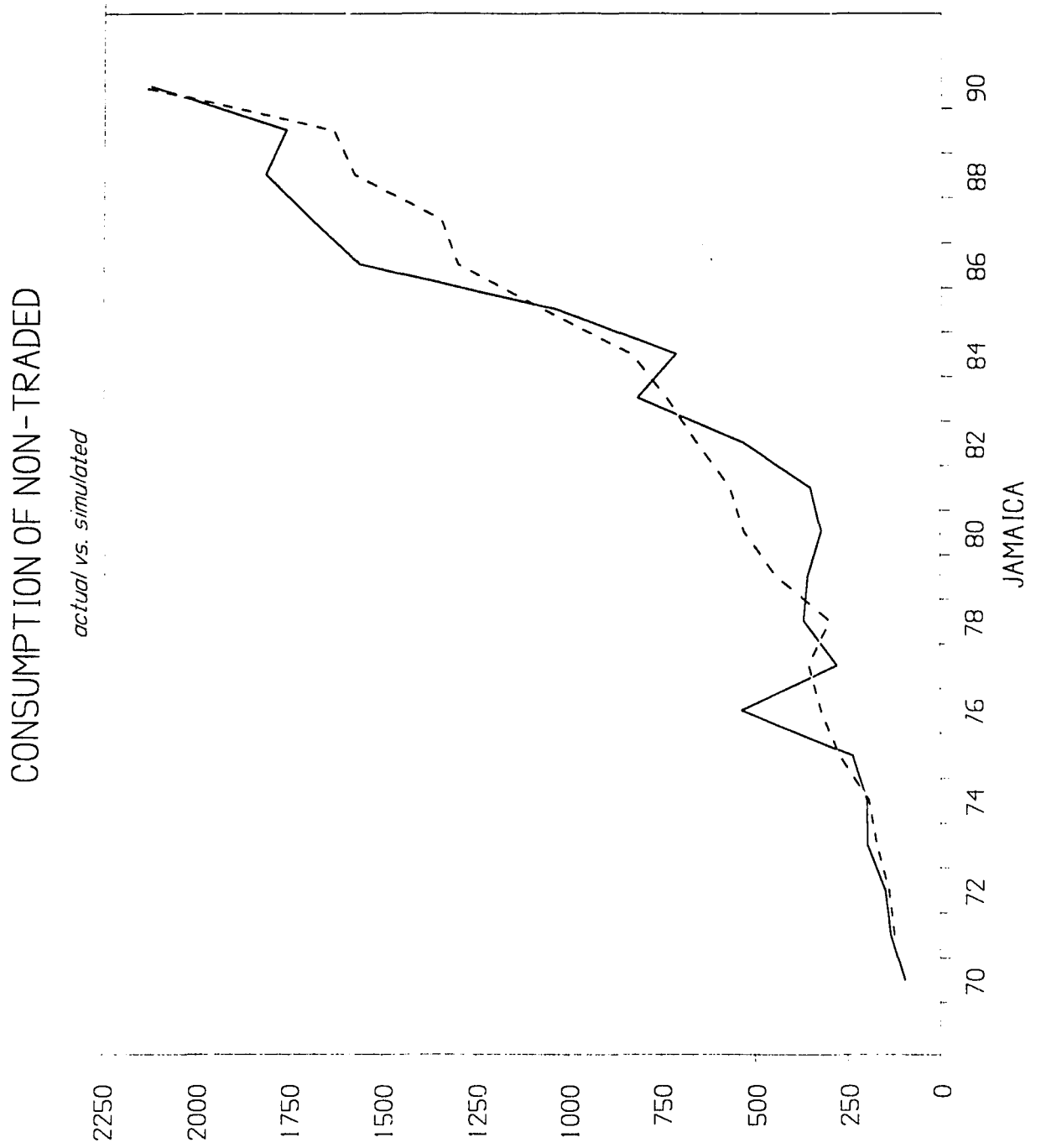

CONSUMPTION OF NON-TRADED
actual vs. simulated
JAMAICA
2250
2000
1750
1500
1250
1000
750
500
250
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 8

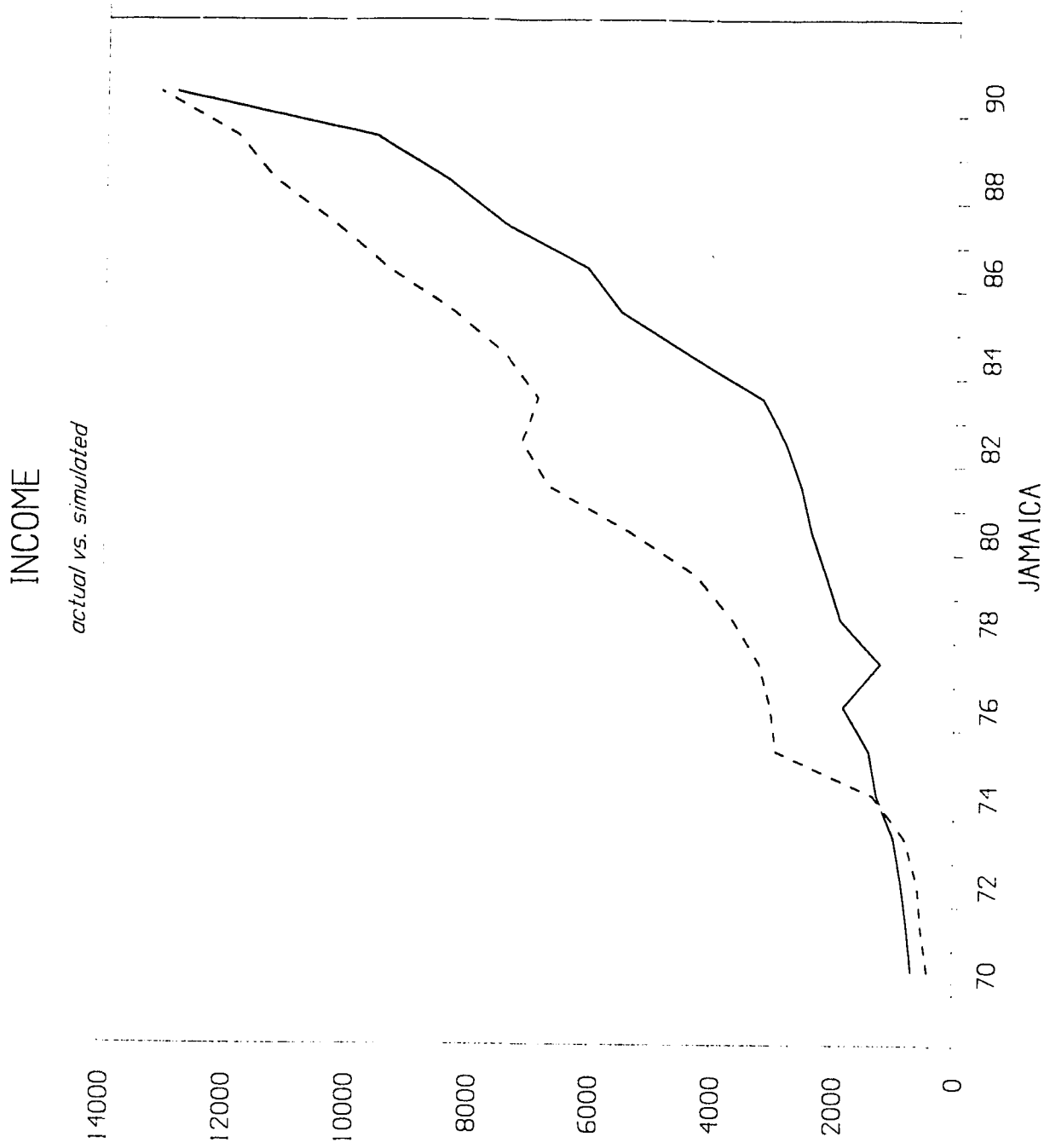

INCOME
actual vs. simulated
JAMAICA
14000
12000
10000
8000
6000
4000
2000
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 9

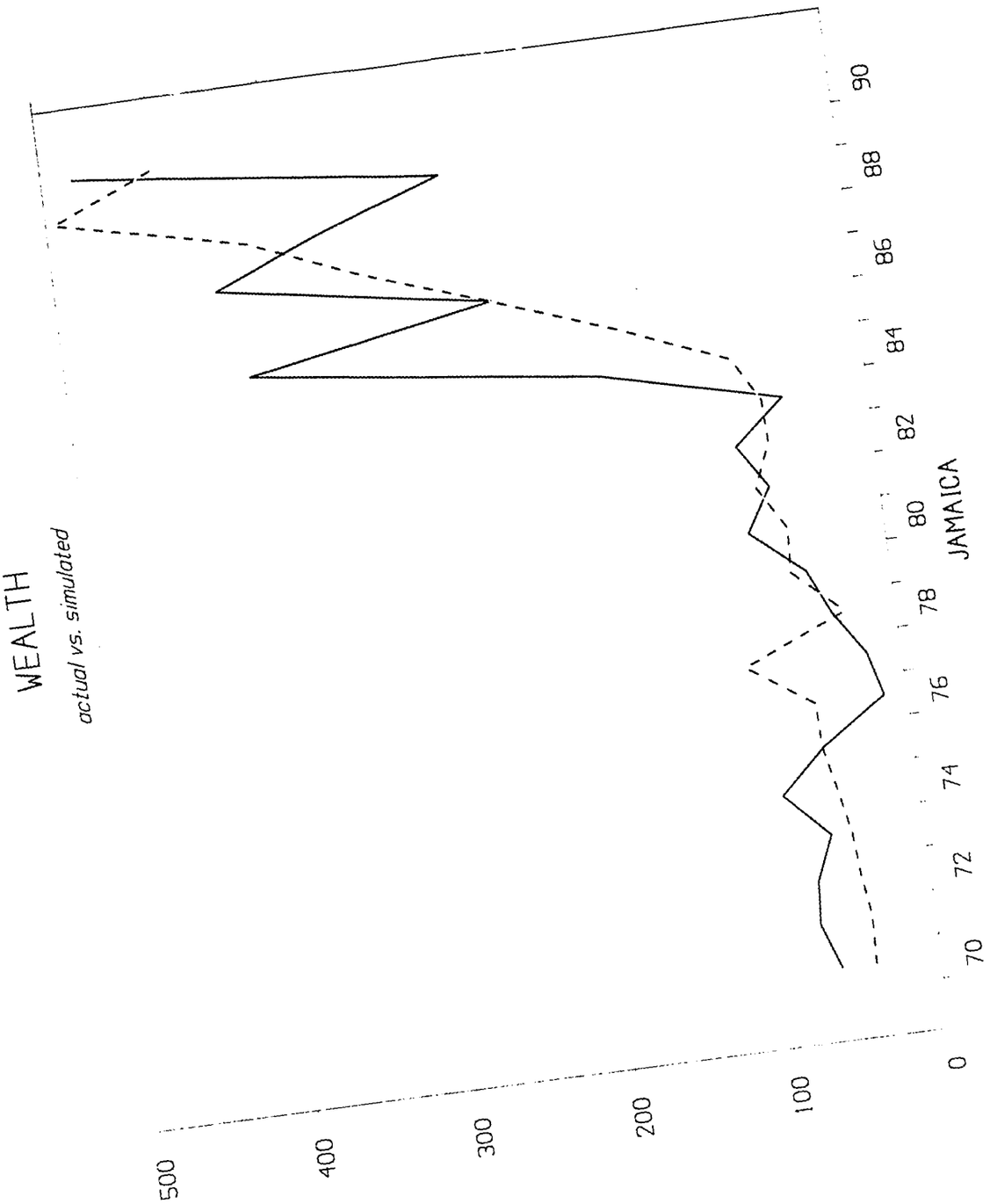

WEALTH
actual vs. simulated
JAMAICA
70
72
74
76
78
80
82
84
86
88
90
0
100
200
300
400
500

Fig. 10

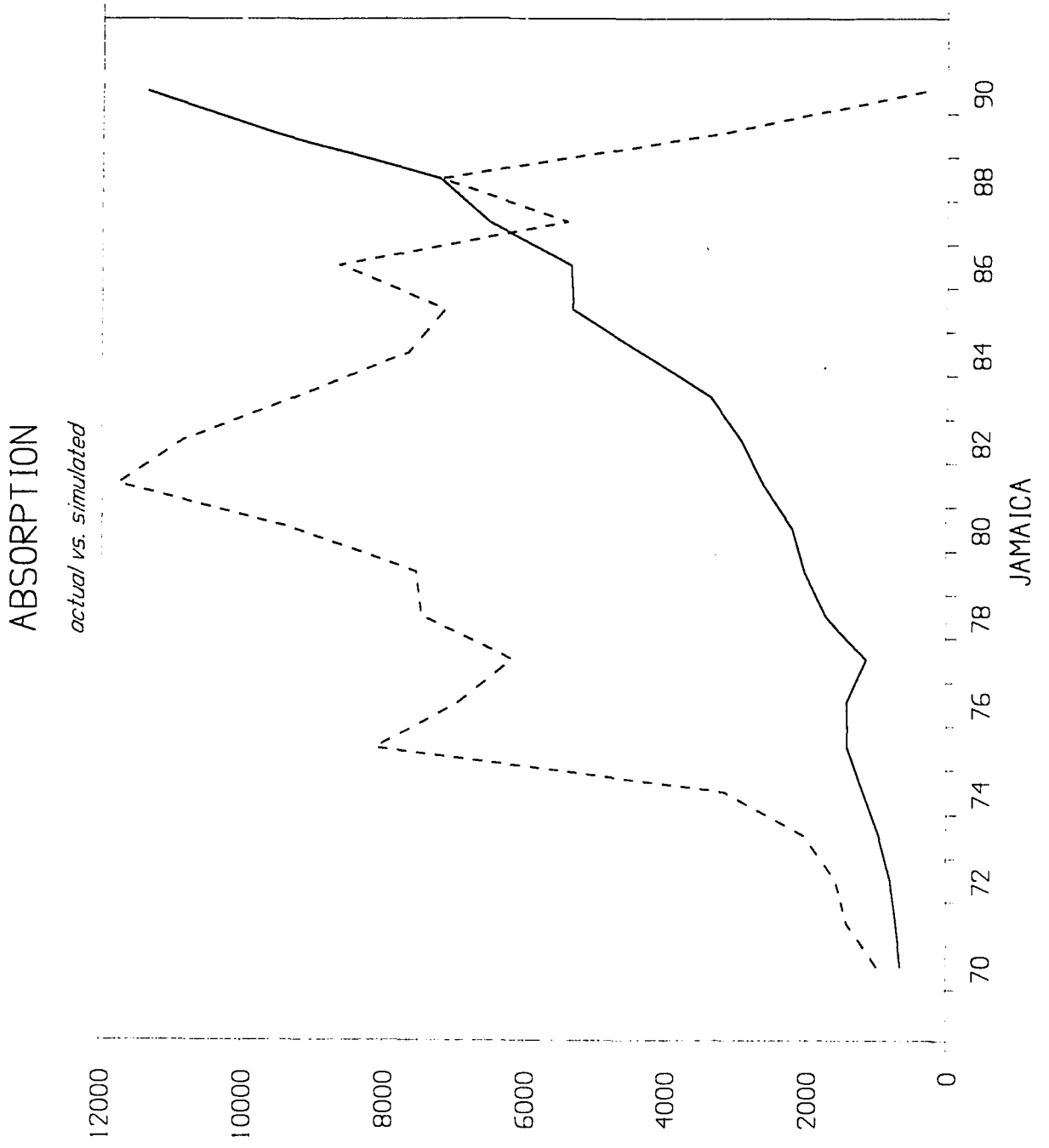

ABSORPTION
actual vs. simulated
JAMAICA
12000
10000
8000
6000
4000
2000
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 11

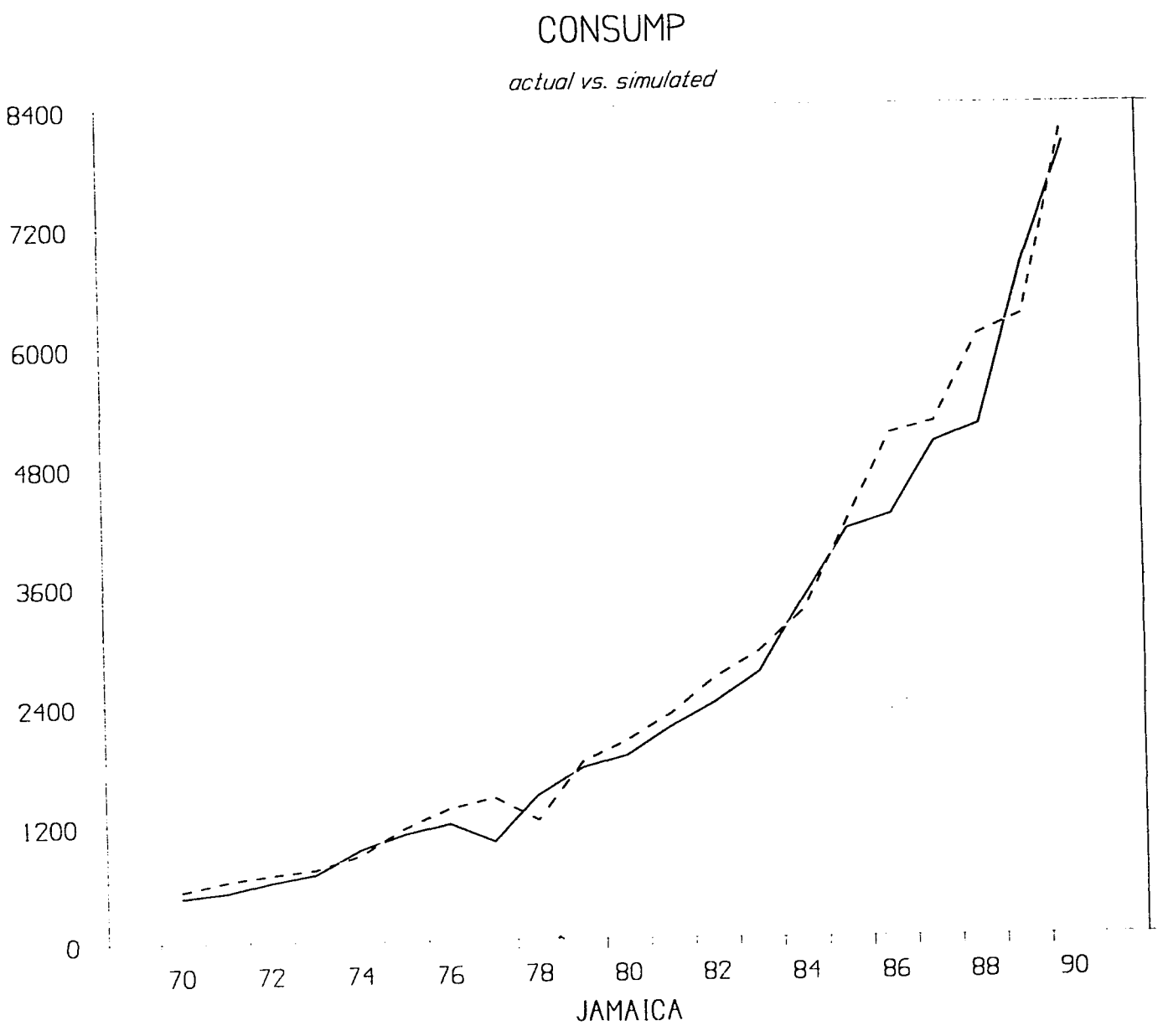

CONSUMP
actual vs. simulated
8400
7200
6000
4800
3600
2400
1200
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 12

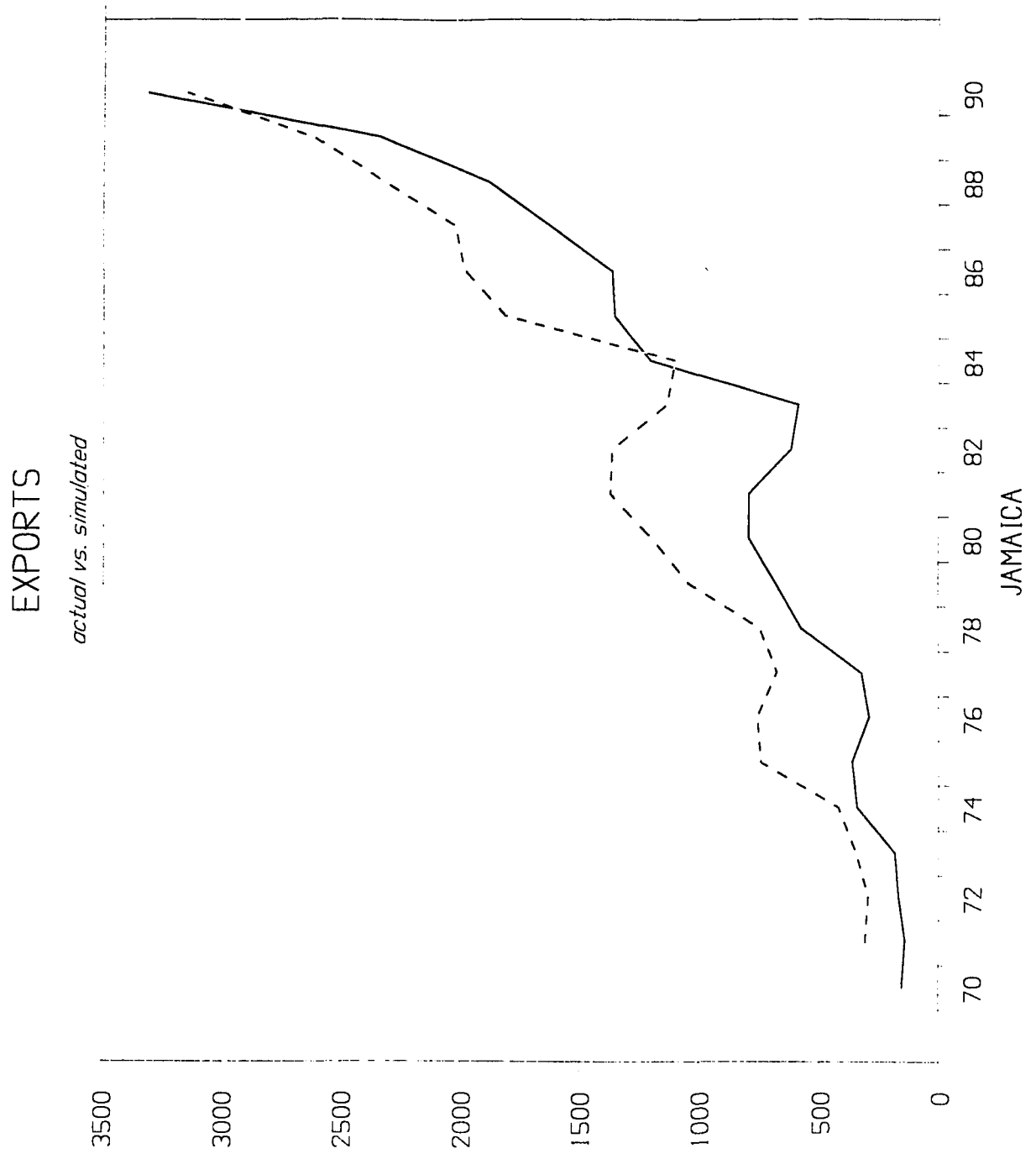

EXPORTS
actual vs. simulated
JAMAICA
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 13

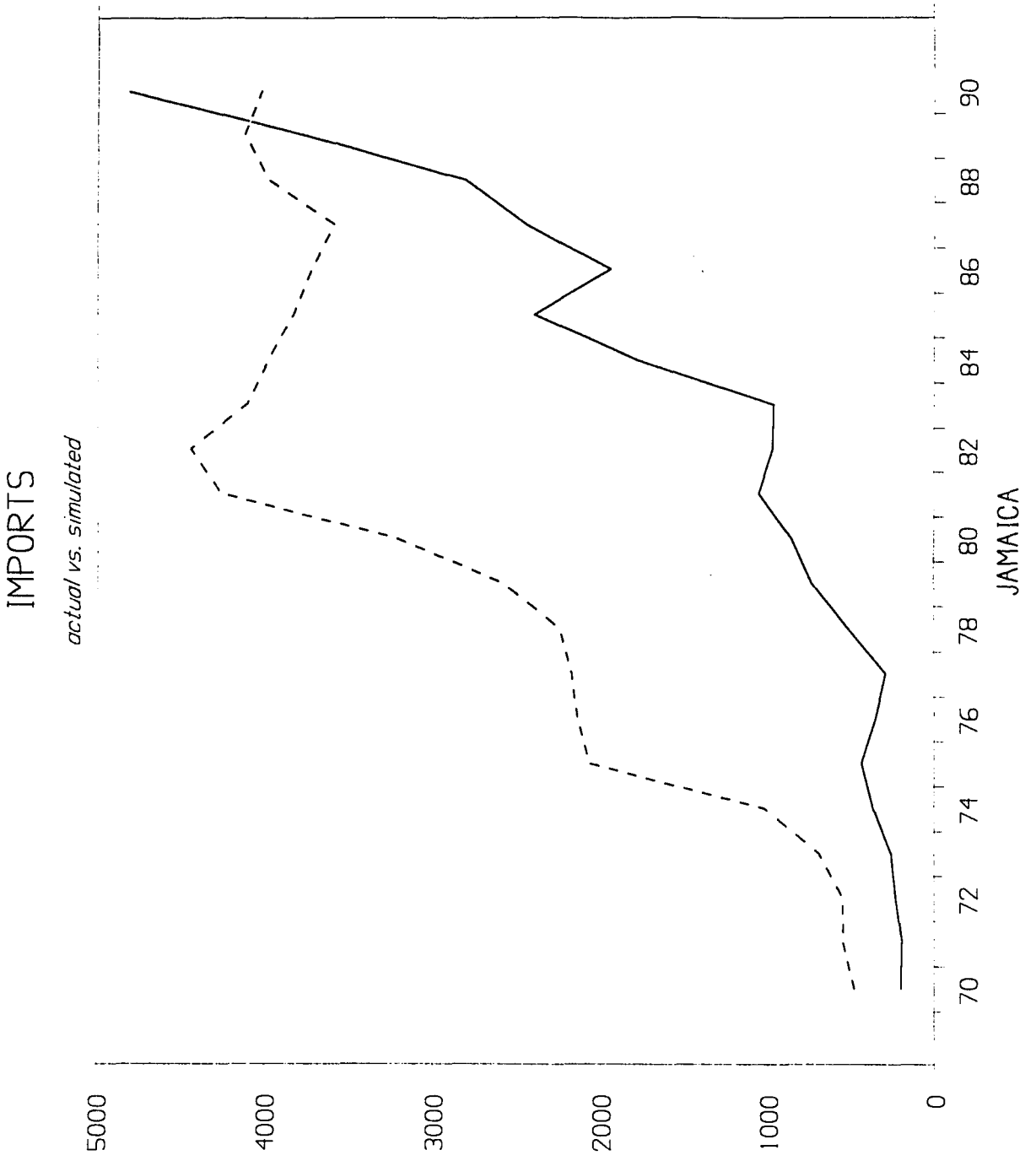

IMPORTS
actual vs. simulated
5000
4000
3000
2000
1000
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 14

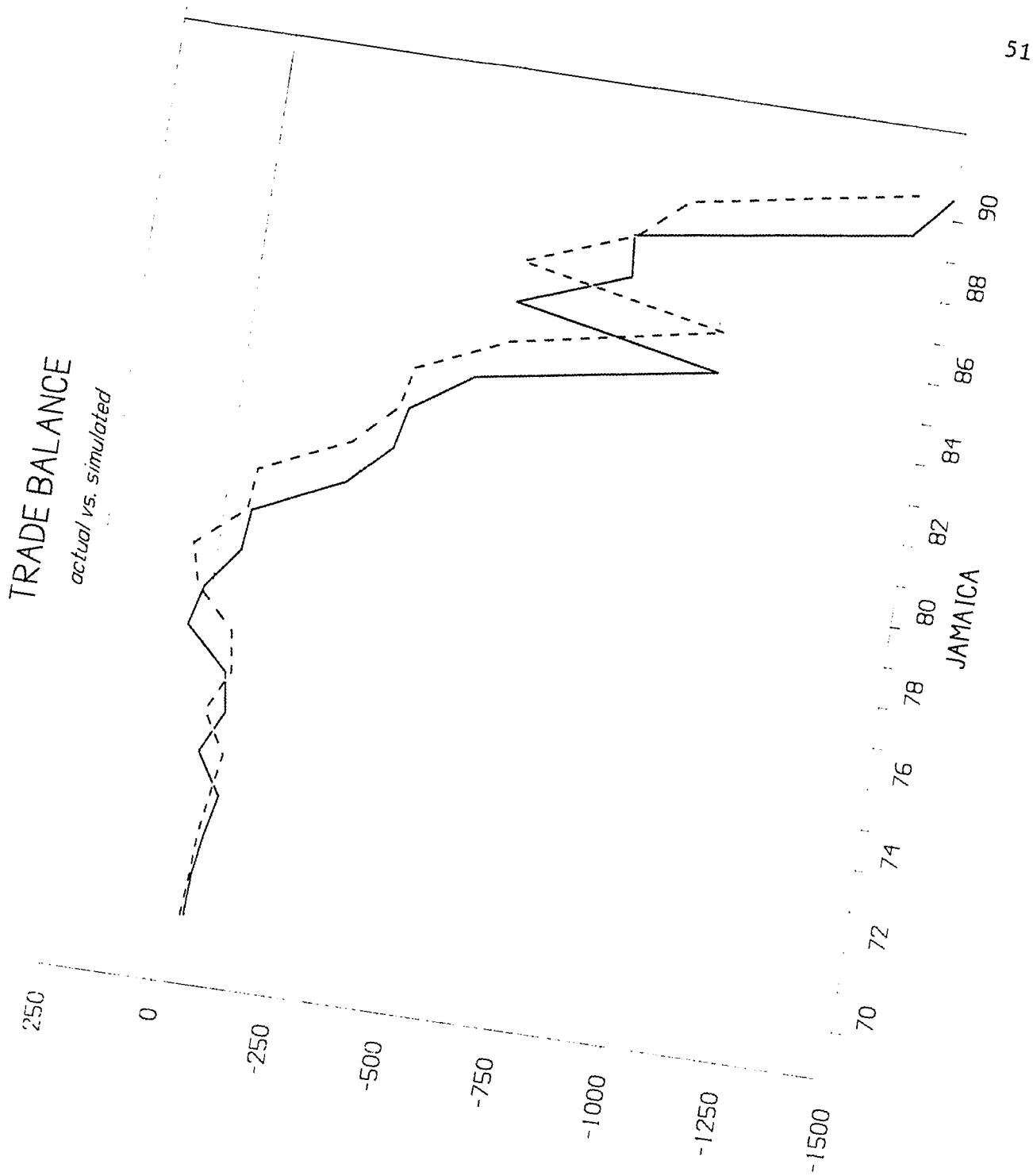

TRADE BALANCE
actual vs. simulated
JAMAICA
250
0
-250
-500
-750
-1000
-1250
-1500
70
72
74
76
78
80
82
84
86
88
90

Fig. 15

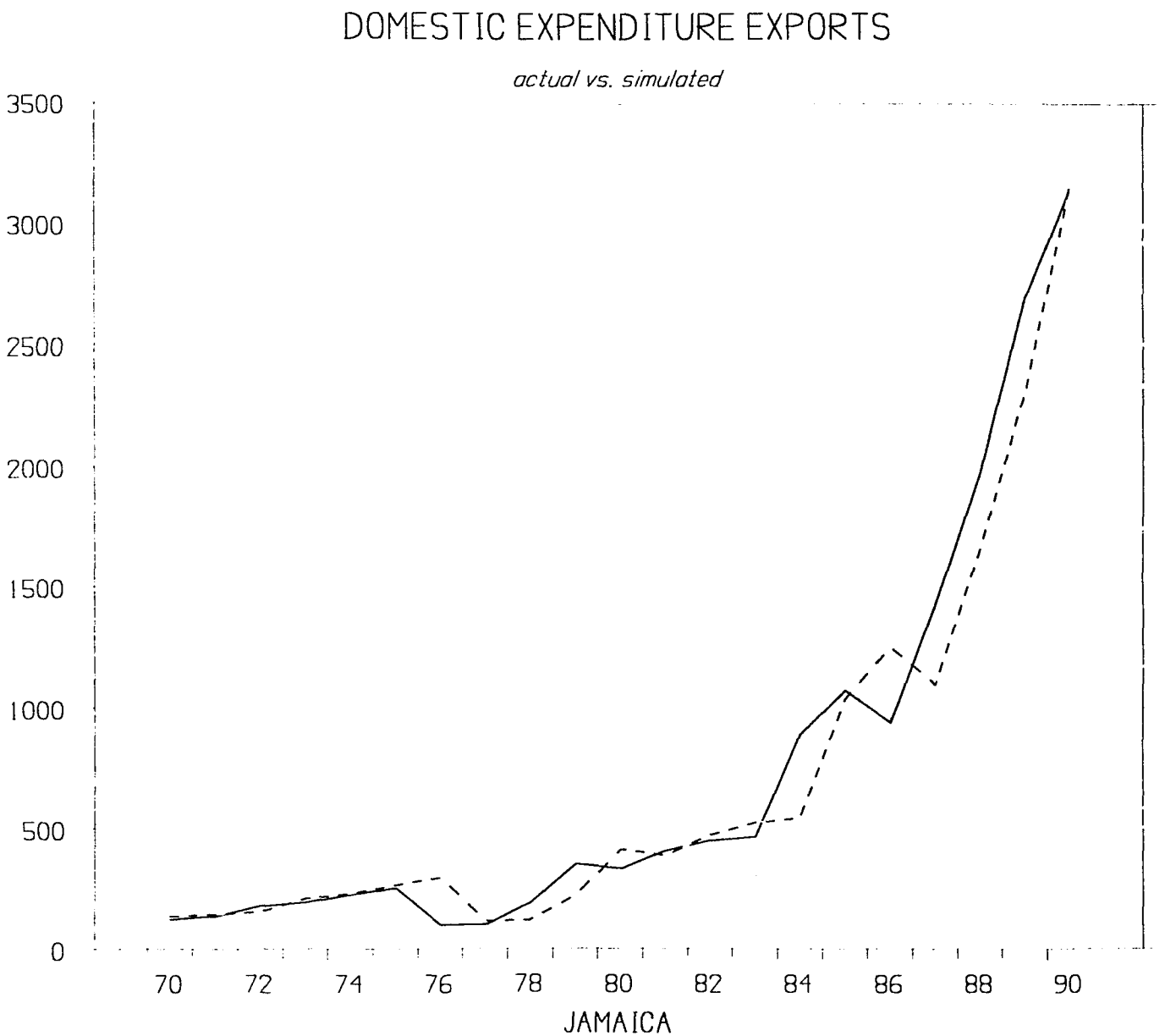

DOMESTIC EXPENDITURE EXPORTS
actual vs. simulated
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 16

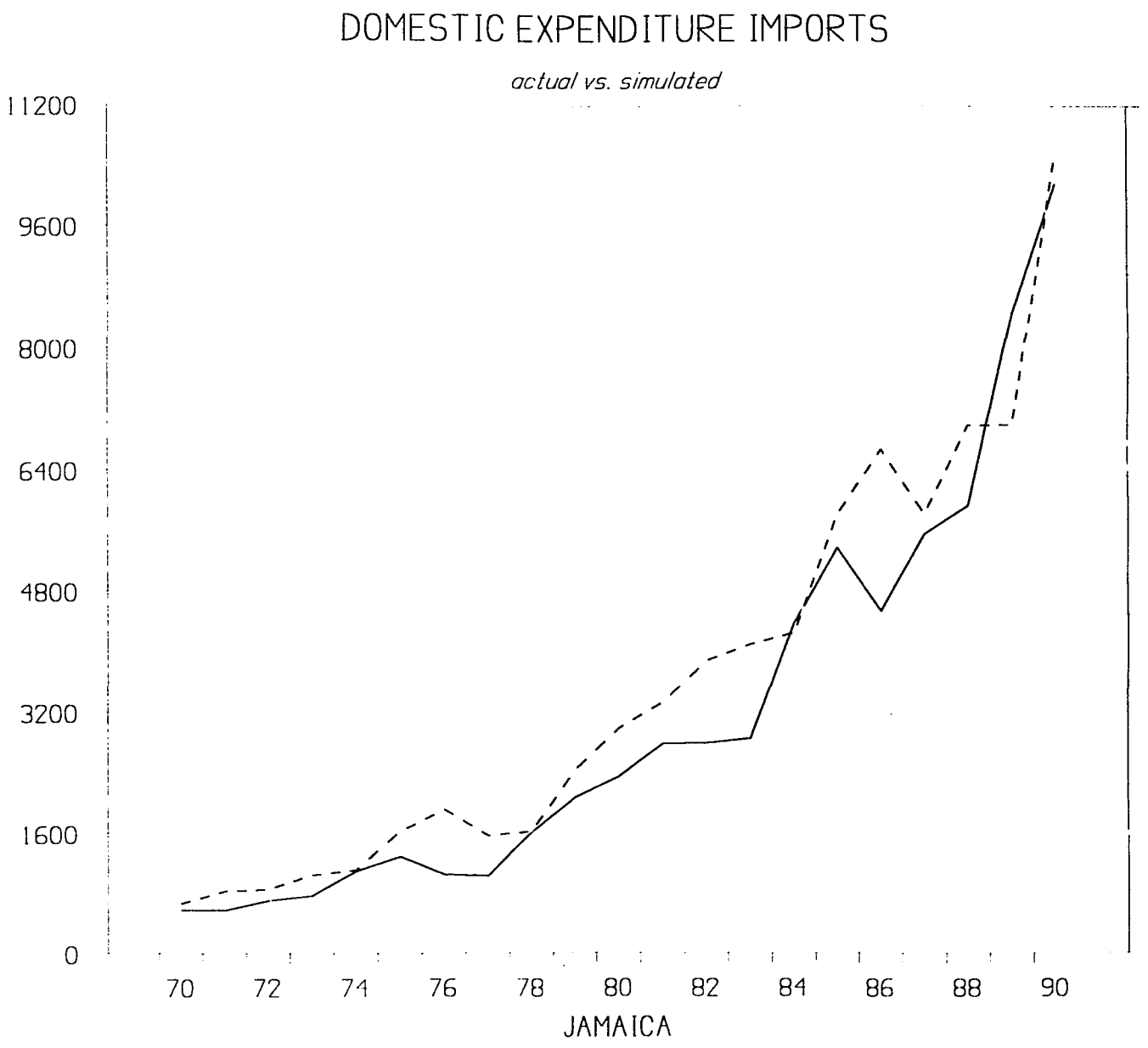

DOMESTIC EXPENDITURE IMPORTS
actual vs. simulated
11200
9600
8000
6400
4800
3200
1600
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 17

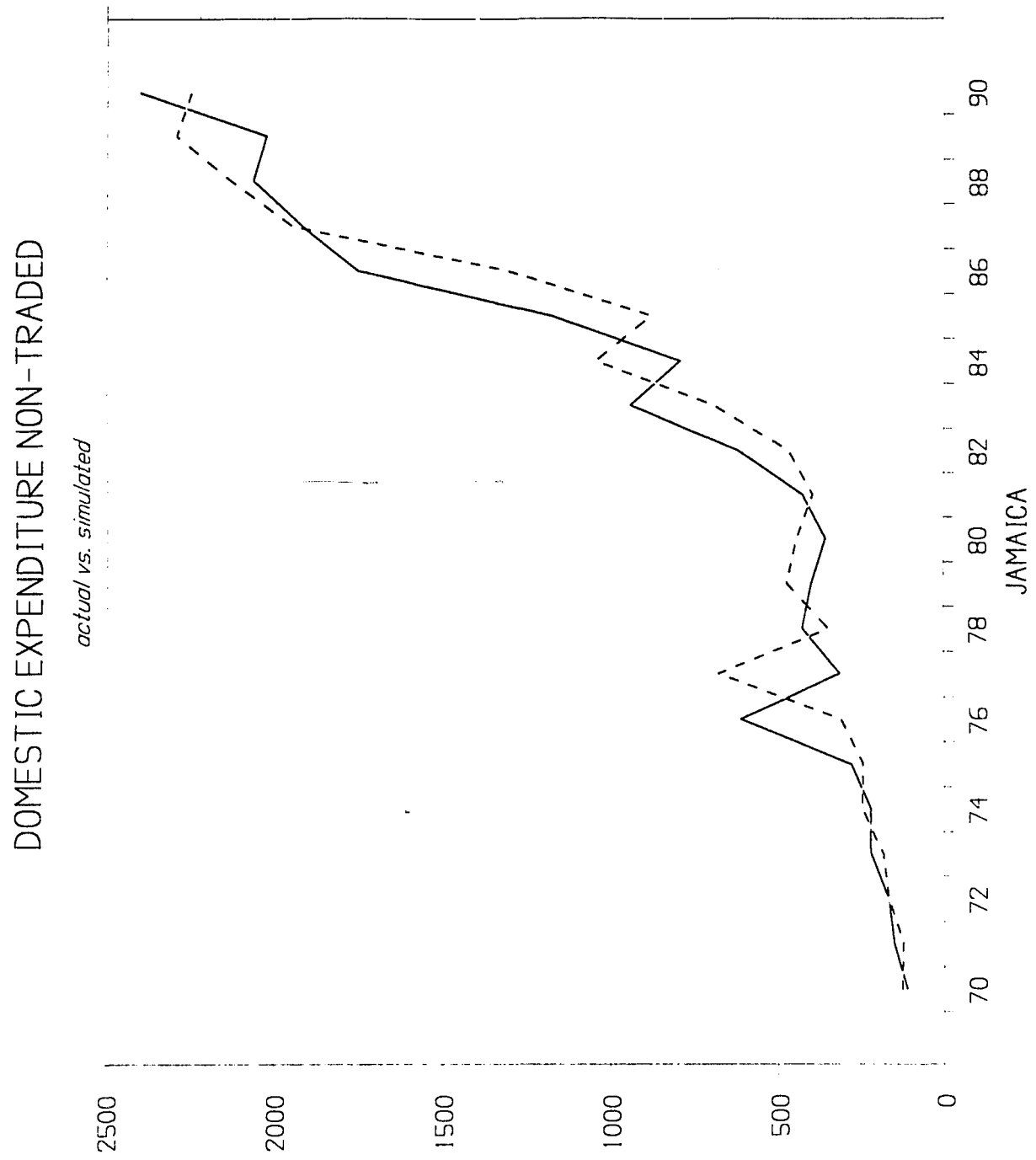

DOMESTIC EXPENDITURE NON-TRADED
actual vs. simulated
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 18

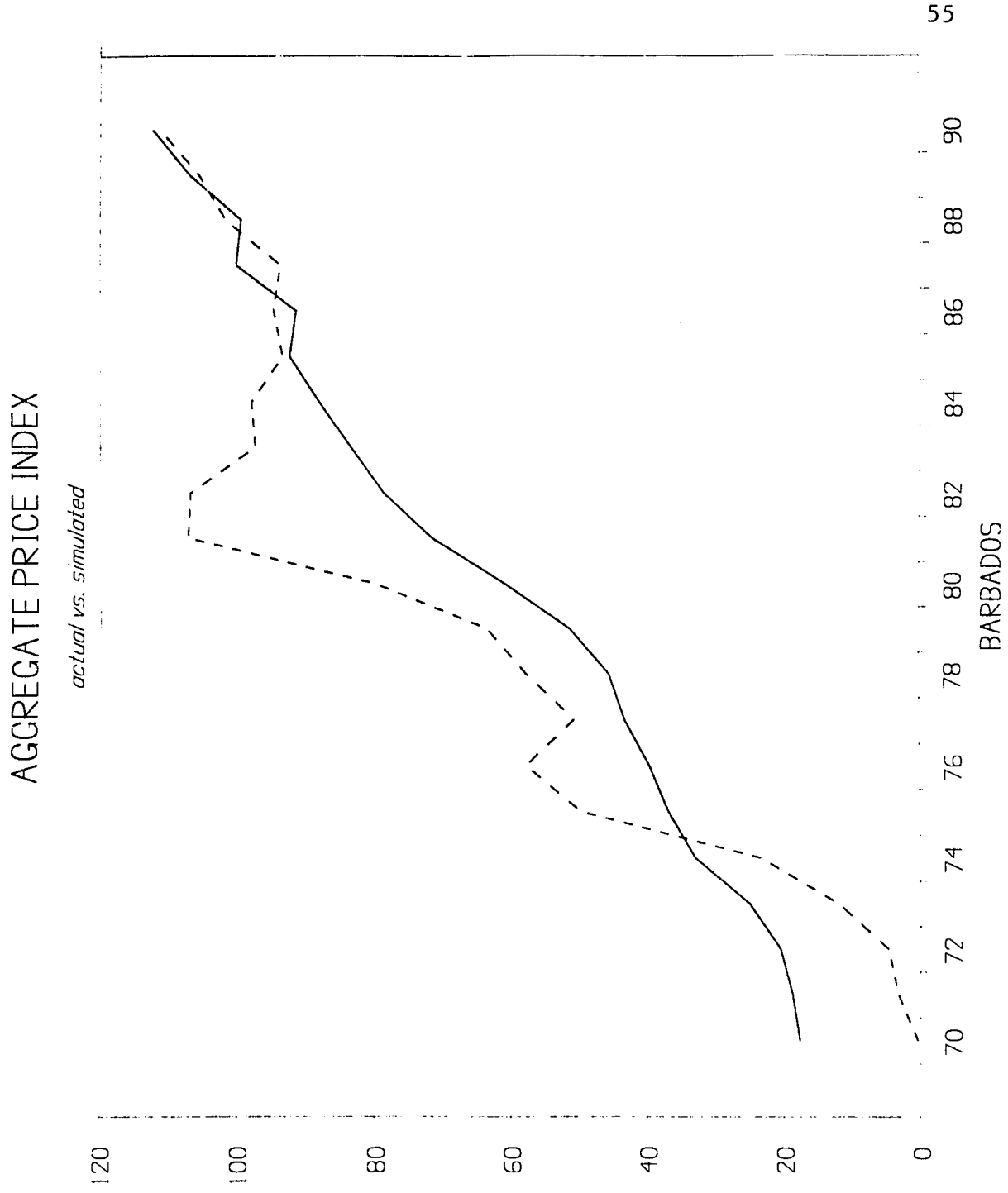

55
AGGREGATE PRICE INDEX
actual vs. simulated
BARBADOS
120
100
80
60
40
20
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 19

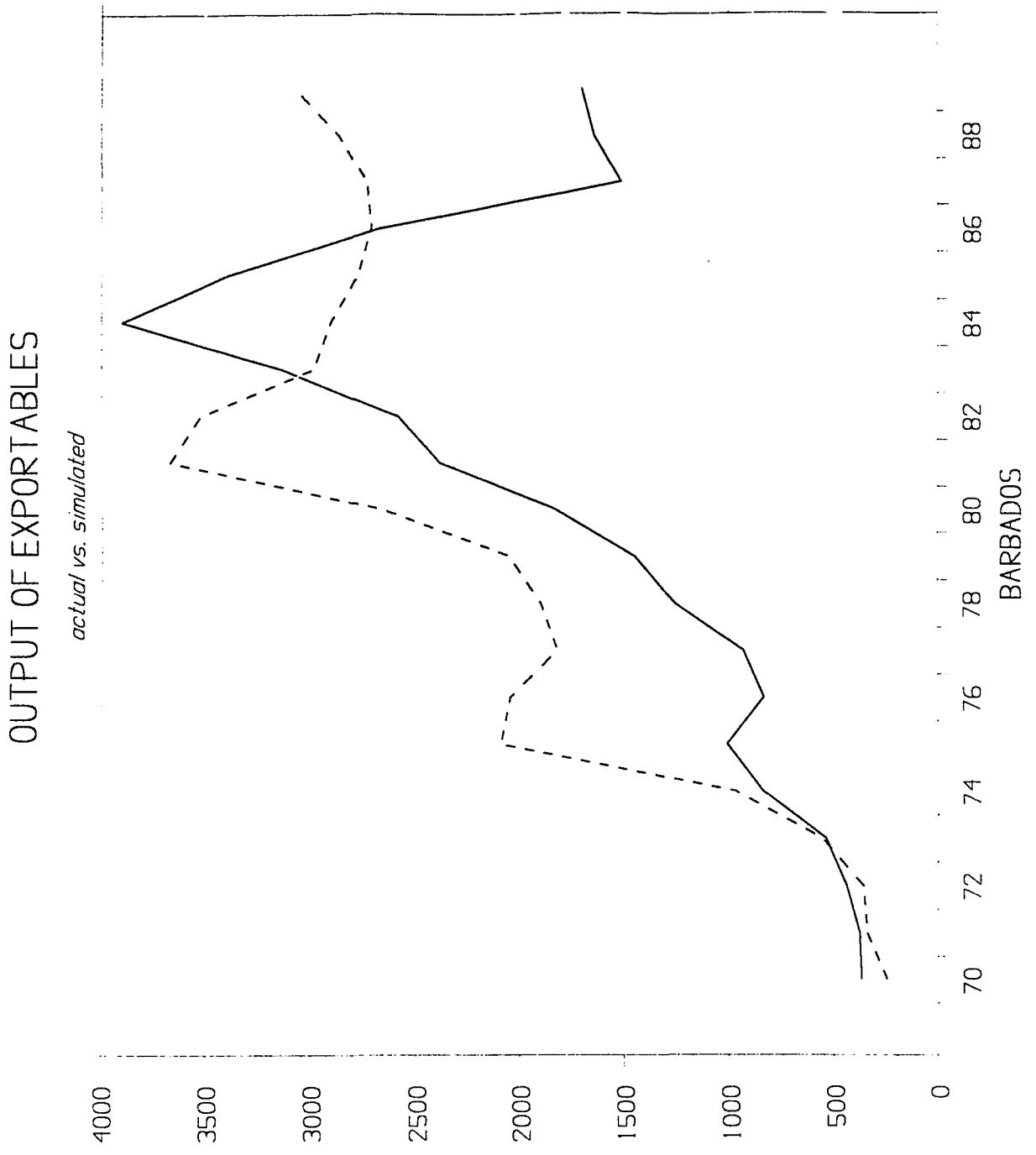

OUTPUT OF EXPORTABLES
actual vs. simulated
4000
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
BARBADOS

Fig. 20

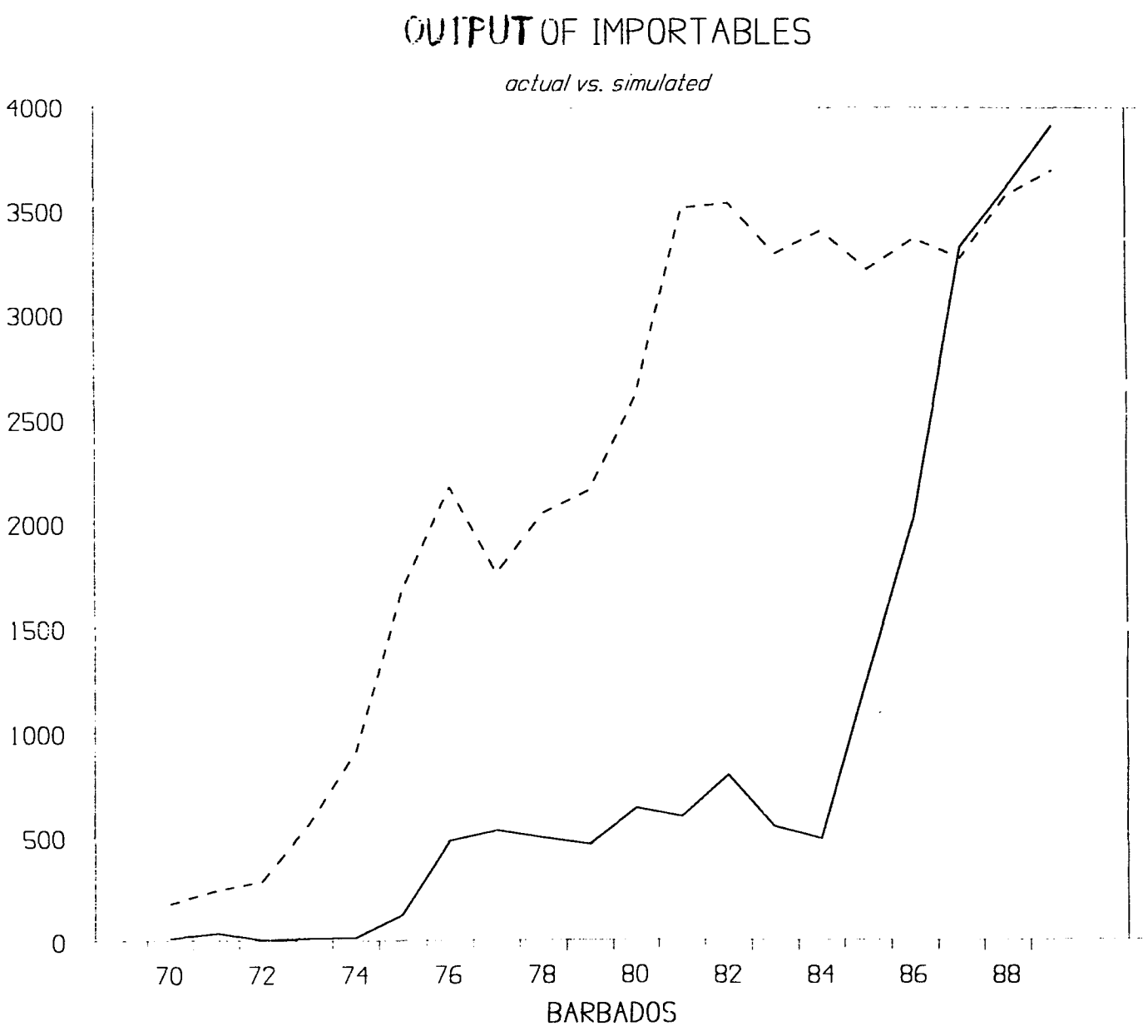

OUTPUT OF IMPORTABLES
actual vs. simulated
4000
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
BARBADOS

Fig. 21

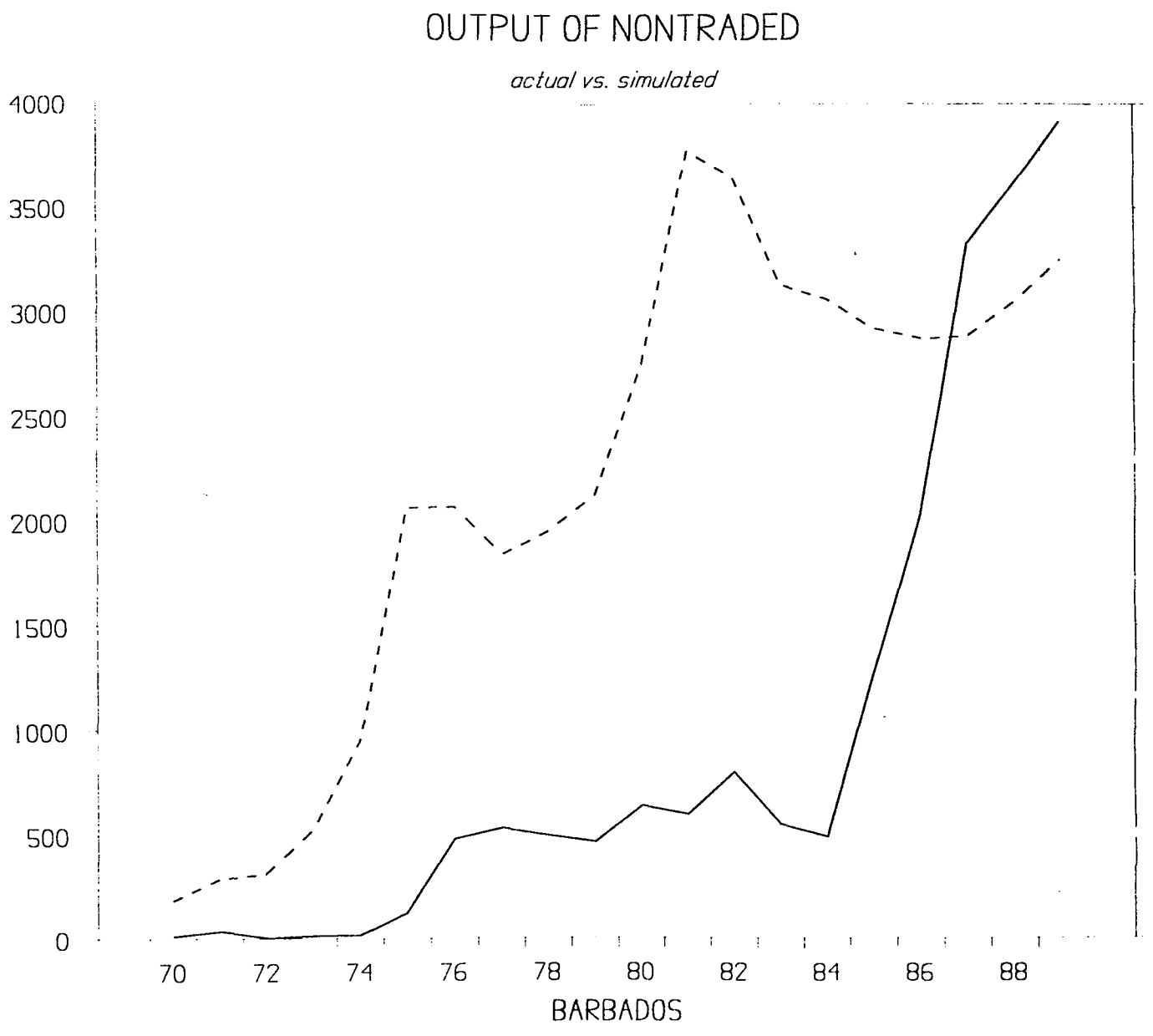
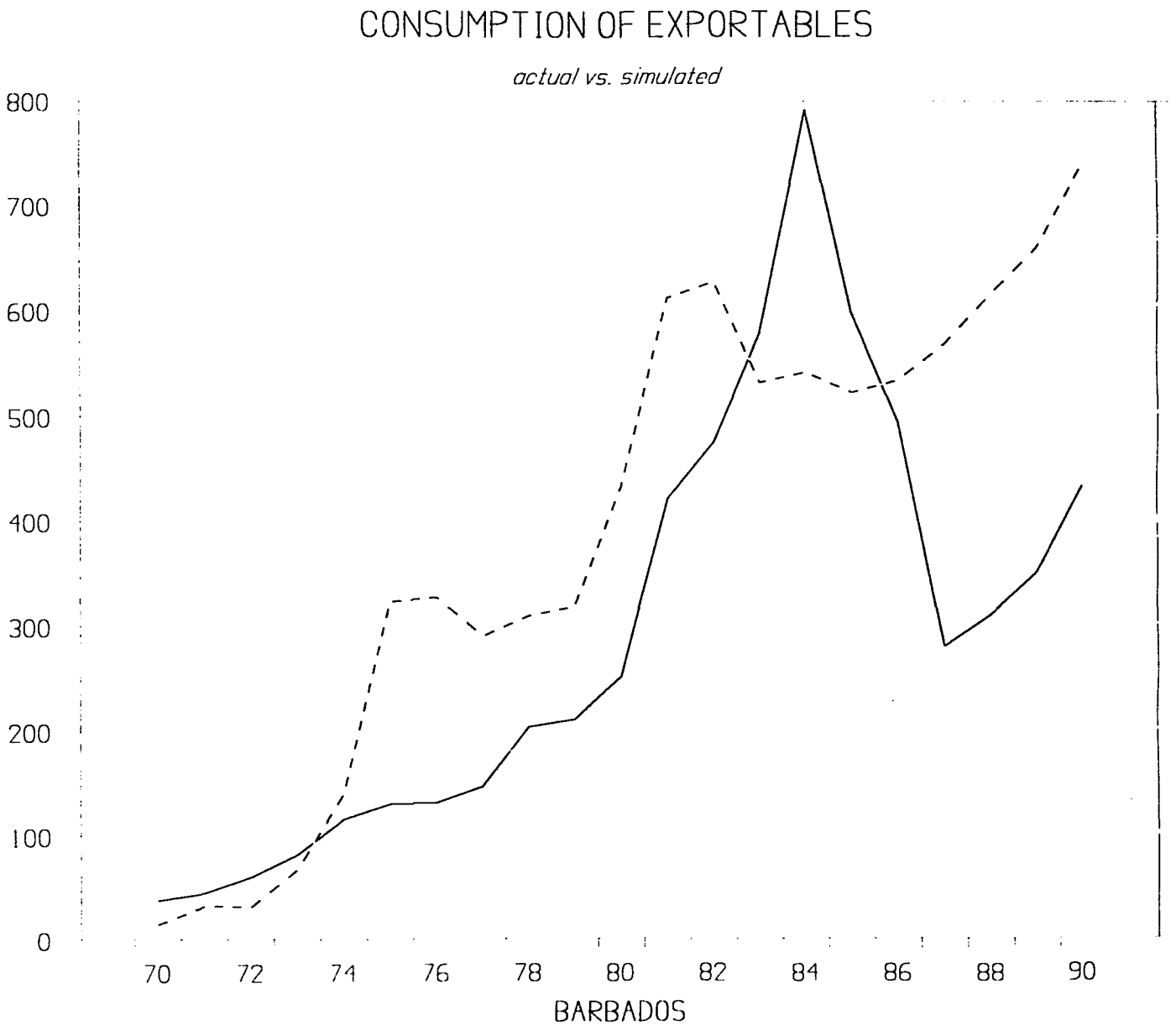

OUTPUT OF NONTRADED
actual vs. simulated
4000
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
BARBADOS

Fig. 22


CONSUMPTION OF EXPORTABLES
actual vs. simulated
800
700
600
500
400
300
200
100
0
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

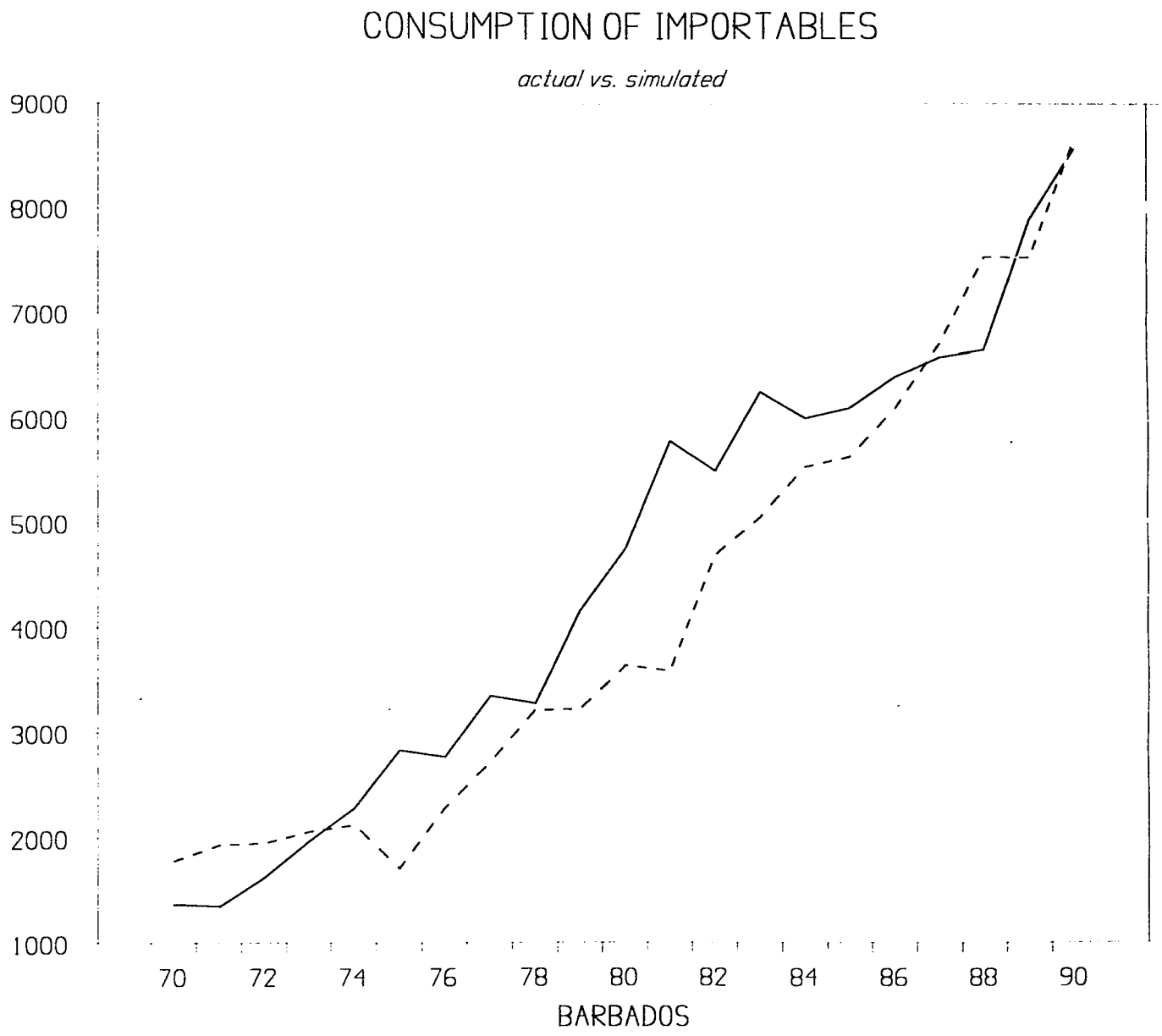

CONSUMPTION OF IMPORTABLES
actual vs. simulated
9000
8000
7000
6000
5000
4000
3000
2000
1000
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 24

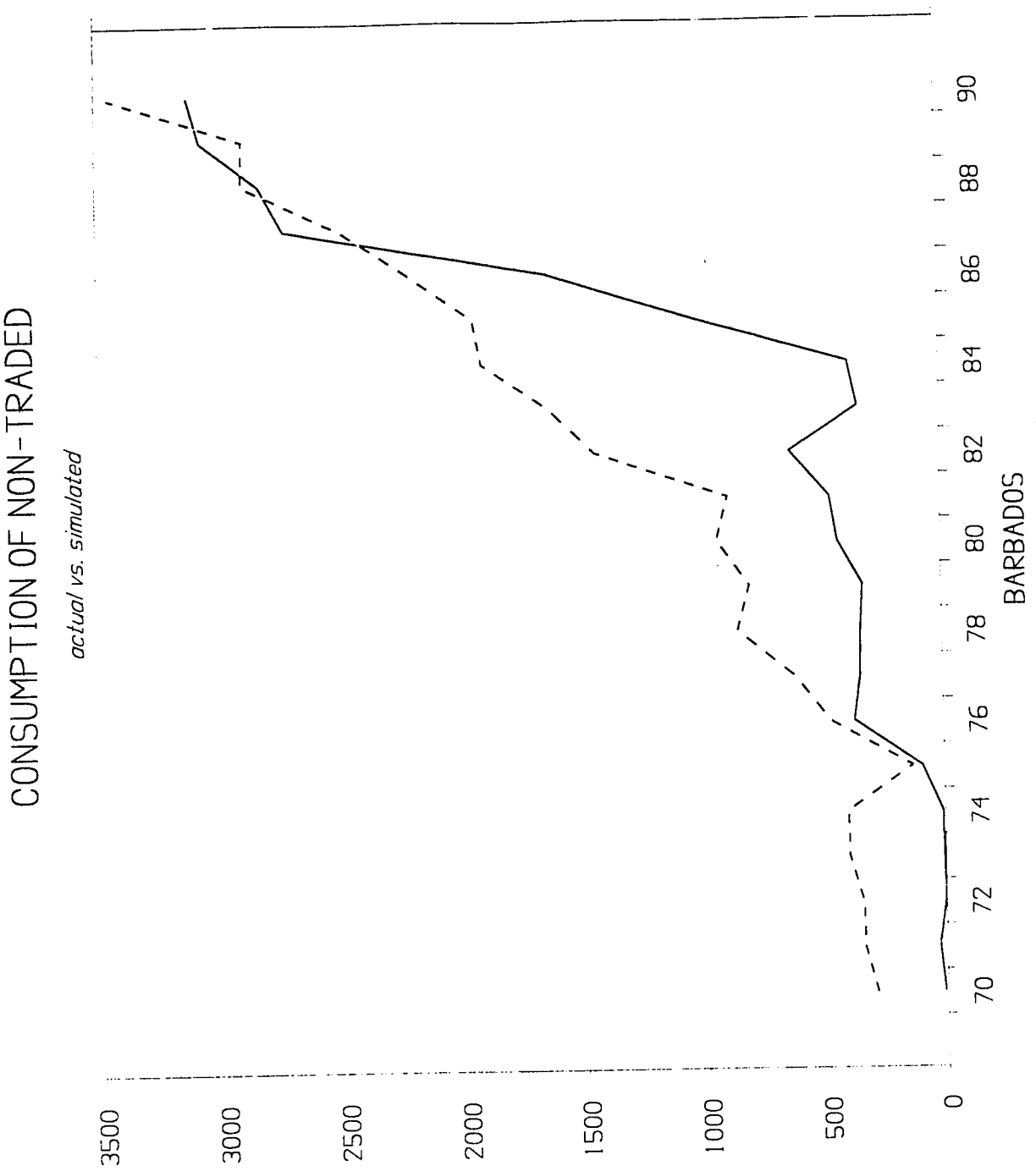

CONSUMPTION OF NON-TRADED
actual vs. simulated
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 25

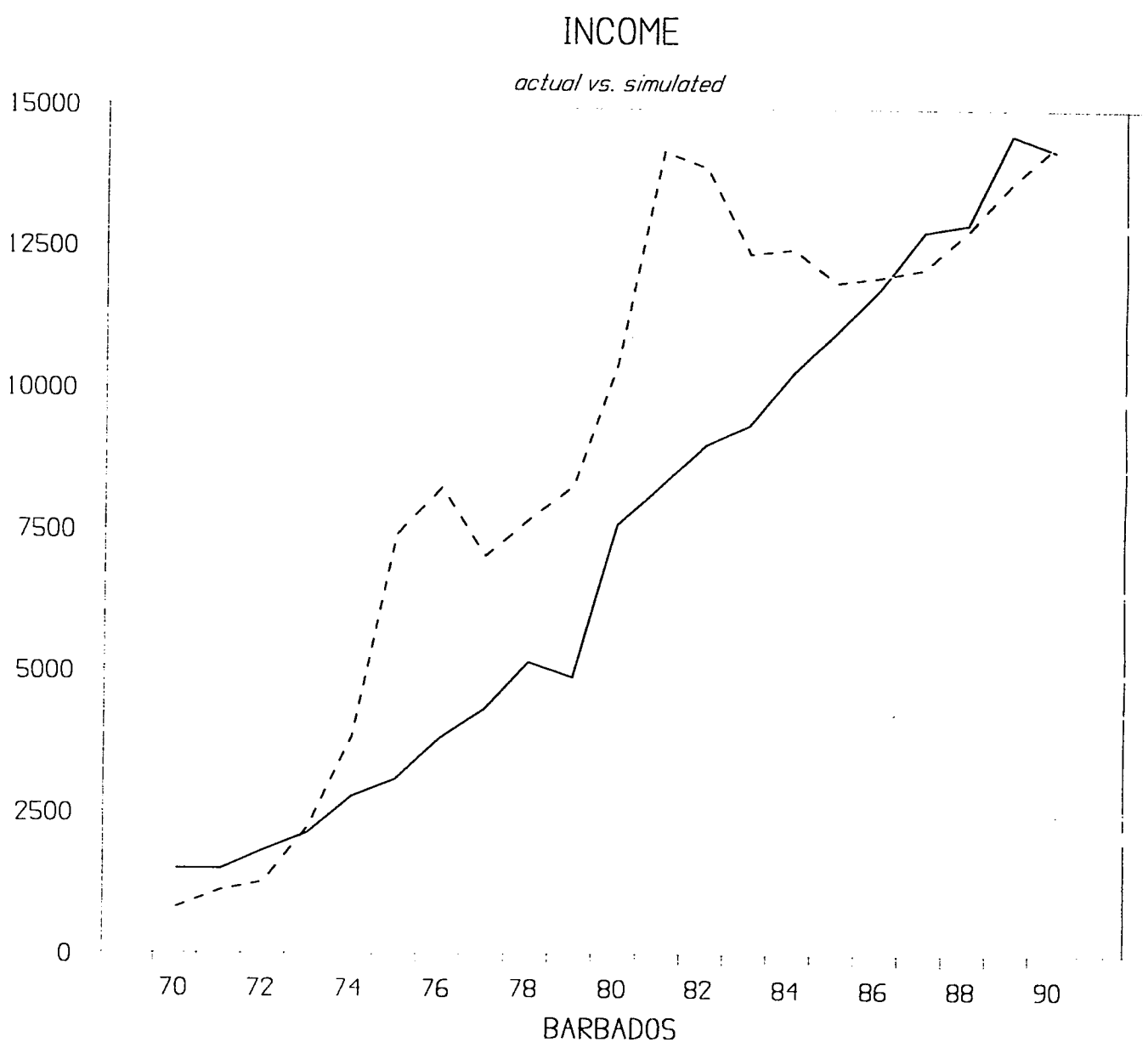

INCOME
actual vs. simulated
15000
12500
10000
7500
5000
2500
0
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 26

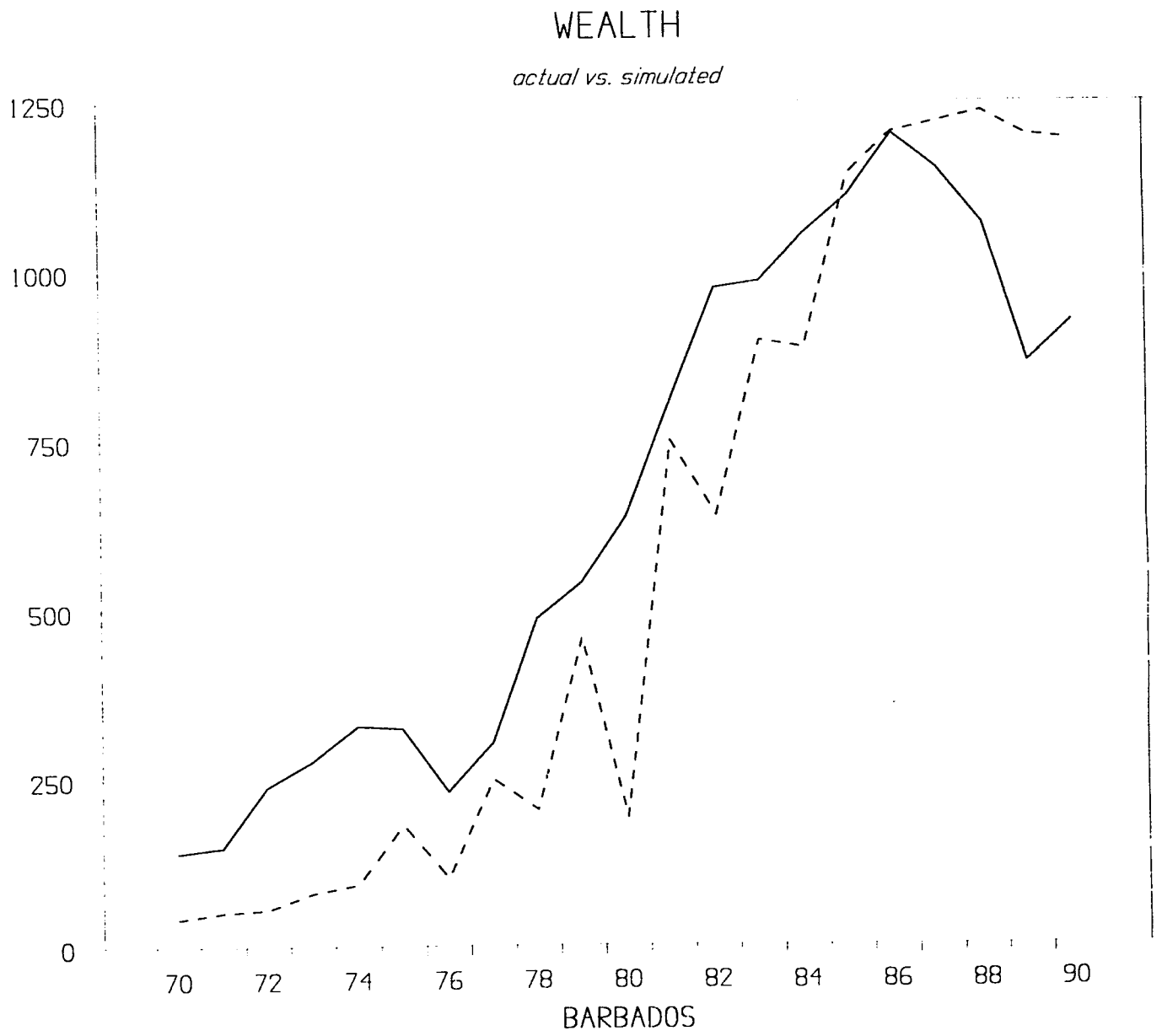

WEALTH
actual vs. simulated
1250
1000
750
500
250
0
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 27

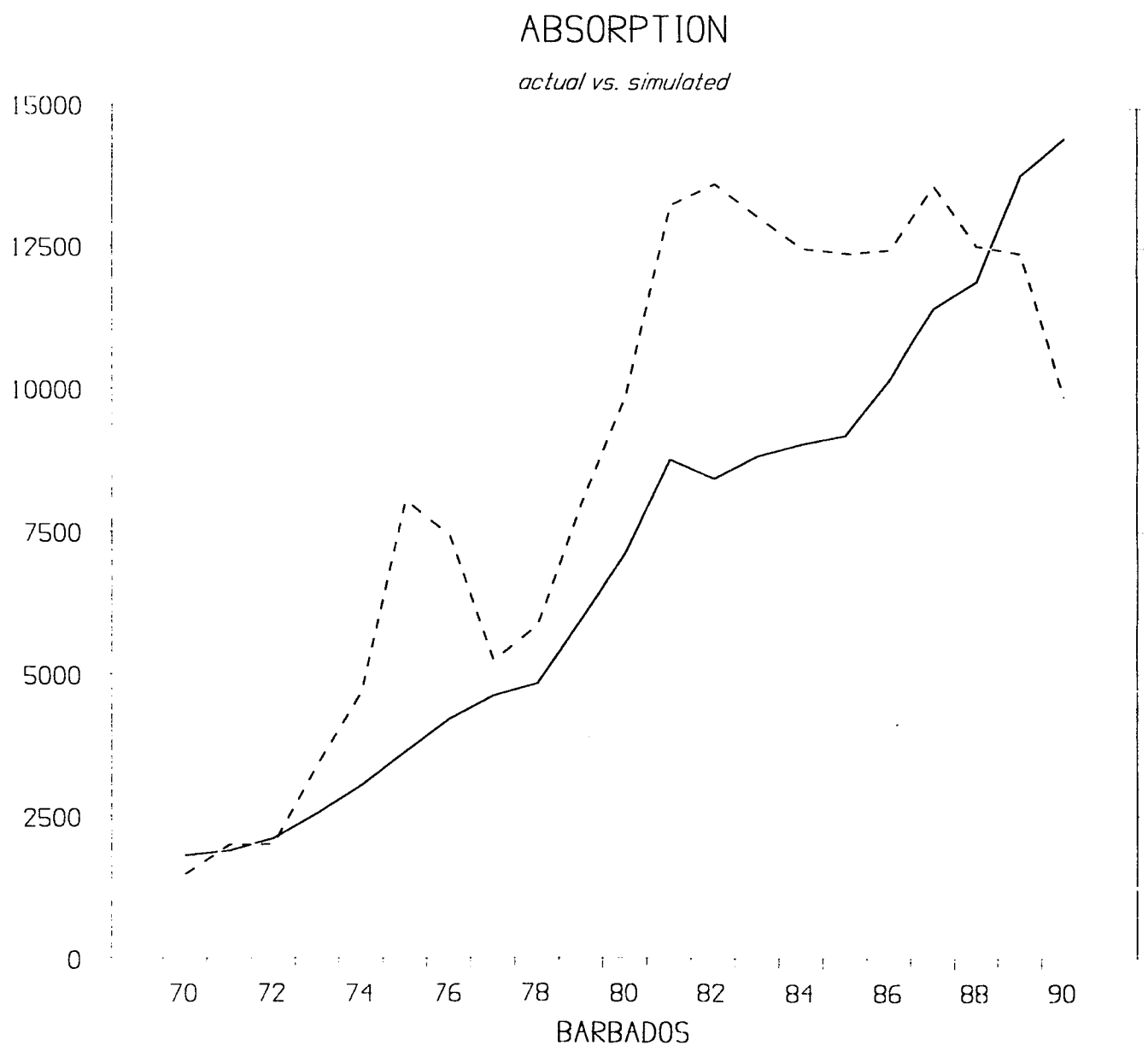

ABSORPTION
actual vs. simulated
15000
12500
10000
7500
5000
2500
0
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 28

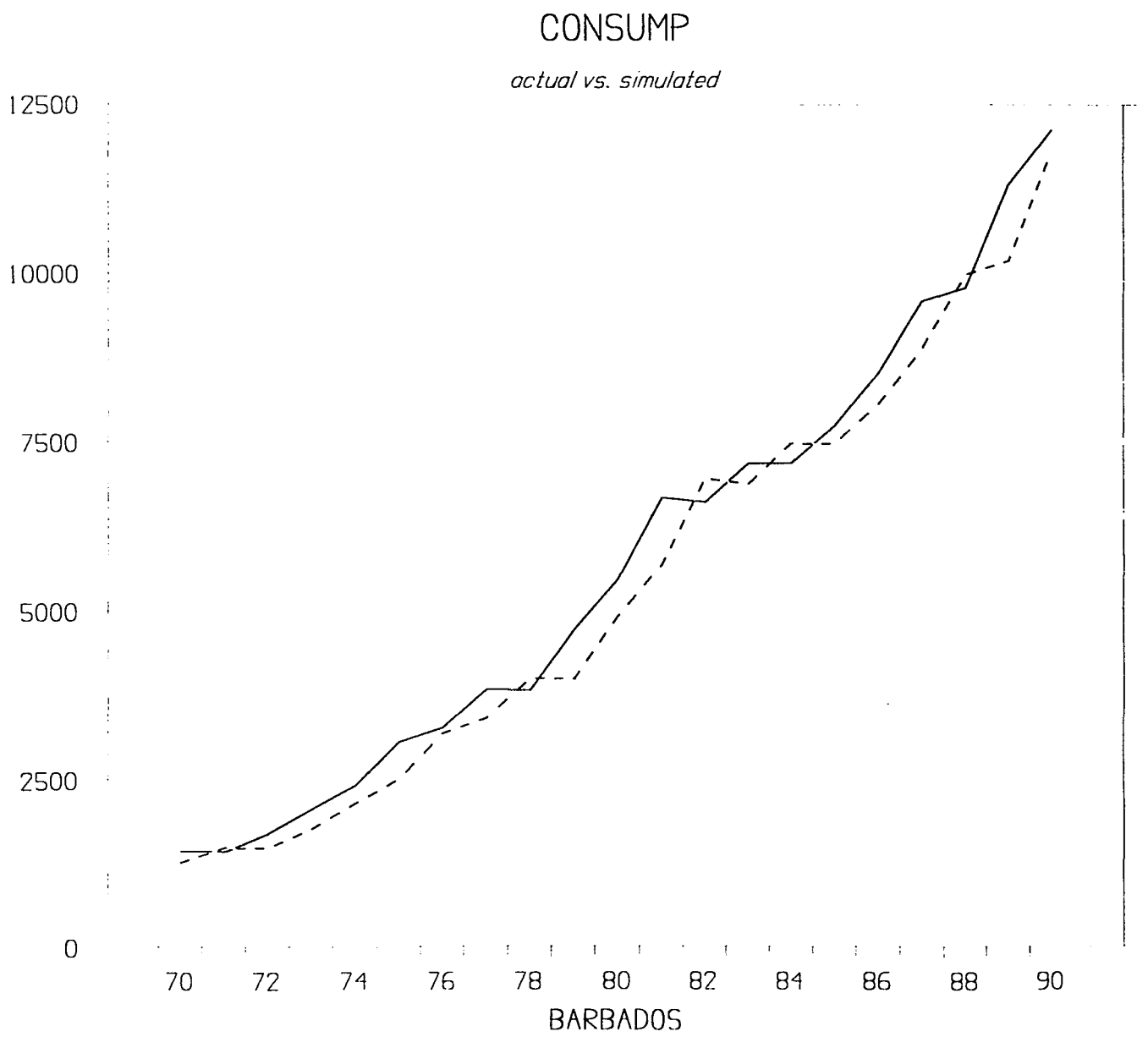

CONSUMP
actual vs. simulated
12500
10000
7500
5000
2500
0
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 29

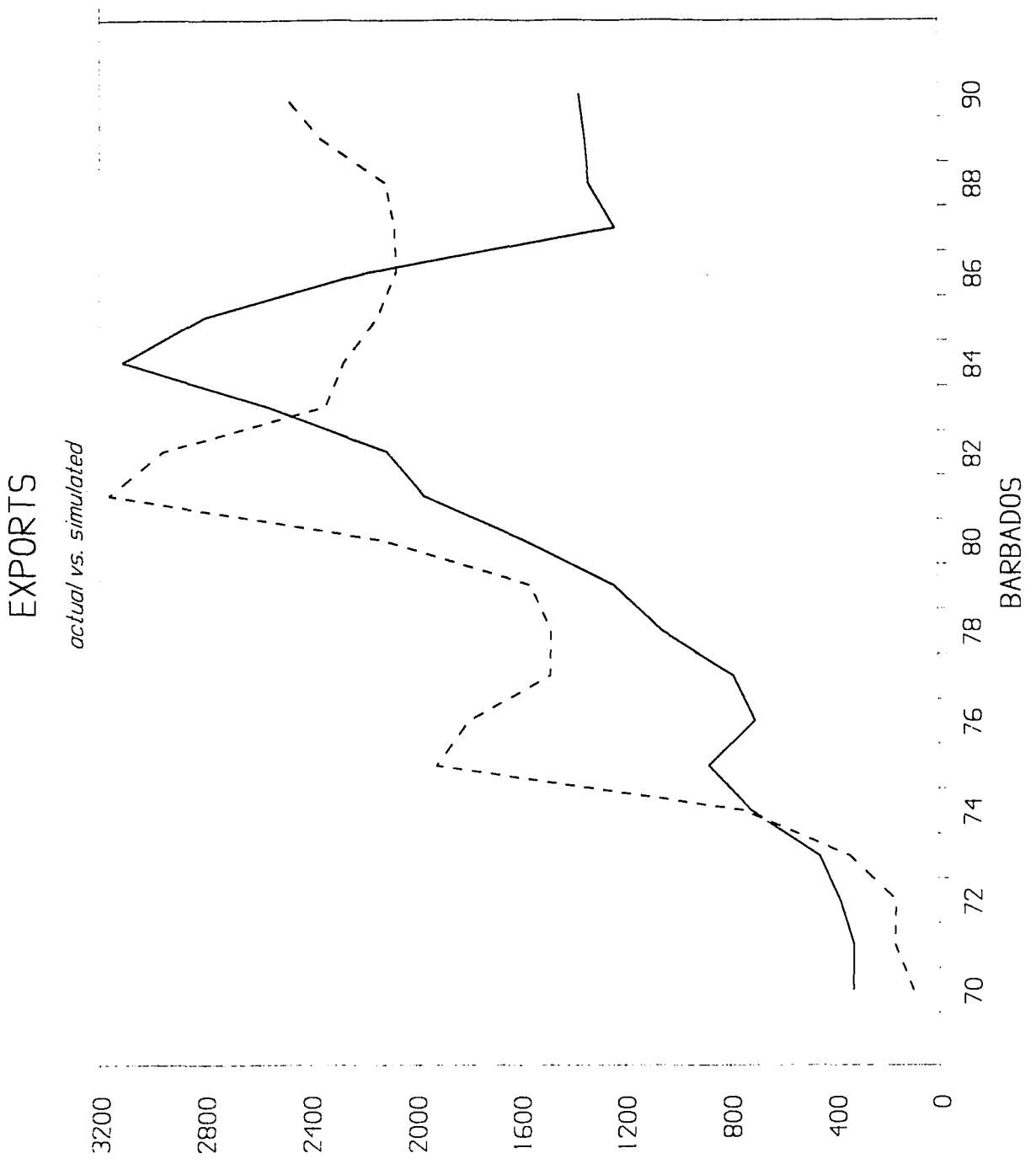

EXPORTS
actual vs. simulated
BARBADOS
3200
2800
2400
2000
1600
1200
800
400
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 30

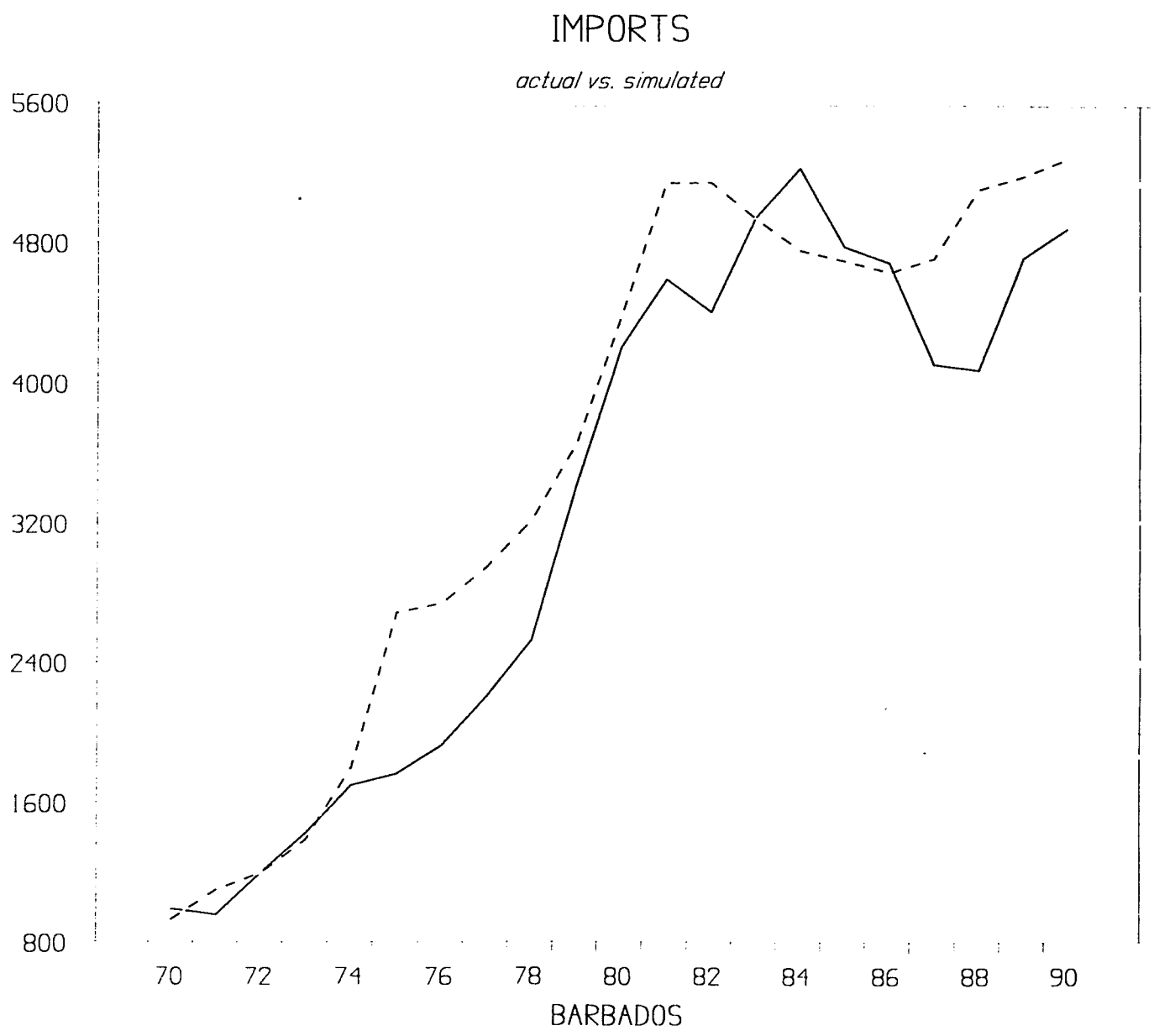

IMPORTS
actual vs. simulated
5600
4800
4000
3200
2400
1600
800
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 31

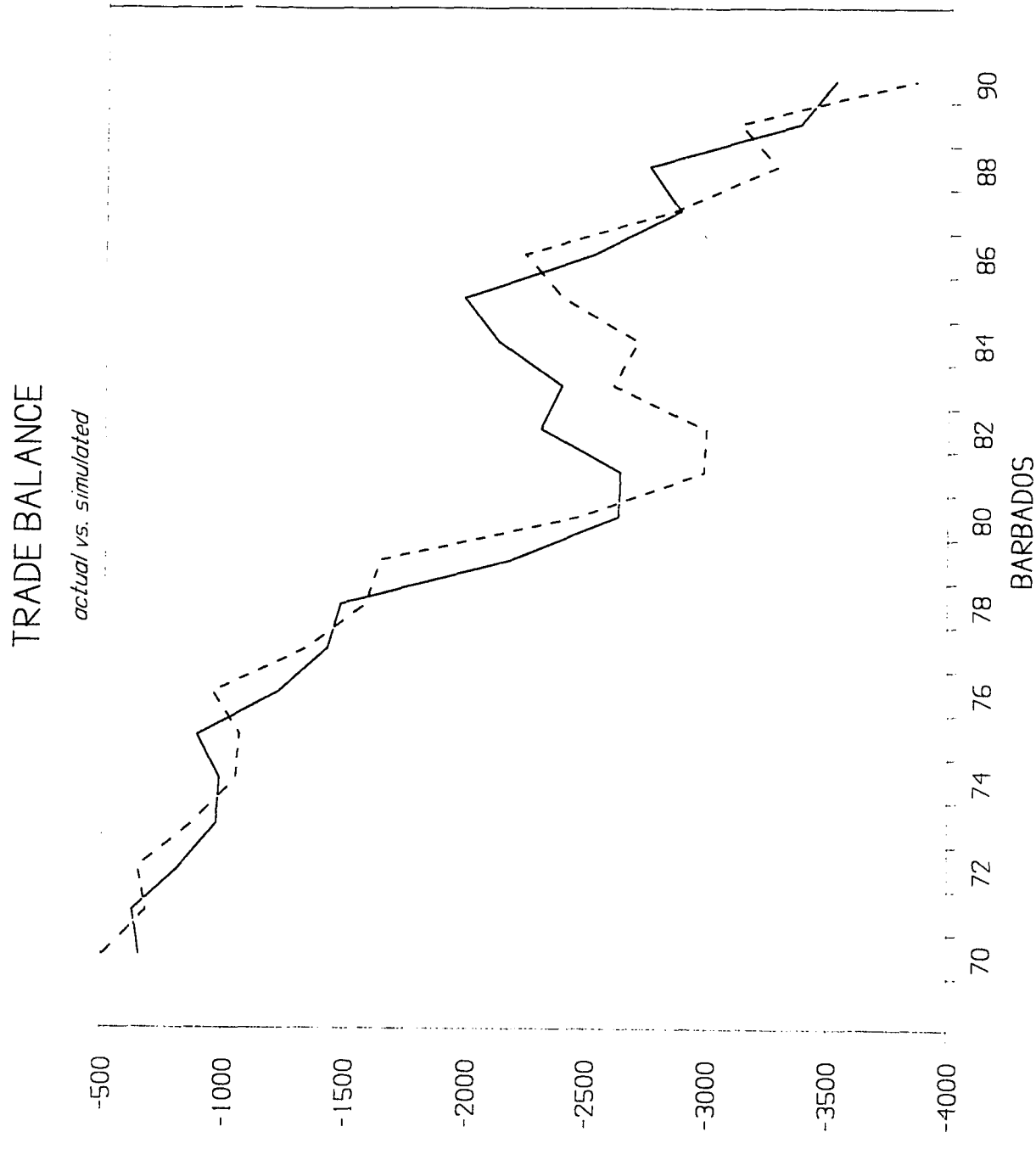

TRADE BALANCE
actual vs. simulated
-500
-1000
-1500
-2000
-2500
-3000
-3500
-4000
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 32

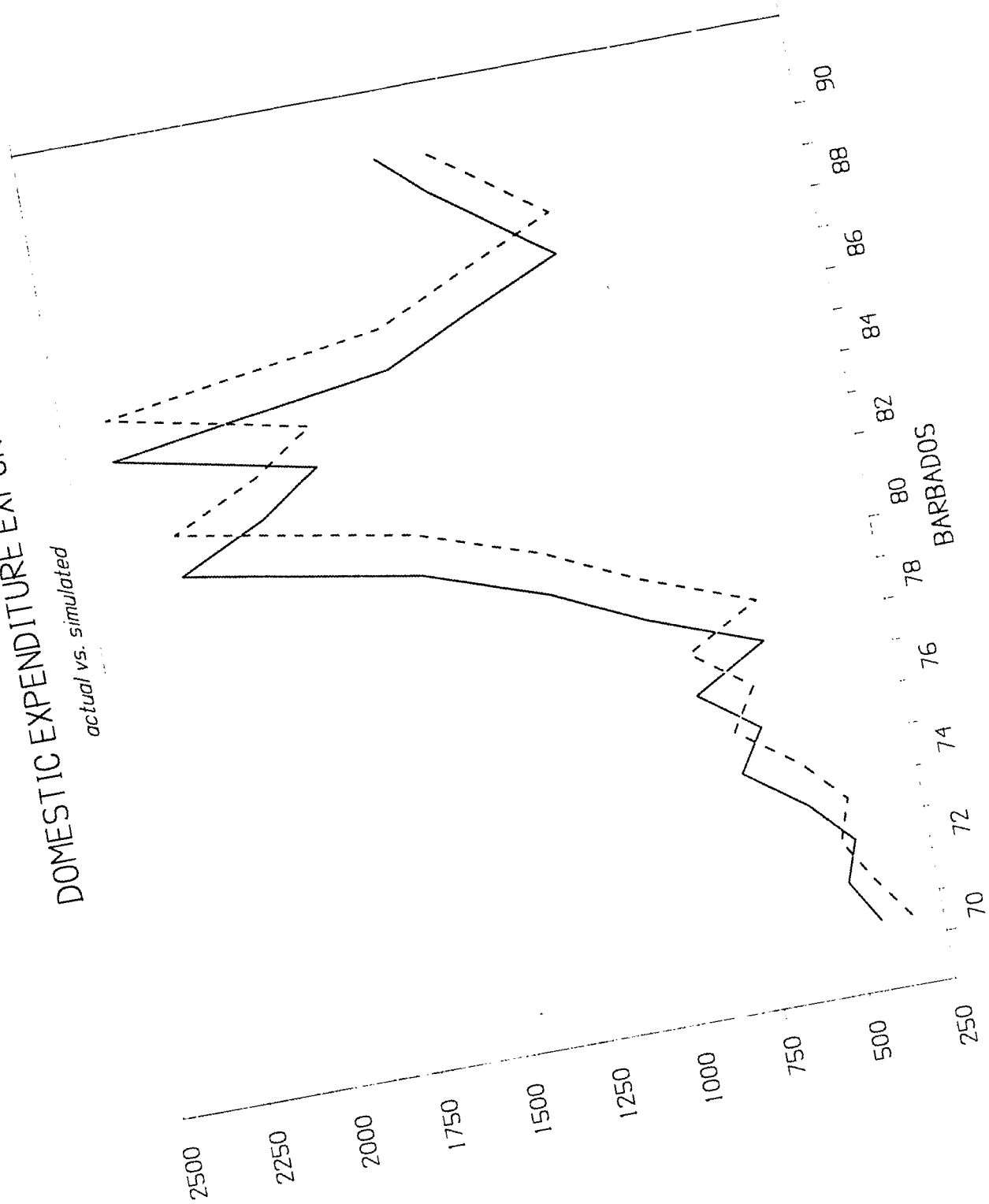

DOMESTIC EXPENDITURE EXPORTS
actual vs. simulated
2500
2250
2000
1750
1500
1250
1000
750
500
250
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 33

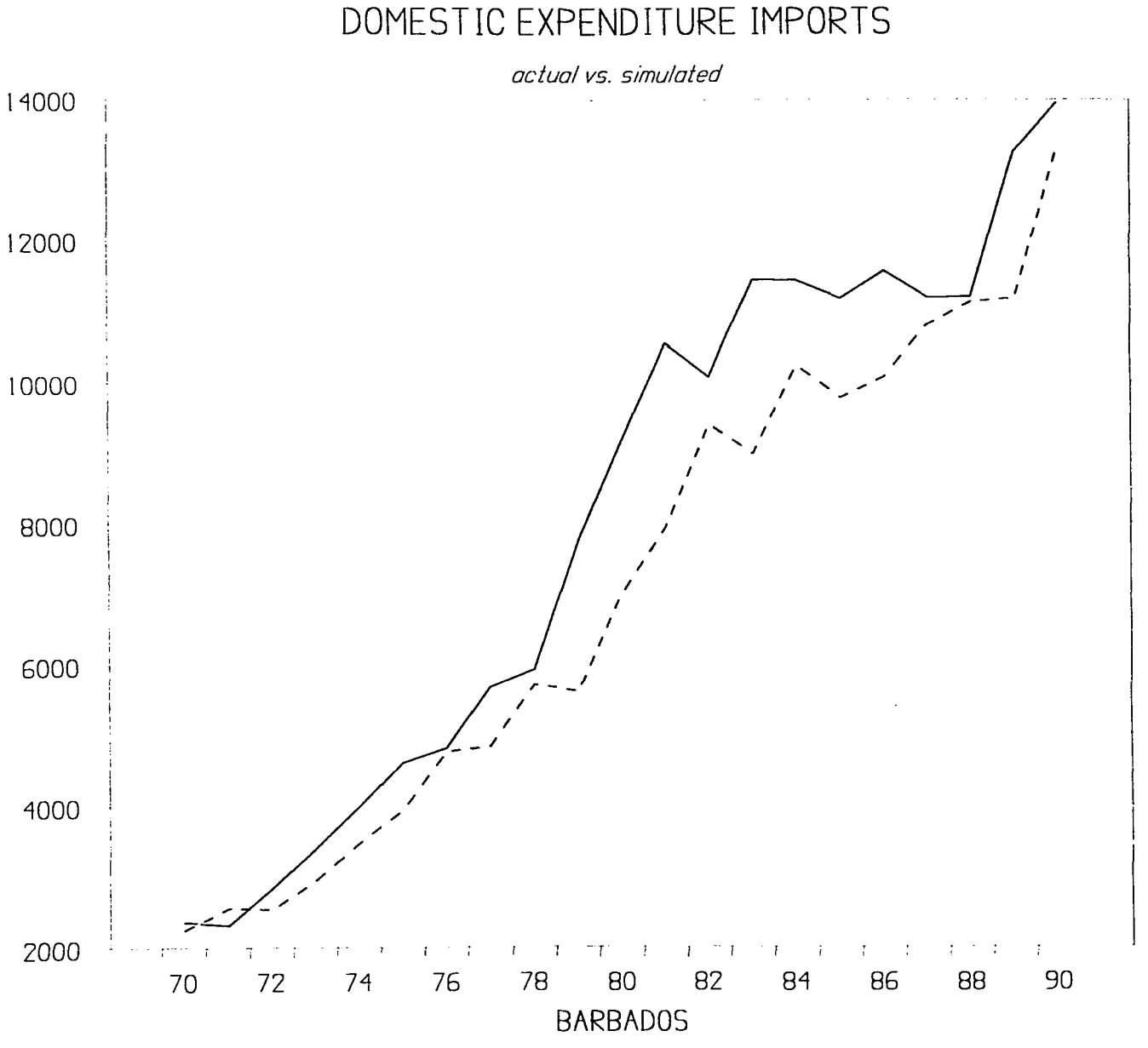

DOMESTIC EXPENDITURE IMPORTS
actual vs. simulated
14000
12000
10000
8000
6000
4000
2000
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 34

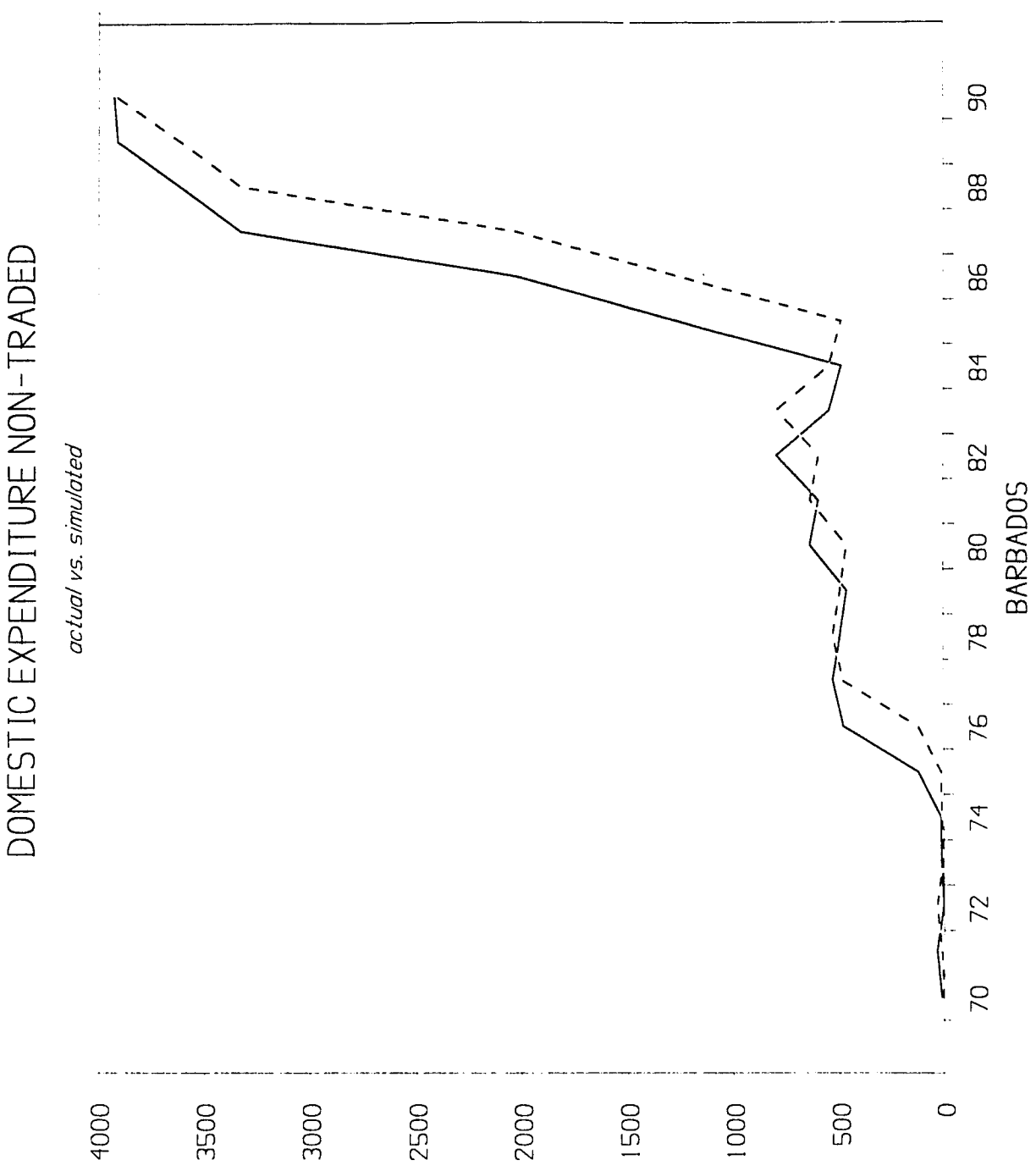

DOMESTIC EXPENDITURE NON-TRADED
actual vs. simulated
4000
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 35

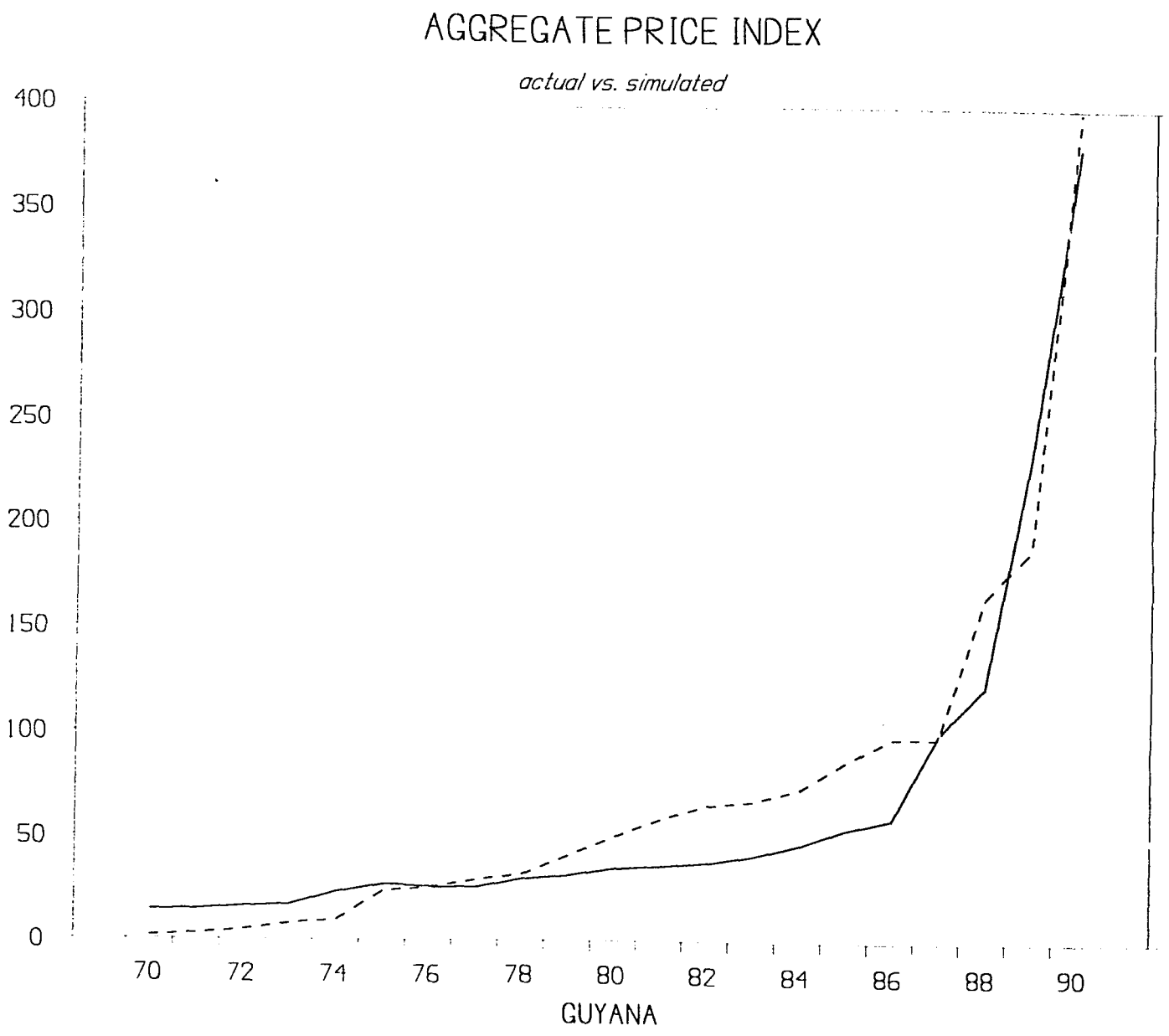

AGGREGATE PRICE INDEX
actual vs. simulated
400
350
300
250
200
150
100
50
0
70
72
74
76
78
80
82
84
86
88
90
GUYANA

Fig. 36

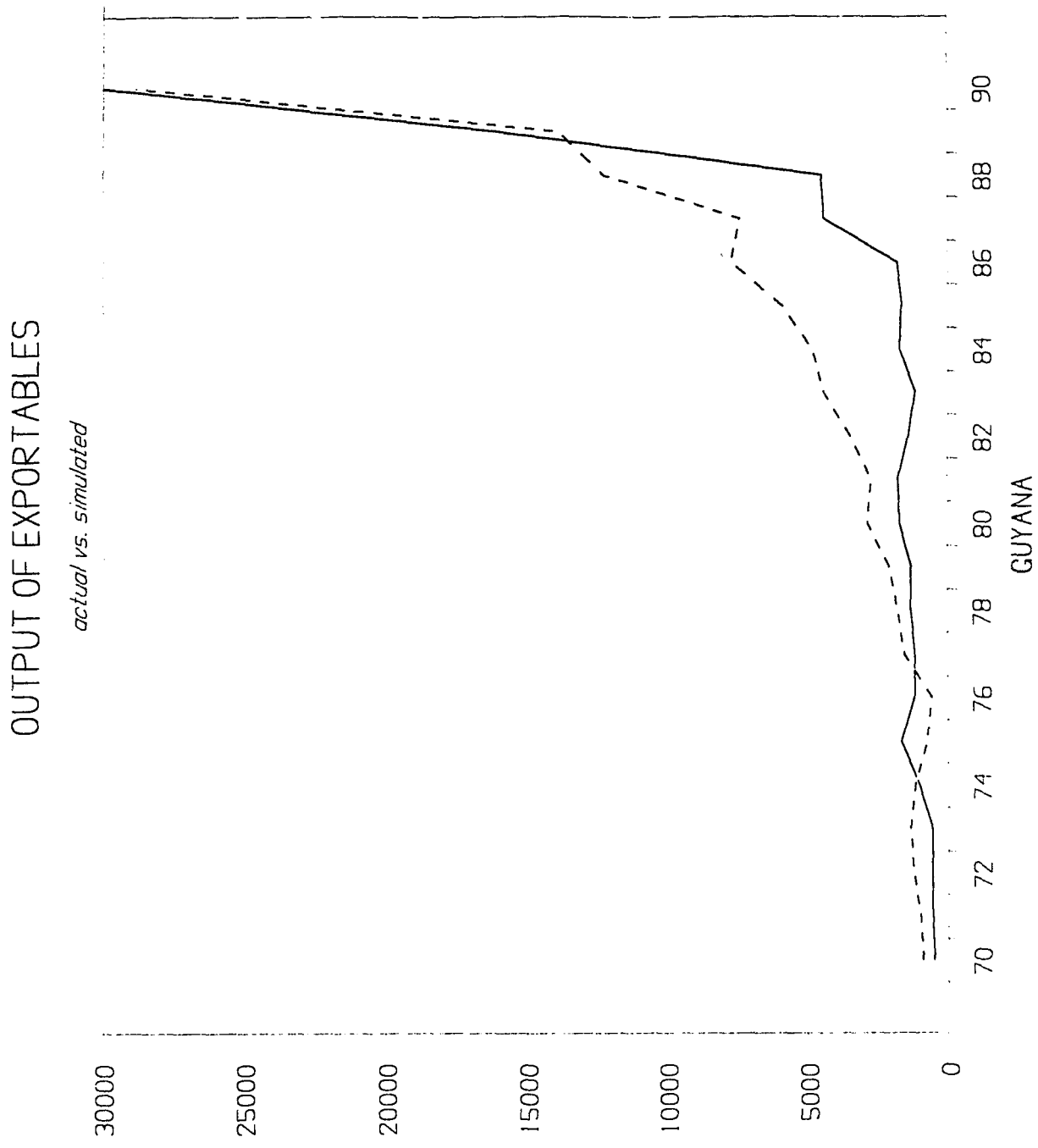

OUTPUT OF EXPORTABLES
actual vs. simulated
GUYANA
30000
25000
20000
15000
10000
5000
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 37

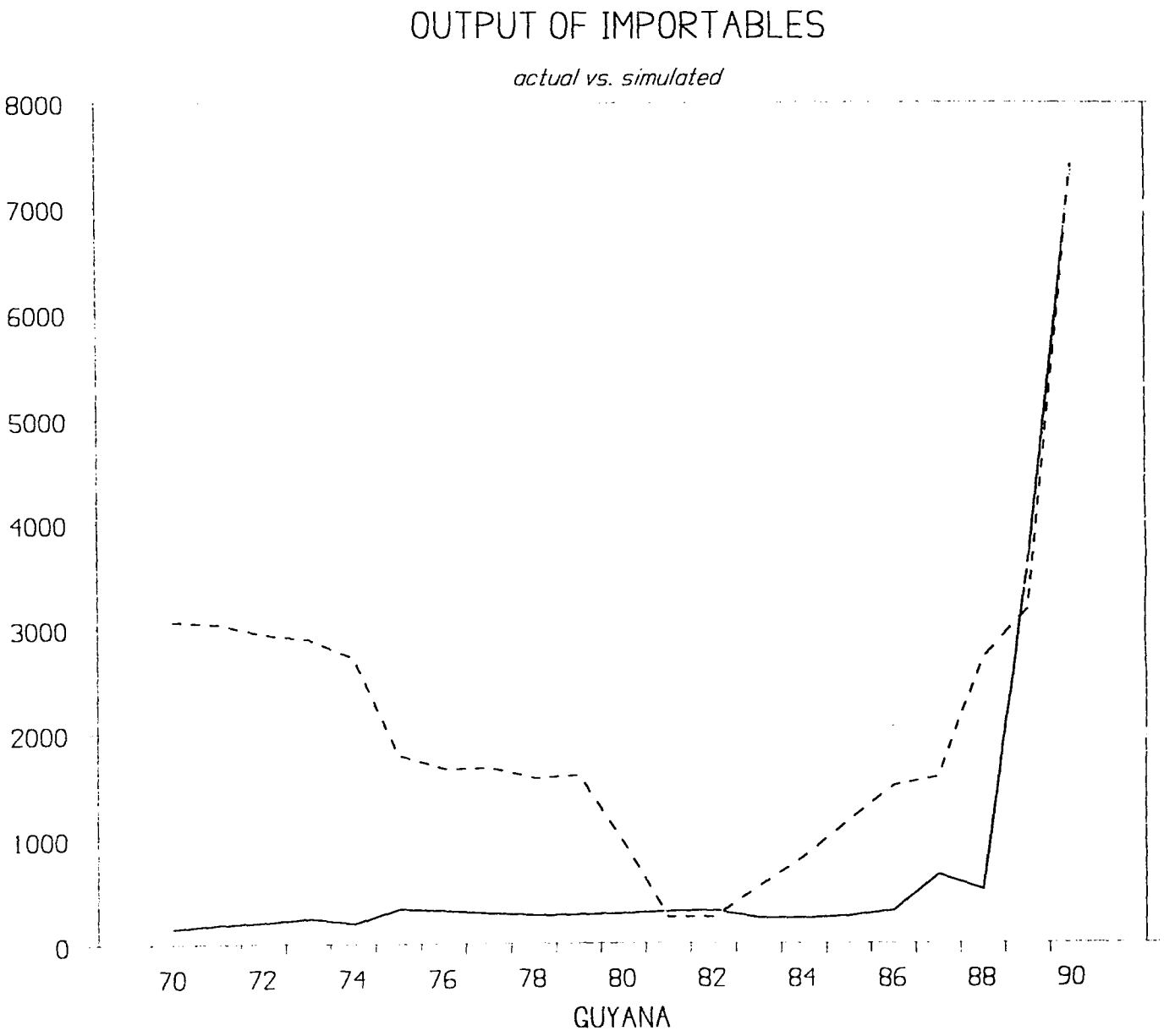

OUTPUT OF IMPORTABLES
actual vs. simulated
8000
7000
6000
5000
4000
3000
2000
1000
0
70
72
74
76
78
80
82
84
86
88
90
GUYANA

Fig. 38

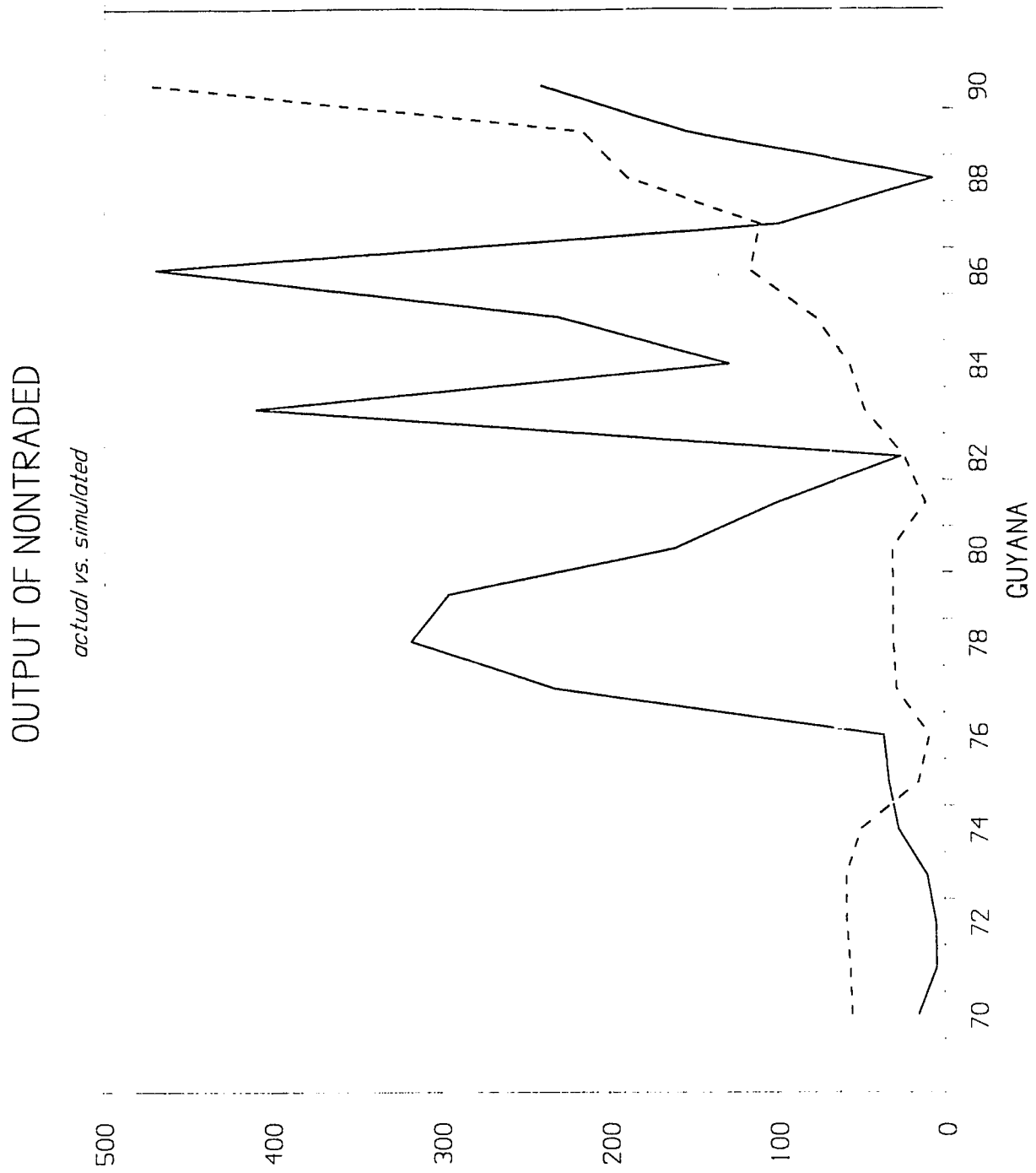

OUTPUT OF NONTRADED
actual vs. simulated
GUYANA
500
400
300
200
100
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 39

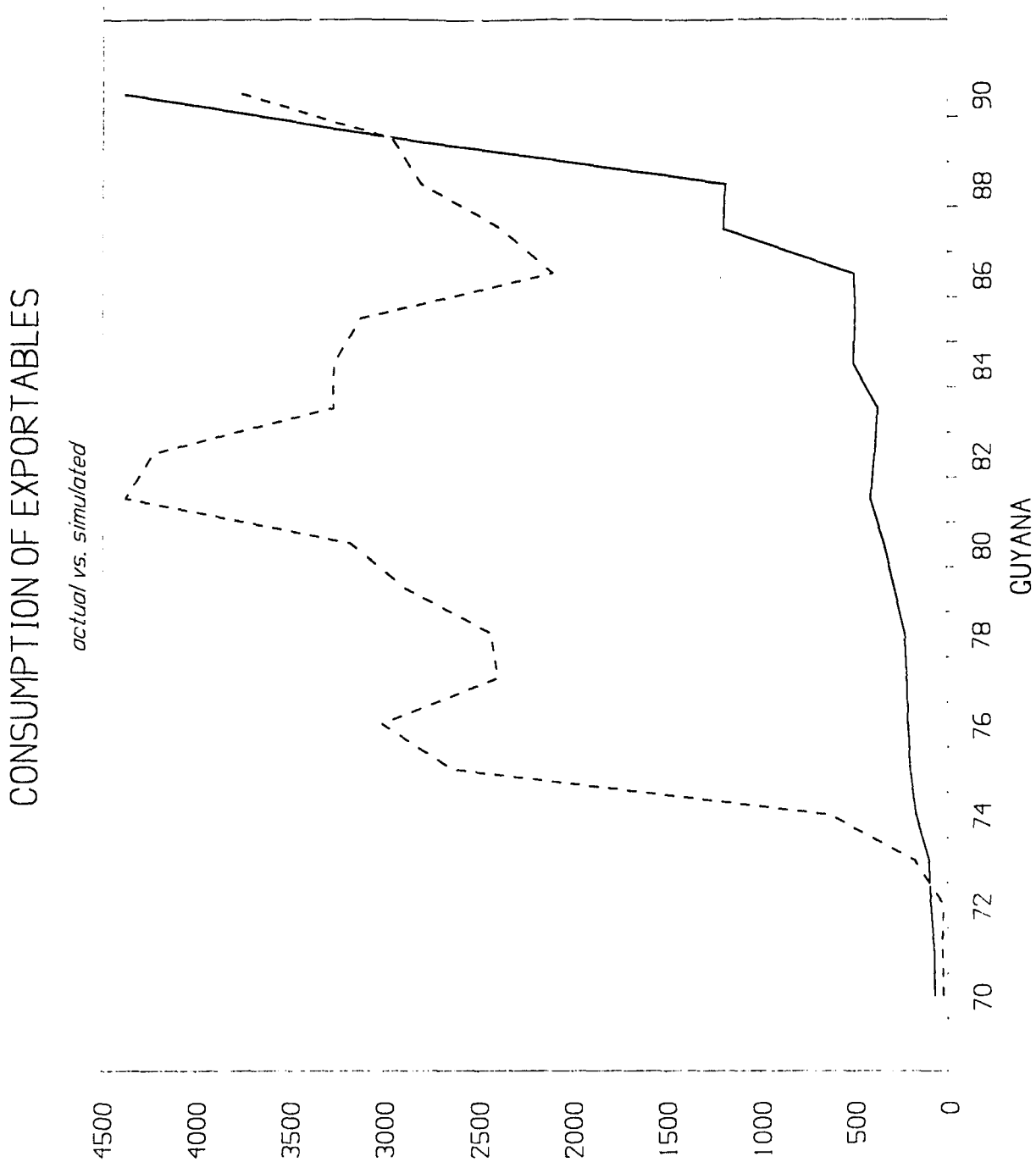

CONSUMPTION OF EXPORTABLES
actual vs. simulated
GUYANA
4500
4000
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 40

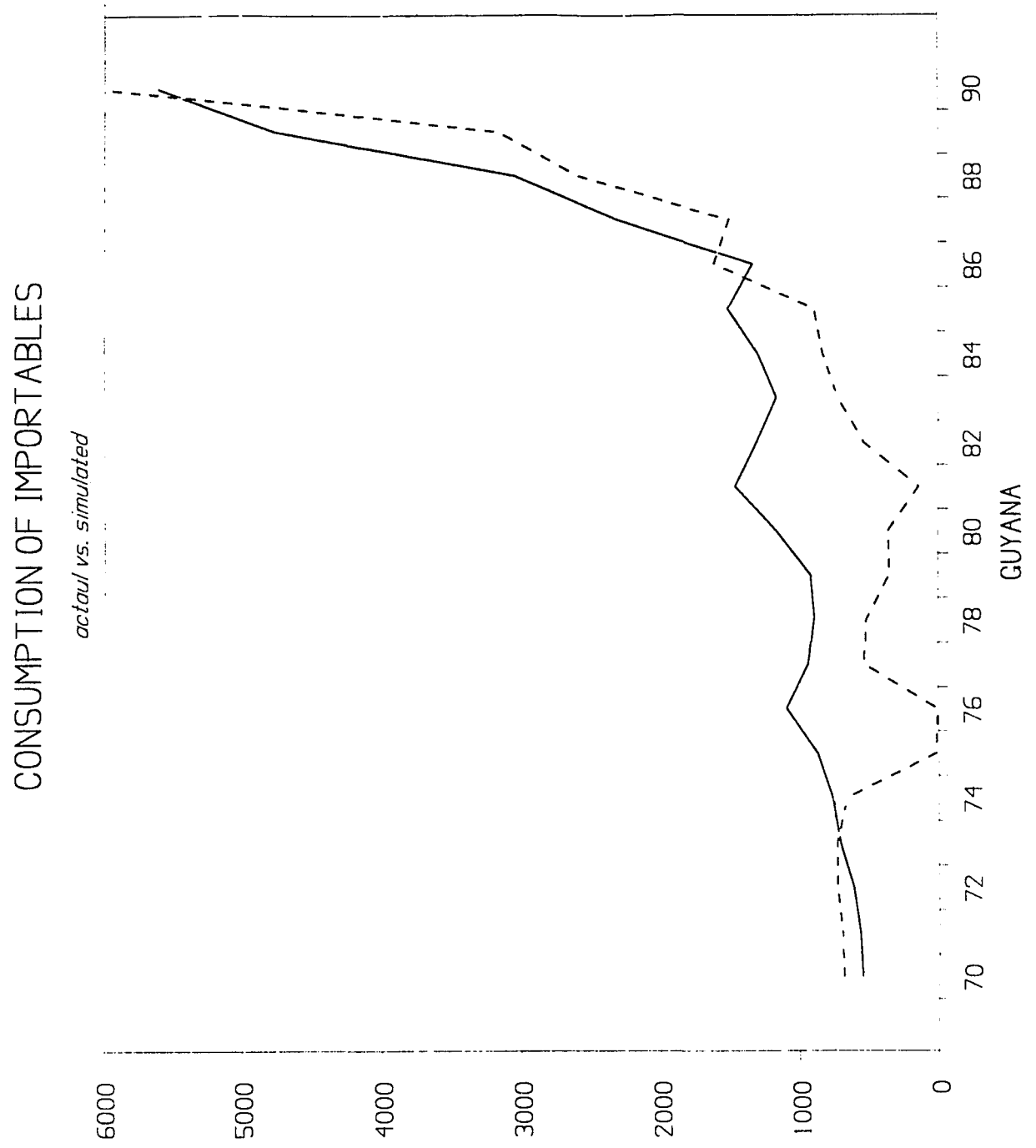

CONSUMPTION OF IMPORTABLES
actaul vs. simulated
GUYANA
6000
5000
4000
3000
2000
1000
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 41

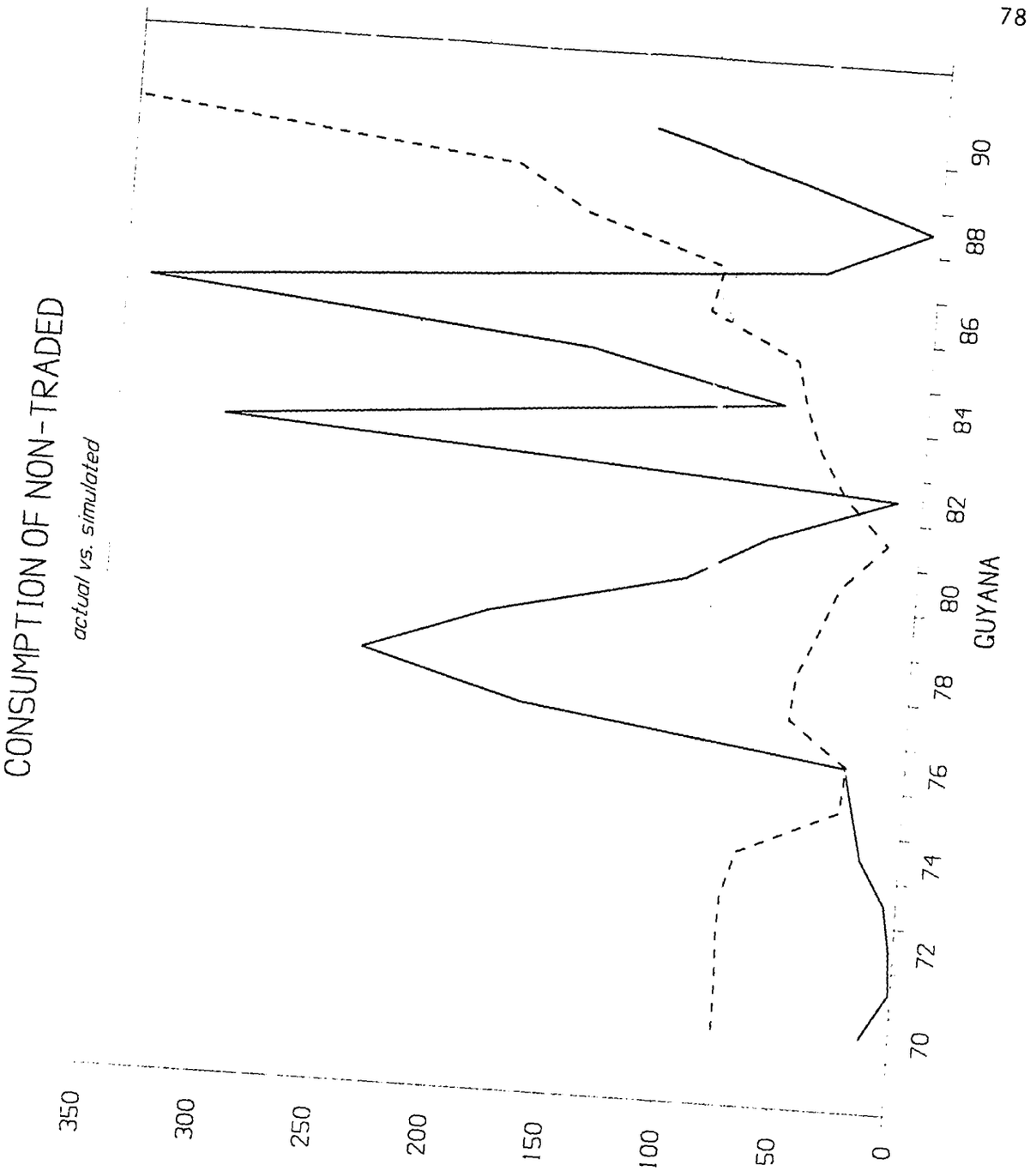

CONSUMPTION OF NON-TRADED
actual vs. simulated
GUYANA
350
300
250
200
150
100
50
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 42

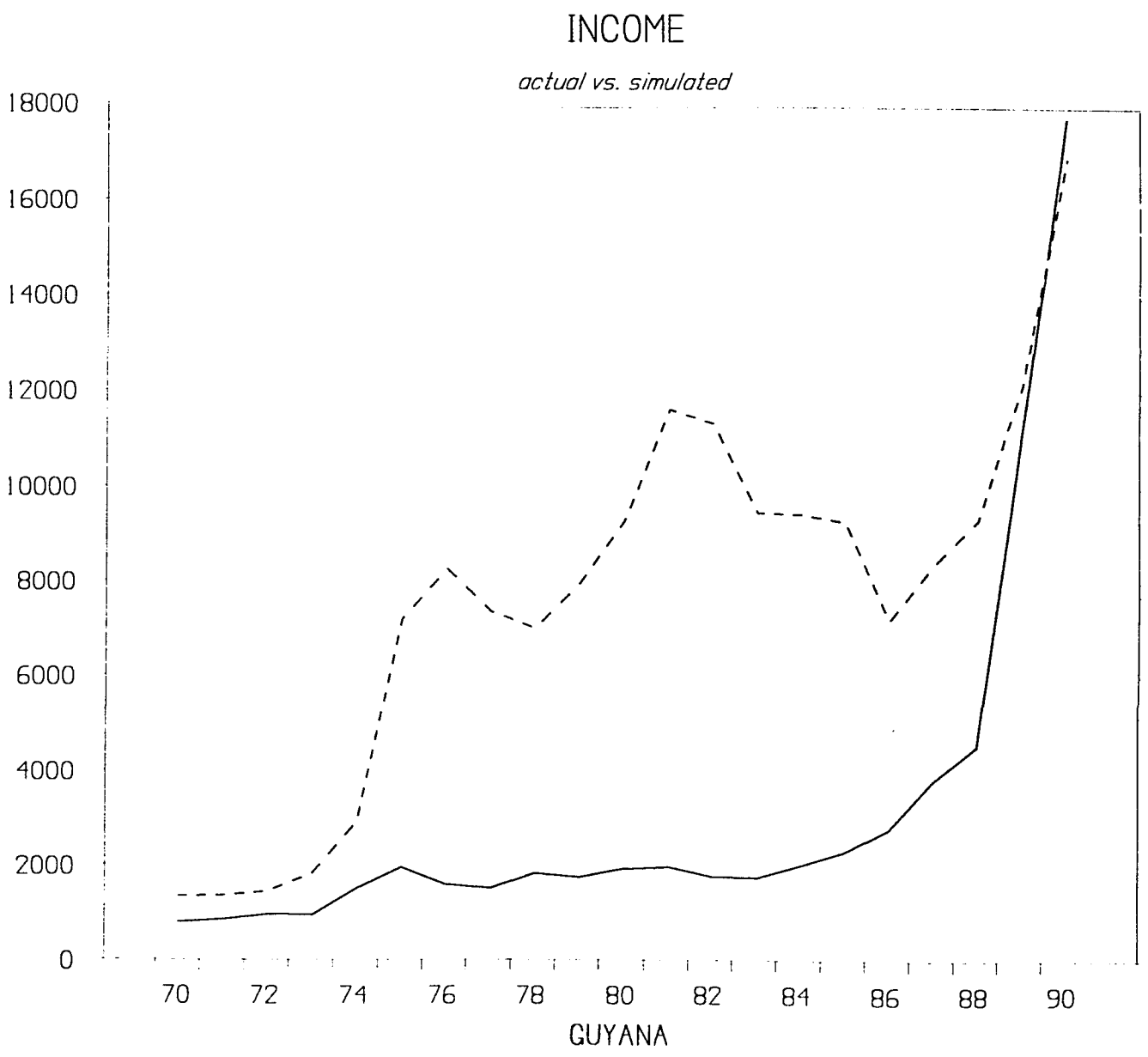

INCOME
actual vs. simulated
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
70
72
74
76
78
80
82
84
86
88
90
GUYANA

Fig. 43

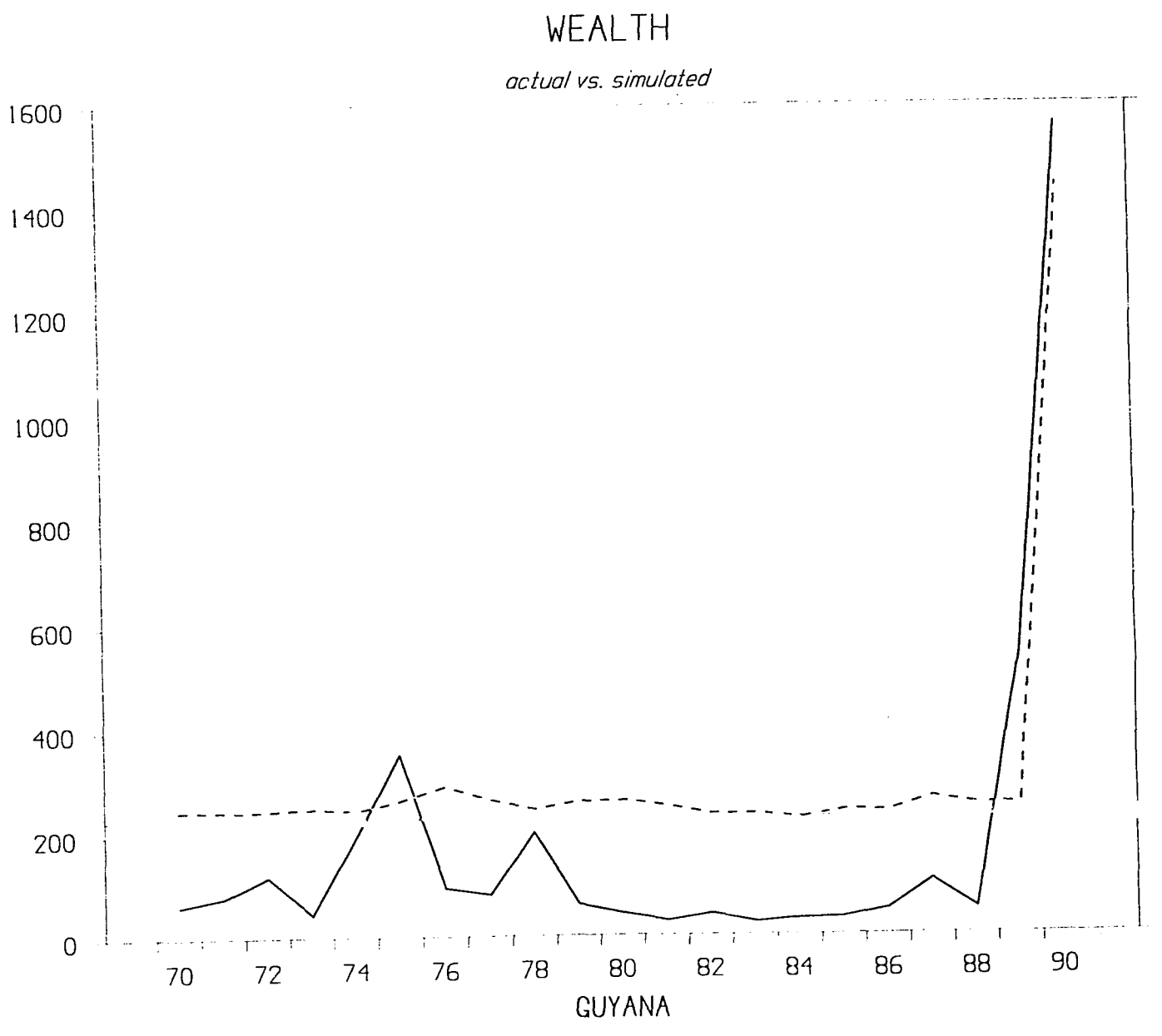

WEALTH
actual vs. simulated
1600
1400
1200
1000
800
600
400
200
0
70
72
74
76
78
80
82
84
86
88
90
GUYANA

Fig. 44

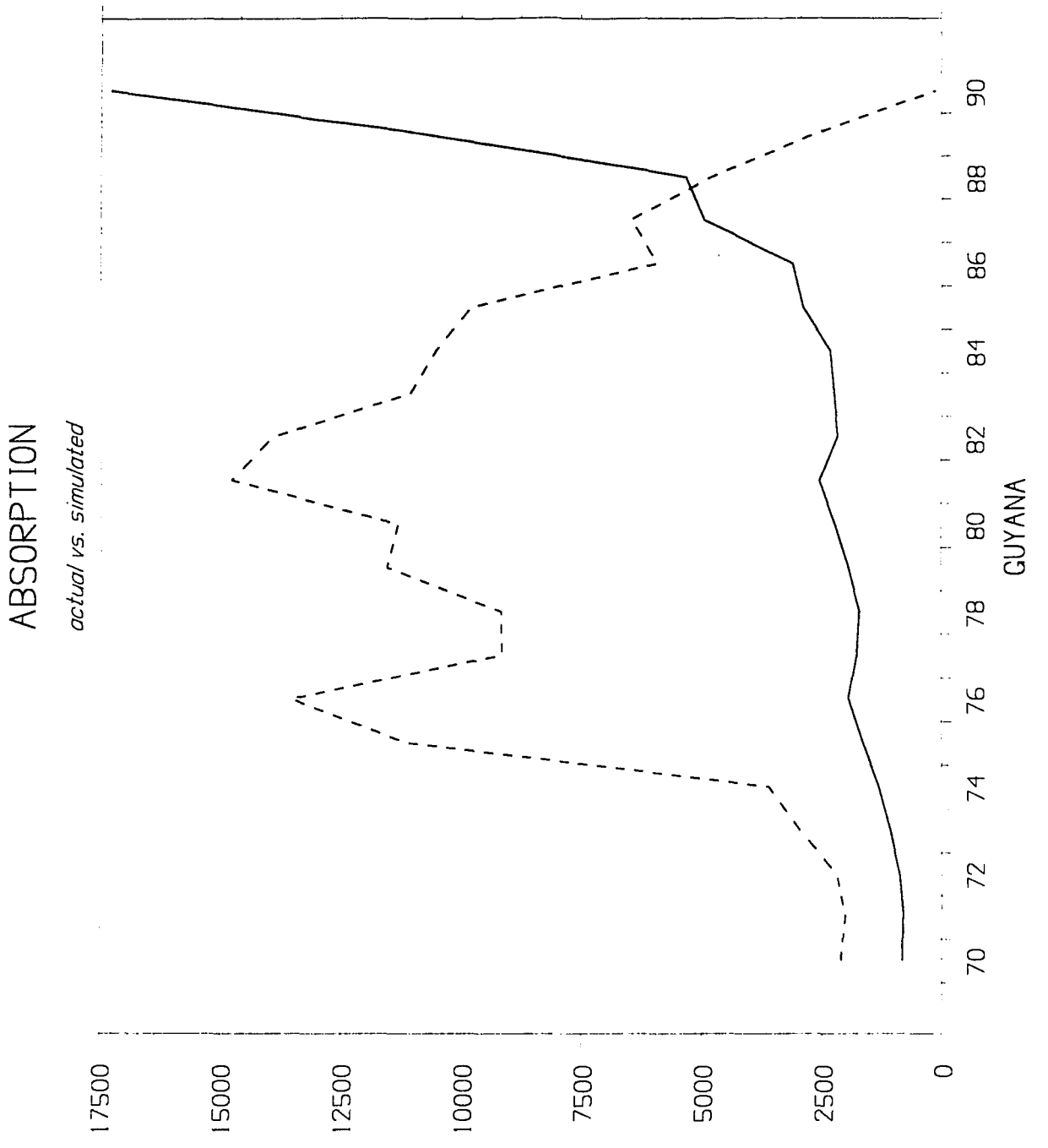

ABSORPTION
actual vs. simulated
GUYANA
17500
15000
12500
10000
7500
5000
2500
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 45

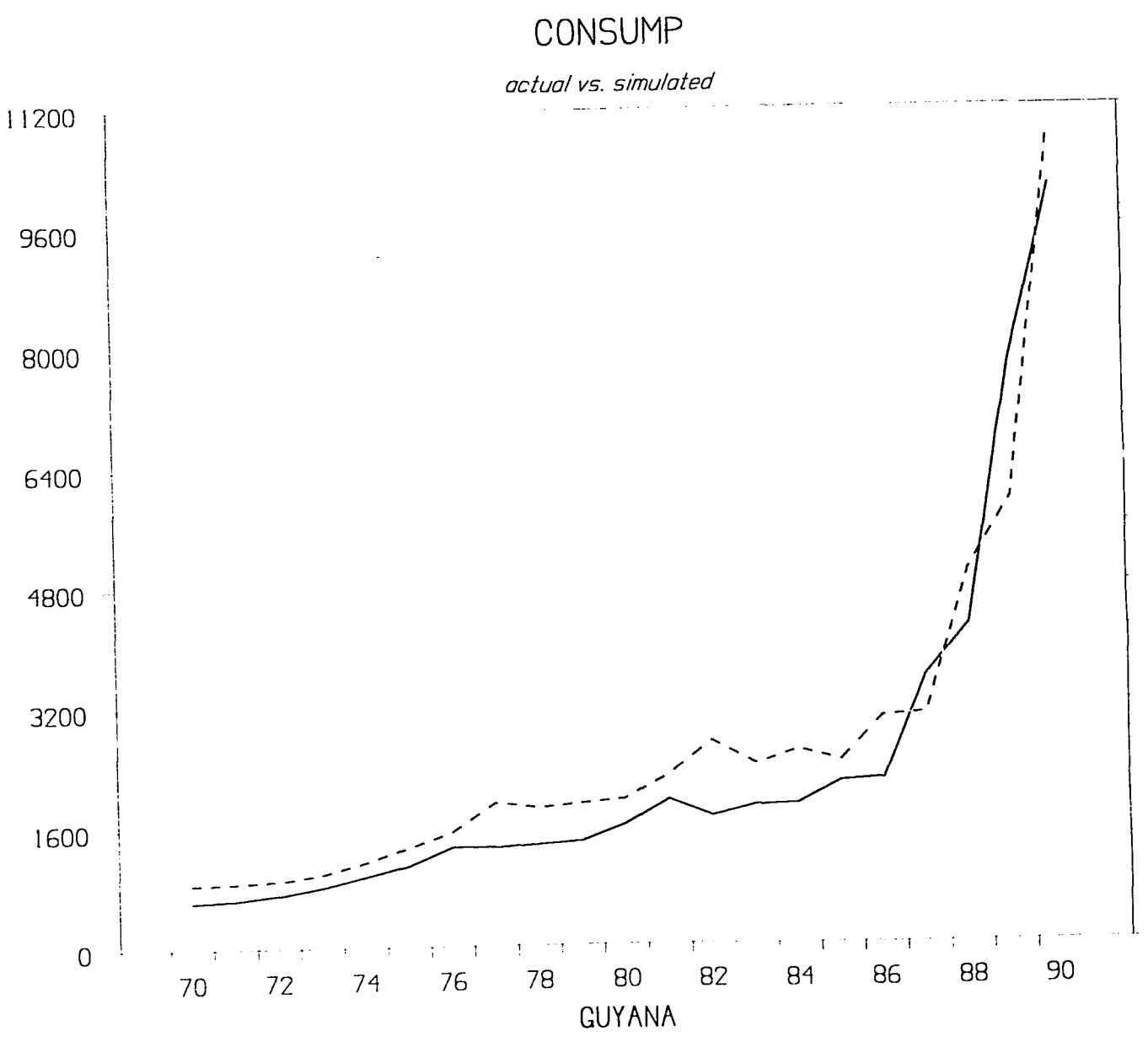

CONSUMP
actual vs. simulated
11200
9600
8000
6400
4800
3200
1600
0
70
72
74
76
78
80
82
84
86
88
90
GUYANA

Fig. 46

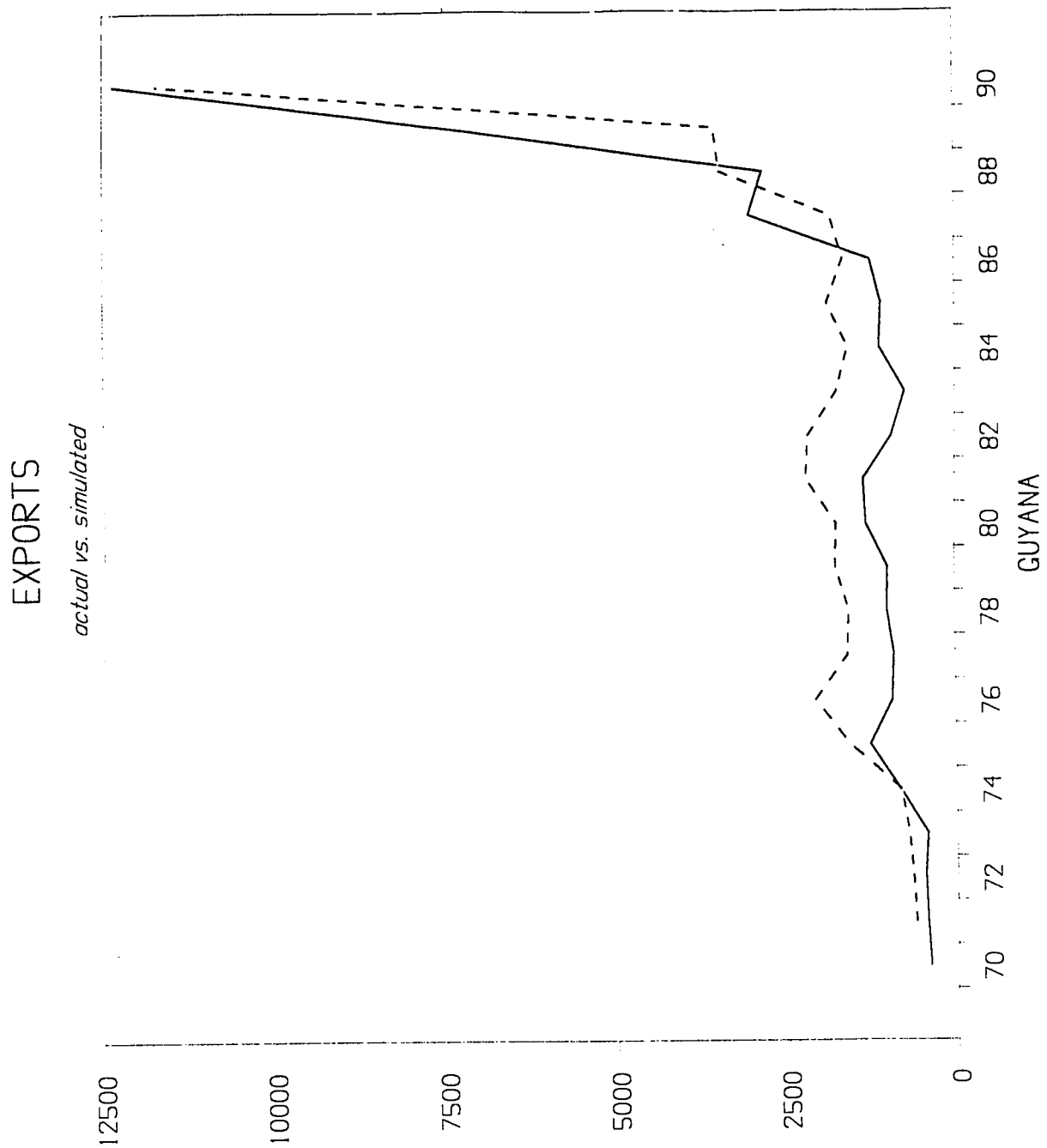

EXPORTS
actual vs. simulated
GUYANA
12500
10000
7500
5000
2500
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 47

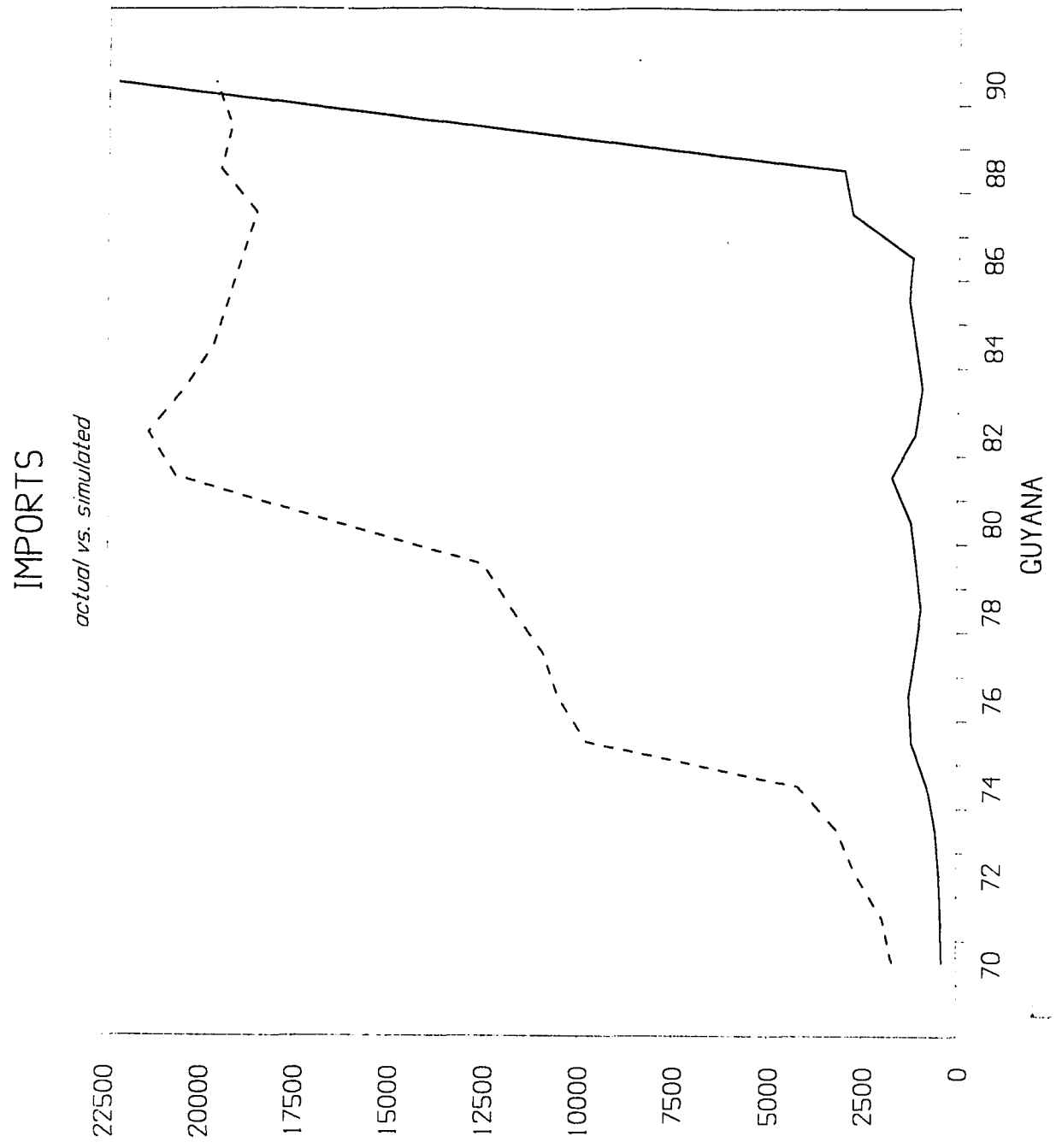

IMPORTS
actual vs. simulated
GUYANA
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 48

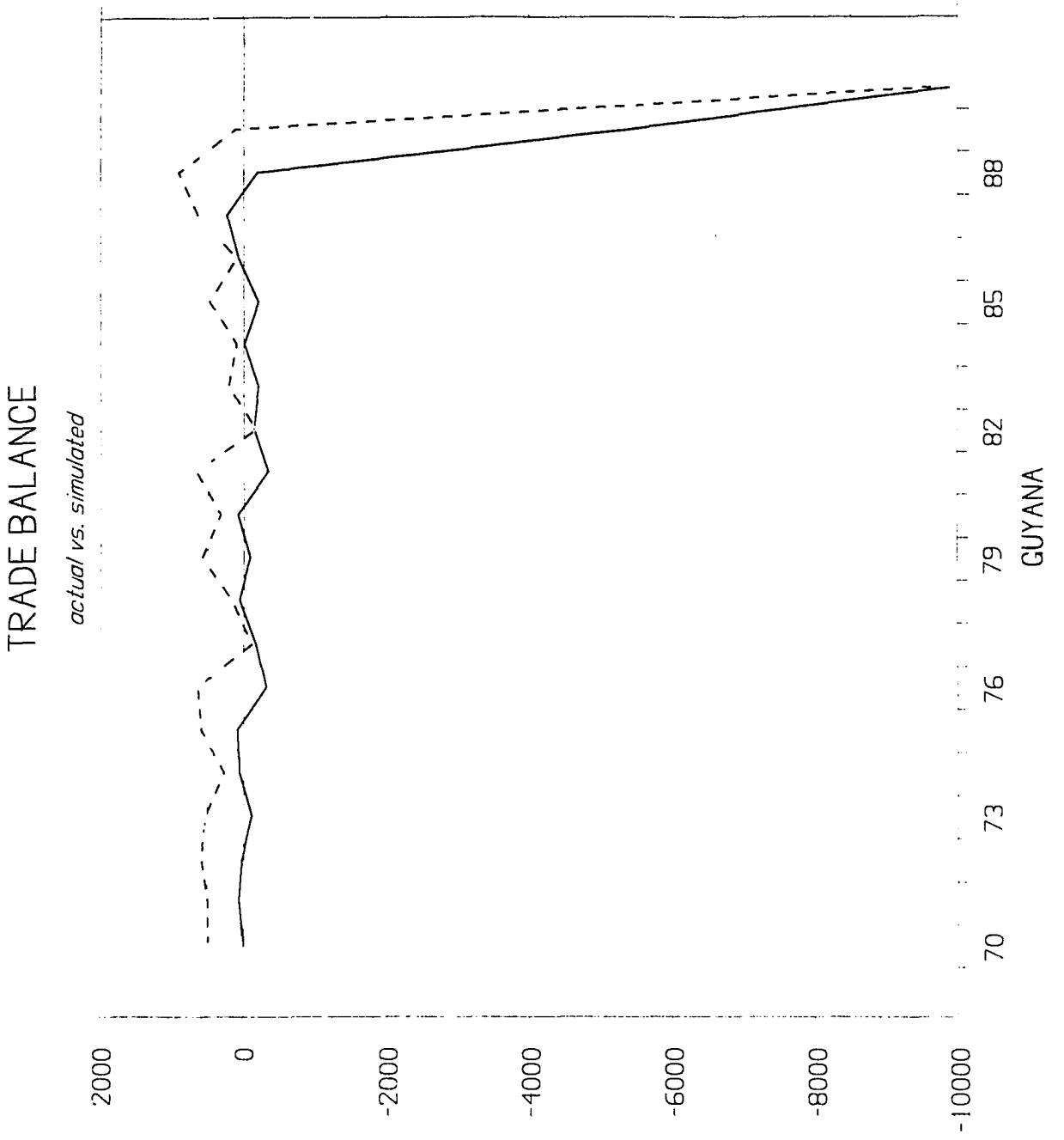

TRADE BALANCE
actual vs. simulated
2000
0
-2000
-4000
-6000
-8000
-10000
70
73
76
79
82
85
88
GUYANA

Fig. 49

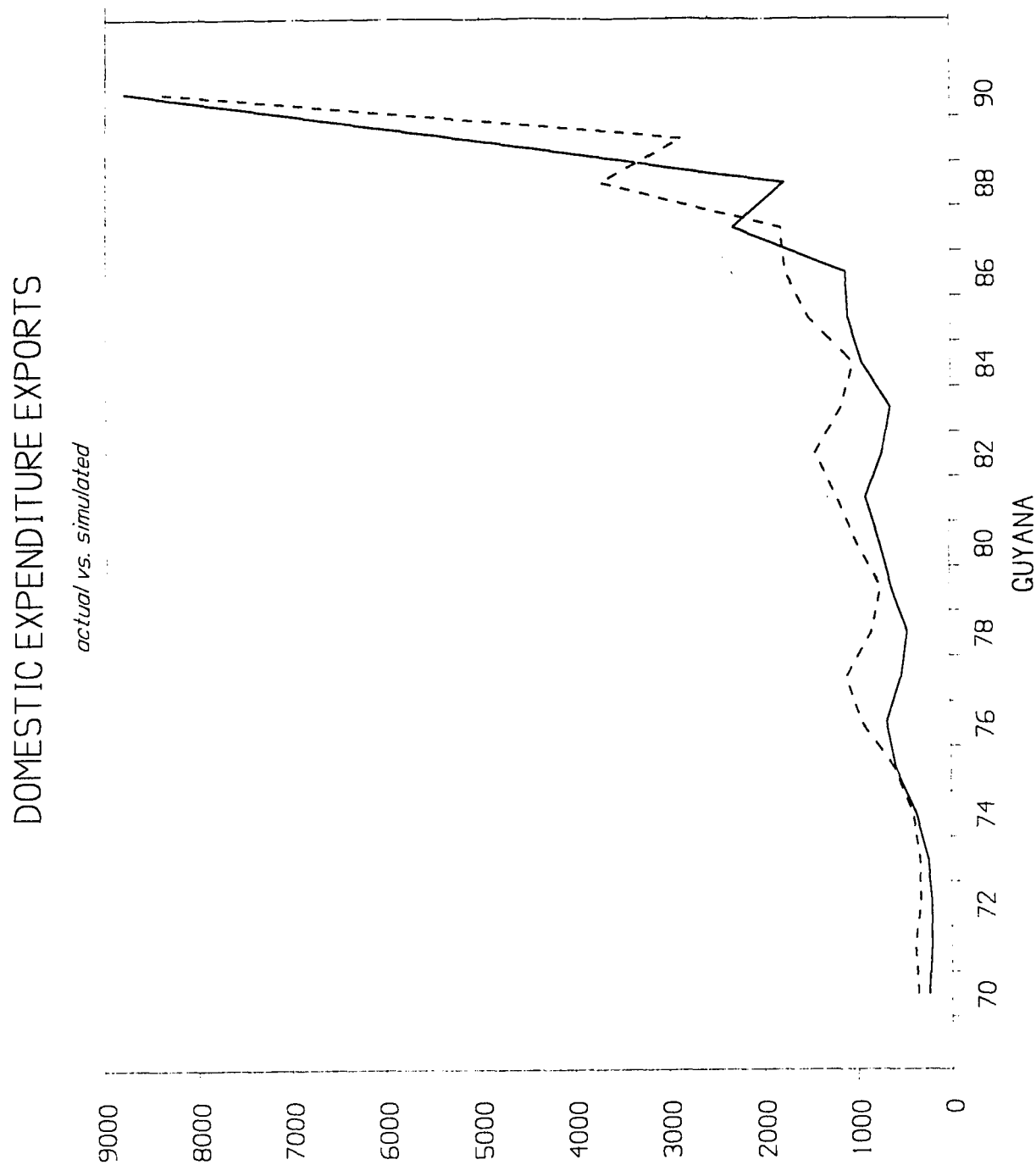

DOMESTIC EXPENDITURE EXPORTS
actual vs. simulated
GUYANA
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 50

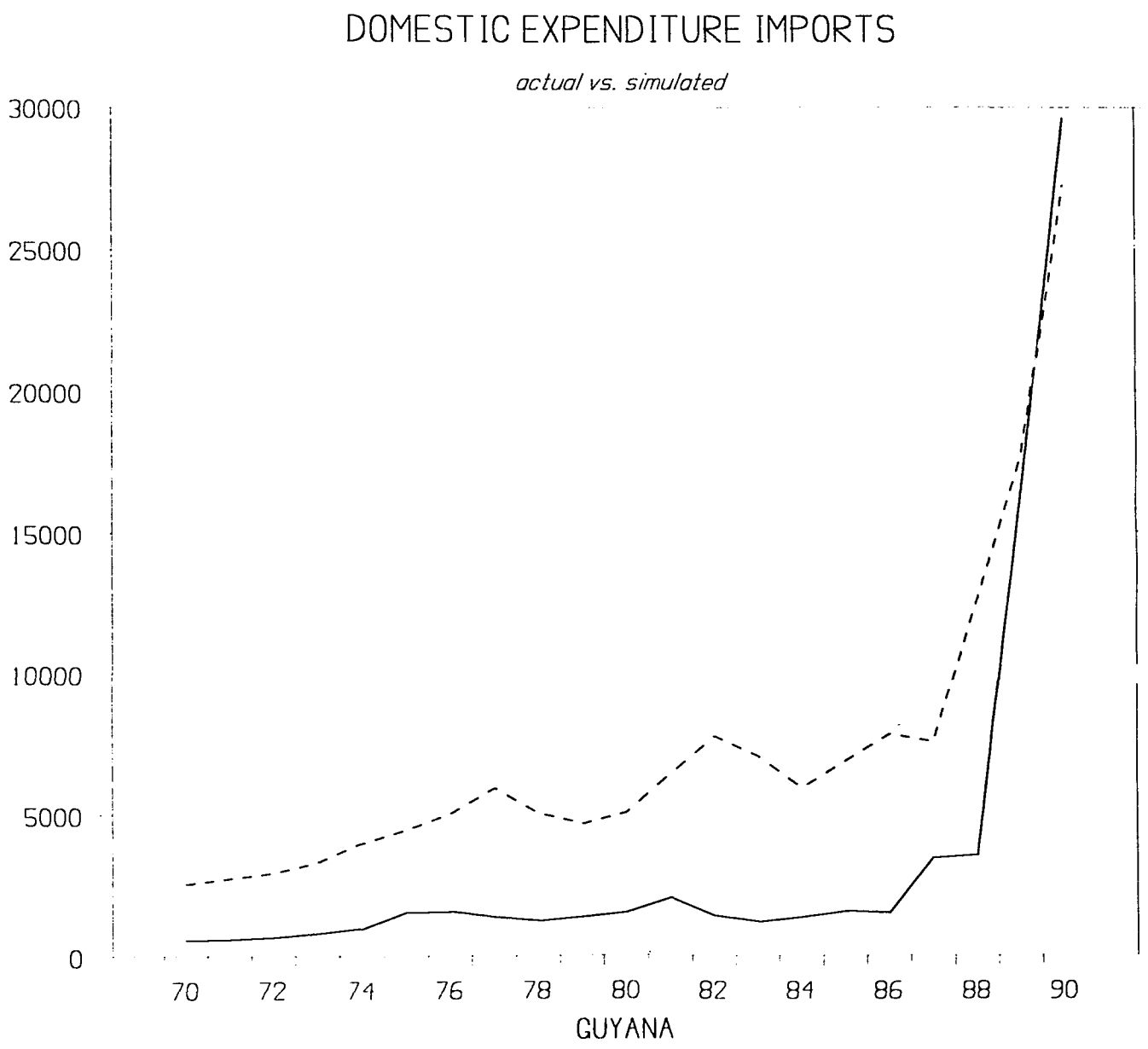

DOMESTIC EXPENDITURE IMPORTS
actual vs. simulated
30000
25000
20000
15000
10000
5000
0
70
72
74
76
78
80
82
84
86
88
90
GUYANA

Fig. 51

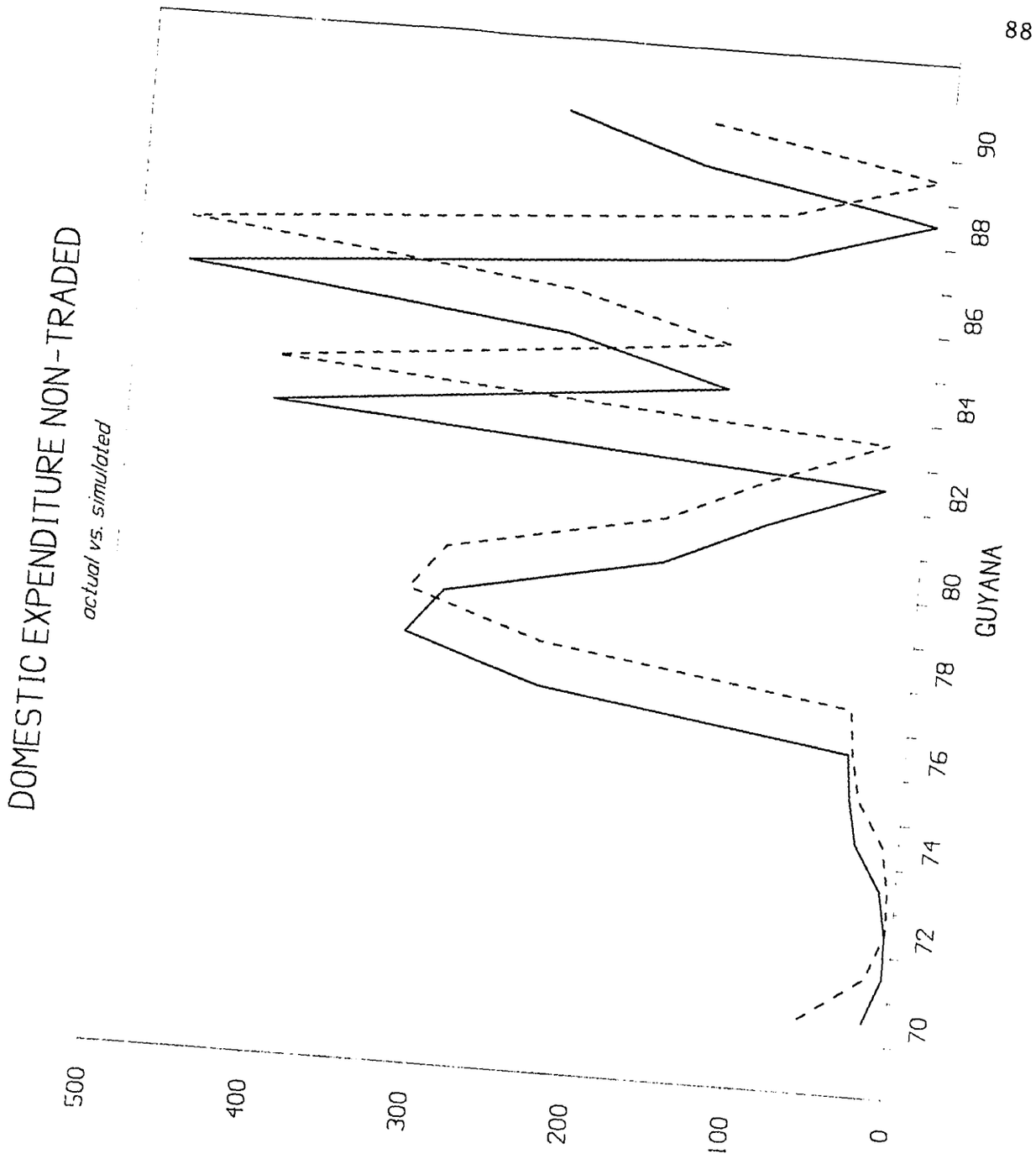

DOMESTIC EXPENDITURE NON-TRADED
actual vs. simulated
GUYANA
500
400
300
200
100
0
70
72
74
76
78
80
82
84
86
88
90

Fig. 52

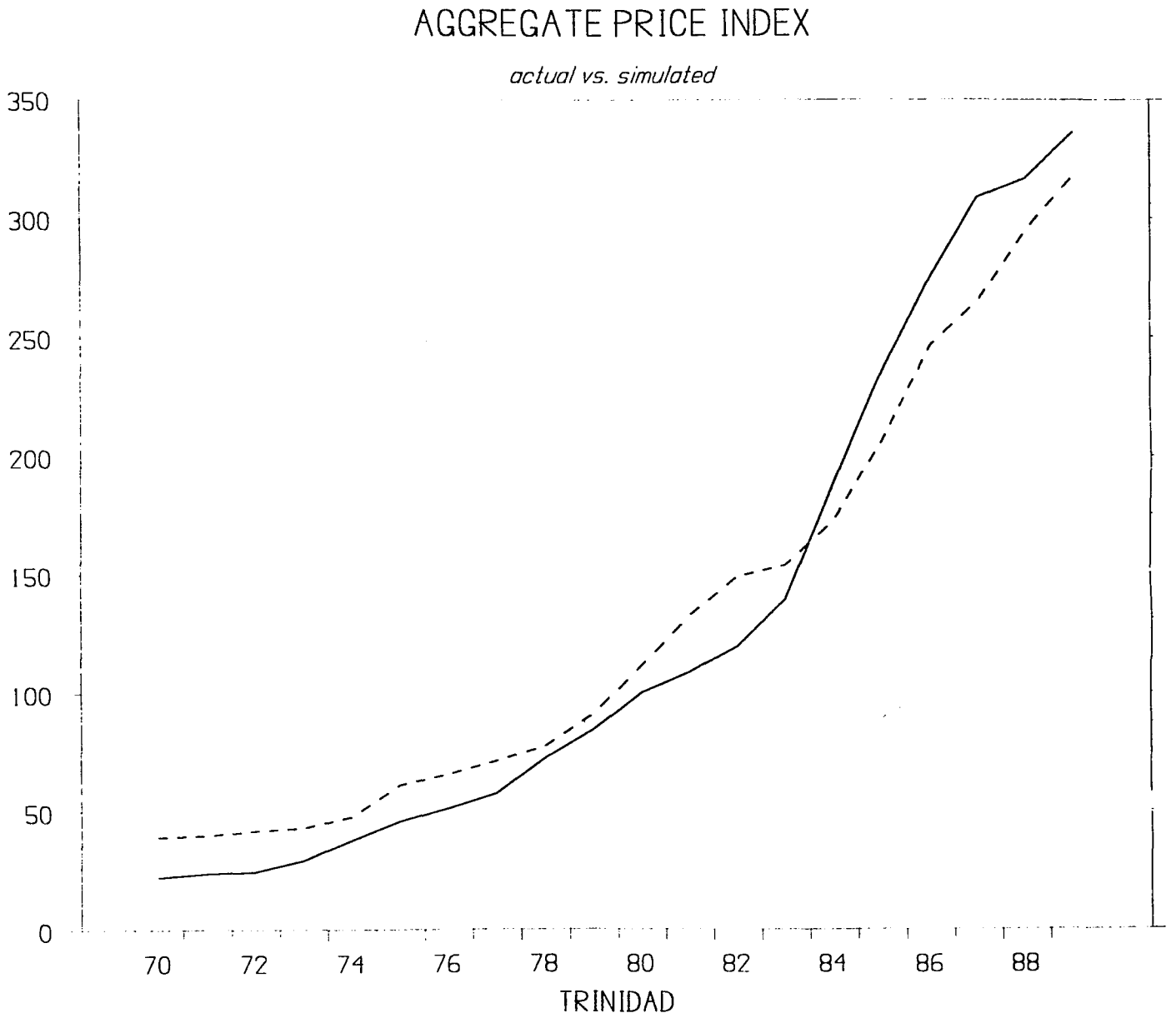

AGGREGATE PRICE INDEX
actual vs. simulated
350
300
250
200
150
100
50
0
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 53

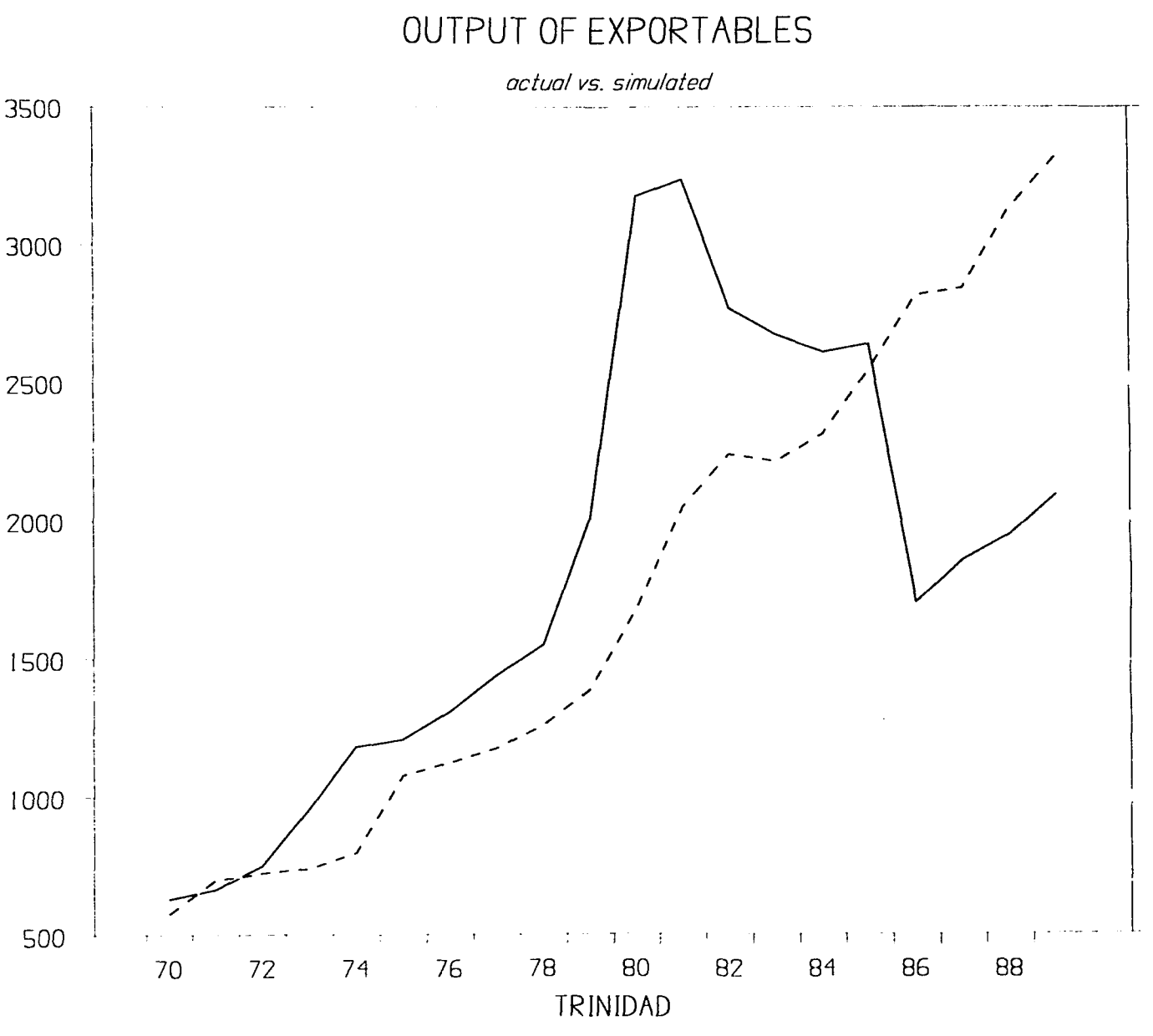

OUTPUT OF EXPORTABLES
actual vs. simulated
3500
3000
2500
2000
1500
1000
500
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 54

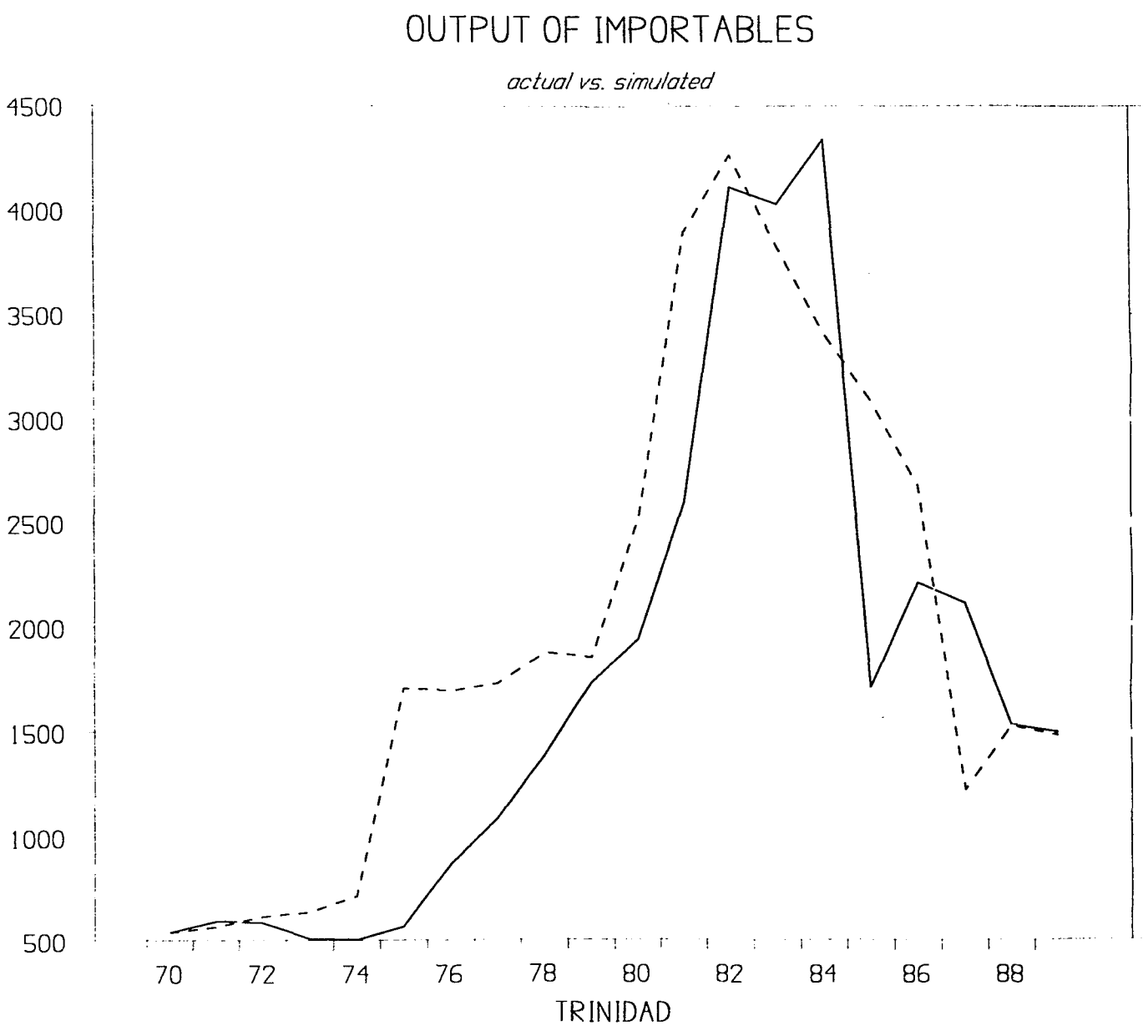

OUTPUT OF IMPORTABLES
actual vs. simulated
4500
4000
3500
3000
2500
2000
1500
1000
500
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 55

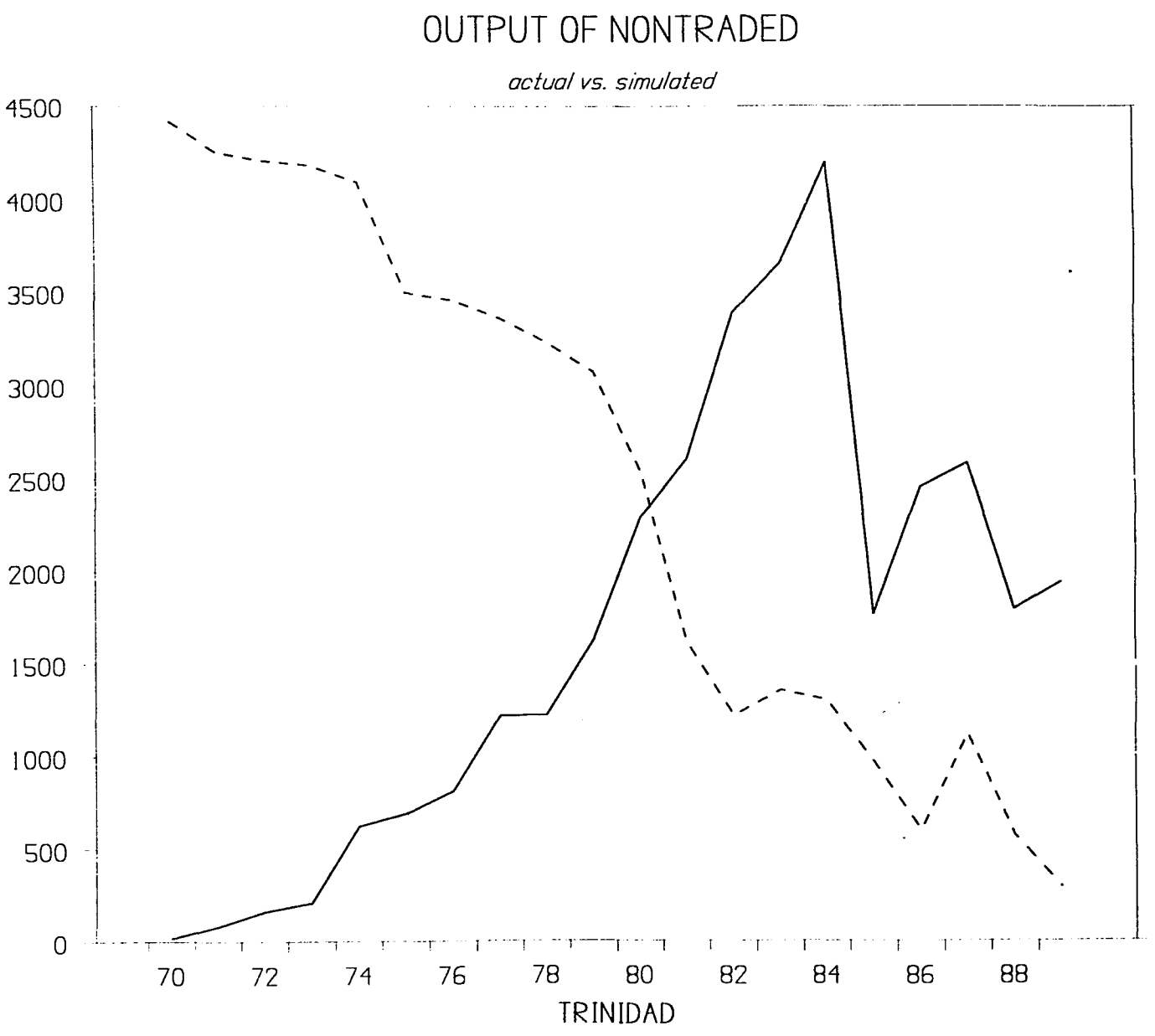

OUTPUT OF NONTRADED
actual vs. simulated
4500
4000
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 56

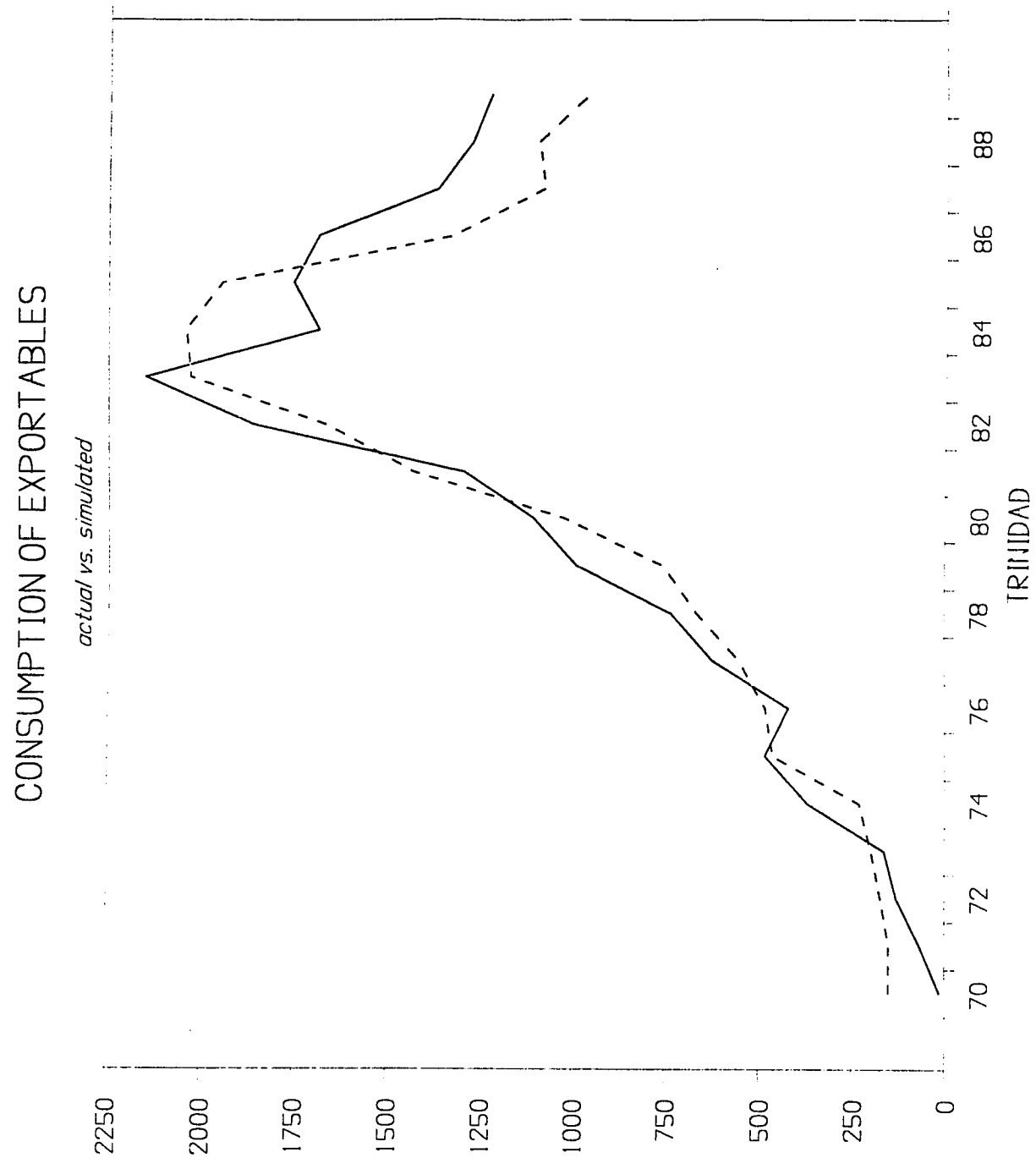

CONSUMPTION OF EXPORTABLES
actual vs. simulated
2250
2000
1750
1500
1250
1000
750
500
250
0
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 57

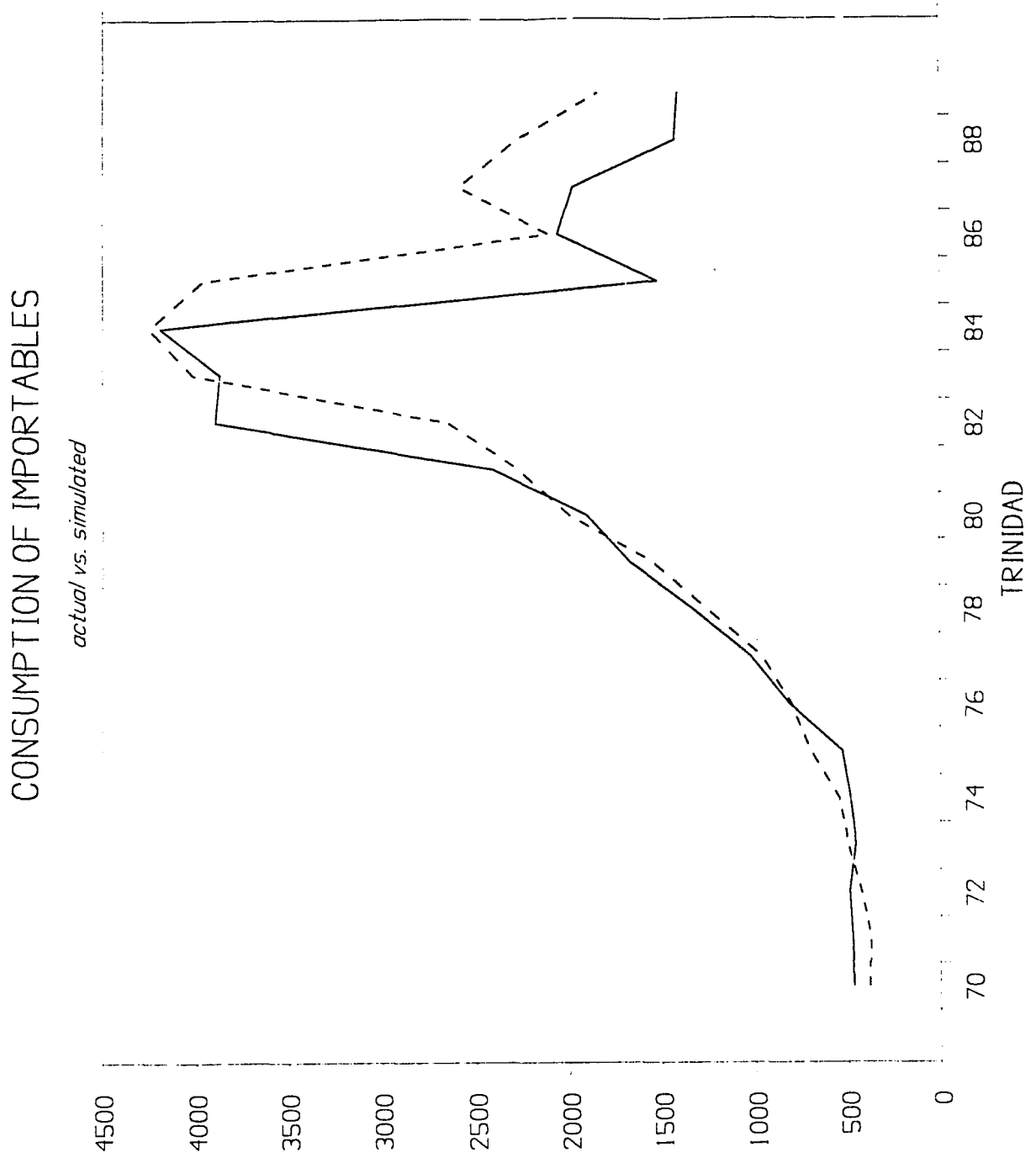

CONSUMPTION OF IMPORTABLES
actual vs. simulated
4500
4000
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 58

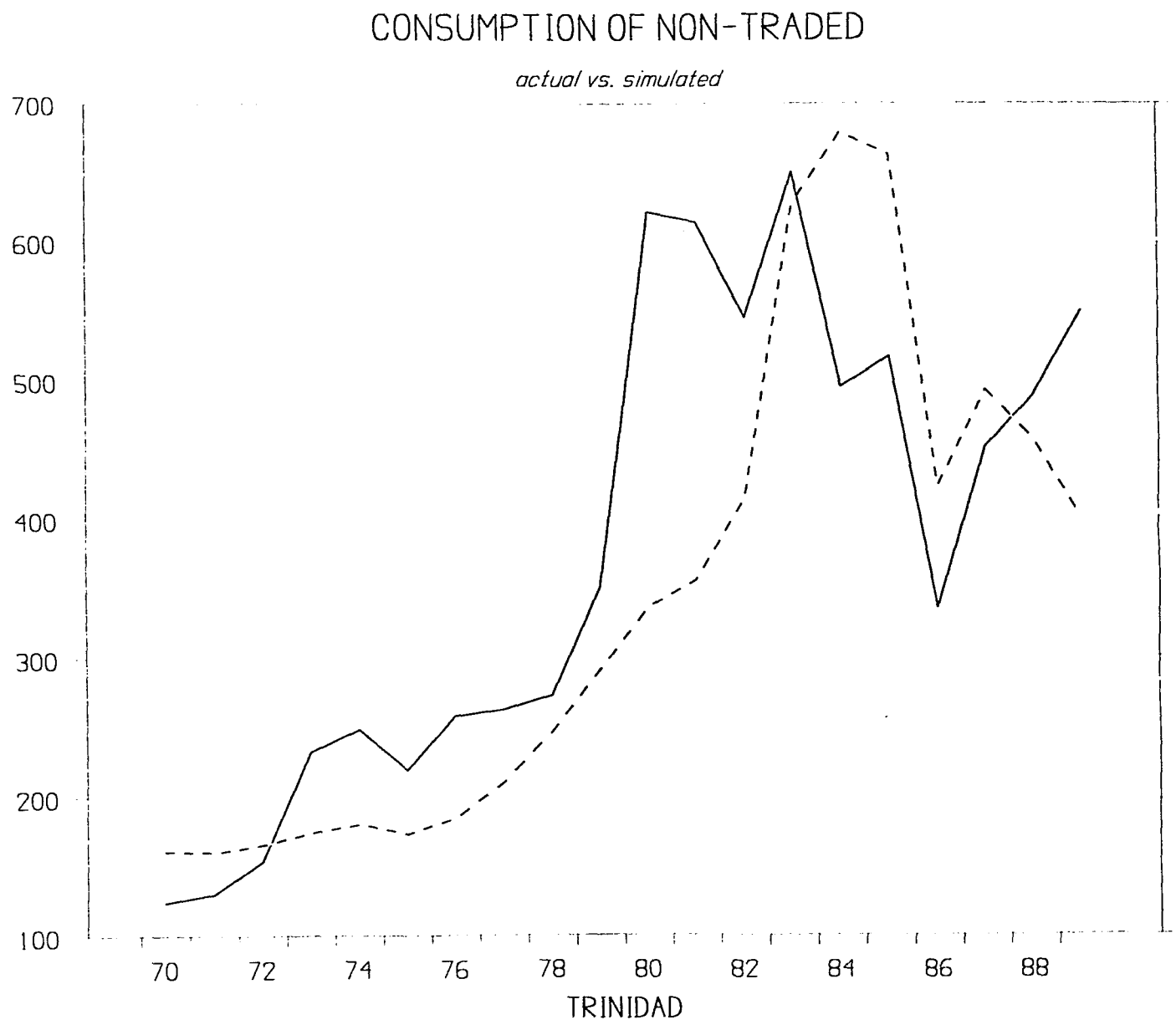

CONSUMPTION OF NON-TRADED
actual vs. simulated
700
600
500
400
300
200
100
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 59

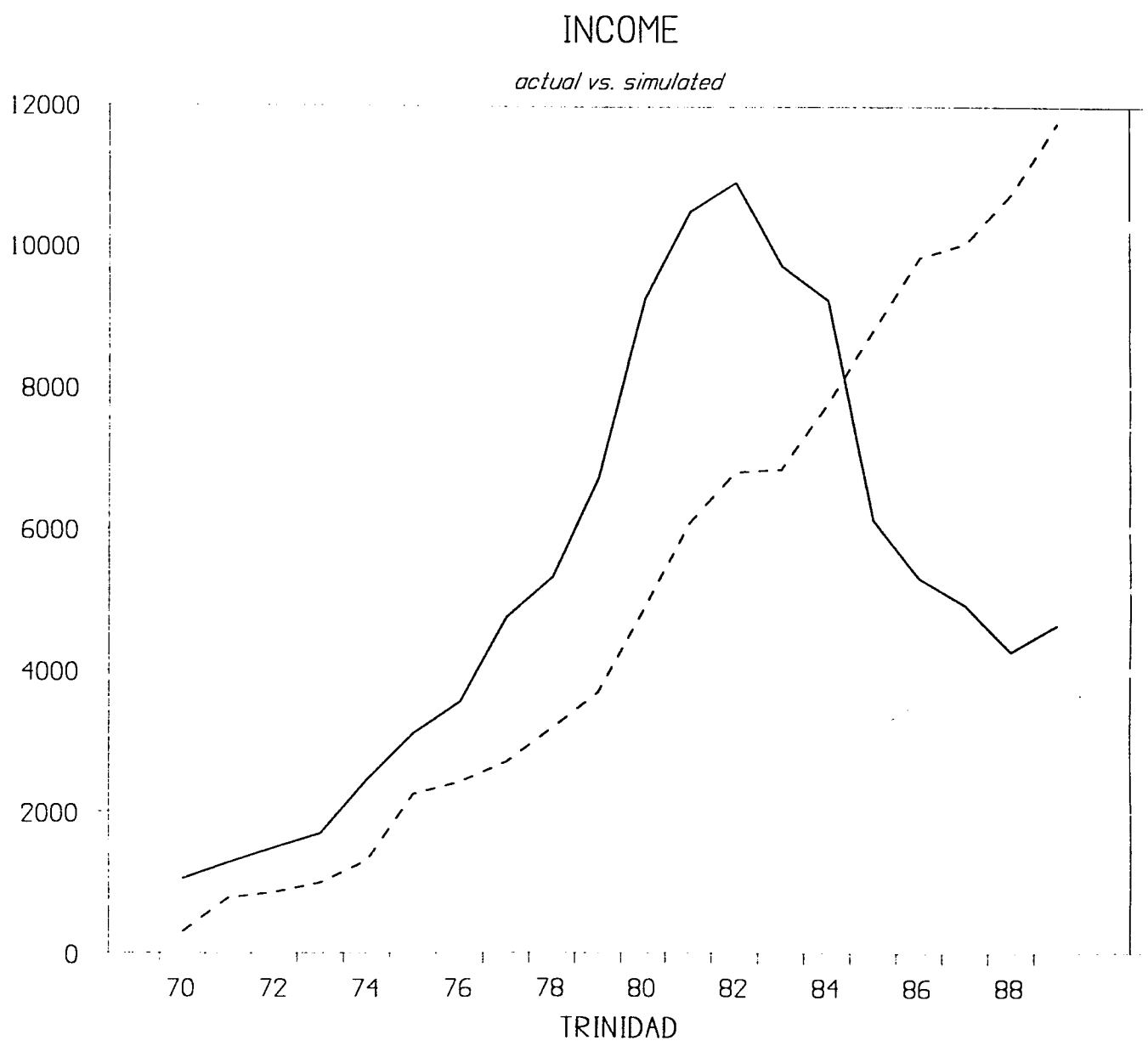

INCOME
actual vs. simulated
12000
10000
8000
6000
4000
2000
0
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 60

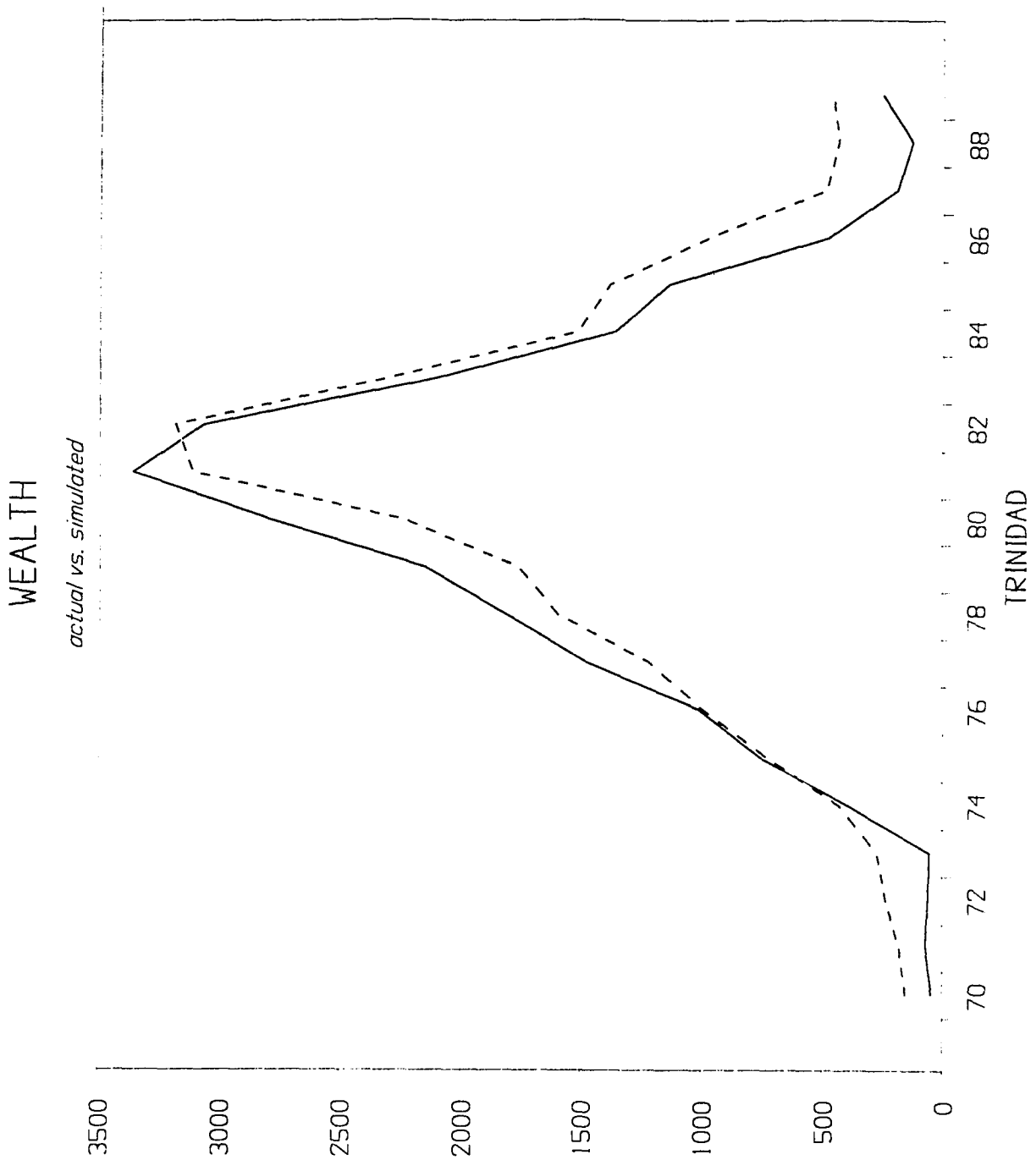

WEALTH
actual vs. simulated
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 61

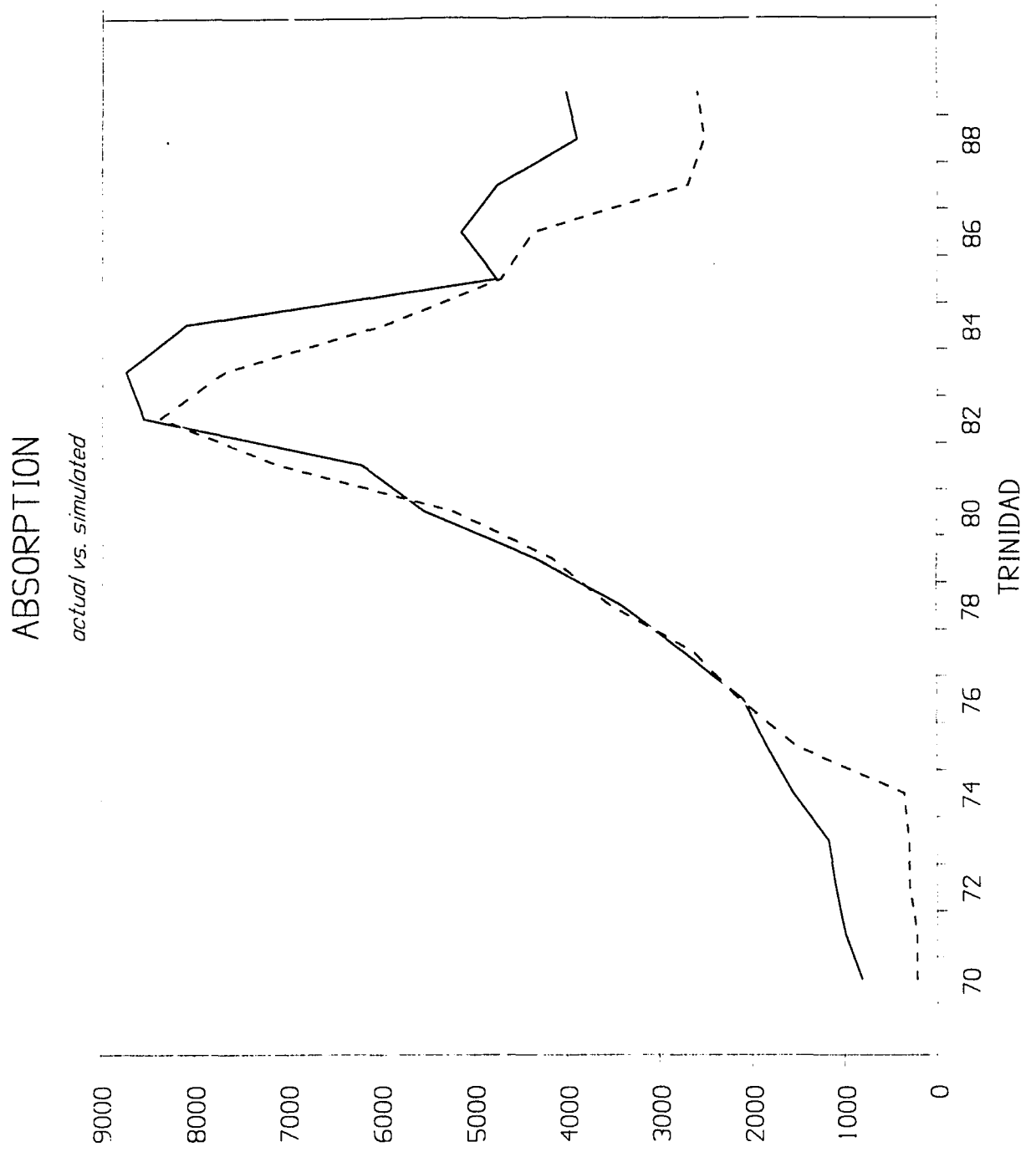

ABSORPTION
actual vs. simulated
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 62

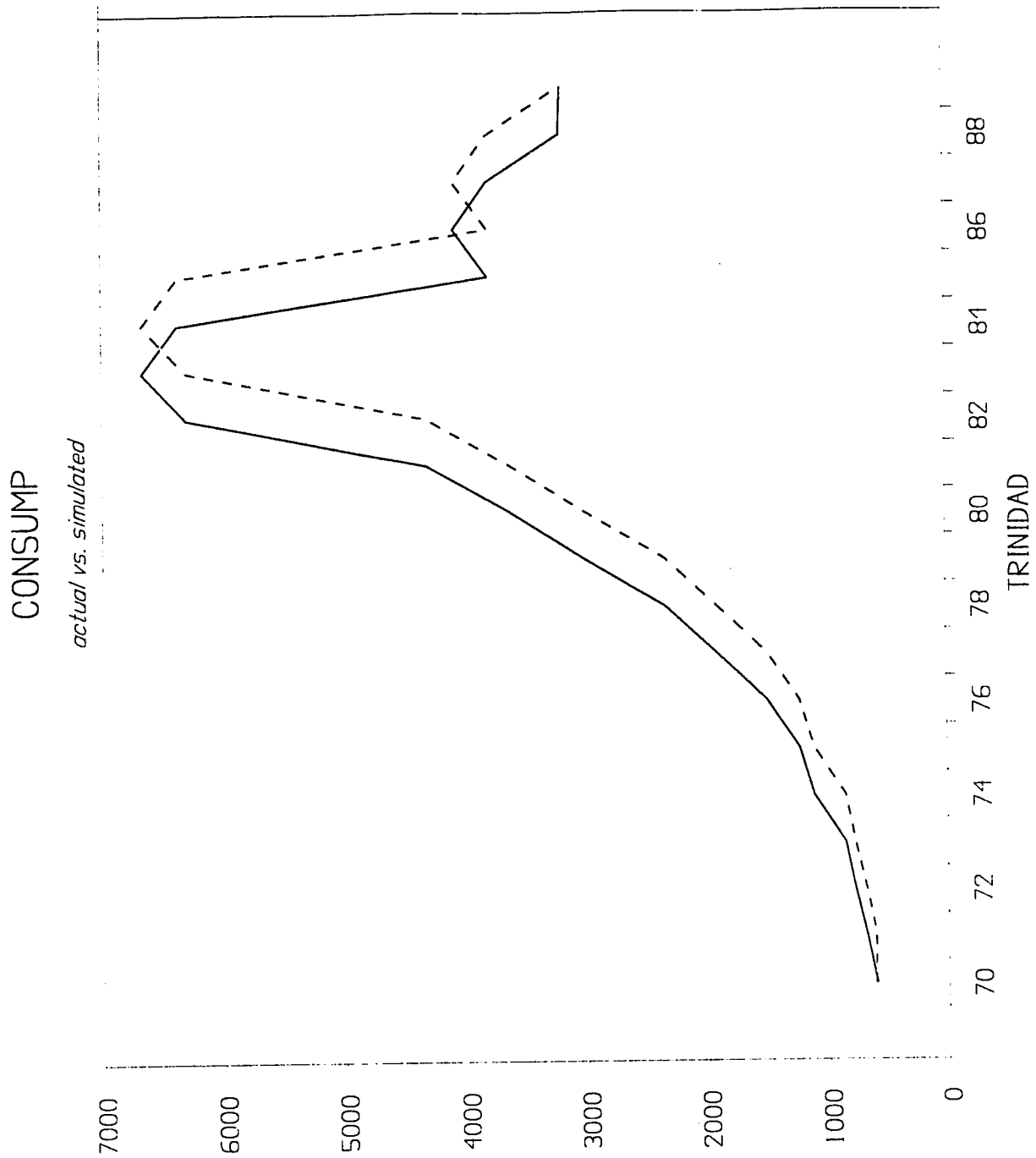

CONSUMP
actual vs. simulated
7000
6000
5000
4000
3000
2000
1000
0
70
72
74
76
78
80
82
81
86
88
TRINIDAD

Fig. 63

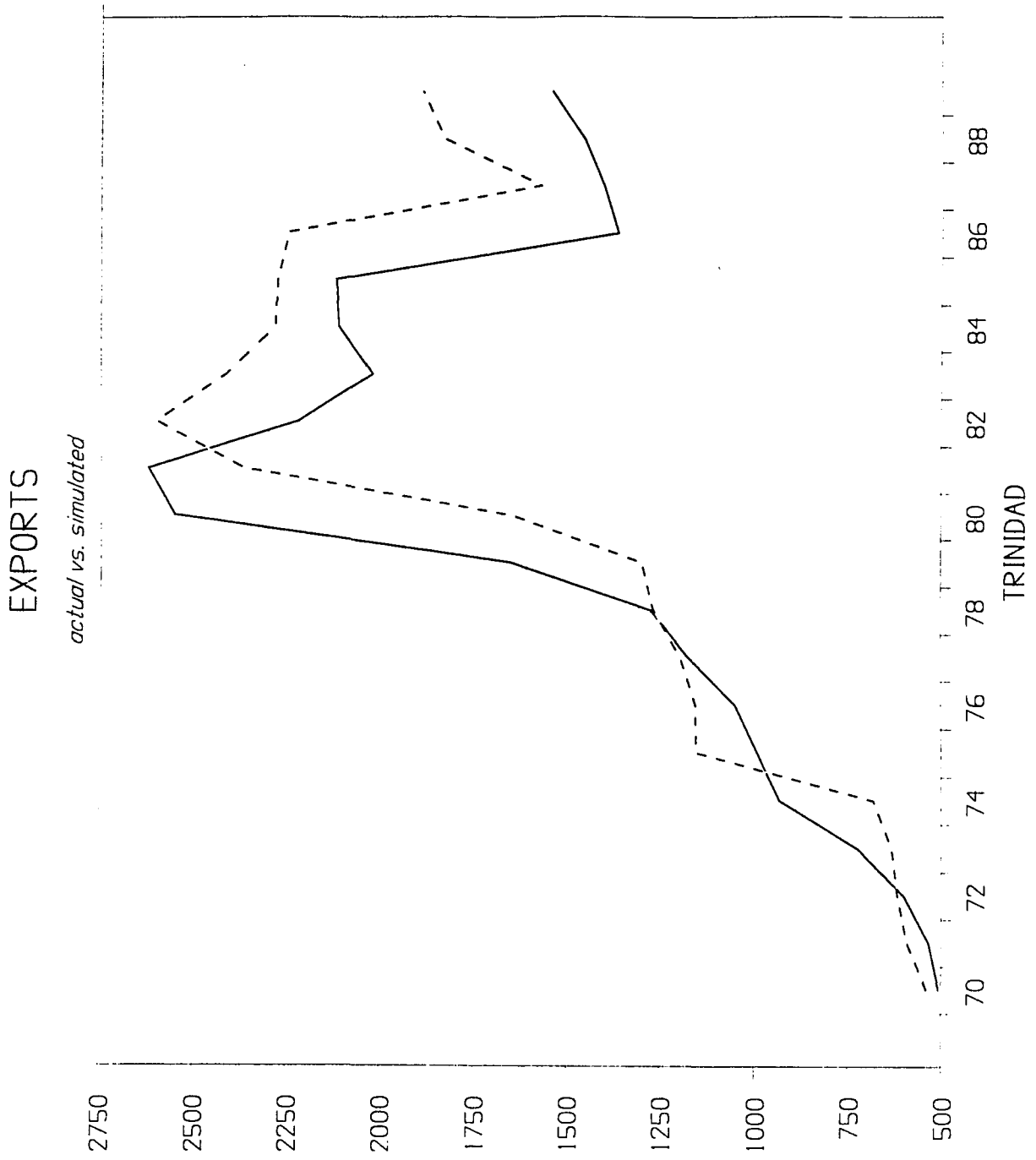

EXPORTS
actual vs. simulated
TRINIDAD
2750
2500
2250
2000
1750
1500
1250
1000
750
500
70
72
74
76
78
80
82
84
86
88

Fig. 64

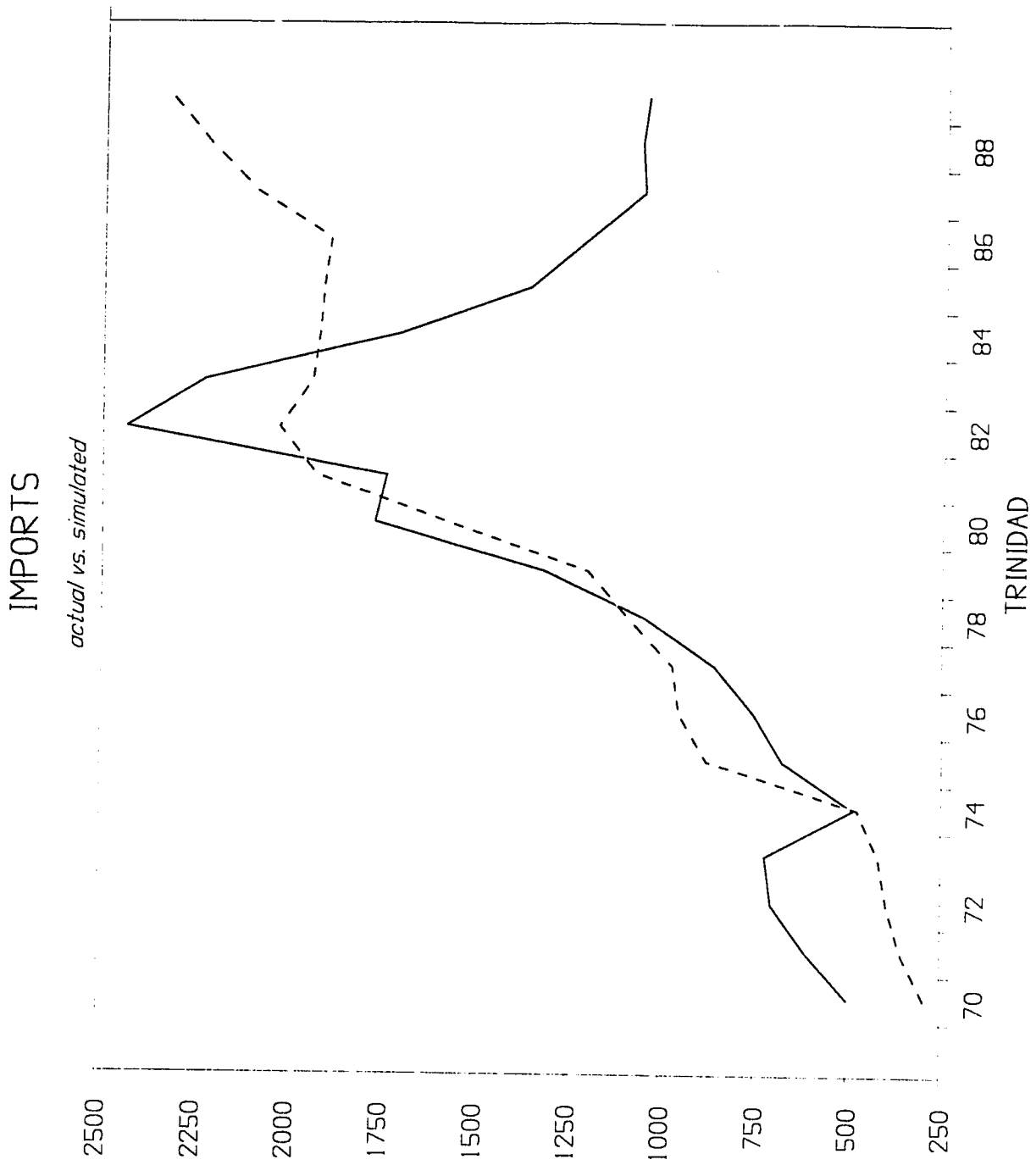
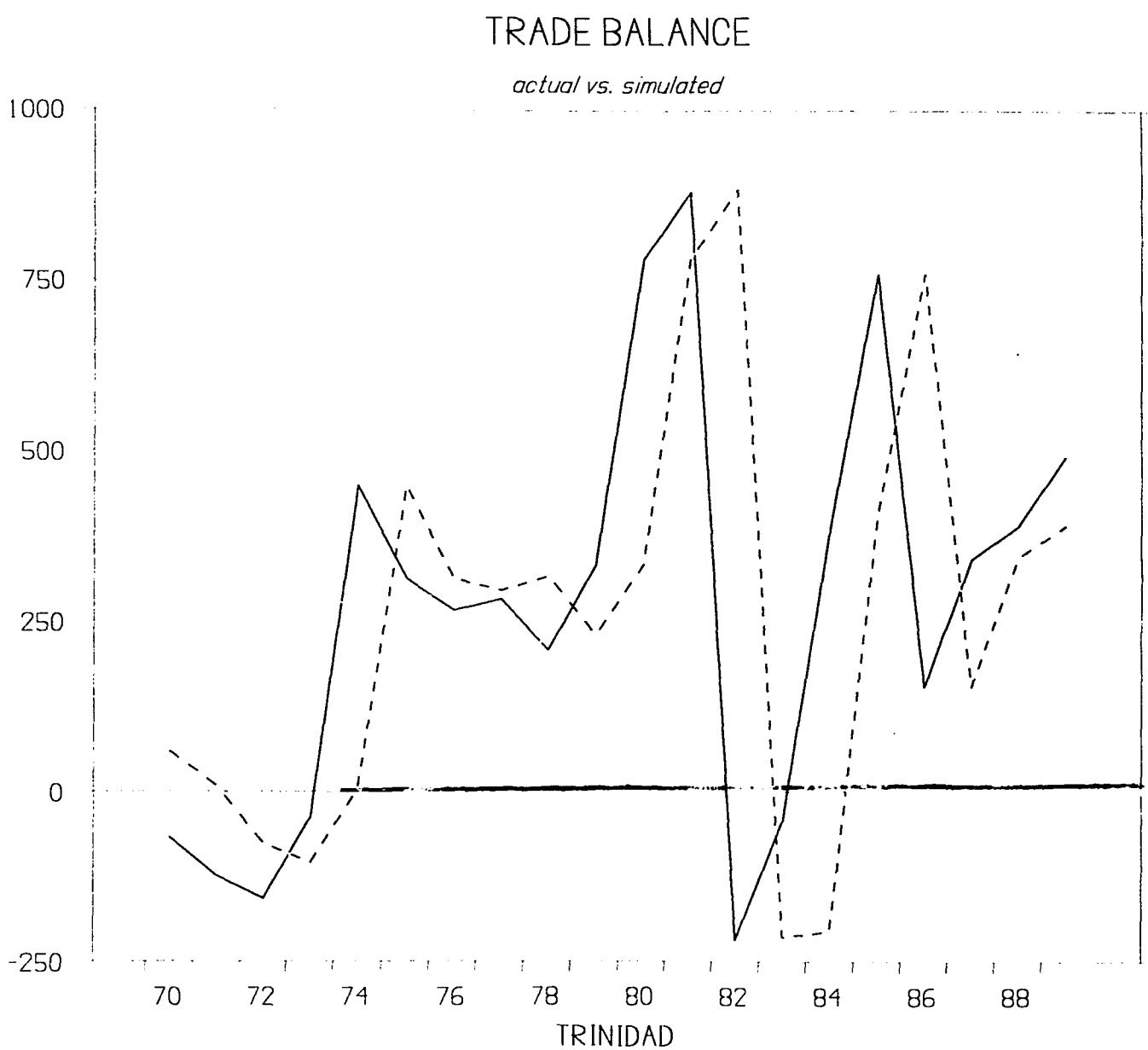

IMPORTS
actual vs. simulated
2500
2250
2000
1750
1500
1250
1000
750
500
250
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 65


TRADE BALANCE
actual vs. simulated
1000
750
500
250
0
-250
70
72
74
76
78
80
82
84
86
88
TRINIDAD

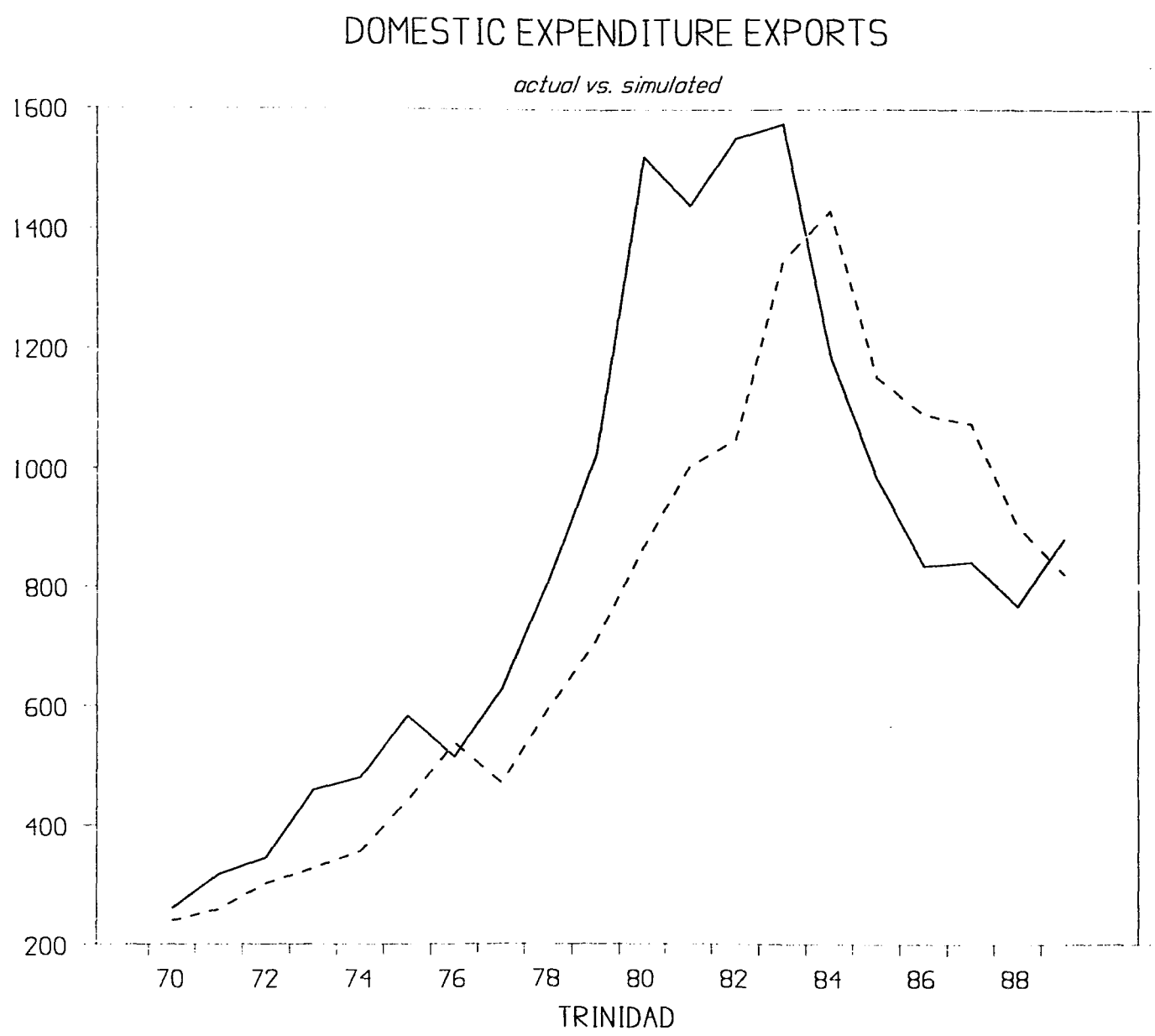

DOMESTIC EXPENDITURE EXPORTS
actual vs. simulated
1600
1400
1200
1000
800
600
400
200
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 67

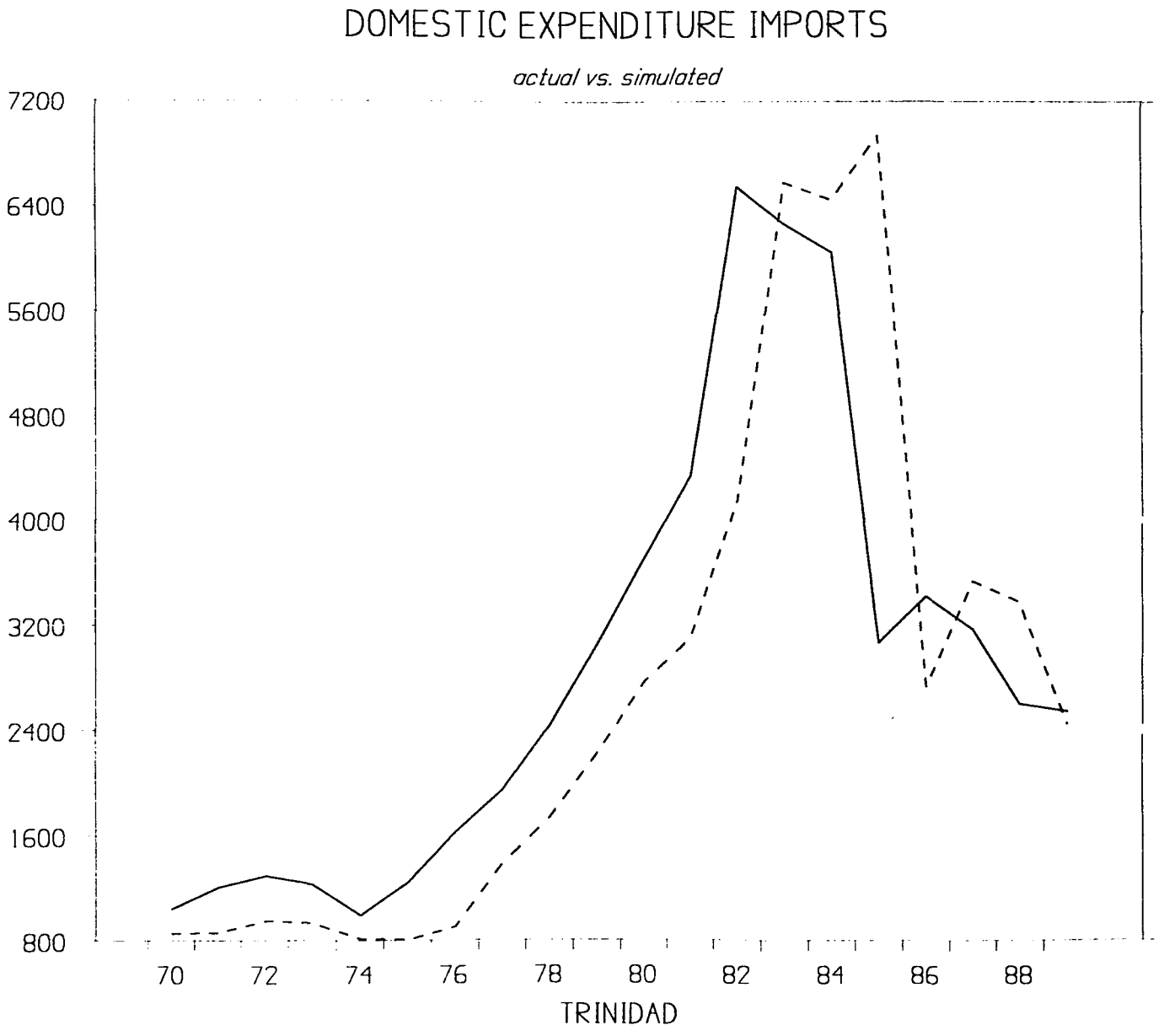
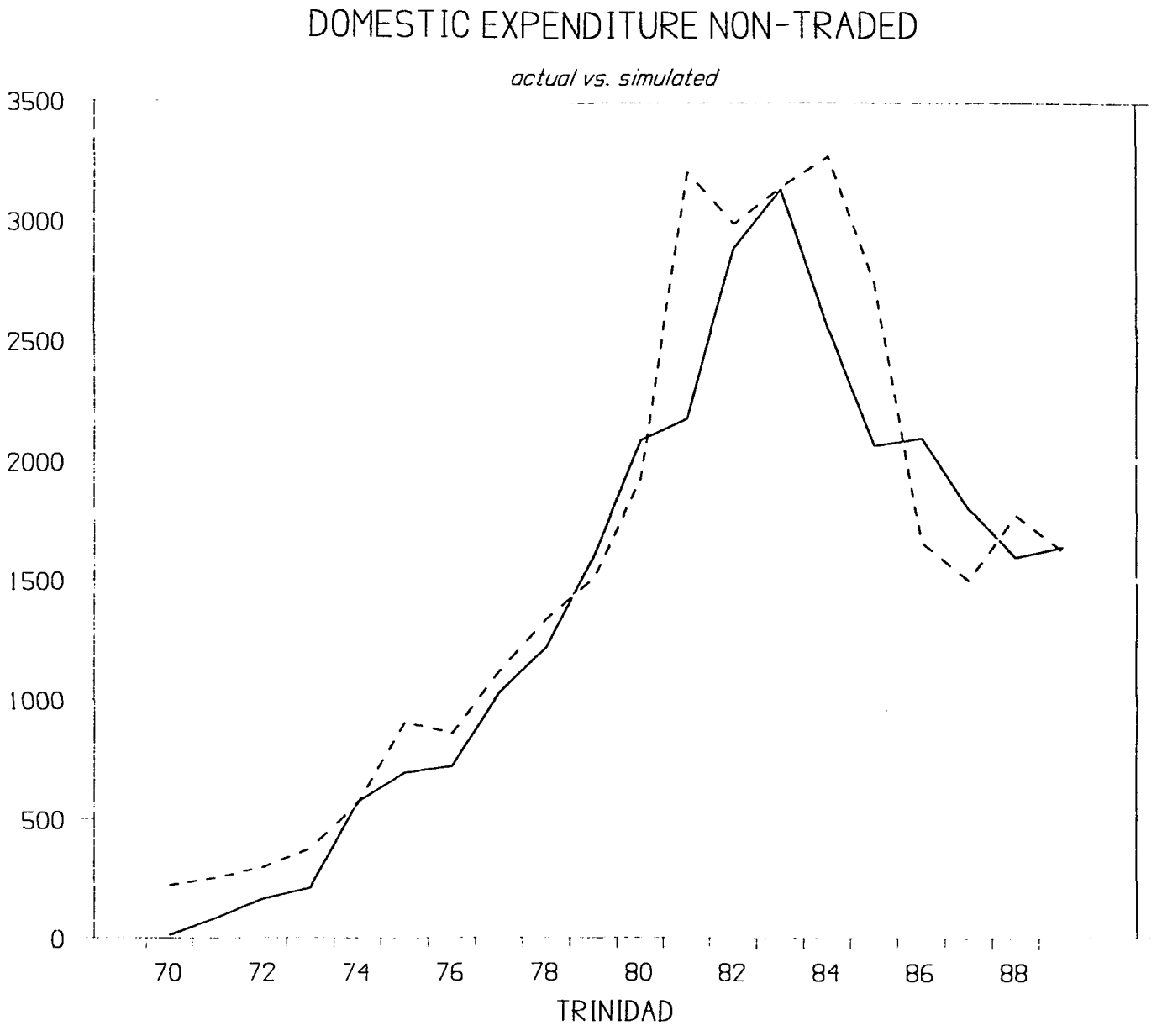

DOMESTIC EXPENDITURE IMPORTS
actual vs. simulated
7200
6400
5600
4800
4000
3200
2400
1600
800
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 68


DOMESTIC EXPENDITURE NON-TRADED
actual vs. simulated
3500
3000
2500
2000
1500
1000
500
0
70
72
74
76
78
80
82
84
86
88
TRINIDAD

including governmental rigidities have affected macroeconomic variables.

A classic example would be the fact that traditional staple exports, such as sugar and bananas, are not determined by free market competition but rather by quotas in the more lucrative markets of the U.S.A. and Europe. Also governmental policies (for example; foreign debt in Jamaica has been estimated to have been as high as 1.7 times GDP)[8] have introduced serious rigidities that have proved problematic for the model to simulate accurate results.

In the next chapter, we use the model to simulate some policy experiments for the economies of all four countries. We limit these experiments in two ways. First of all, we limit them only to endogenous variables accurately estimated by the model. Secondly, there is the implicit limitation that these policy experiments are not entirely fictitious. That is to say that for example devaluations have taken place in some countries over the sample period. We will explain how this is dealt with later.

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[8] See Norman Girvan et. al (1980) pg. 37

Chapter 4

Applications: Devaluation, Tariff and Monetary Expansion.

Introduction

In this chapter, we use the estimated model as was stated above in three policy experiments for all four countries. We are interested in the effects of (a) a devaluation equivalent to a 10% increase in the prices of exportables and importables respectively (both exogenous variables) (b) the imposition of a tariff equivalent to a 10% increase in the price of importables (c) an increase in domestic monetary expansion equivalent to a 50% increase in growth of the domestic credit component of the monetary base over "normal" [1] on our endogenous variables.

The effects of these policy changes are isolated by showing a comparison between the newly generated solutions and a control solution. The control solution is obtained by solving the model with the actual values of all endogenous variables. The newly generated solutions are obtained by solving the model each period using:

---

[1] Since actual money creation has taken place over the period, for our policy experiment we simulate a further increase of 50% over and above the actual increase which we refer to as normal.

1) the new exogenous variables associated with policy changes
2) actual values of the remaining exogenous variables
3) the previous period's simulated endogenous variables for this period's lagged endogenous variables

This implies that we are not comparing the newly generated solutions for endogenous variables with their actual paths, but rather their simulated values. Thus, the control solution is equivalent to the simulated result shown in figures 1 - 68.

Devaluation

As has been stated above, devaluation has been represented by a 10% increase in the domestic prices of the trade goods. Since these prices are exogenous (i.e. the world prices of these goods) and ignoring short run deviations from purchasing power parity, we note the following effects of the devaluation on the model.

First of all, in all four countries, the 10% devaluation was simulated in 1970. We found that in all four cases there was an immediate increase in the Aggregate Price Index which tapered off. Secondly, there was an initial increase in

exports for all countries which tapered off towards the end of the sample period. Thirdly, there was an initial decrease in imports which tended to taper off towards the end of the sample period. Finally, the trade balance of all four countries was unchanged during the period.

These results substantially contradict both established theory as well as Clements results [2]. Several factors contribute to an explanation of these findings.

Firstly, over the sample period, all four countries have experienced downward revaluations of their currencies against the currencies of the developed nations and as such the actual sample data already reflects the effects of devaluation policies. Secondly, the role of dynamic expectations over the period (which was explicitly omitted in setting up this model) implies that because of actual extensive devaluations over the sample period, people have incorporated devaluations in their future expectations producing a wash in terms of the effects of devaluation on relevant endogenous variables. Thirdly, as has been stated above; the existence of quotas and import restrictions across all four countries restricts the ability of the model to fully reflect the reactions of exports and imports to policy stimuli (e.g. devaluation).

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[2] See Clements Op. Cit. pgs. 198 -203

Tables 17 - 20 show devaluation simulated endogenous variables (specifically exports, imports and the price of exportables relative to non-traded goods) for all four countries. Also, figures 69 - 84 show the plotted values of both the control solution and the devaluation simulated solution of relevant endogenous variables.

Table 17 Jamaica Devaluation Simulated Endogenous Variables as a Percentage of Control

Year	Real Exports	Real Imports	Price of Exportables Relative to Non-traded Goods
1969	1.0000	1.0000	1.0000
1970	1.0641	0.8636	1.0937
1971	1.0622	0.8437	1.0868
1972	1.0601	0.8561	1.0835
1973	1.0587	0.9631	1.0786
1974	1.0562	0.9724	1.0753
1975	1.0548	0.9931	1.0721
1976	1.0611	1.0000	1.0684
1977	1.0539	1.0131	1.0633
1978	1.0537	1.0267	1.0621
1979	1.0532	1.0124	1.0604
1980	1.0496	1.0138	1.0564
1981	1.0482	1.0421	1.0521
1982	1.0468	1.0447	1.0487
1983	1.0441	1.0386	1.0463
1984	1.0426	1.0212	1.0431
1985	1.0386	1.0031	1.0417
1986	1.0365	1.0021	1.0389
1987	1.0587	1.0004	1.0362
1988	1.0329	1.0063	1.0341
1989	1.0311	1.0231	1.0303
1990	1.0287	1.0167	1.0294

Table 18 Barbados Devaluation Simulated Endogenous Variables as a Percentage of Control

Year	Real Exports	Real Imports	Price of Exportables Relative to Non-traded goods
1969	1.0000	1.0000	1.0000
1970	1.3744	0.8631	1.1631
1971	1.3368	0.8439	1.1448
1972	1.3359	0.8724	1.1367
1973	1.3326	0.8945	1.1321
1974	1.3236	0.9166	1.1264
1975	1.2437	0.9472	1.1189
1976	1.0131	0.9731	1.1049
1977	1.0089	0.9821	1.1010
1978	0.9437	0.9789	1.0886
1979	0.9361	0.9746	1.0824
1980	0.9867	0.9768	1.0779
1981	1.0032	0.9842	1.0731
1982	1.2761	0.9877	1.0643
1983	1.3127	0.9421	1.0618
1984	1.2622	0.8636	1.0565
1985	1.1439	0.8721	1.0541
1986	1.0044	0.8659	1.0437
1987	1.0032	0.8634	1.0368
1988	1.0009	0.8647	1.0342
1989	1.0024	0.8689	1.0291
1990	1.0116	0.8641	1.0256

Table 19 Devaluation Simulated Endogenous Variables as a Percentage of Control Guyana

Year	Real Exports	Real Imports	Price of Exportables Relative to Non-traded
1969	1.0000	1.0000	1.0000
1970	1.6135	0.7938	1.1437
1971	1.6459	0.8734	1.1128
1972	1.7217	0.8931	1.0921
1973	1.5937	0.9632	1.0858
1974	1.7437	0.9549	1.0836
1975	1.3621	0.9731	1.0804
1976	1.5854	0.9784	1.0766
1977	1.5946	0.9638	1.0735
1978	1.6101	0.9661	1.0658
1979	1.6243	0.9893	1.0622
1980	1.5857	0.9844	1.0574
1981	1.4991	0.9987	1.0538
1982	1.6433	0.9998	1.0463
1983	1.6108	0.9986	1.0381
1984	1.5957	0.9702	1.0359
1985	1.5682	0.9638	1.0321
1986	1.5931	0.9826	1.0286
1987	1.4129	1.0014	1.0251
1988	1.0136	1.0008	1.0204
1989	0.9731	1.0002	1.0163
1990	0.9014	1.0001	1.0091

Table 20 Trinidad Devaluation Simulated Endogenous Variables as a Percentage of Control

Year	Real Exports	Real Imports	Price of Exportables Relative to Non-traded Goods
1969	1.0000	1.0000	1.0000
1970	1.0401	0.8726	1.1674
1971	1.0388	0.9135	1.1596
1972	1.0010	0.9647	1.1402
1973	1.0100	0.9989	1.1357
1974	1.0000	1.0000	1.1285
1975	1.0000	1.0000	1.1169
1976	1.0000	1.0000	1.1114
1977	1.0000	1.0000	1.0863
1978	1.0000	1.0000	1.0524
1979	1.0000	1.0000	1.0137
1980	1.0000	1.0000	1.0096
1981	1.0000	1.0000	1.0081
1982	1.0000	1.0000	1.0063
1983	1.0000	1.0000	1.0058
1984	1.0000	1.0000	1.0036
1985	1.0000	1.0000	1.0029
1986	1.0000	1.0000	1.0014
1987	1.0000	1.0000	1.0008
1988	1.0000	1.0000	1.0003
1989	1.0000	1.0000	1.0016
1990	1.0000	1.0000	1.0001

Fig. 69

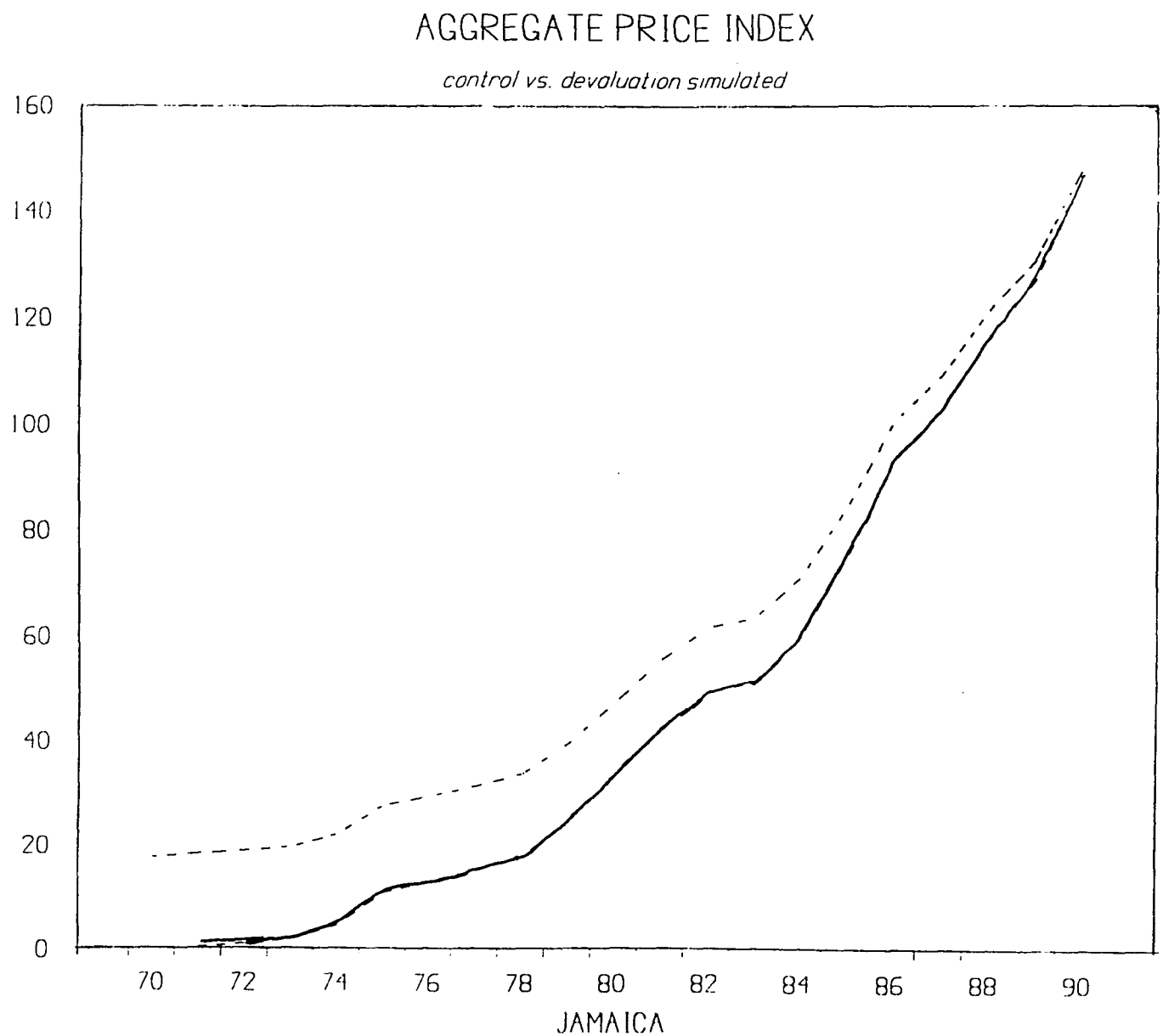

AGGREGATE PRICE INDEX
control vs. devaluation simulated
160
140
120
100
80
60
40
20
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 70

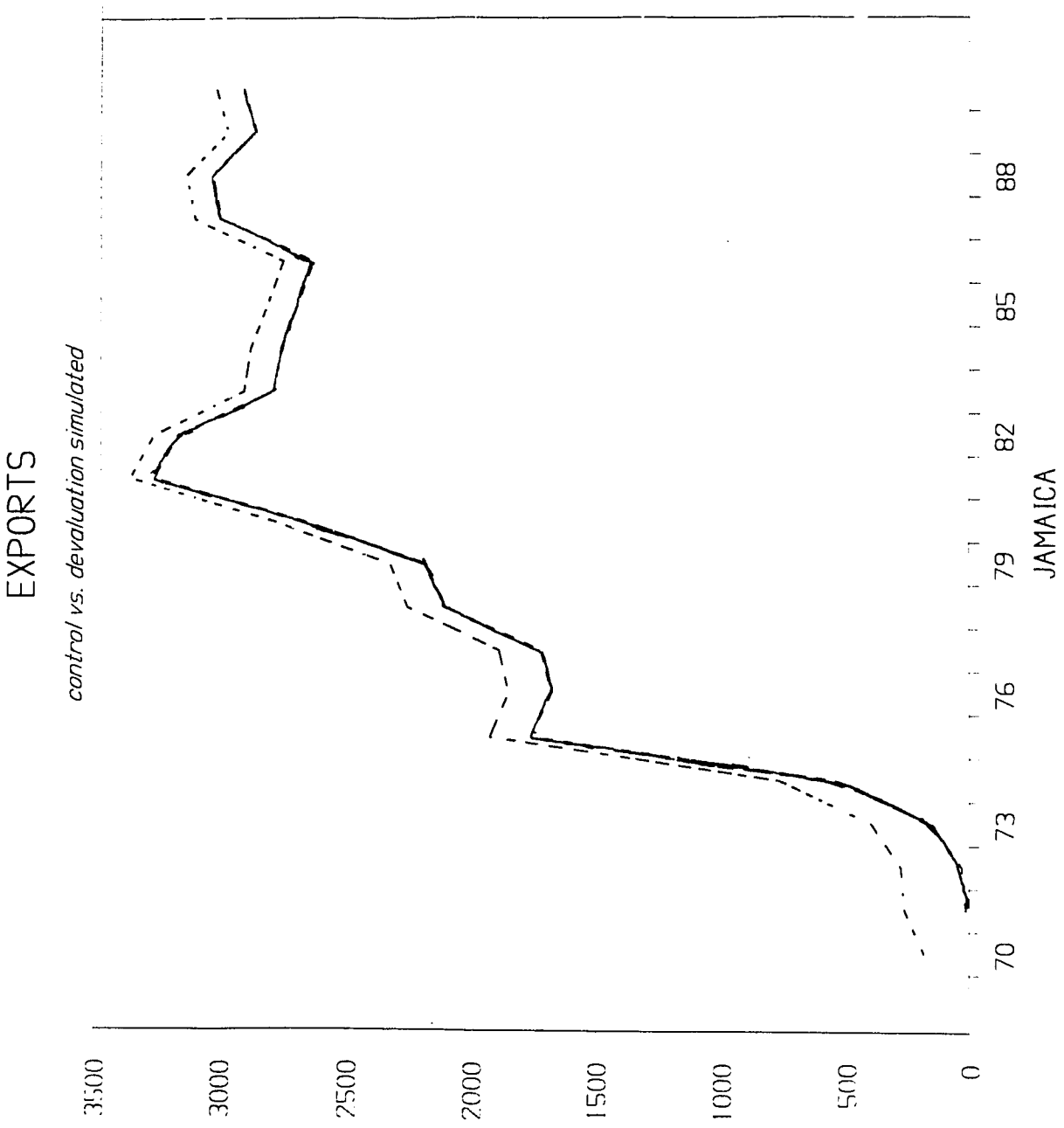

EXPORTS
control vs. devaluation simulated
JAMAICA
70
73
76
79
82
85
88
0
500
1000
1500
2000
2500
3000
3500

Fig. 71

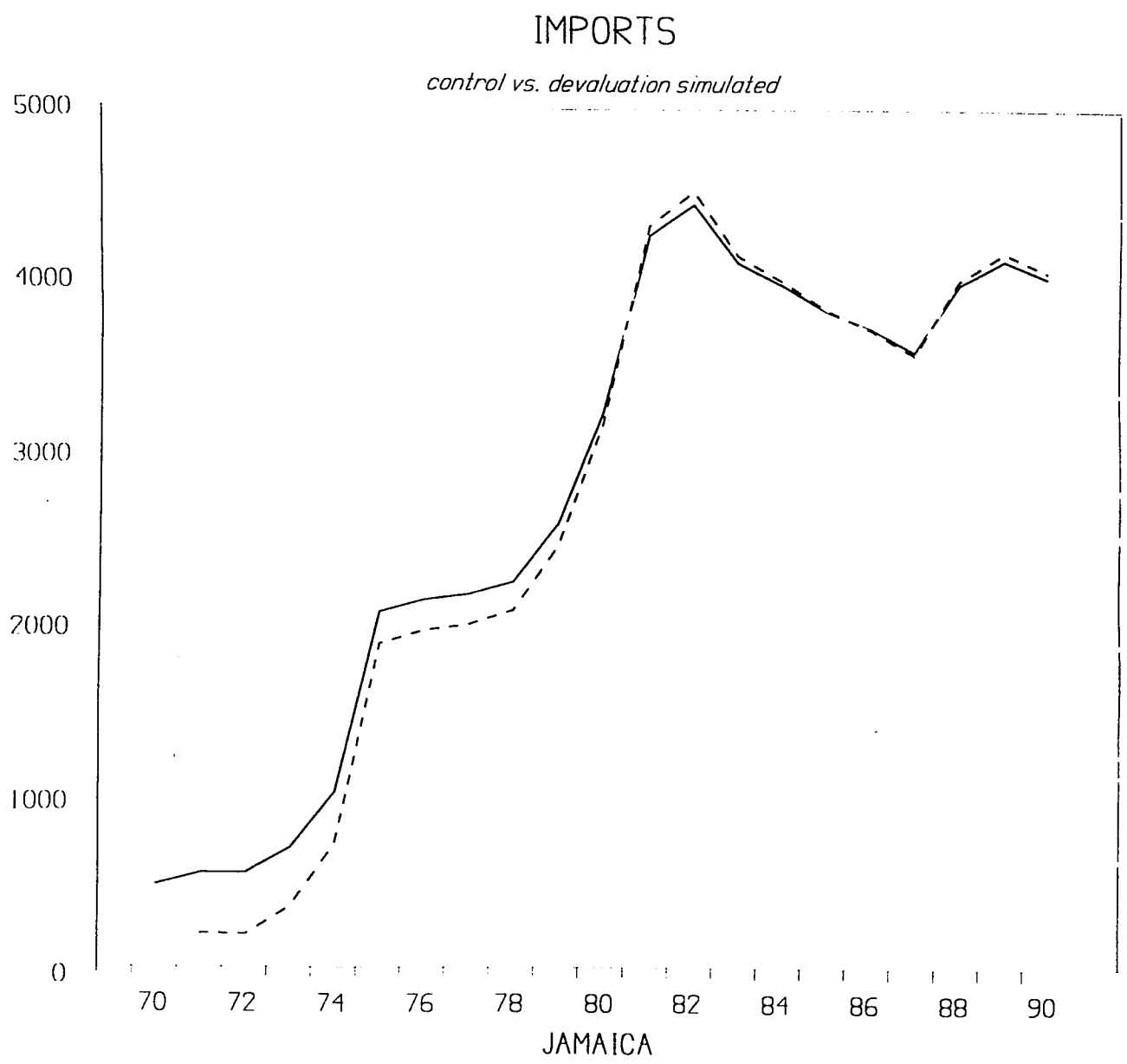

IMPORTS
control vs. devaluation simulated
5000
4000
3000
2000
1000
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 72

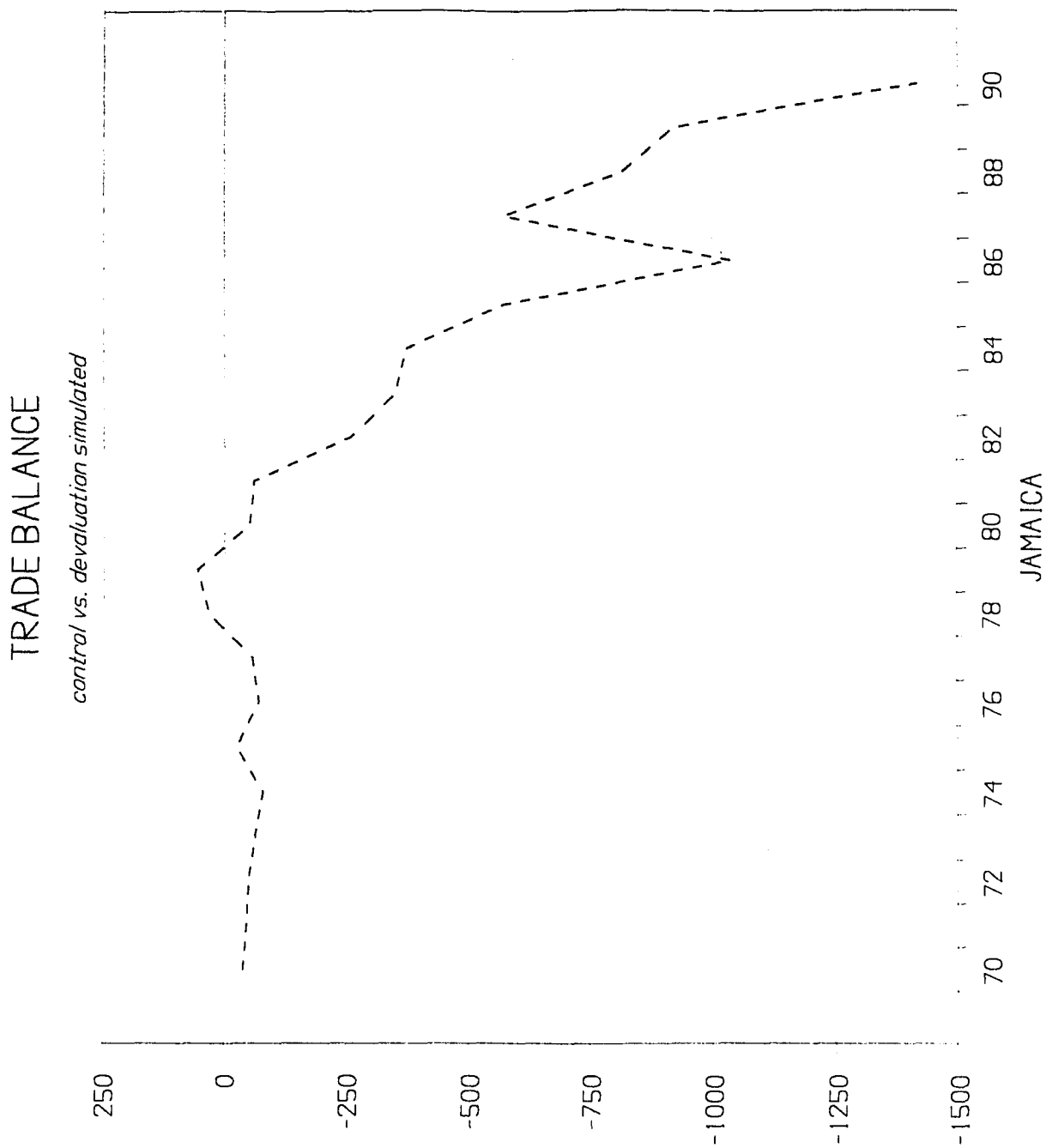

TRADE BALANCE
control vs. devaluation simulated
250
0
-250
-500
-750
-1000
-1250
-1500
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 73

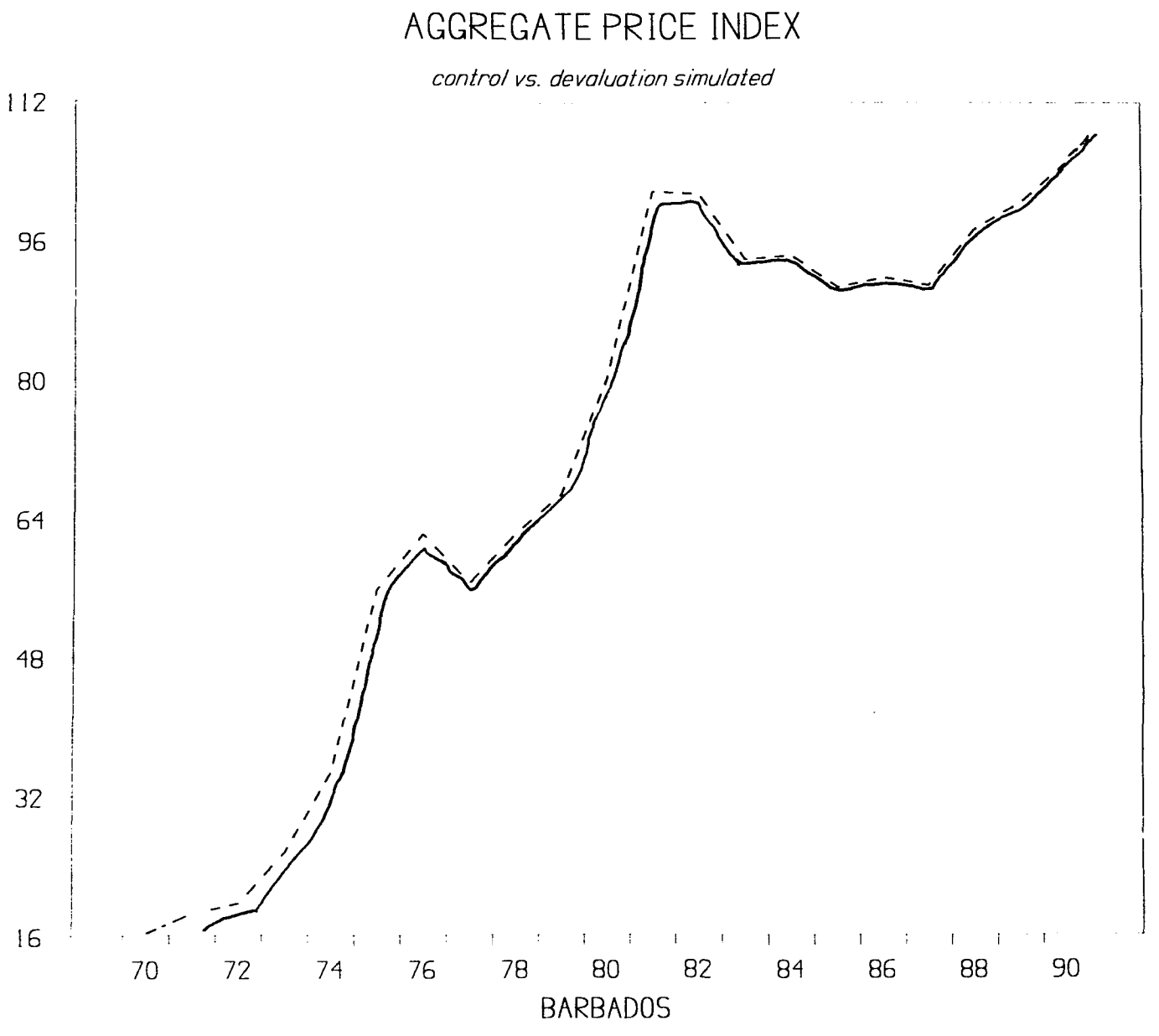

AGGREGATE PRICE INDEX
control vs. devaluation simulated
112
96
80
64
48
32
16
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 74

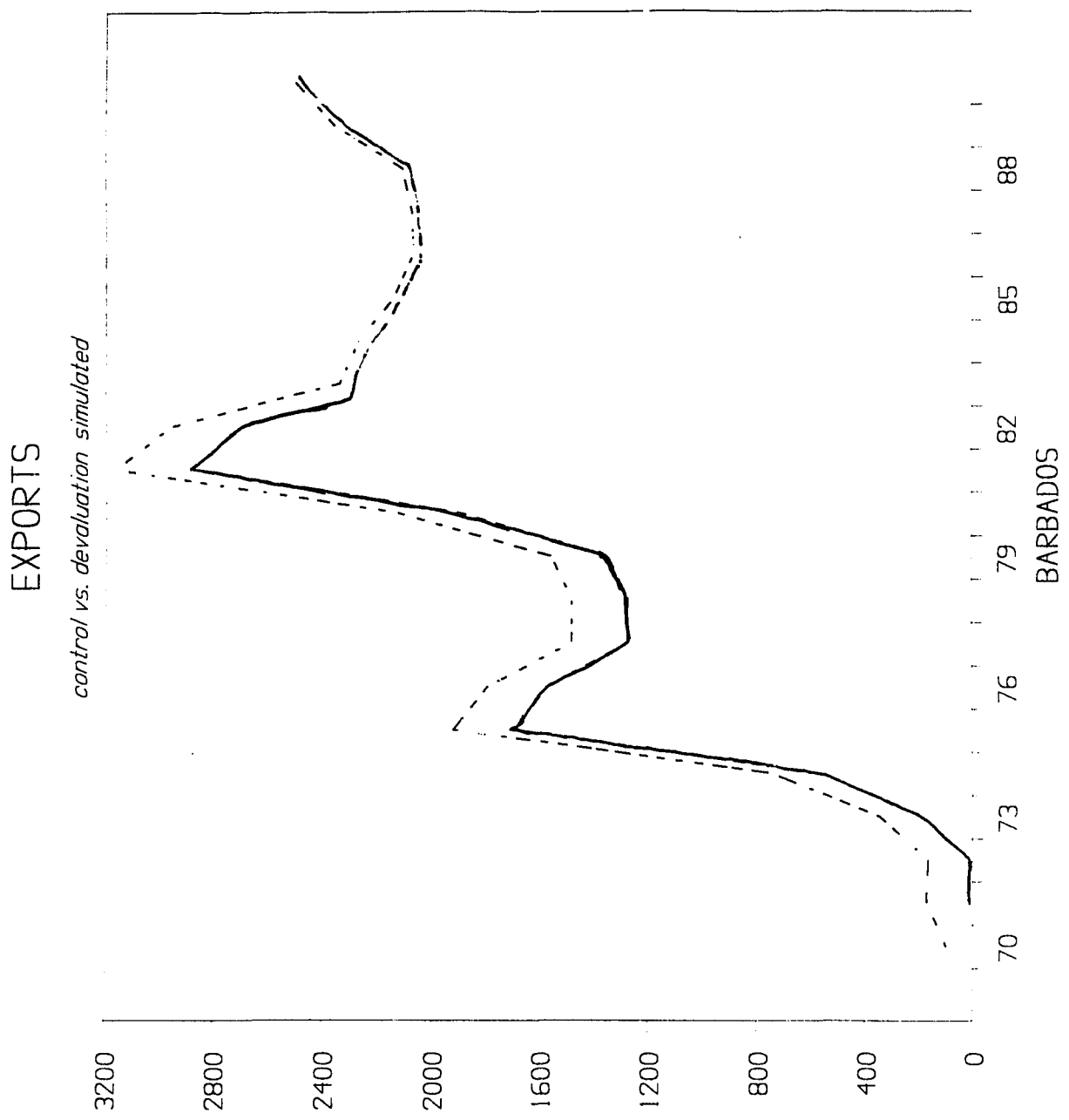
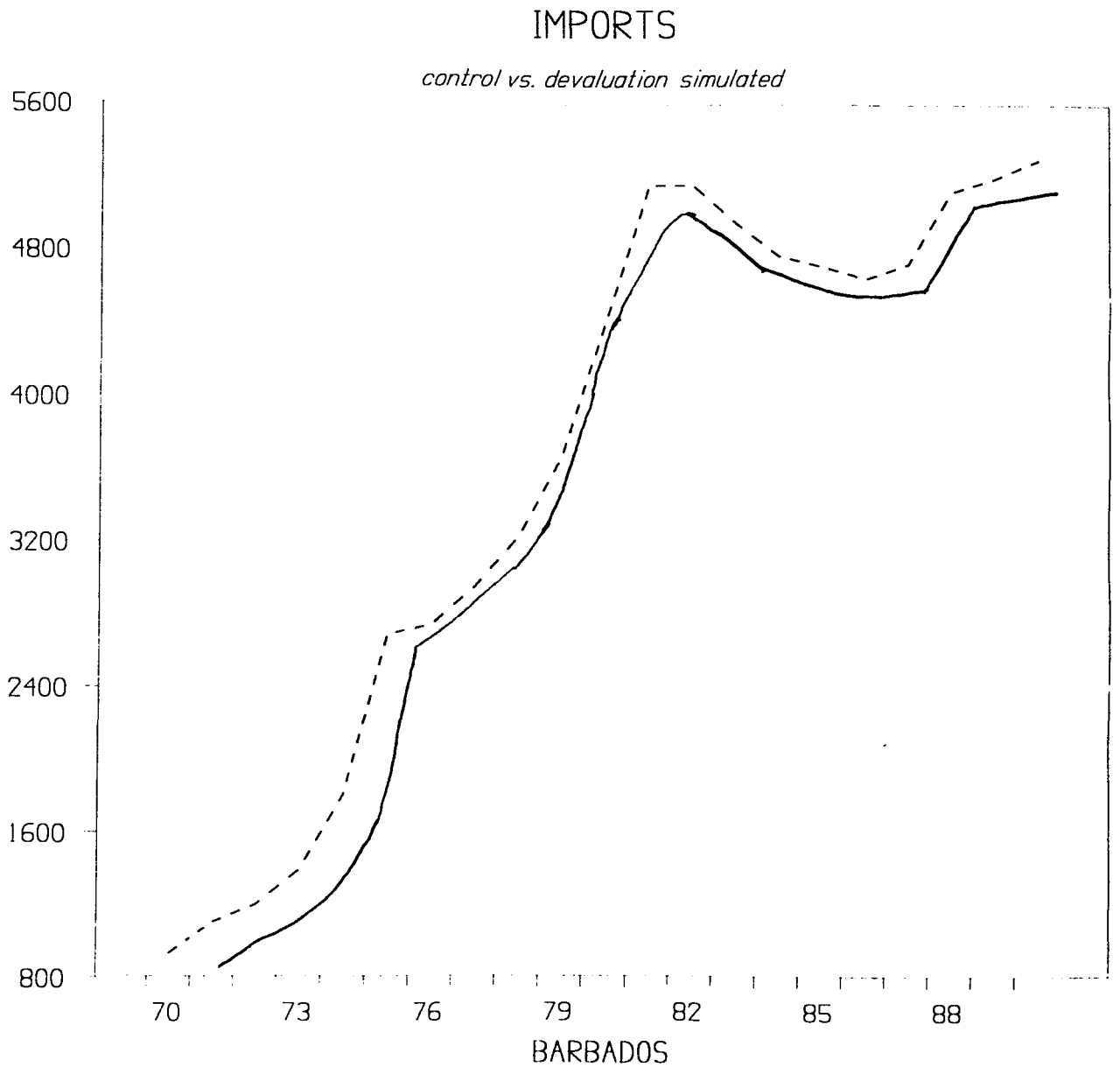

EXPORTS
control vs. devaluation simulated
3200
2800
2400
2000
1600
1200
800
400
0
70
73
76
79
82
85
88
BARBADOS

Fig. 75


IMPORTS
control vs. devaluation simulated
5600
4800
4000
3200
2400
1600
800
70
73
76
79
82
85
88
BARBADOS

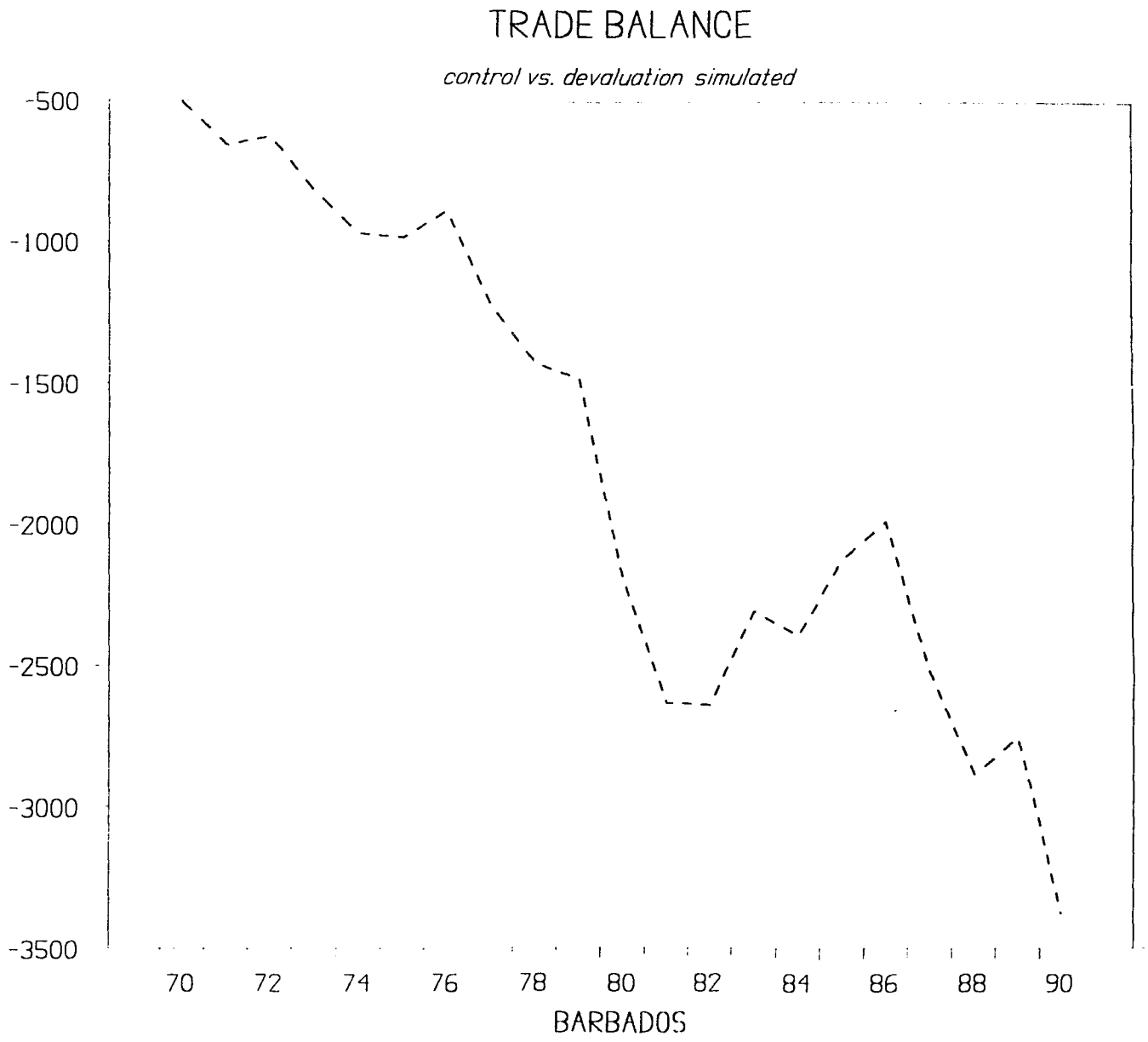

TRADE BALANCE
control vs. devaluation simulated
-500
-1000
-1500
-2000
-2500
-3000
-3500
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 77

AGGREGATE PRICE INDEX

control vs. devaluation simulated

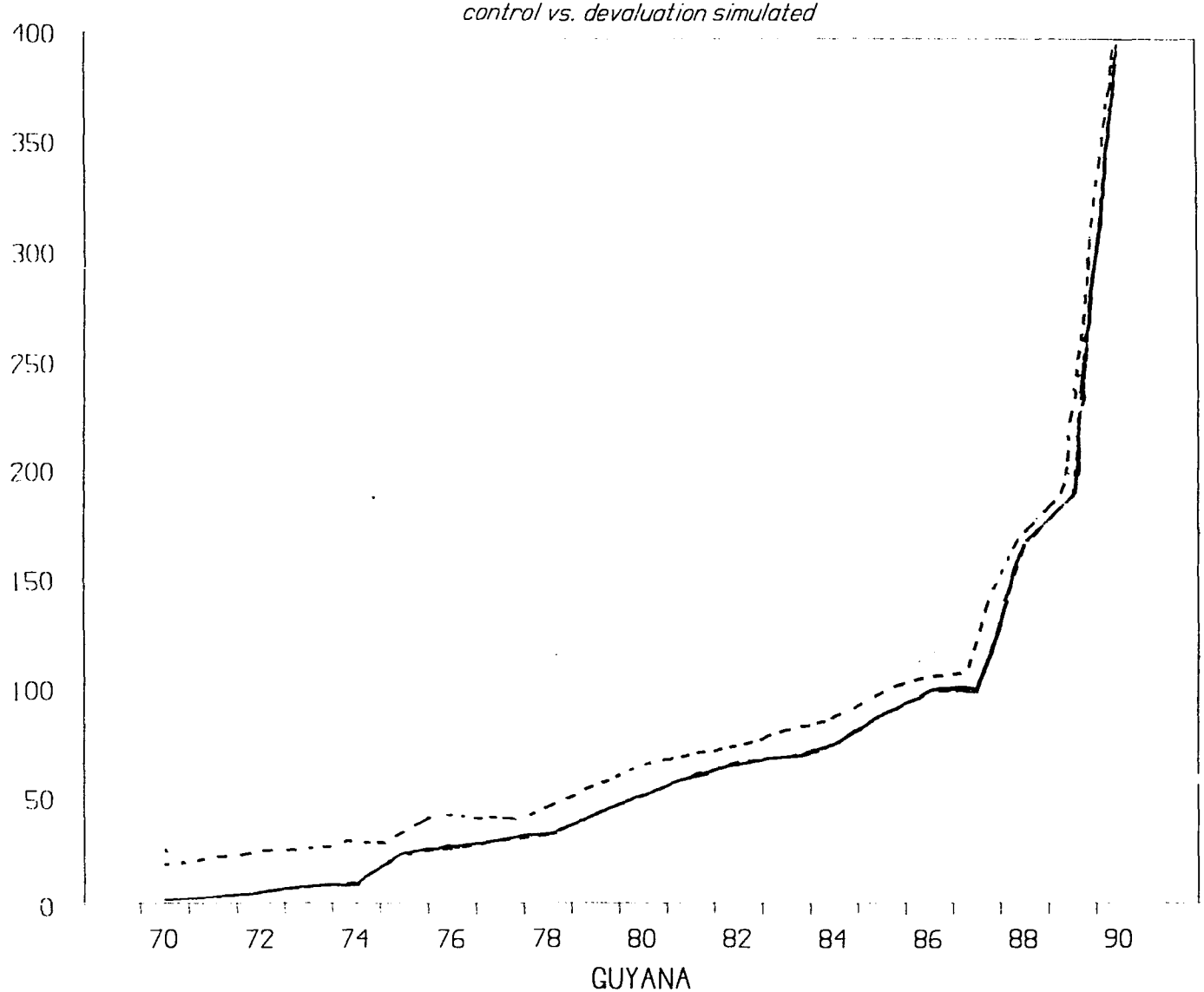
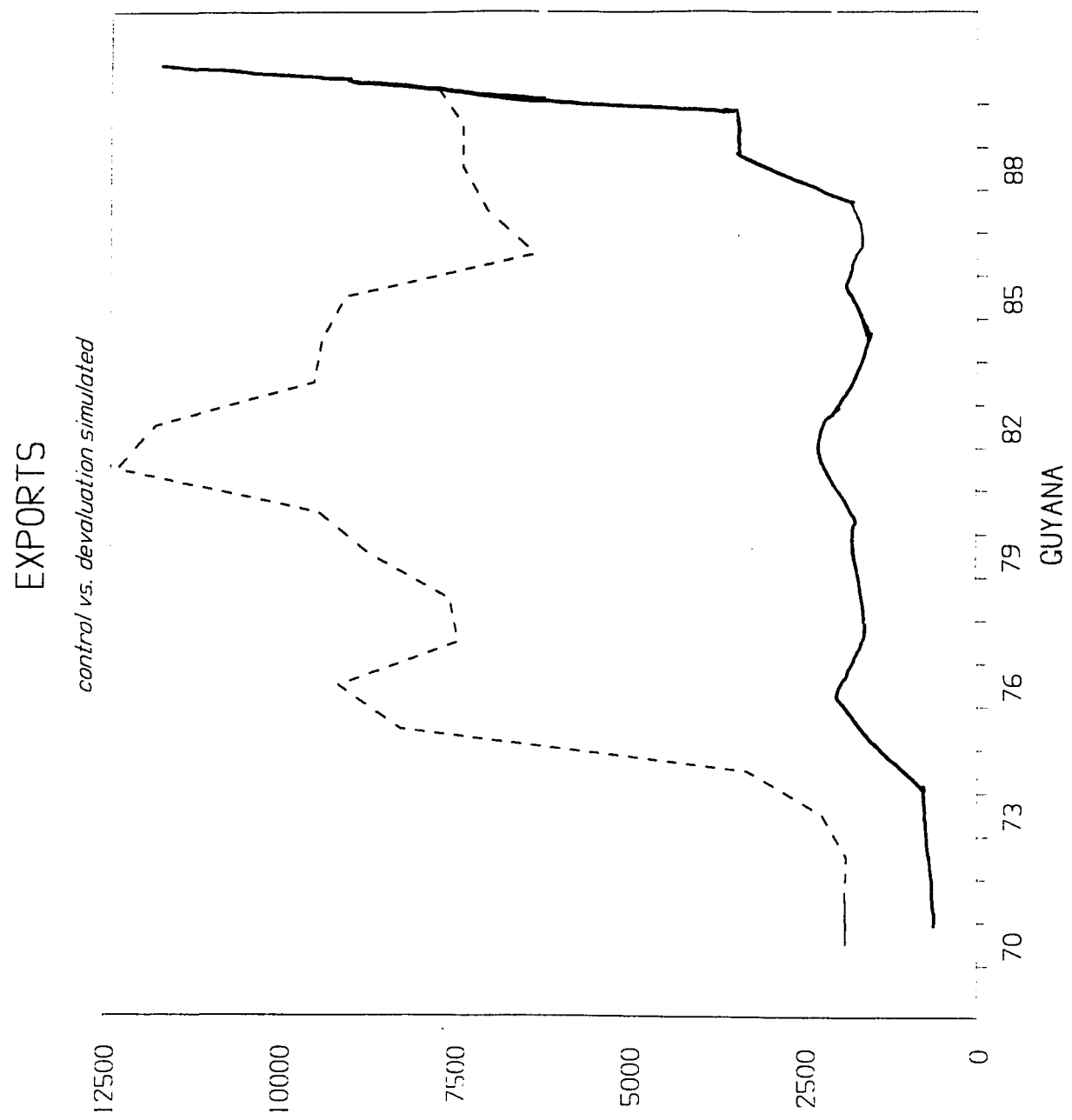
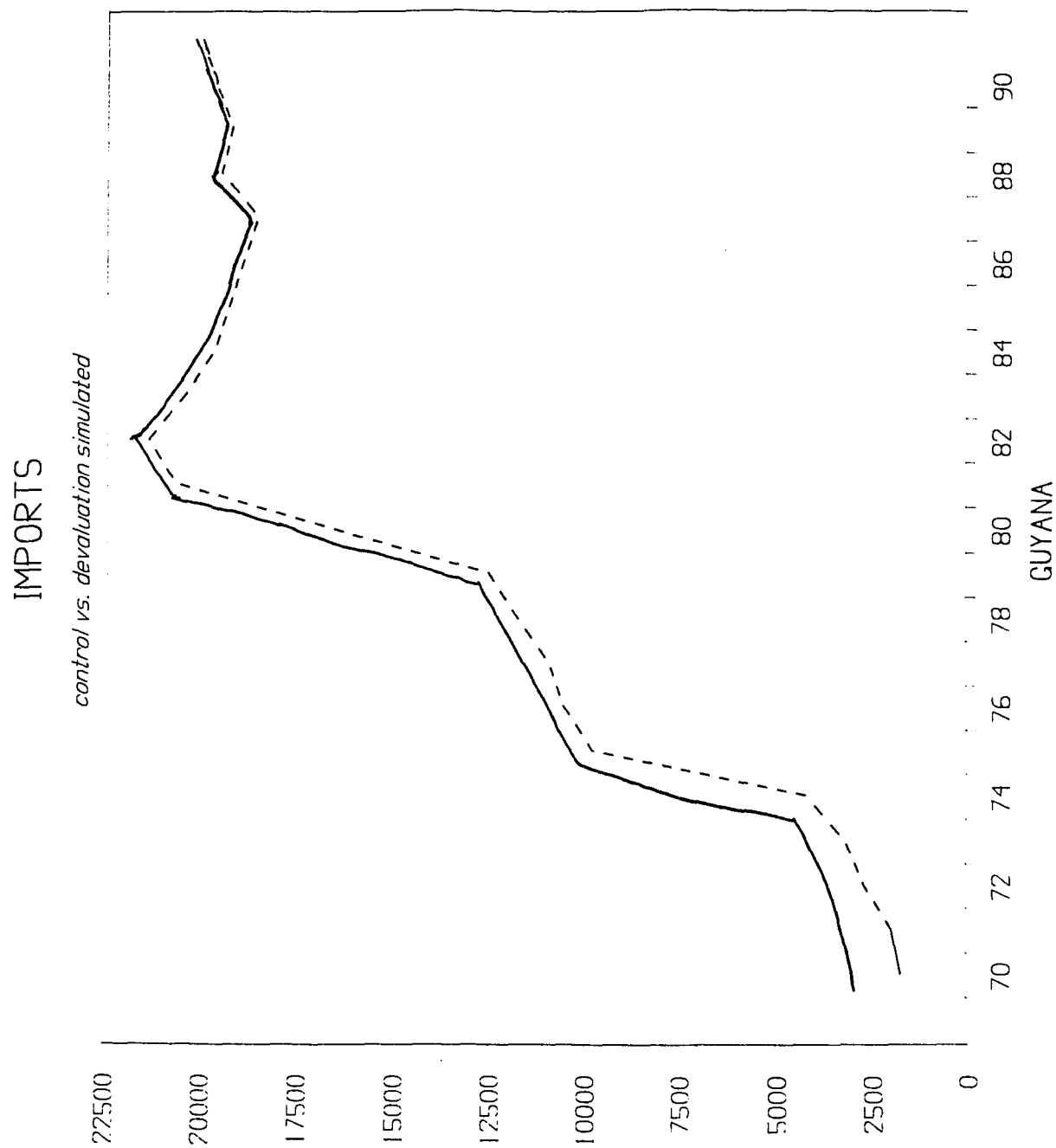


Fig. 78


EXPORTS
control vs. devaluation simulated
12500
10000
7500
5000
2500
0
70
73
76
79
82
85
88
GUYANA


IMPORTS
control vs. devaluation simulated
GUYANA
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
70
72
74
76
78
80
82
84
86
88
90

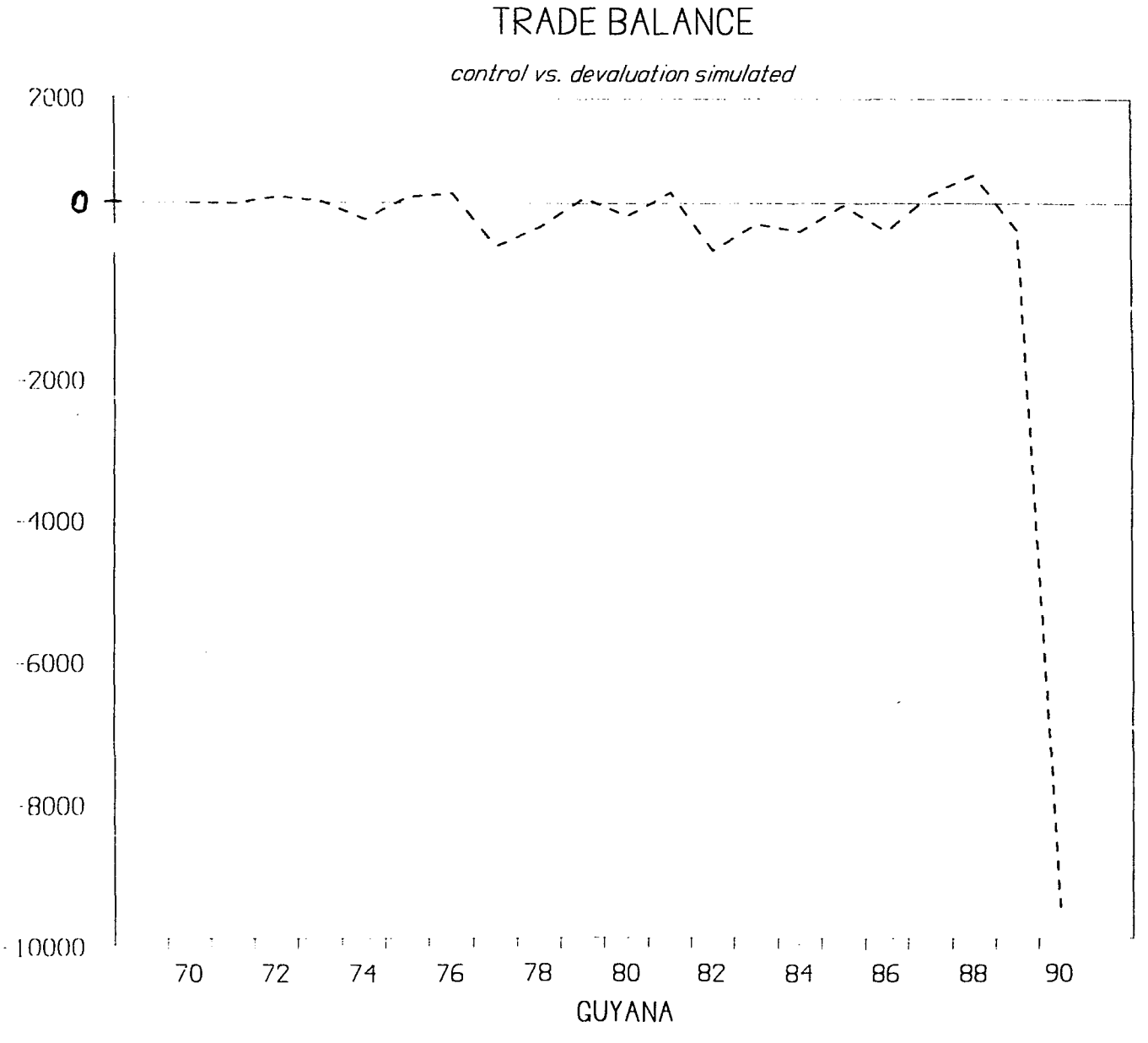

TRADE BALANCE
control vs. devaluation simulated
2000
0
-2000
-4000
-6000
-8000
-10000
70
72
74
76
78
80
82
84
86
88
90
GUYANA

Fig. 81

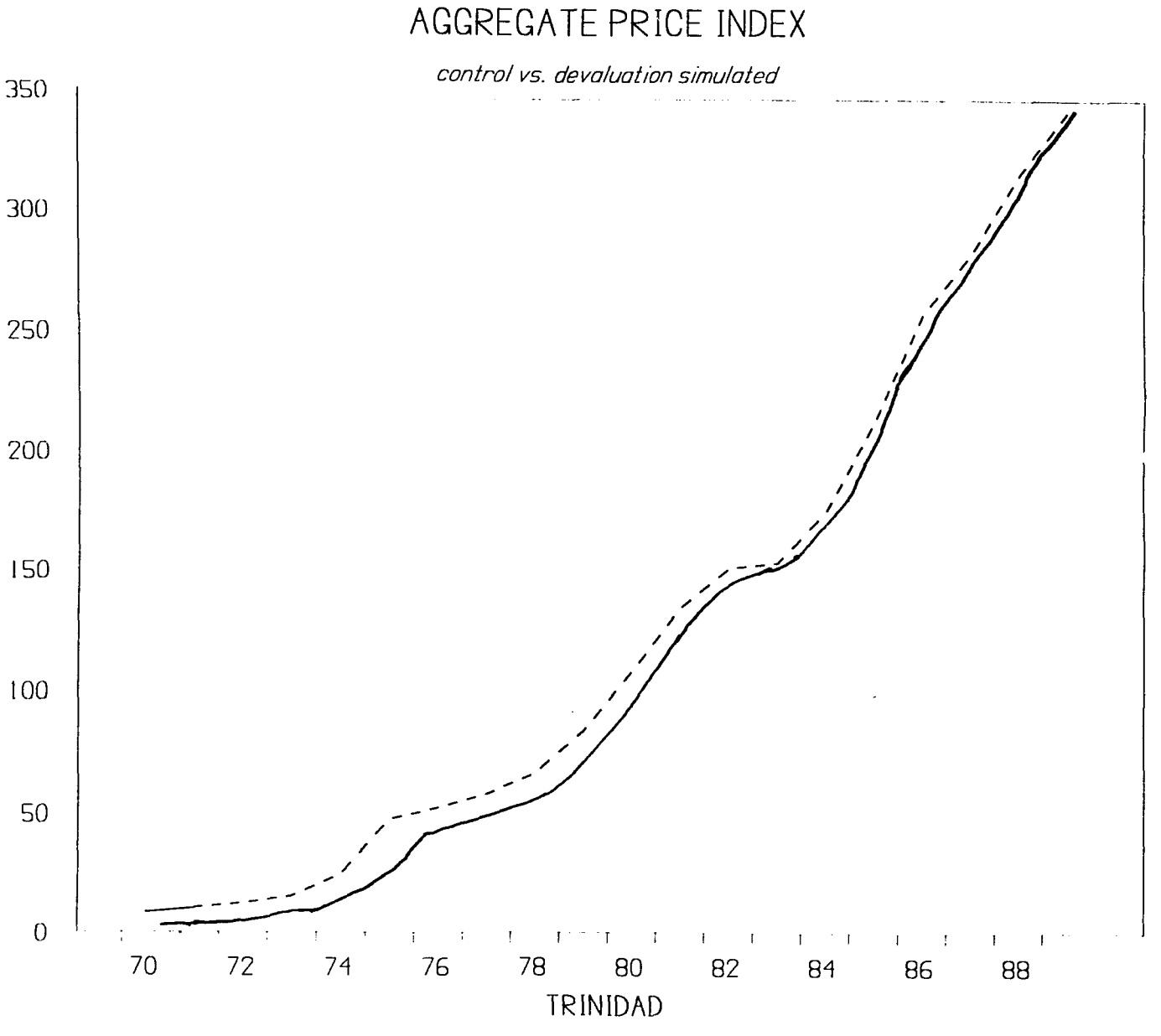

AGGREGATE PRICE INDEX
control vs. devaluation simulated
350
300
250
200
150
100
50
0
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 82

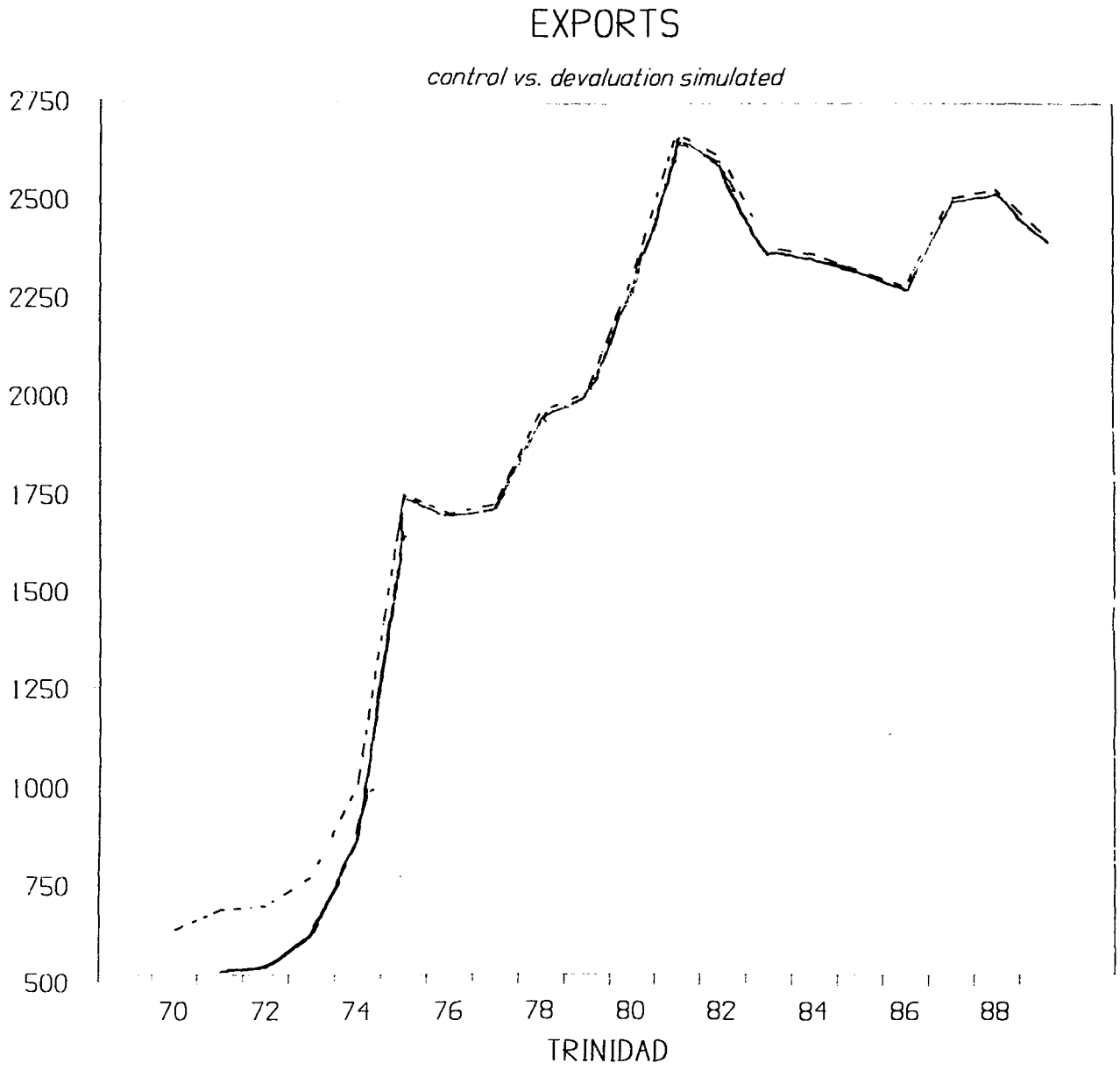
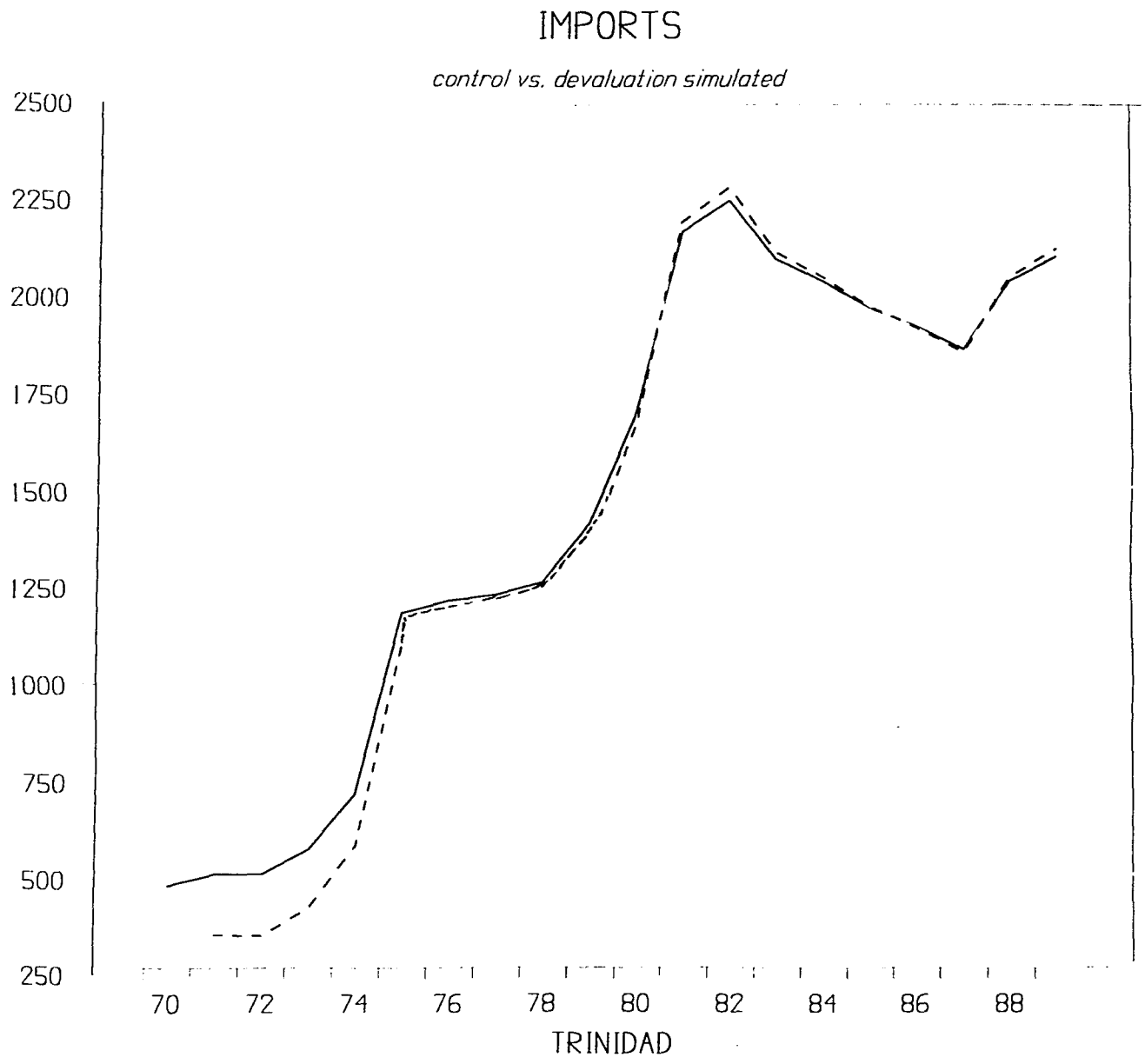
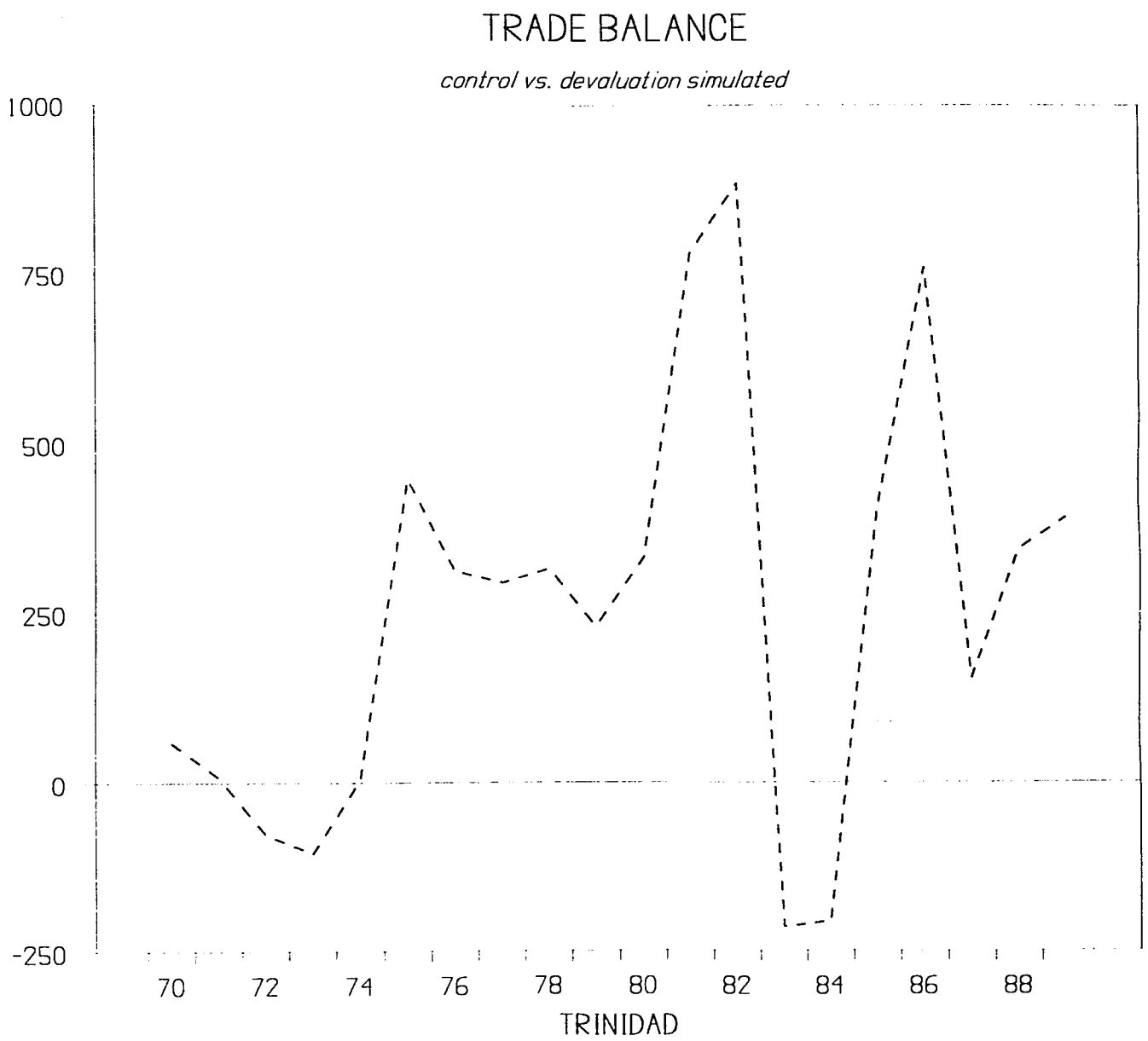

EXPORTS
control vs. devaluation simulated
2750
2500
2250
2000
1750
1500
1250
1000
750
500
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 83


IMPORTS
control vs. devaluation simulated
2500
2250
2000
1750
1500
1250
1000
750
500
250
70
72
74
76
78
80
82
84
86
88
TRINIDAD


TRADE BALANCE
control vs. devaluation simulated
1000
750
500
250
0
-250
70
72
74
76
78
80
82
84
86
88
TRINIDAD

There appears to be a significant difference also between these four countries. In Jamaica, for example, a 10% simulated devaluation produces approximately a 6% increase in real exports, however, after 20 years real exports are still 2% more than they would be without this simulated devaluation, indicating the speed of adjustment is slow . In Trinidad, the effect of simulated devaluation is quite brief. A 10% simulated devaluation produces approximately a 4% increase in real exports which dies out in 5 years. In Guyana, a 10% simulated devaluation produces approximately a 60% increase in real exports, which lasts for almost the entire sample period. In Barbados, a 10% simulated devaluation produces a 37% increase in real exports, which declines to a 1% increase by the end of the sample period.

These results confirms what was stated above. There also appears to be different speeds of adjustment in the model, giving credence to the view that rigidities in exports and imports prevent devaluation as a policy from having the desired results on endogenous variables.

As far as imports is concerned, they fall initially as a result of the simulated devaluation. In Jamaica, for example, the initial 10% simulated devaluation, reduces imports to 86% of what they would be without the policy experimentation of a simulated devaluation. However, they return to their pre-

devaluation levels within 8 years. In Barbados, the initial effect is approximately the same, returning to normal level within 9 years. In Guyana, the speed of adjustment is somewhat slower. The effect of the initial devaluation is 79%, however, real imports return to their normal level in 19 years. This is not the case for Trinidad, however, where the speed of adjustment was quite rapid; where the initial effect was 87% returning to pre-devaluation levels in five years.

As far as the relative price of exportables relative to non-traded is concerned, there is some overshooting. That is to say, the percentage increase is more than the devaluation (0.104 - 0.167) for all four countries. This implies that the price of the non-traded goods falls relative to the model estimated value initially. This, however, declines slowly over the sample period, indicating a slow adjustment to long run equilibrium.

Finally, devaluation appears to have no long term effect on the trade balance. This is somewhat expected from economic theory. However, it does not seem even to have any significant short run effect either. This is due primarily to export and import rigidities and an inherent unpredictability of the model to estimate the trade balance. It would appear that devaluation as a policy is limited in its effect on the trade balance where there exists export rigidities (quotas,

etc.) and import rigidities (import restriction, etc.) not only in the long run, but also in the short run as well.

Tariff on Imports

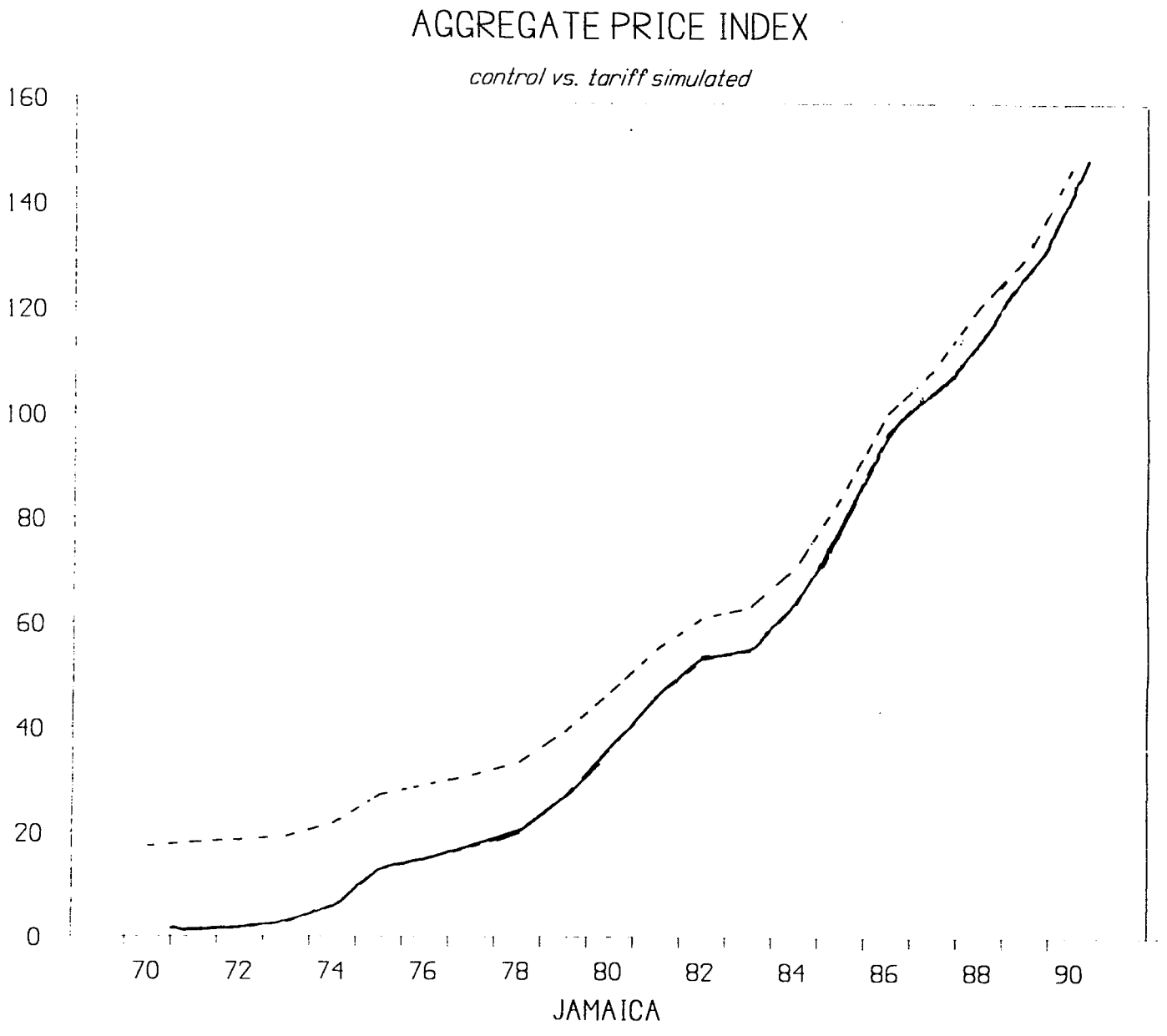
The tariff on imports is represented by a 10% rise on the price of importables for the period 1969 - 1990, that is equi-proportional to the tariff rate. The effect of the tariff is two-fold. It produces an increase in the price of importables relative to exportables and non-traded goods. This causes an increase in the output of importables relative to exportables. Consumption of importables decrease while consumption of exportables increase.

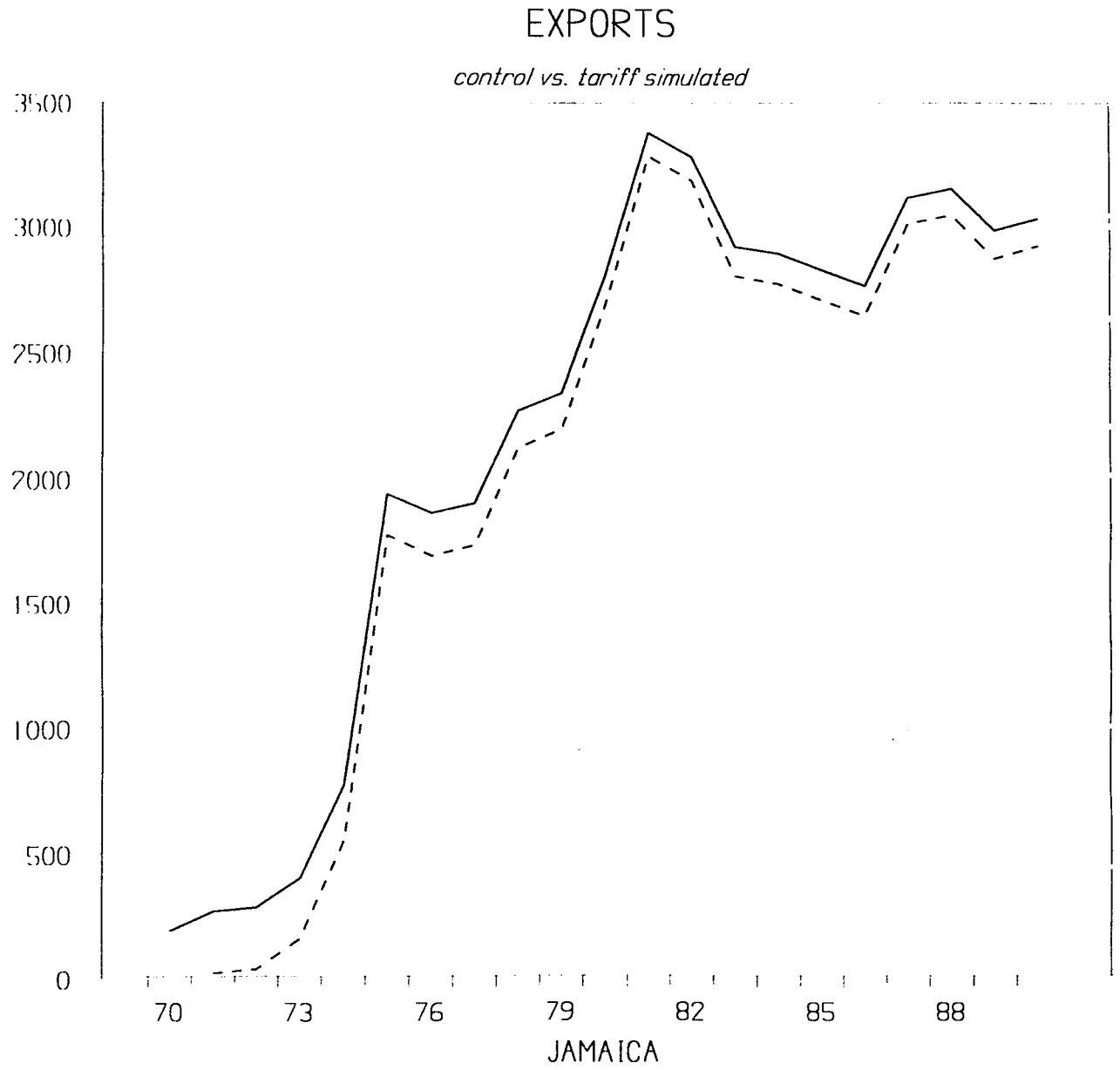
The second effect is that there is an initial change in the trade balance. The change in prices in favor of importables, relative to exportables, induces a change between income and spending affecting savings, current wealth creation and the trade balance. The effect on the trade balance, however, is temporary and there is no long run effect on the trade balance.

The effects of the tariff on production and consumption are mutually reinforcing, combining to give a fall in both real exports and imports.

In figures 85 - 100 below, we show the effect of the tariff on real exports, real imports, the aggregate price level and the trade balance for all four countries. In all cases, the aggregate price level has risen as a result of the rise in the price of importables. In all cases, the rise is permanent for the entire sample period.

Real imports and real exports fall in the long run and there is no long change in the trade balance.


AGGREGATE PRICE INDEX
control vs. tariff simulated
160
140
120
100
80
60
40
20
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA


EXPORTS
control vs. tariff simulated
3500
3000
2500
2000
1500
1000
500
0
70
73
76
79
82
85
88
JAMAICA

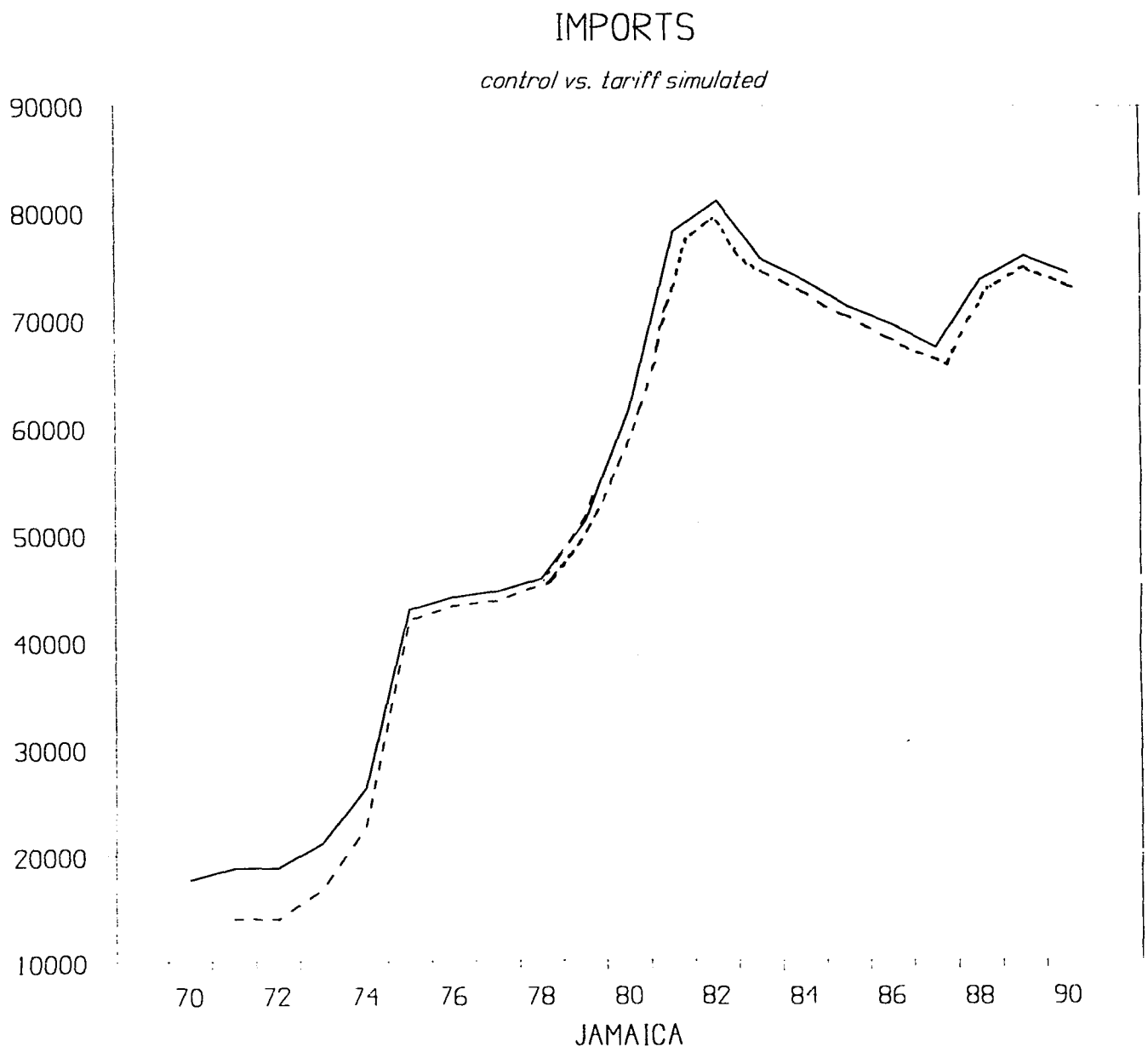

IMPORTS
control vs. tariff simulated
90000
80000
70000
60000
50000
40000
30000
20000
10000
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 88

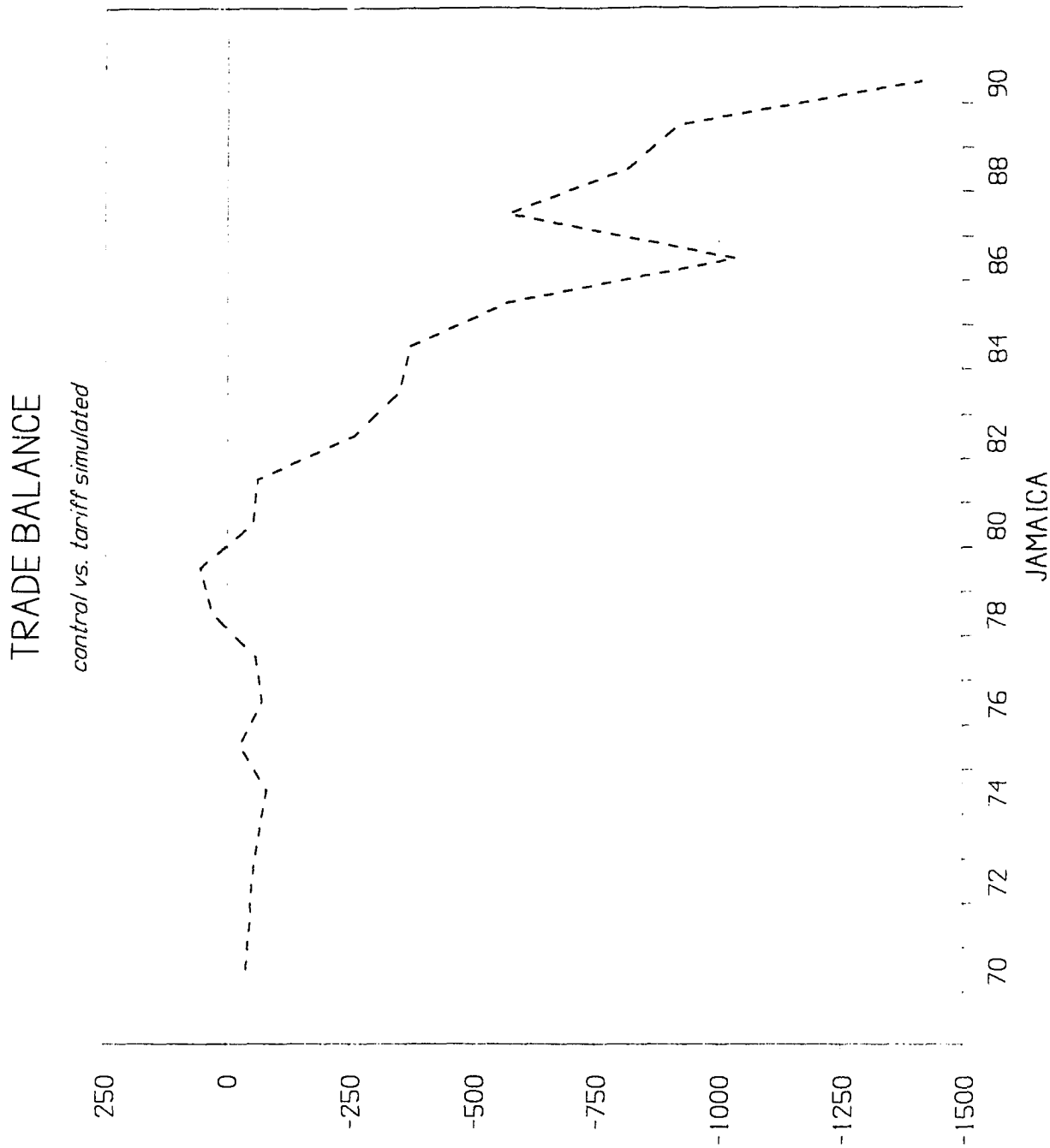

TRADE BALANCE
control vs. tariff simulated
250
0
-250
-500
-750
-1000
-1250
-1500
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 89

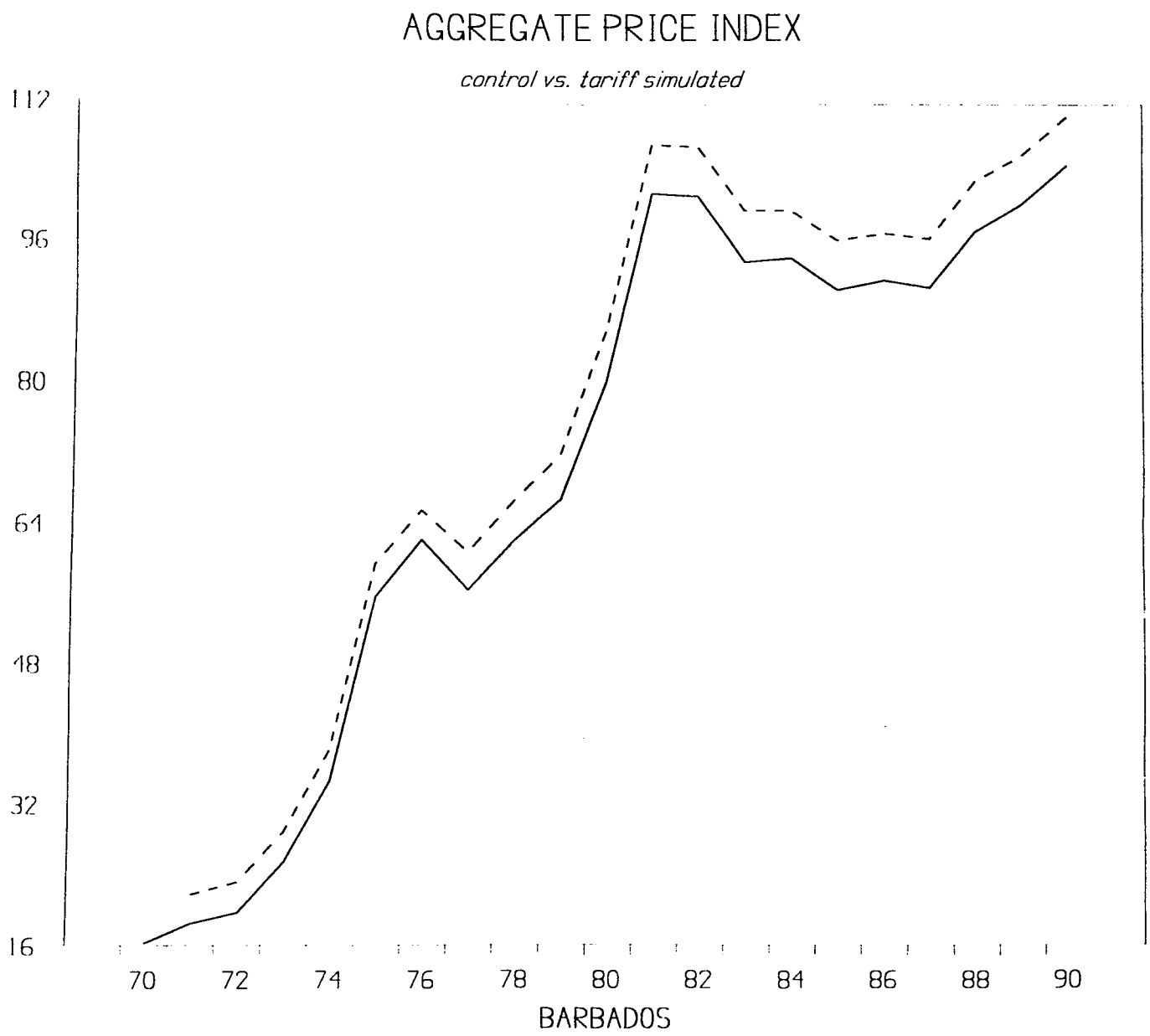

AGGREGATE PRICE INDEX
control vs. tariff simulated
112
96
80
64
48
32
16
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 90

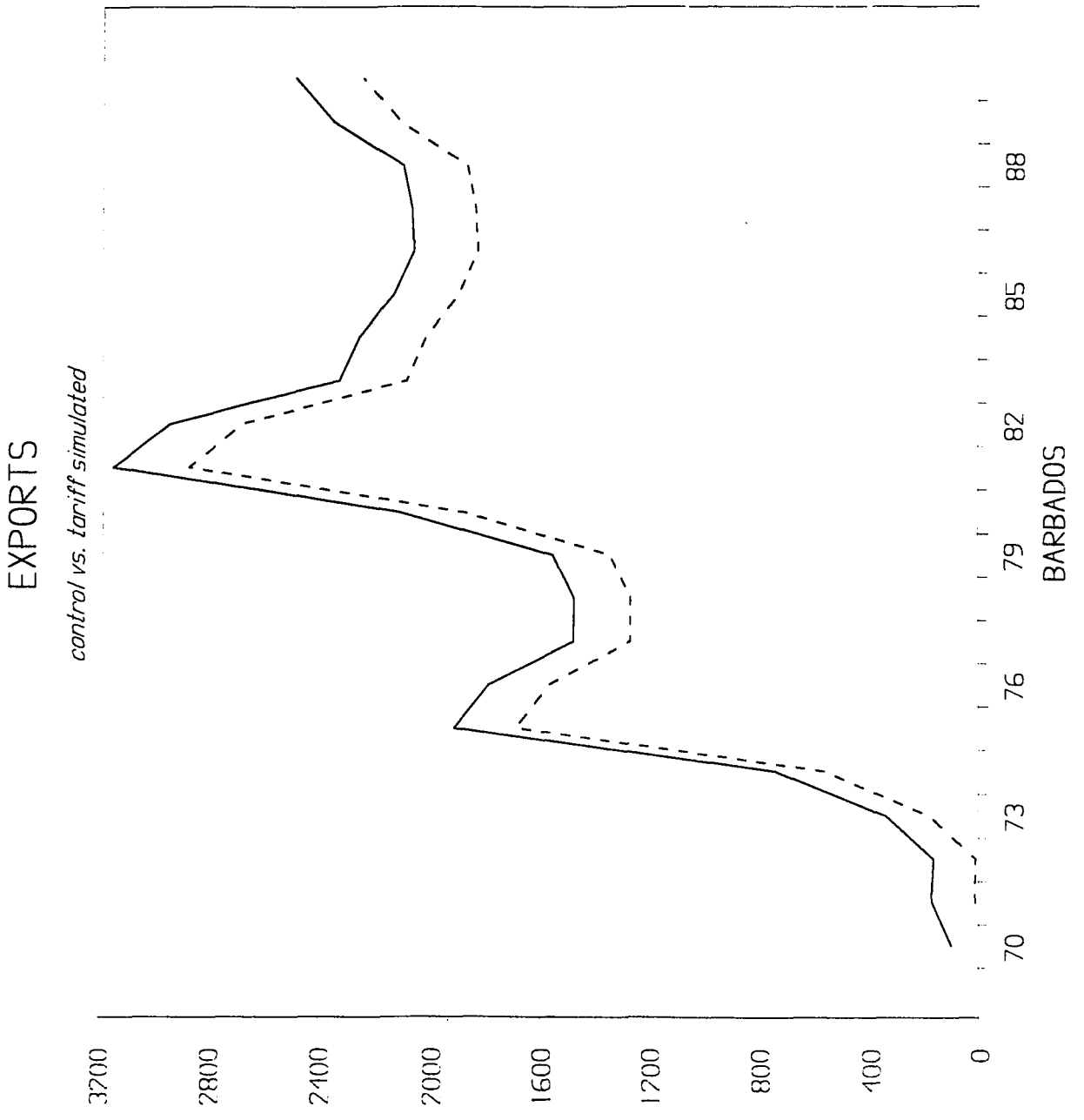

EXPORTS
control vs. tariff simulated
BARBADOS
70
73
76
79
82
85
88
0
100
800
1200
1600
2000
2400
2800
3200

Fig. 91

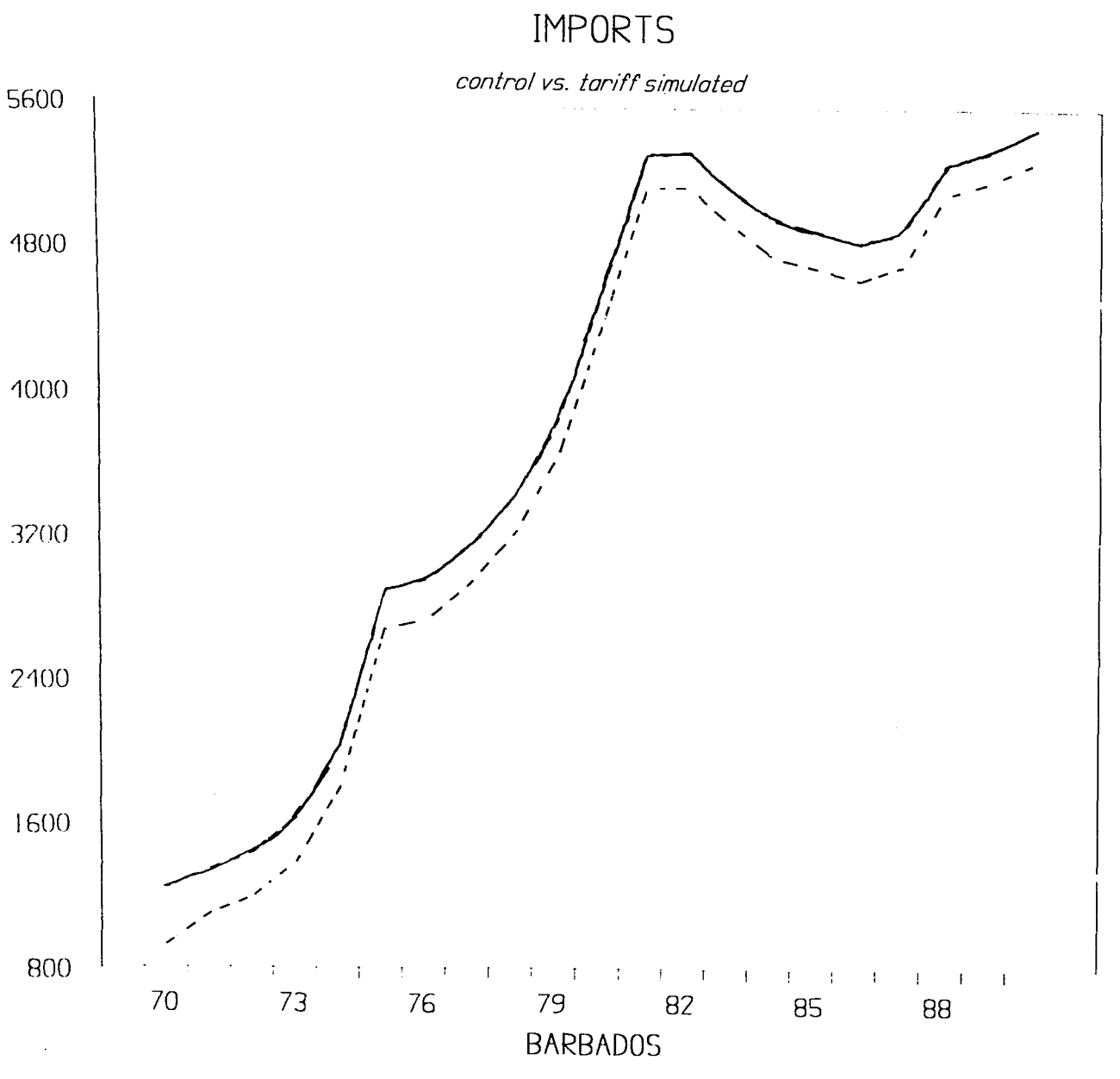

IMPORTS
control vs. tariff simulated
5600
4800
4000
3200
2400
1600
800
70
73
76
79
82
85
88
BARBADOS

Fig. 92

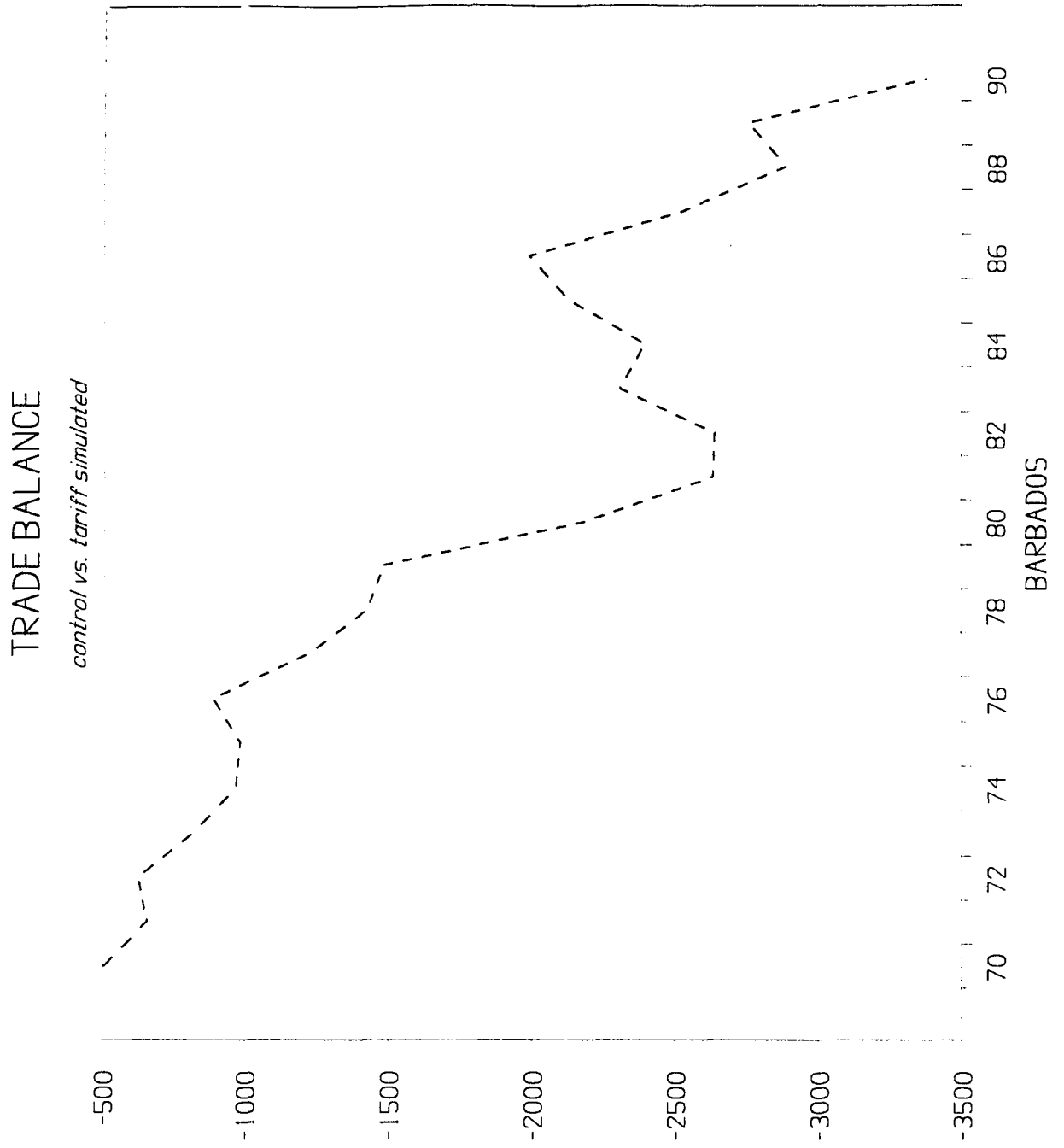

TRADE BALANCE
control vs. tariff simulated
-500
-1000
-1500
-2000
-2500
-3000
-3500
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 93

AGGREGATE PRICE INDEX

control vs. tariff simulated

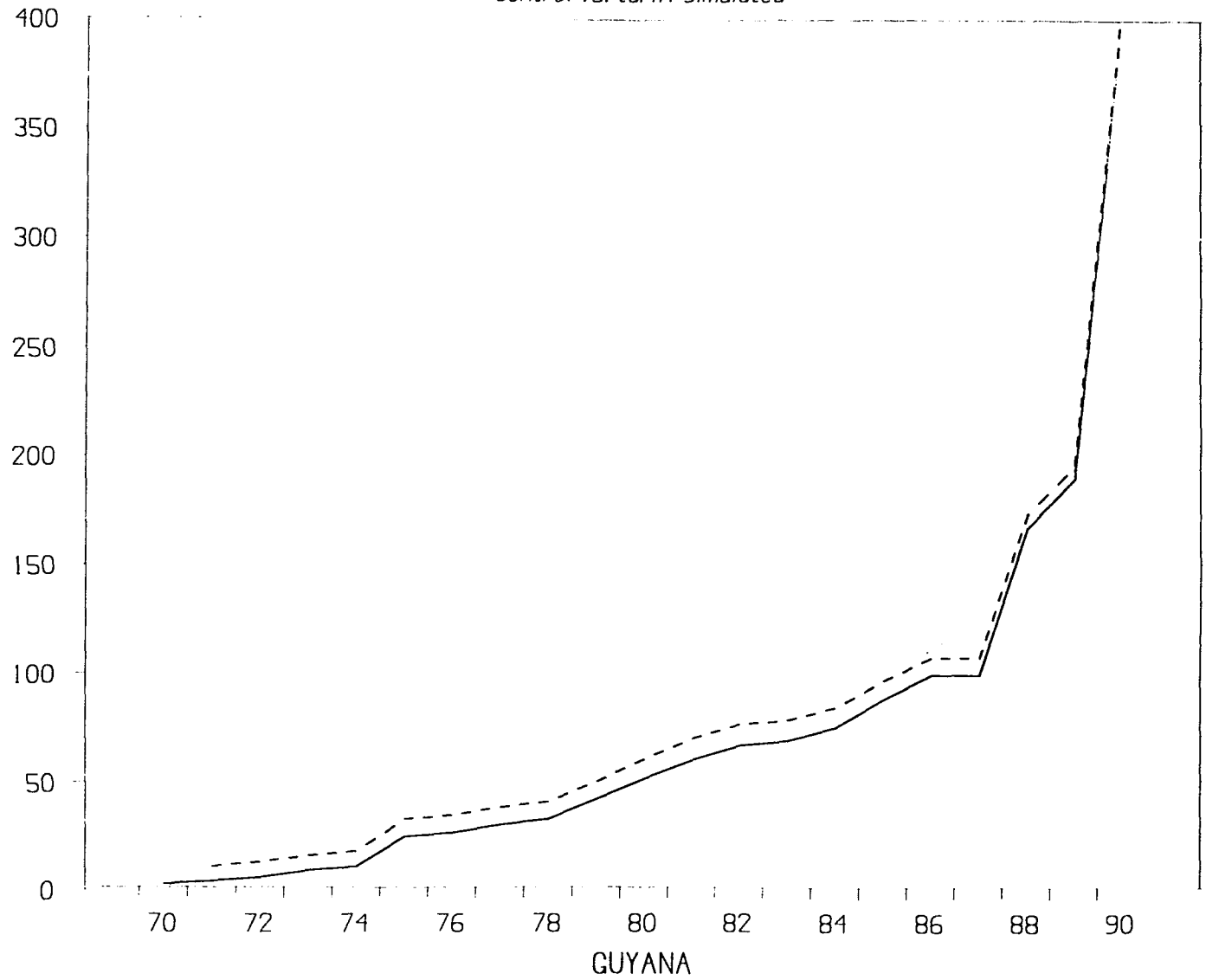


Fig. 94

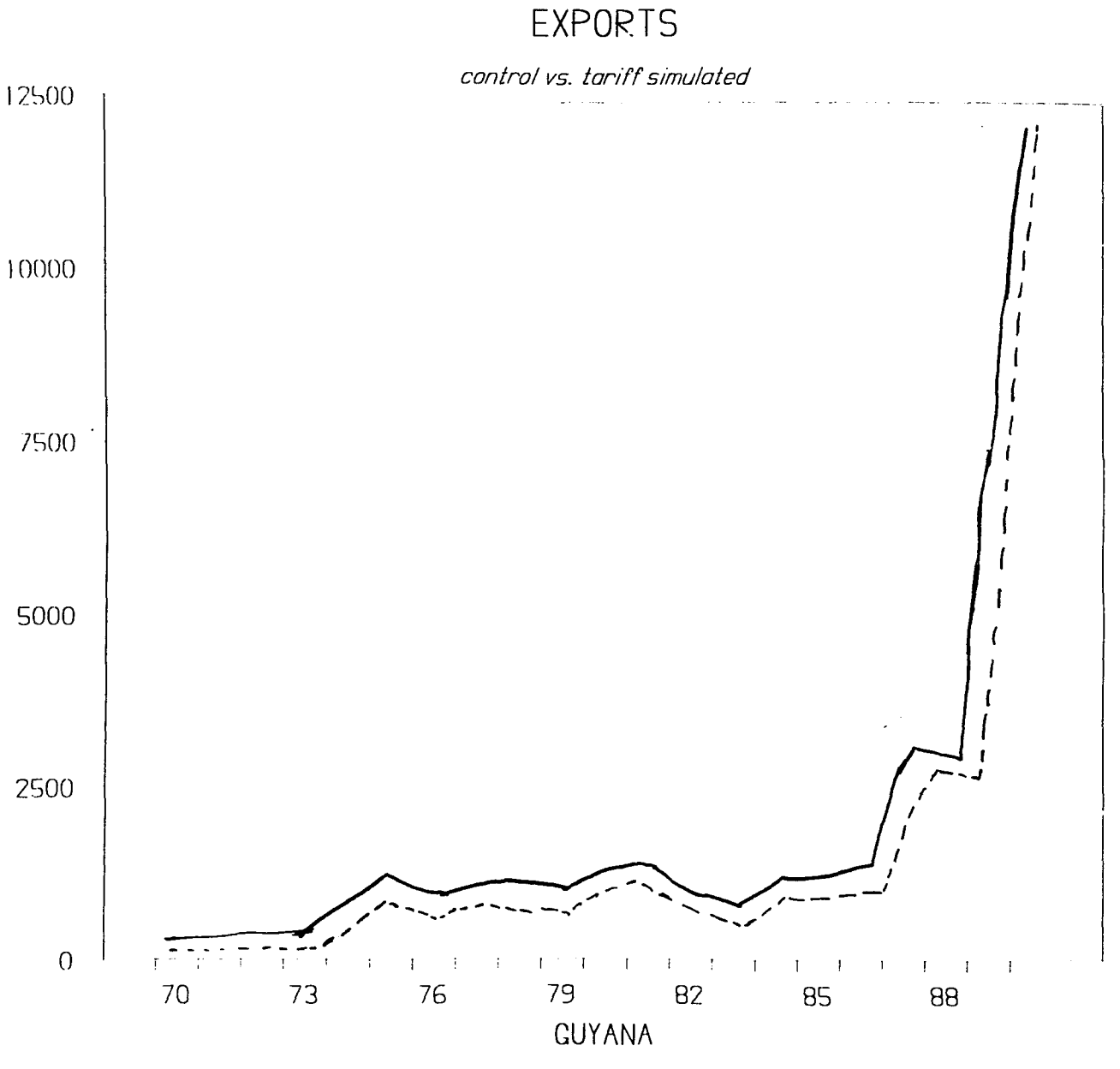

EXPORTS
control vs. tariff simulated
12500
10000
7500
5000
2500
0
70
73
76
79
82
85
88
GUYANA

Fig. 95

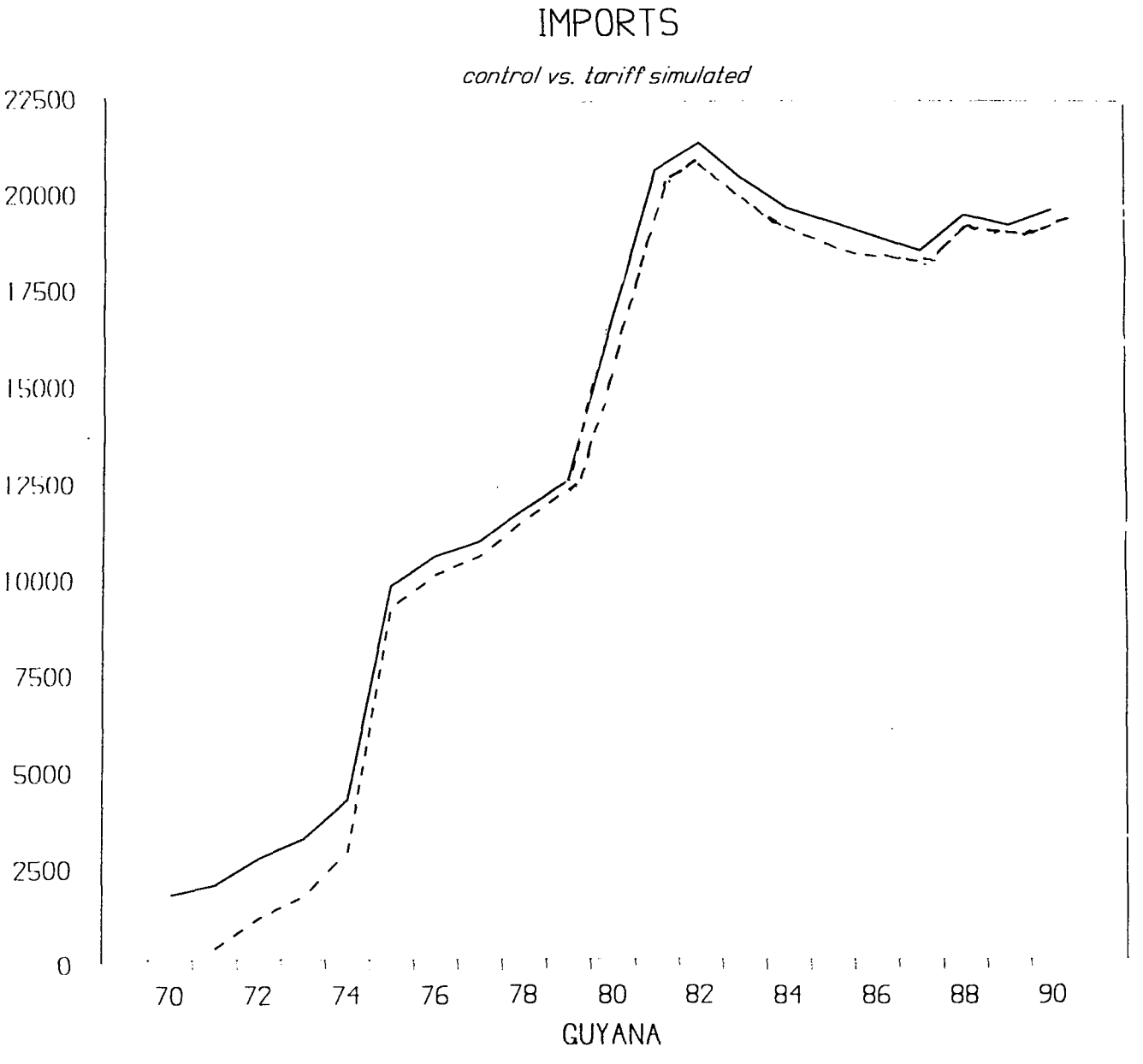

IMPORTS
control vs. tariff simulated
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
70
72
74
76
78
80
82
84
86
88
90
GUYANA

Fig. 96

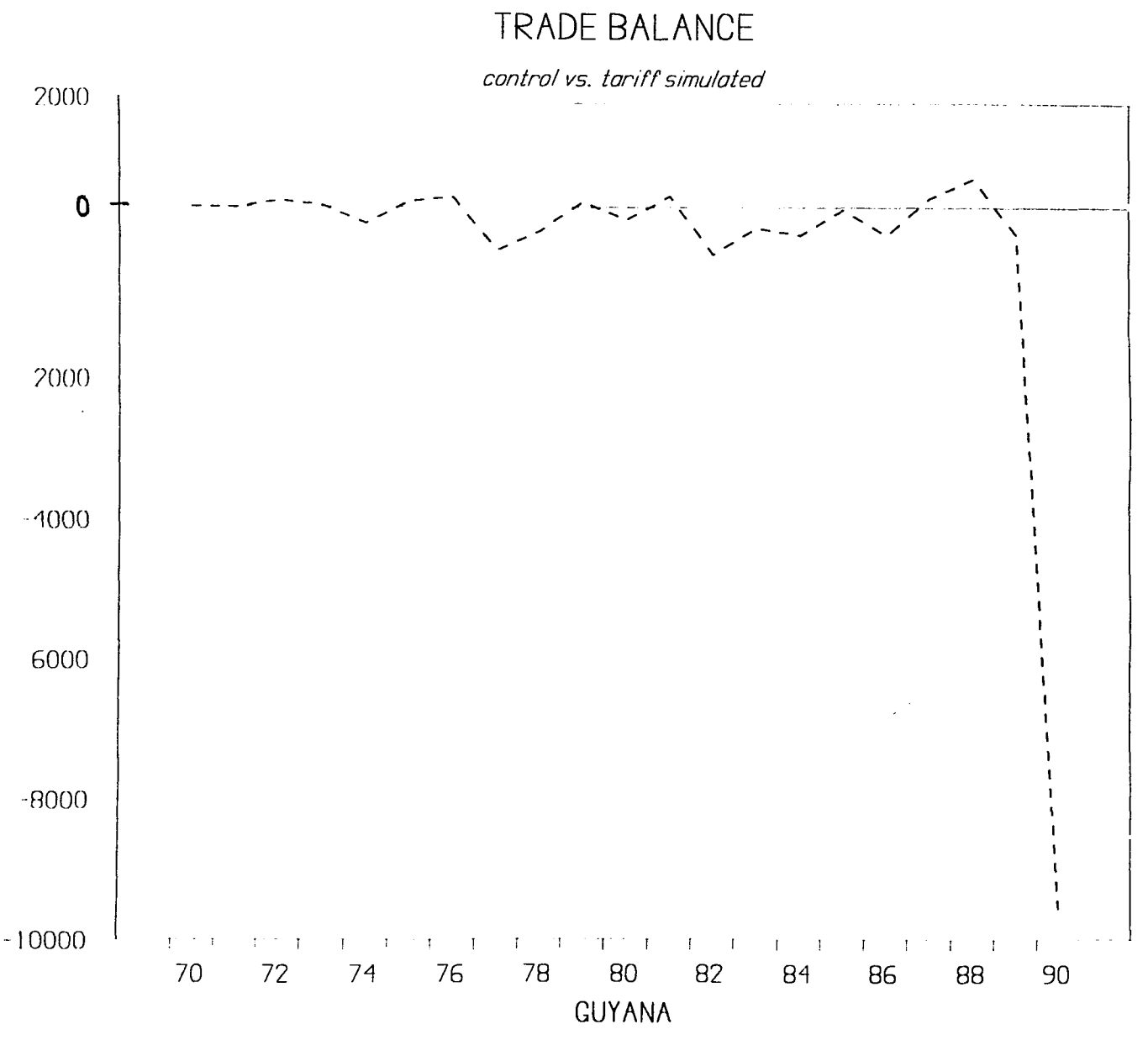

TRADE BALANCE
control vs. tariff simulated
2000
0
-2000
-4000
-6000
-8000
-10000
70
72
74
76
78
80
82
84
86
88
90
GUYANA

Fig. 97

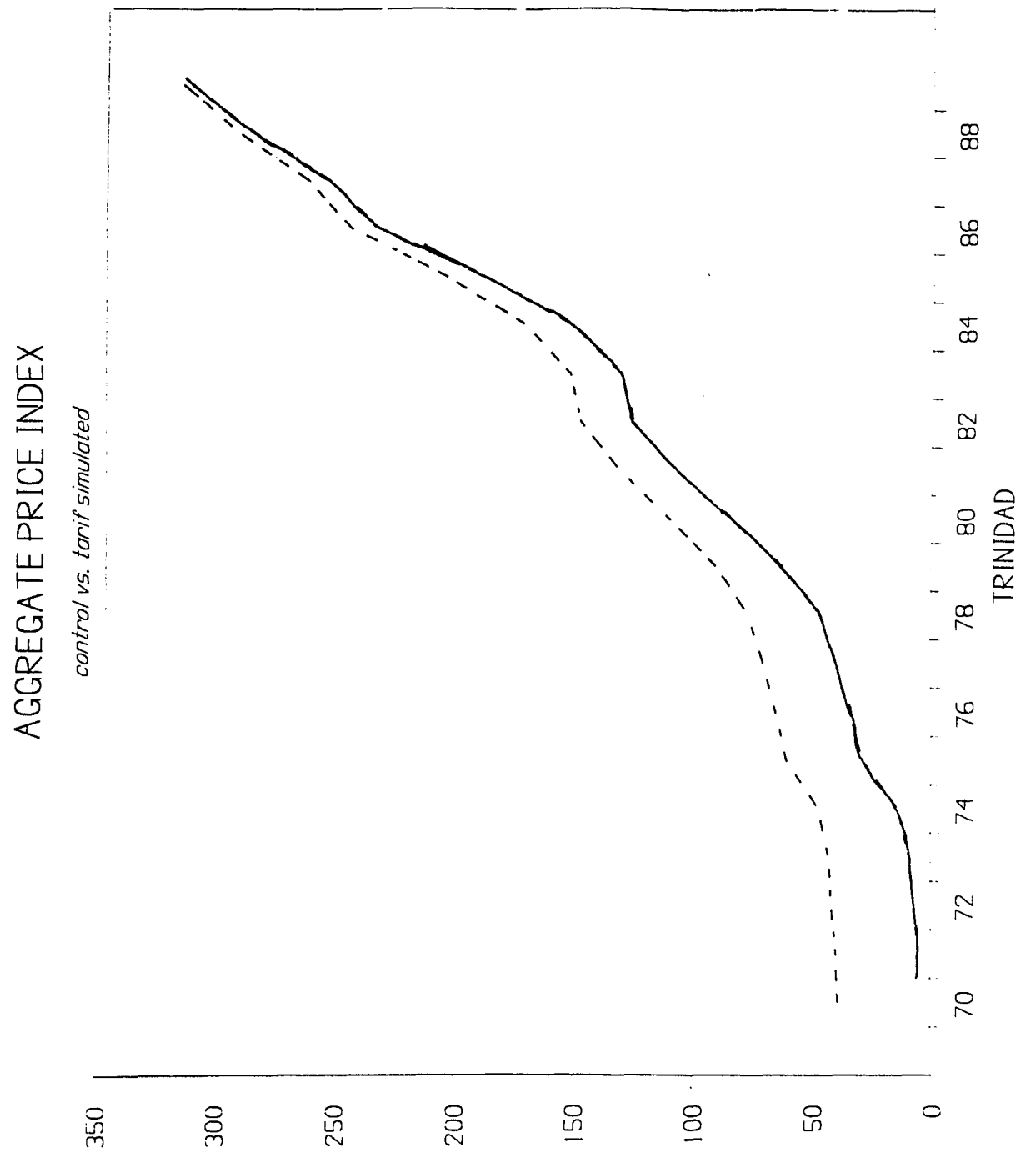

AGGREGATE PRICE INDEX
control vs. tarif simulated
350
300
250
200
150
100
50
0
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 98

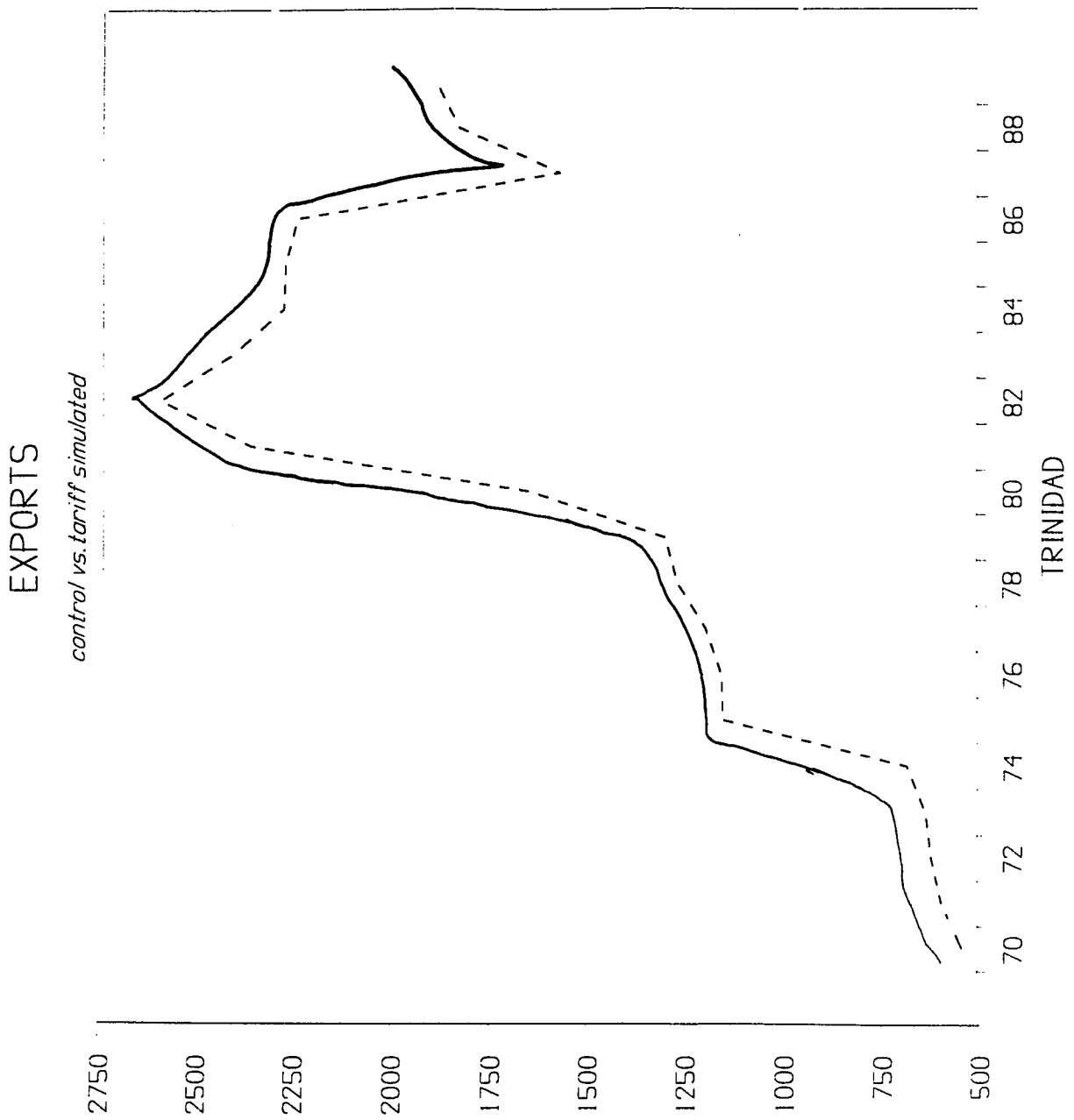

EXPORTS
control vs. tariff simulated
2750
2500
2250
2000
1750
1500
1250
1000
750
500
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 99

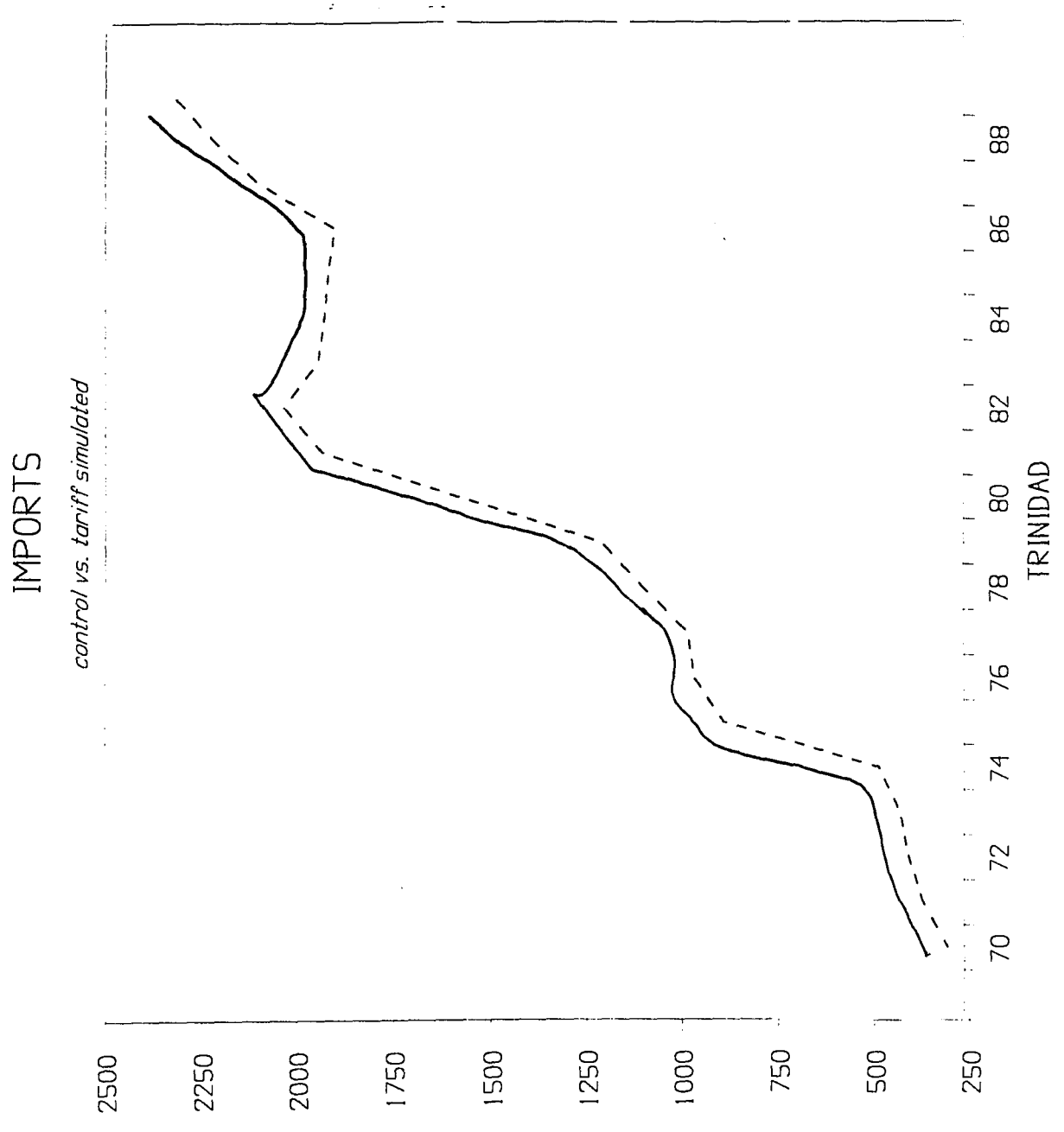
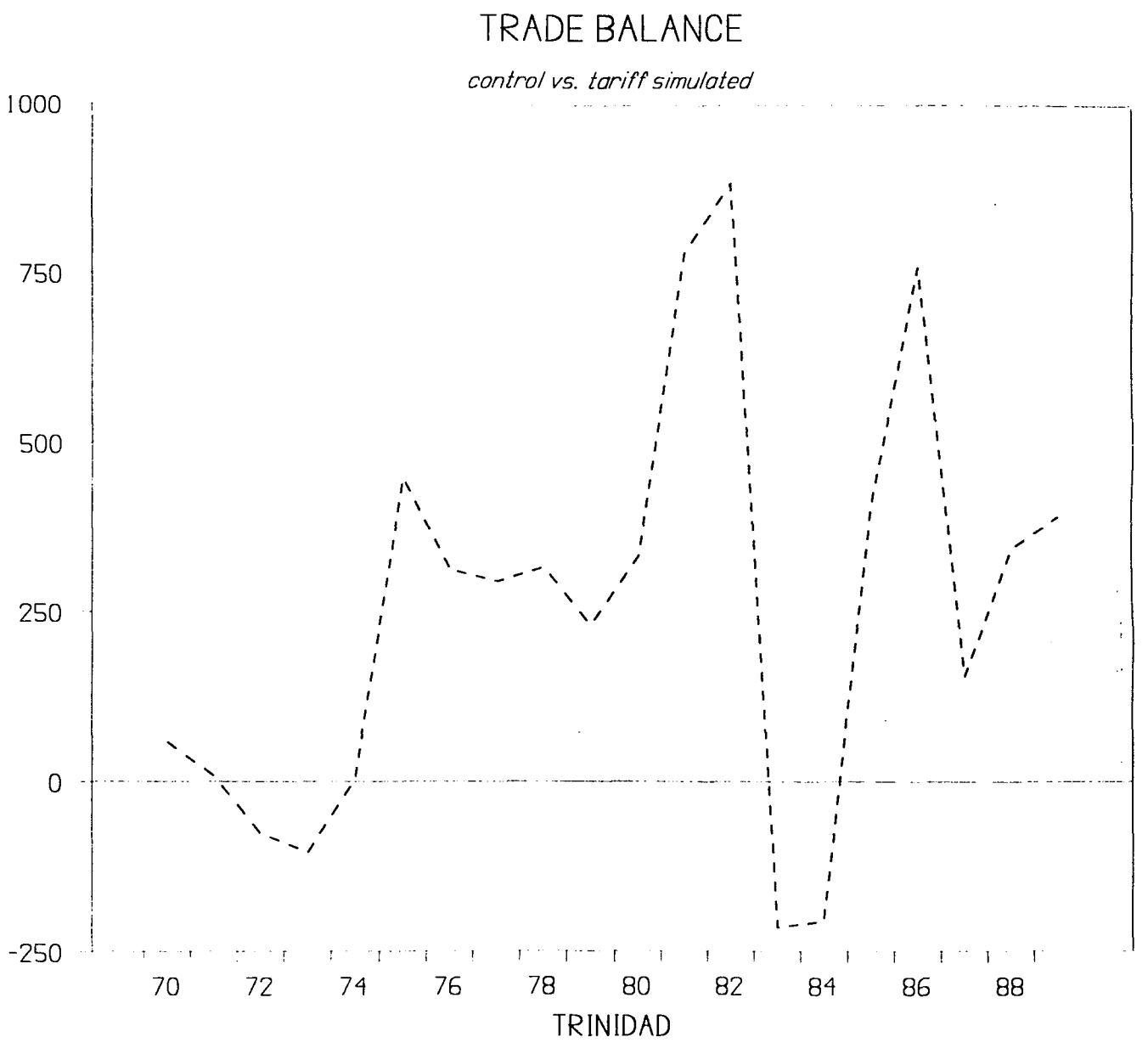

IMPORTS
control vs. tariff simulated
2500
2250
2000
1750
1500
1250
1000
750
500
250
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 100


TRADE BALANCE
control vs. tariff simulated
1000
750
500
250
0
-250
70
72
74
76
78
80
82
84
86
88
TRINIDAD

In tables 21 - 24 below, we show the effect of the tariff, calculated as a percentage of control. In all countries, both real exports and real imports declined, while the relative price of importables increased initially by 14% to 19% declining, over the course of the sample period, from 5% to 9%.

There is no significant difference between the countries as far as the effects of tariff simulation is concerned. In Jamaica and Trinidad, real exports fall from approximately 89%

Table 21 Trinidad Tariff Simulated Endogenous Variables as a Percentage of Control

Year	Real Exports	Real Imports	Price of Importables Relative to Non-traded Goods
1969	0.8873	0.5631	1.1932
1970	0.8965	0.5742	1.1641
1971	0.8839	0.5769	1.1608
1972	0.8821	0.5804	1.1534
1973	0.8947	0.5849	1.1506
1974	0.9126	0.5889	1.1487
1975	0.8637	0.5832	1.1424
1976	0.8621	0.5927	1.1368
1977	0.8892	0.5981	1.1322
1978	0.8845	0.6034	1.1298
1979	0.9235	0.6089	1.1237
1980	0.9461	0.6121	1.1216
1981	0.9379	0.6437	1.1188
1982	0.9342	0.6545	1.1162
1983	0.9261	0.6583	1.1119
1984	0.8932	0.6594	1.1086
1985	0.8861	0.6621	1.0894
1986	0.8946	0.6667	1.0721
1987	0.8839	0.6693	1.0686
1988	0.8804	0.6721	1.0643
1989	0.8635	0.6777	1.0621
1990	0.8627	0.6823	1.0587

Table 22 Jamaica Tariff Simulated Endogenous Variables as a Percentage of Control

Year	Real Exports	Real Imports	Price of Importables Relative to Non-traded Goods
1969	0.8921	0.5630	1.1873
1970	0.8964	0.5744	1.1812
1971	0.8840	0.5770	1.1786
1972	0.8820	0.5812	1.1759
1973	0.8947	0.5850	1.1802
1974	0.9127	0.5890	1.1735
1975	0.8640	0.5841	1.1694
1976	0.8621	0.5934	1.1669
1977	0.8892	0.5981	1.1623
1978	0.8846	0.6034	1.1556
1979	0.9236	0.6089	1.1522
1980	0.9464	0.6121	1.1479
1981	0.9380	0.6441	1.1418
1982	0.9343	0.6548	1.1402
1983	0.9262	0.6585	1.1371
1984	0.8932	0.6592	1.1329
1985	0.8863	0.6628	1.1266
1986	0.8891	0.6674	1.1209
1987	0.8839	0.6697	1.1173
1988	0.8800	0.6732	1.1138
1989	0.8640	0.6847	1.1069
1990	0.8621	0.6893	1.0931

Table 23 Guyana Tariff Simulated Endogenous Variables as a Percentage of Control

Year	Real Exports	Real Imports	Price of Importables Relative to Non-traded Goods
1969	0.8721	0.5871	1.1732
1970	0.8648	0.5935	1.1689
1971	0.8615	0.5994	1.1621
1972	0.8587	0.6136	1.1578
1973	0.8529	0.6259	1.1534
1974	0.8505	0.6331	1.1461
1975	0.8464	0.6472	1.1494
1976	0.8426	0.6491	1.1425
1977	0.8403	0.6587	1.1378
1978	0.8387	0.6521	1.1324
1979	0.8326	0.6508	1.1307
1980	0.8284	0.6564	1.1273
1981	0.8249	0.6593	1.1228
1982	0.8221	0.6627	1.1189
1983	0.8198	0.6683	1.1081
1984	0.8149	0.6696	1.0987
1985	0.8107	0.6684	1.0938
1986	0.8034	0.6831	1.0962
1987	0.8016	0.6725	1.0921
1988	0.8001	0.6931	1.0877
1989	0.7987	0.7121	1.0824
1990	0.7954	0.6858	1.0769

Table 24 Barbados Tariff Simulated Endogenous Variables as a Percentage of Control

Year	Real Exports	Real Imports	Price of Importables Relative to Non-traded Goods
1969	0.8488	0.4631	1.1461
1970	0.8411	0.5389	1.1408
1971	0.8269	0.5164	1.1387
1972	0.8214	0.5896	1.1354
1973	0.8173	0.6384	1.1308
1974	0.9094	0.6621	1.1283
1975	0.9361	0.6958	1.1224
1976	0.8183	0.6129	1.1177
1977	0.8259	0.5781	1.1128
1978	0.8374	0.6137	1.1106
1979	0.8689	0.6842	1.1091
1980	0.8571	0.6934	1.1058
1981	0.8936	0.7122	1.1003
1982	0.9172	0.7246	1.0967
1983	0.8659	0.6013	1.0942
1984	0.8873	0.5861	1.1048
1985	0.8729	0.6136	1.0921
1986	0.8325	0.5433	1.0903
1987	0.8476	0.5649	1.0876
1988	0.8321	0.5527	1.0947
1989	0.8176	0.5831	1.0932
1990	0.8037	0.5846	1.0886

to 86% of what they would have been if there were no tariff, over the entire sample period. In Guyana, the range is from 87% to 79% approximately, again over the sample period. Finally, for Barbados the decline is not as sharp, the range being from 84% to 80% over the sample period.

As far as real imports are concerned, Trinidad, Jamaica and Guyana show essentially the same effect. Real imports for all three decline, initially by approximately 50%, due to the effect of a 10% increase in the domestic price of importables. This rises over the sample period, however, to almost 70% of what they would be if there were no simulated tariff increase. This is not the case for Barbados where the tariff seems to have a stronger effect. The 10% increase in the price of importables causes initially real imports to be 46% of what they would normally be. This increases also, however, only rises to less than 60% of what it would be without tariff simulation.

This implies somewhat slower speeds of adjustment for Guyana for real exports and Barbados for real imports.

As far as the trade balance is concerned, there is no long run change which would be expected from economic theory. However, in all four countries, there also seems to be no short run effect either. This seems to be highly unlikely.

It appears that government rigidities in both markets for exportables and importables as mentioned above [3] as well as expectation formation based on past histories of increasing import prices, have lead to rapid adjustment of the trade balance to its steady state equilibrium. This does not, however, fully explain the almost immediate return of the trade balance to its steady state equilibrium. Also the changes in real exports and real imports while offsetting are not as a rule identical and would indicate some short run turbulence in the trade balance before it returned to steady state equilibrium.

We can only conclude that the model does not predict short run deviations of the trade balance from its steady state if those deviations are induced via a tariff. There appears to be a weakness in this particular application, as Clements found, applying U.S. data that a simulated tariff causes deviations in the trade balance away from steady state equilibrium for at least 5 years, though this tapered off over the duration of his sample [4].

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[3] See Clements Op. Cit. pg. 193 [4]

Monetary Expansion Simulation

We simulate an increase in the supply of money by increasing the domestic credit component of the monetary base by a 50% increase over each year's actual increase. This directly increases income via the helicopter drop. This increased income is not matched by any increase in production and, therefore, is somewhat inflationary.

In addition, increased income means increased local demand for all goods as expenditure on all commodities increase due to marginal budget shares. This implies that all demand curves shift to the right.

As such, the local consumption of exports increase without any increase in the production of exportables, implying a fall in exports. At the same time, there is an increased demand for importables, again without increased production, implying an increase in imports. There is, therefore, a worsening of the trade balance, as well as inflation.

In tables 25 - 28 below, we show the effect of a 50% simulated increase (over and above the actual increase) in domestic credit on real exports, real imports and the induced increase in the price of non-traded goods. This is also shown in figures 101 - 113, which compares real exports, real imports, the aggregate price index and the trade balance pre- and post- monetary expansion simulation.

For all four countries, real exports declined, real imports increased and the trade balance unambiguously deteriorates. The rates of changes, however, are somewhat different. In Jamaica and Trinidad, a 50% increase in domestic credit over its "natural" rate of increase, decreases real exports by approximately 20% initially. Over the sample period, this decreases to less than 4%. This is not the same for Barbados and Guyana. For Barbados, a 50% increase in the domestic credit over actual non simulated increases cause real exports to fall by 14% and despite variability, this does not decrease over the sample period. For Guyana, a 13% decrease in real exports, from the 50% simulated increase in domestic credit, grows to a 20% fall in real exports.

As far as real imports are concerned, we note that in all four cases it increases. In Jamaica and Trinidad, the 50% simulated increase in domestic credit induces a 50% increase in real imports. This appears to be unusually high and may be due to high import demand sensitivity along with in place import restrictions which are implicitly assumed to be simultaneously relaxed. However, after the initial shock is incorporated into expectations over the sample period, it declines to less than a 5% increase for Jamaica and less than a 1% increase for Trinidad. In Barbados, the initial increase is 20%, which declines over the sample period to 9%.

In Guyana, the percentage increase is initially 26% declining to approximately 6% over the sample period.

In simulating a 50% increase in domestic credit, we have ignored the effect this would have on the country's holdings of foreign reserves. This would absolutely deplete them. We also, by treating the Aggregate Resource Index (the model's measure of employment) as an exogenous variable, rule out the effect of an expansionary monetary policy on employment.

Expansionary monetary policy has the effect in the model of increasing income directly, increasing expenditures with unchanged output, which is partially inflationary and partially contributes to a deteriorating trade balance.

Table 25 Jamaica Monetary Expansion Simulated Endogenous Variables as a Percentage of Control

Year	Real Exports	Real Imports	Price of Exportables Relative to Non-traded Goods
1969	0.8021	1.5021	0.9437
1970	0.8231	1.4876	0.9581
1971	0.8647	1.4635	0.9628
1972	0.8321	1.4984	0.9679
1973	0.8729	1.3631	0.9744
1974	0.9135	1.0821	0.9853
1975	0.9847	1.0734	0.9896
1976	0.9235	1.0947	0.9935
1977	0.9189	1.1135	0.9062
1978	0.9437	1.1264	0.9174
1979	0.9641	1.0937	0.9237
1980	0.9937	1.0889	0.9291
1981	0.9961	1.0946	0.9266
1982	0.9873	1.2436	0.9339
1983	0.9632	1.2653	0.9567
1984	0.9446	1.0861	0.9648
1985	0.9324	1.0934	0.9697
1986	0.9587	1.0787	0.9751
1987	0.8637	1.0643	0.9861
1988	0.9721	1.0861	0.9835
1989	0.9644	1.0735	0.9927
1990	0.9620	1.0563	0.9946

Table 26 Trinidad Monetary Expansion Simulated Endogenous Variables as a Percentage of Control

Year	Real Exports	Real Imports	Price of Exportables Relative to Non-traded Goods
1969	0.8141	1.5126	0.9403
1970	0.8187	1.4837	0.9514
1971	0.8535	1.3983	0.9527
1972	0.8471	1.4647	0.9578
1973	0.8929	1.3841	0.9632
1974	0.9246	1.2965	0.9677
1975	0.9739	1.1851	0.9690
1976	0.9301	1.1625	0.9735
1977	0.9263	1.0988	0.9782
1978	0.9657	1.0531	0.9831
1979	0.9680	1.0261	0.9804
1980	0.9831	1.0080	0.9826
1981	0.9908	1.0000	0.9888
1982	0.9921	1.9961	0.9921
1983	0.9535	0.9902	0.9903
1984	0.9426	1.0024	0.9947
1985	0.9448	1.0008	0.9962
1986	0.9637	1.0000	0.9909
1987	0.9783	1.0000	0.9944
1988	0.9859	1.0000	0.9986
1989	0.9784	1.0060	0.9991
1990	0.9735	1.0068	0.9983

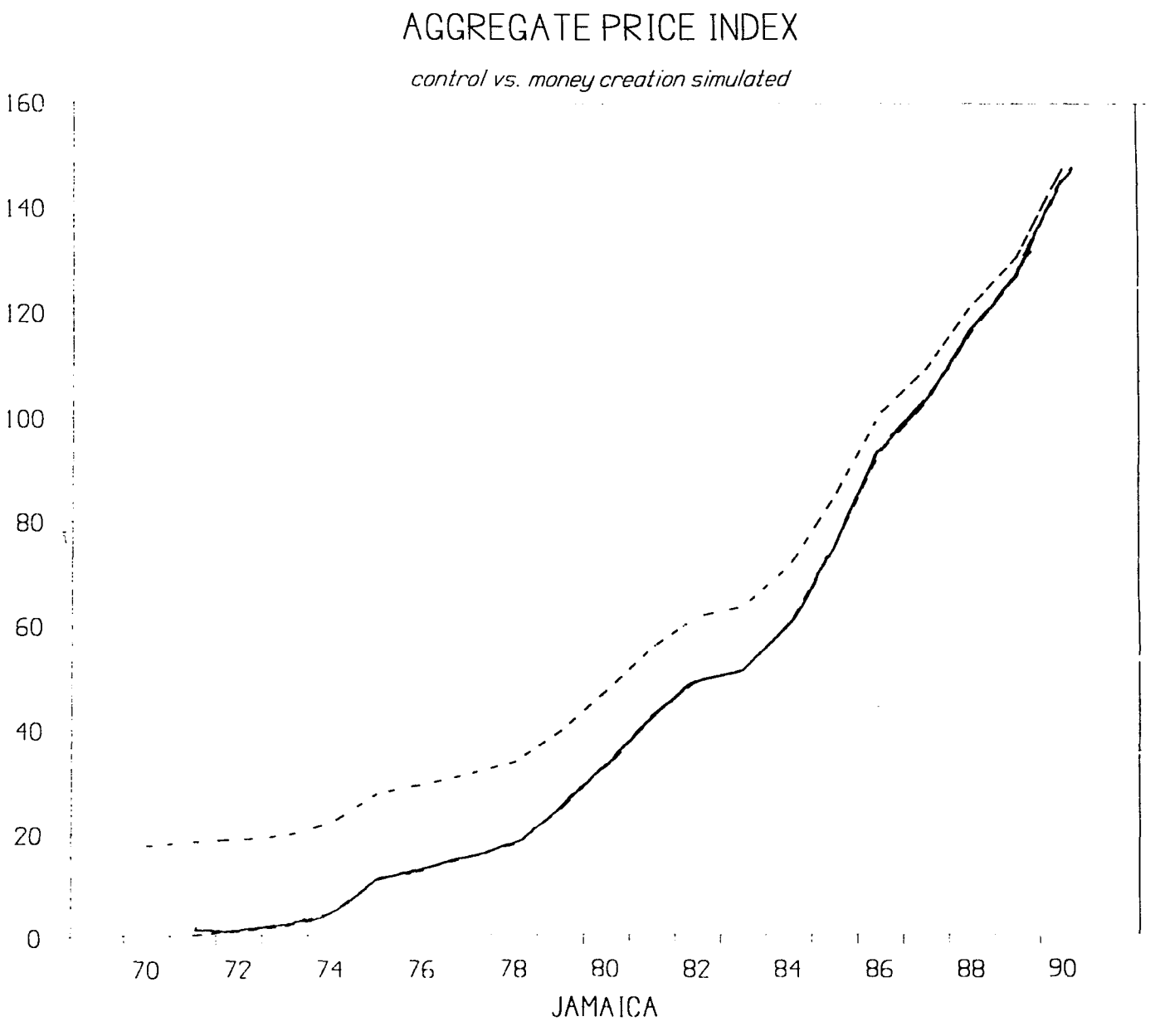
Table 27 Barbados Monetary Expansion Simulated Endogenous Variables as a Percentage of Control

Year	Real Exports	Real Imports	Price of Exportables Relative to Non-traded Goods
1969	0.8631	1.2037	0.9996
1970	0.8426	1.1788	0.9971
1971	0.8731	1.1831	0.9928
1972	0.8951	1.1927	0.9901
1973	0.9126	1.2041	0.9732
1974	0.9457	1.2218	0.9621
1975	0.9883	1.2384	0.9654
1976	0.9005	1.2010	0.9585
1977	0.8735	1.2254	0.9933
1978	0.8431	1.2251	0.9964
1979	0.8326	1.2259	0.9989
1980	0.8758	1.2283	0.8831
1981	0.9426	1.2364	0.8437
1982	0.9659	1.2389	0.8261
1983	0.9741	1.1336	0.7947
1984	0.8634	1.1187	0.9010
1985	0.8327	1.1238	0.9231
1986	0.8441	1.1277	0.9047
1987	0.8457	1.1321	0.9286
1988	0.8469	1.1196	0.9354
1989	0.8571	1.1041	0.9567
1990	0.8633	1.0932	0.9642

Table 28 Guyana Monetary Expansion Simulated Endogenous Variables as a Percentage of Control

Year	Real Exports	Real Imports	Price of Exportables Relative to Non-traded Goods
1969	0.8871	1.2638	0.9981
1970	0.9186	1.2549	0.9963
1971	0.9231	1.2523	0.9963
1972	0.9354	1.2505	0.9958
1973	0.9447	1.2487	0.9967
1974	0.9561	1.2463	0.9981
1975	0.8633	1.2439	0.9993
1976	0.8759	1.2411	0.9997
1977	0.8582	1.2387	0.9991
1978	0.9167	1.2322	0.9994
1979	0.9331	1.2261	0.9993
1980	0.9657	1.2128	0.9990
1981	0.9794	1.2204	0.9992
1982	0.9323	1.2021	0.9992
1983	0.9286	1.1863	0.9992
1984	0.8849	1.1641	0.9992
1985	0.8722	1.1439	0.9994
1986	0.8351	1.1027	0.9995
1987	0.8435	1.0931	0.9986
1988	0.8669	1.1247	0.9991
1989	0.8725	1.0849	0.9991
1990	0.8931	1.0832	0.9993

Fig. 101


AGGREGATE PRICE INDEX
control vs. money creation simulated
160
140
120
100
80
60
40
20
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

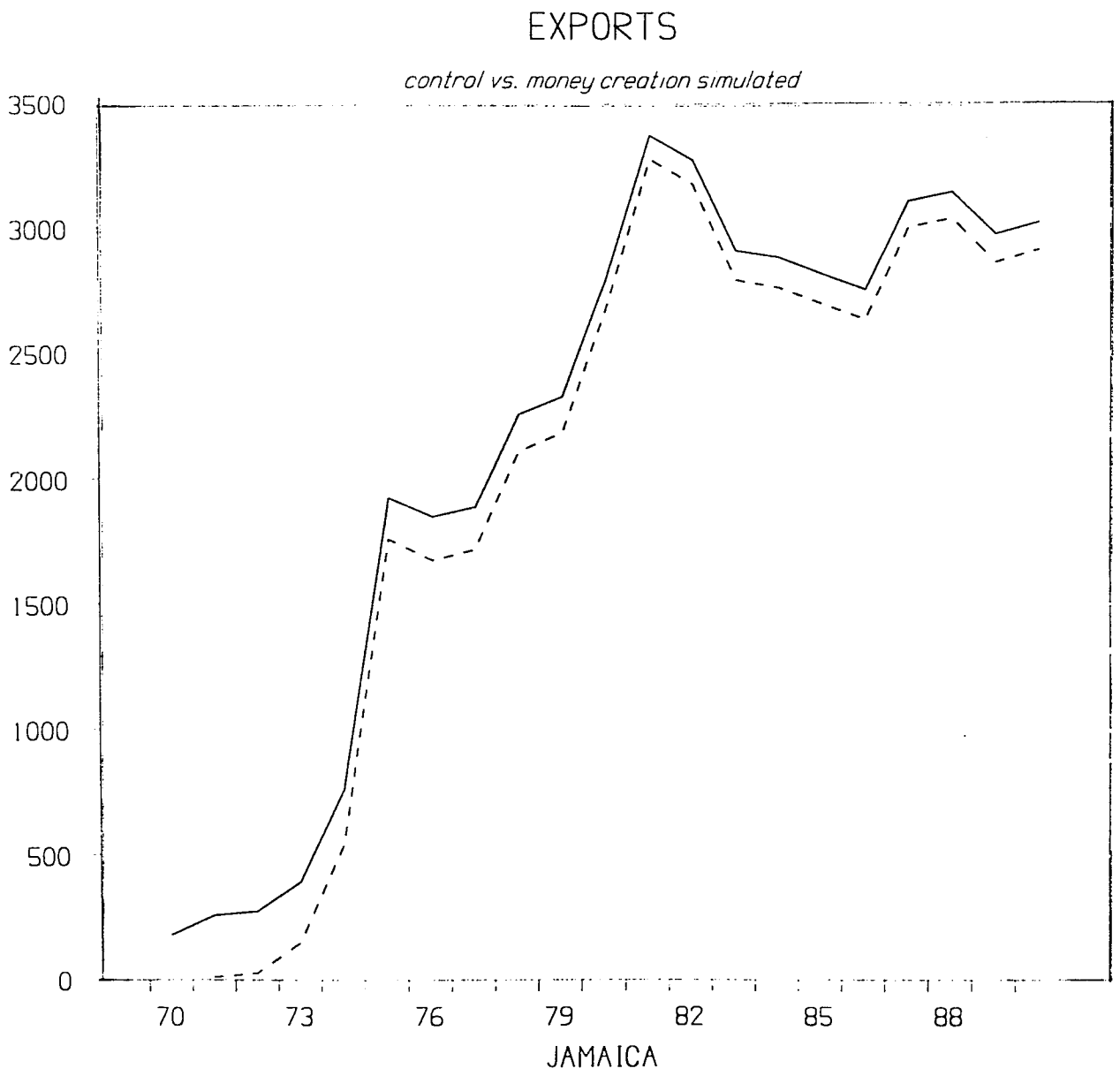
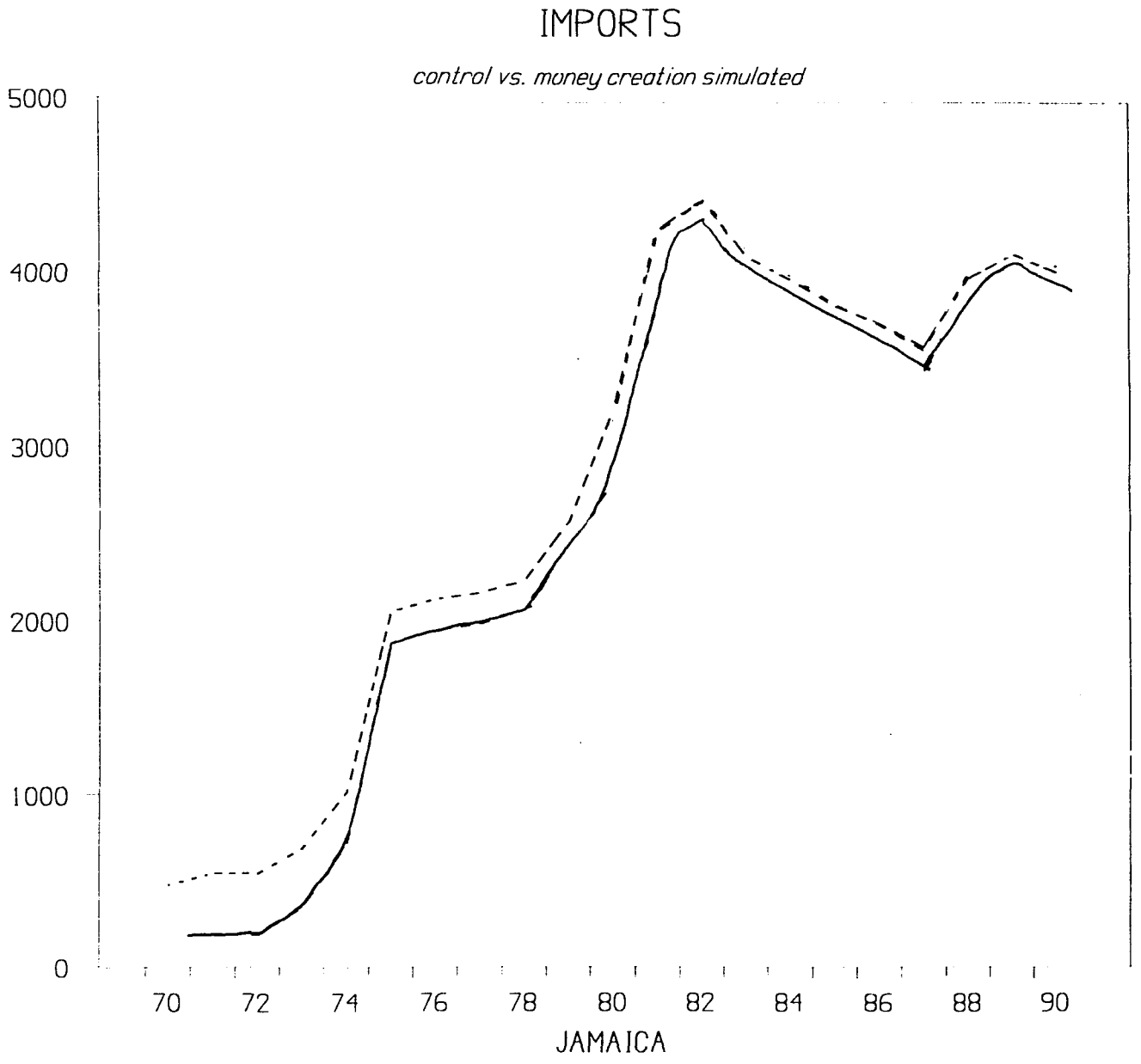

EXPORTS
control vs. money creation simulated
3500
3000
2500
2000
1500
1000
500
0
70
73
76
79
82
85
88
JAMAICA

Fig. 103


IMPORTS
control vs. money creation simulated
5000
4000
3000
2000
1000
0
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

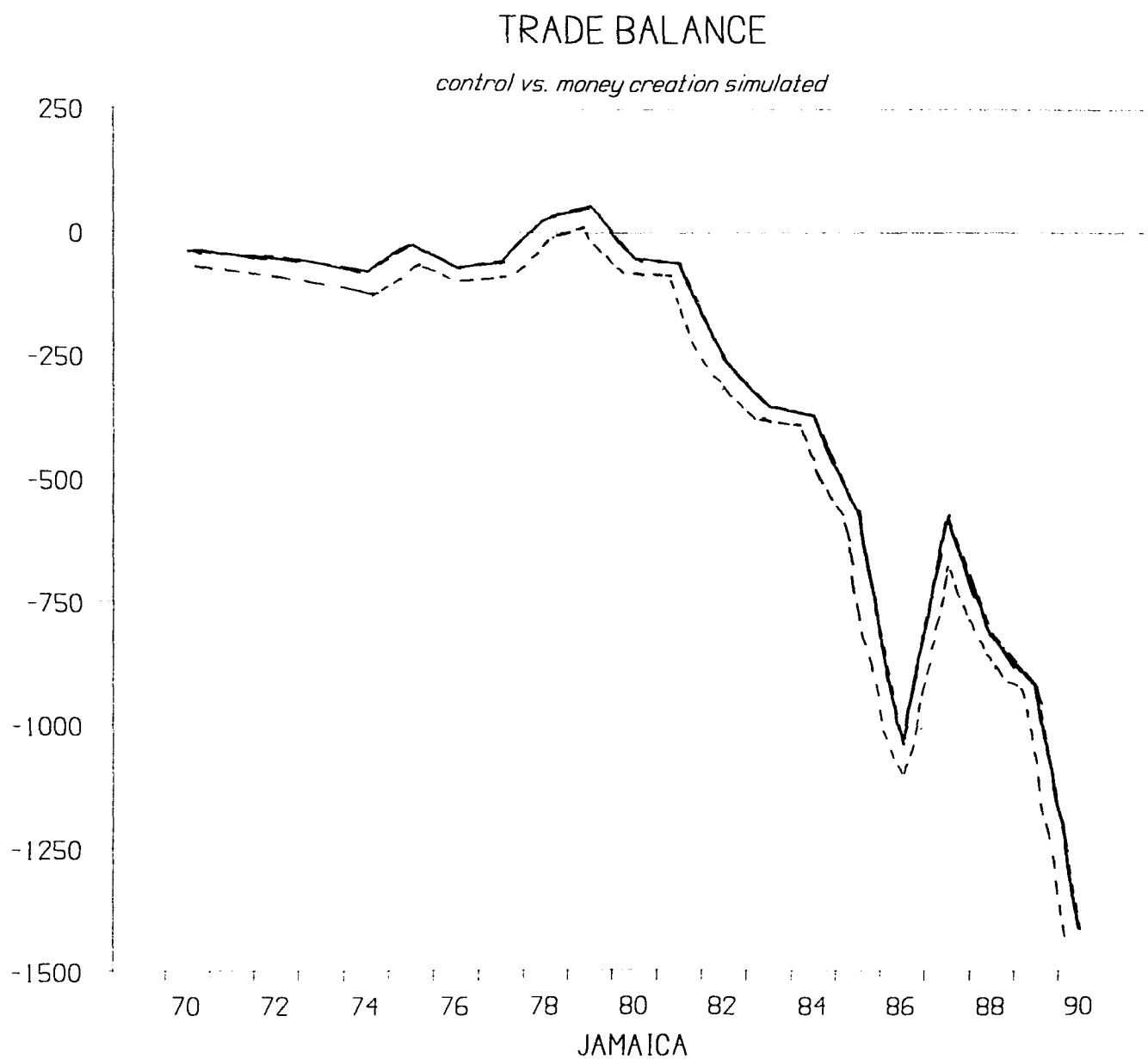

TRADE BALANCE
control vs. money creation simulated
250
0
-250
-500
-750
-1000
-1250
-1500
70
72
74
76
78
80
82
84
86
88
90
JAMAICA

Fig. 105

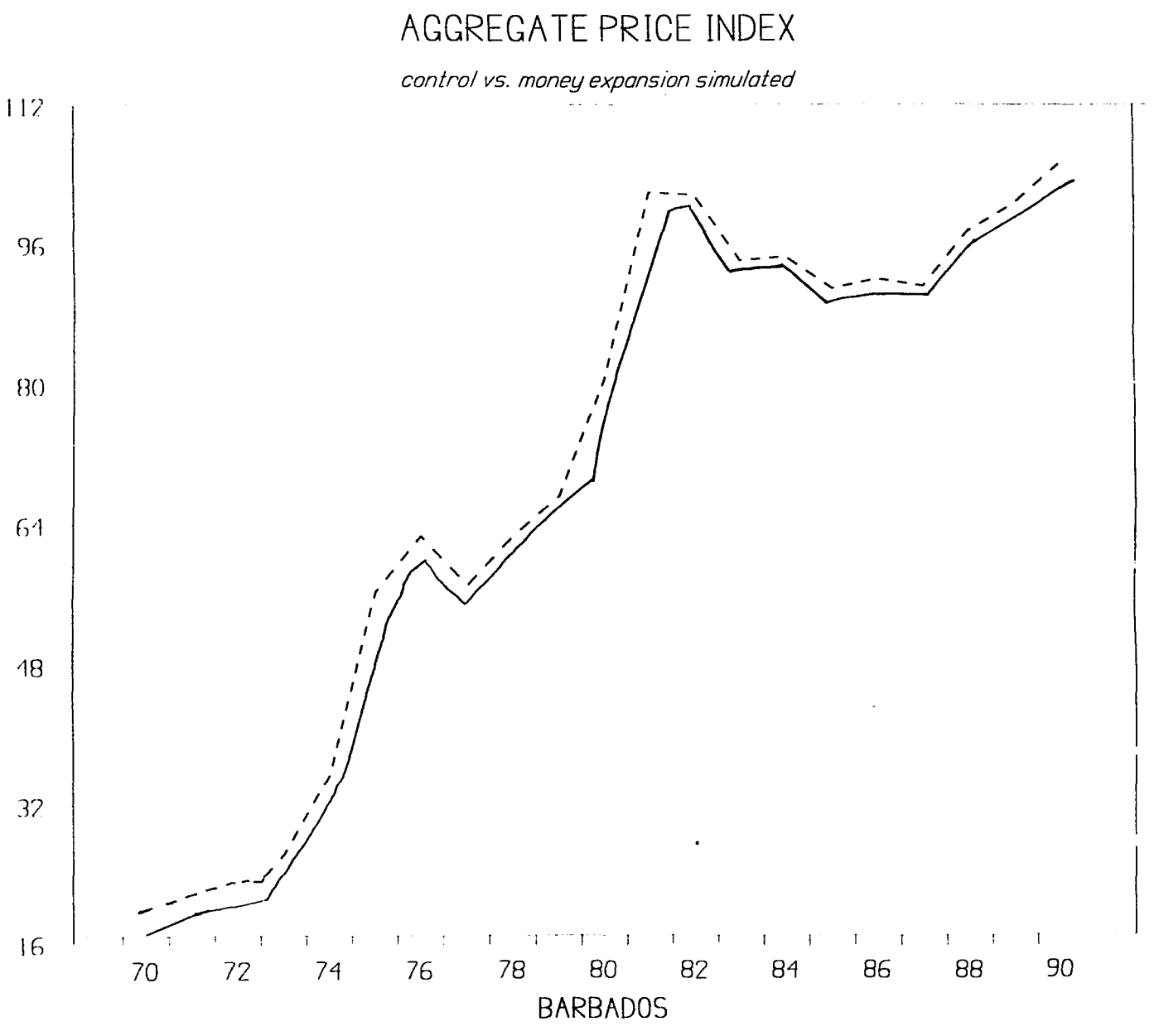
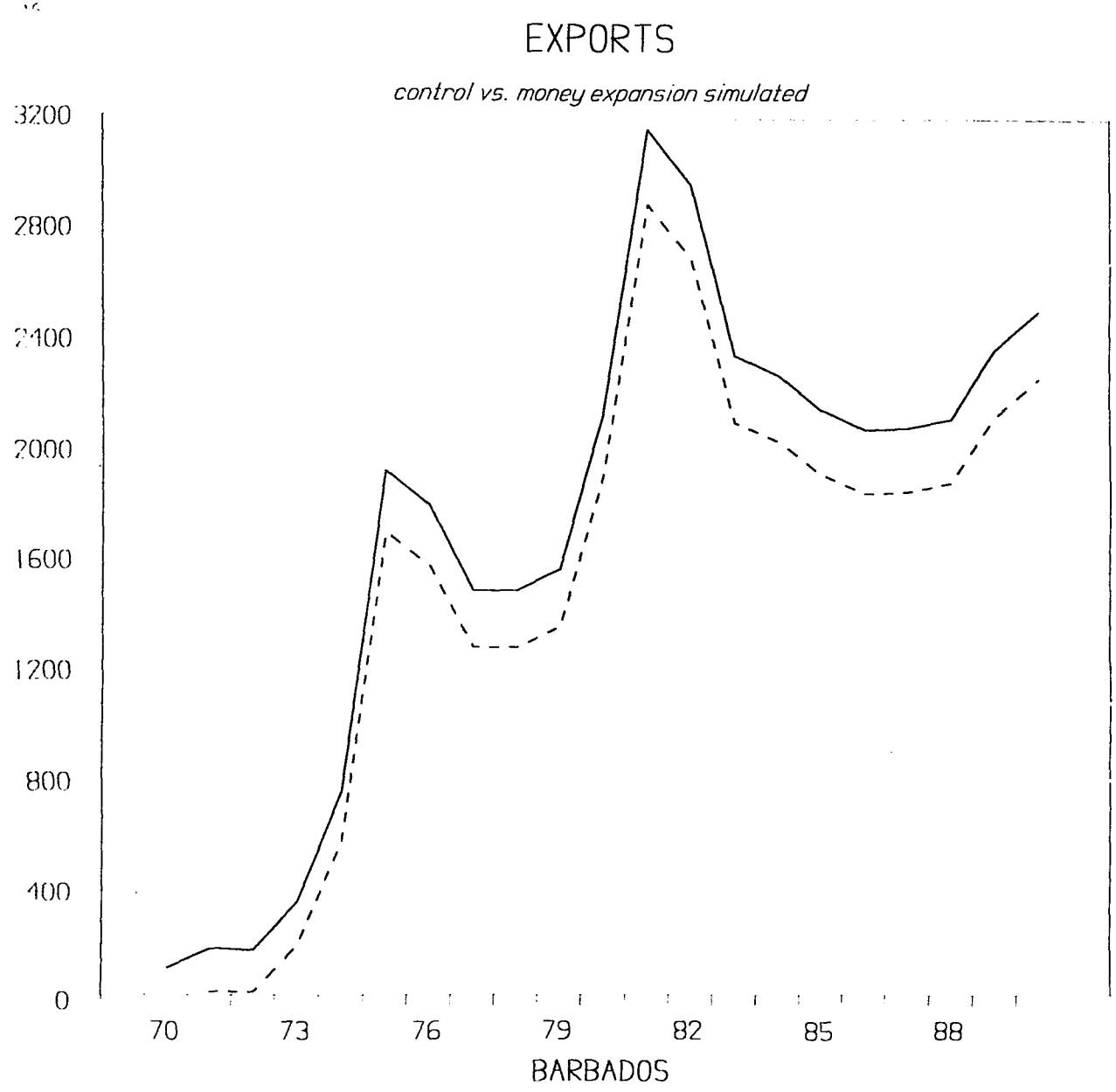

AGGREGATE PRICE INDEX
control vs. money expansion simulated
112
96
80
64
48
32
16
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 106


EXPORTS
control vs. money expansion simulated
3200
2800
2400
2000
1600
1200
800
400
0
70
73
76
79
82
85
88
BARBADOS

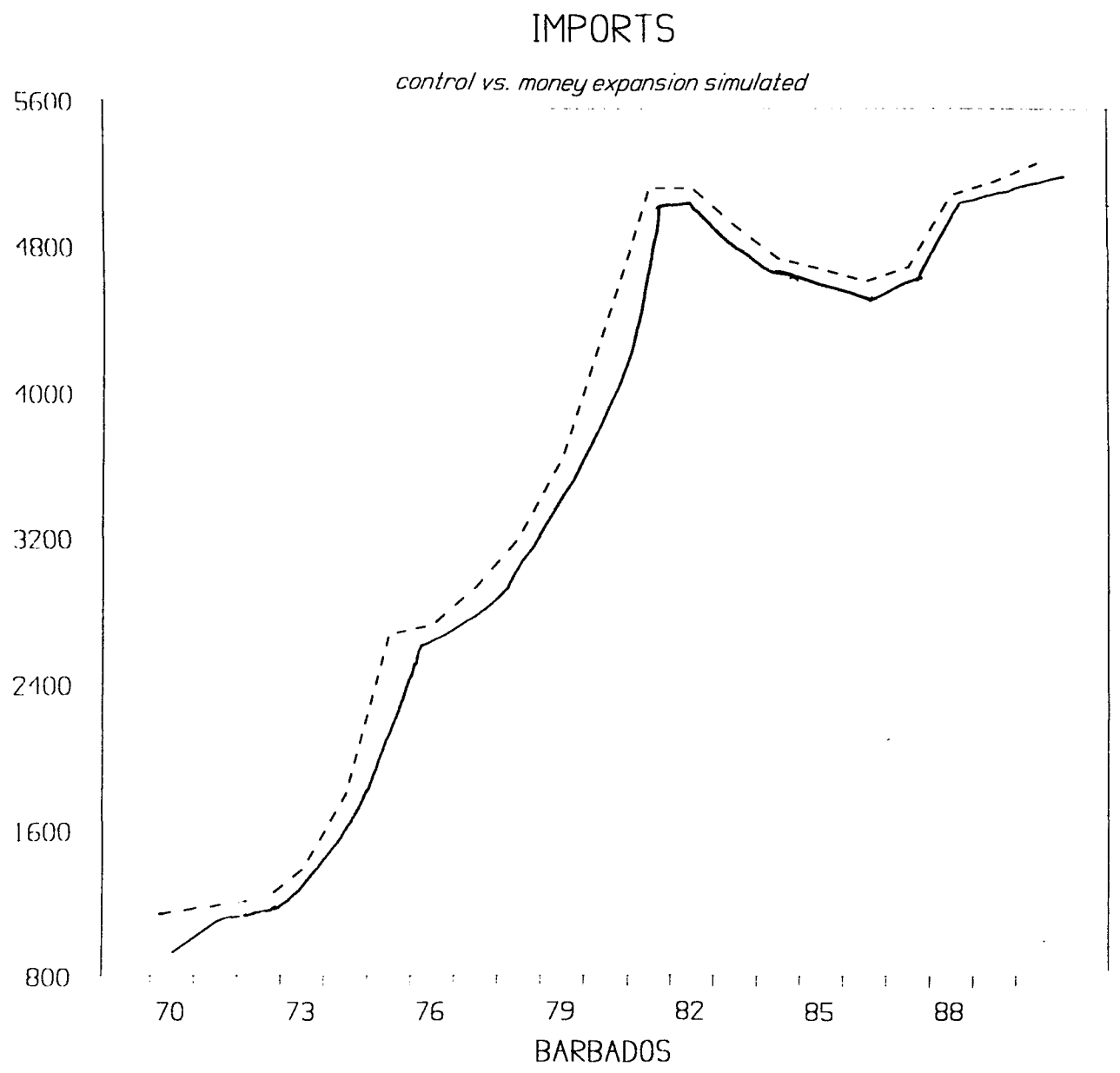

IMPORTS
control vs. money expansion simulated
5600
4800
4000
3200
2400
1600
800
70
73
76
79
82
85
88
BARBADOS

Fig. 108

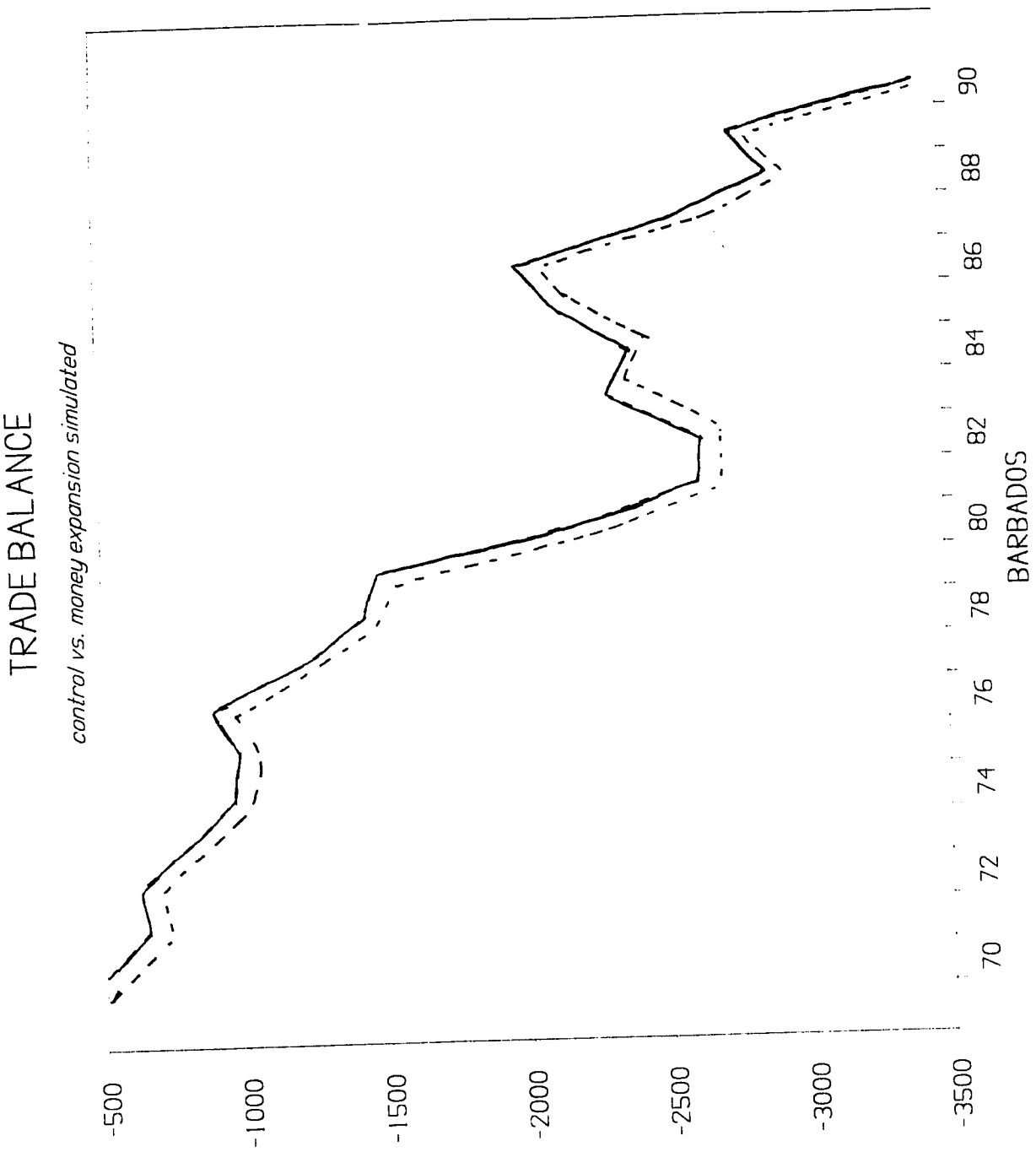
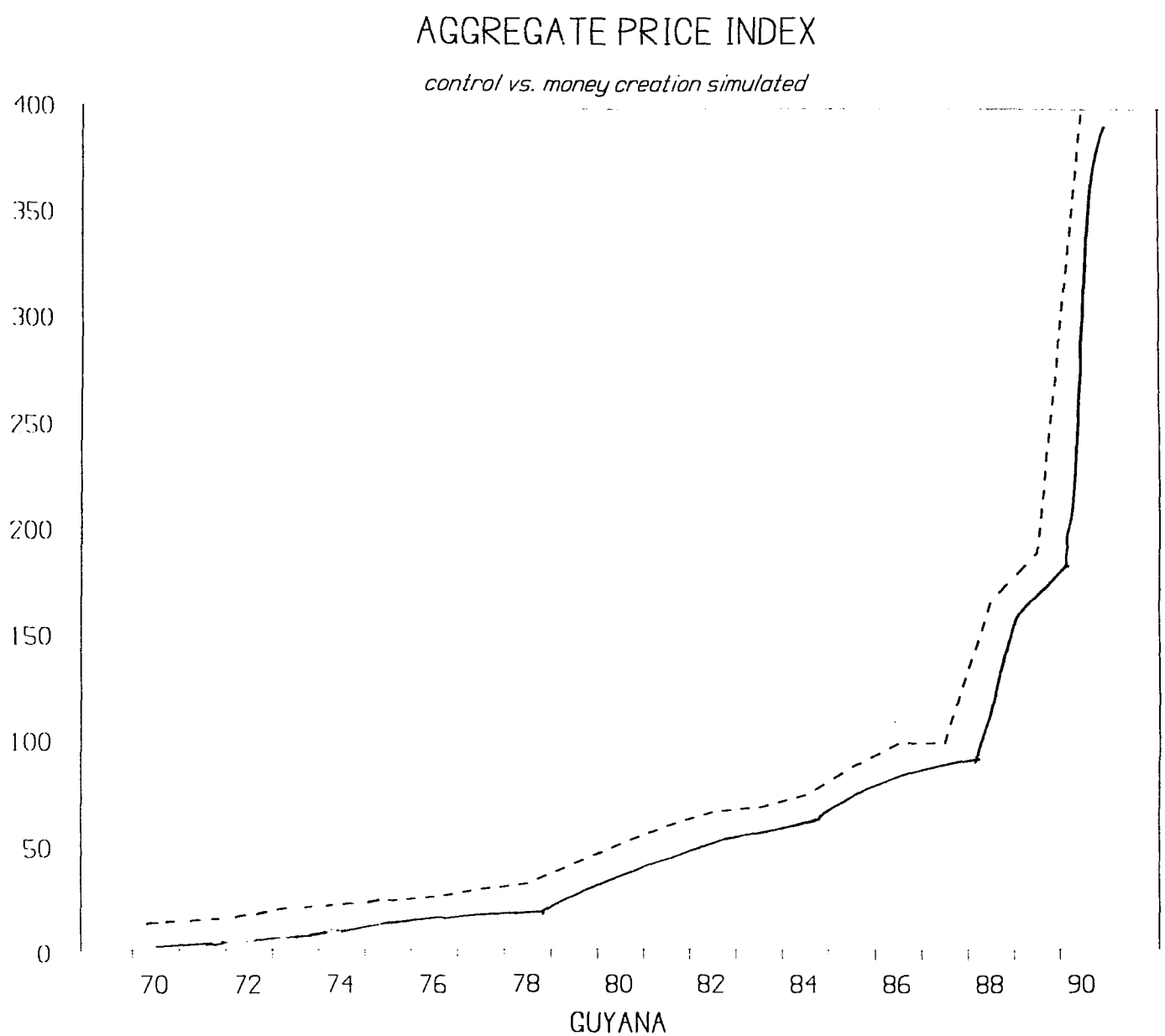

TRADE BALANCE
control vs. money expansion simulated
-500
-1000
-1500
-2000
-2500
-3000
-3500
70
72
74
76
78
80
82
84
86
88
90
BARBADOS

Fig. 109


AGGREGATE PRICE INDEX
control vs. money creation simulated
400
350
300
250
200
150
100
50
0
70
72
74
76
78
80
82
84
86
88
90
GUYANA

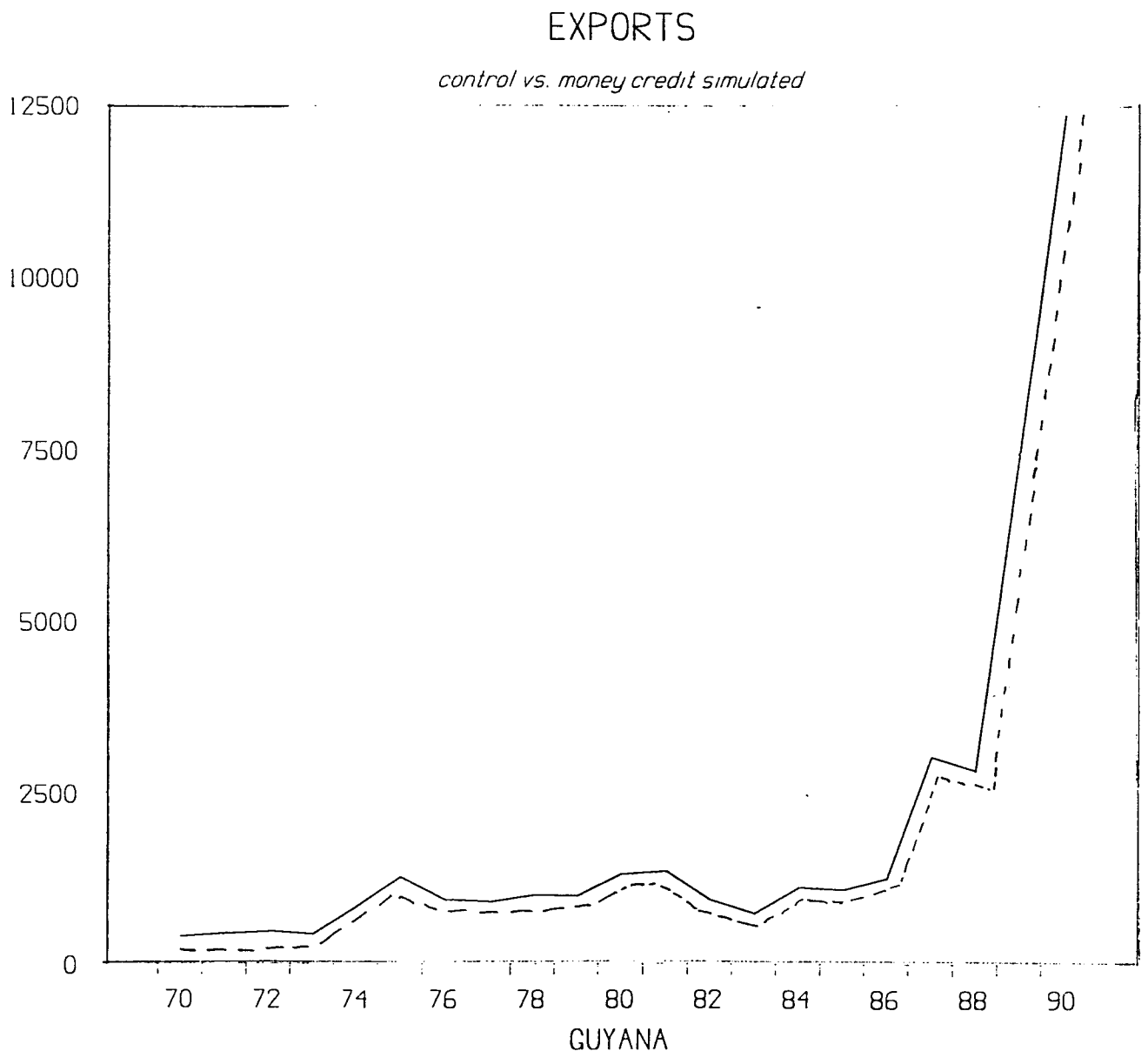
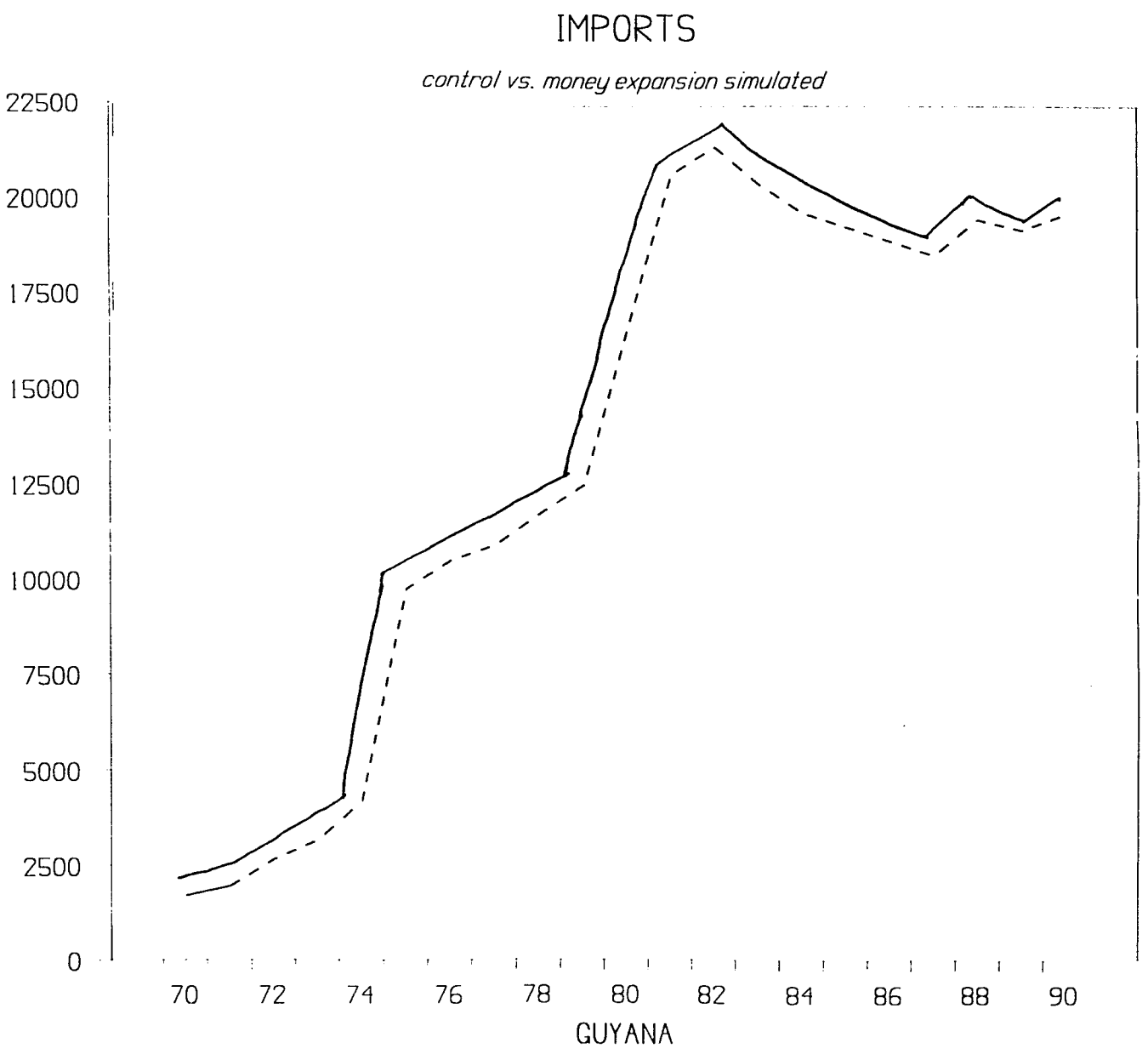

EXPORTS
control vs. money credit simulated
12500
10000
7500
5000
2500
0
70
72
74
76
78
80
82
84
86
88
90
GUYANA

Fig. 111


IMPORTS
control vs. money expansion simulated
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
70
72
74
76
78
80
82
84
86
88
90
GUYANA

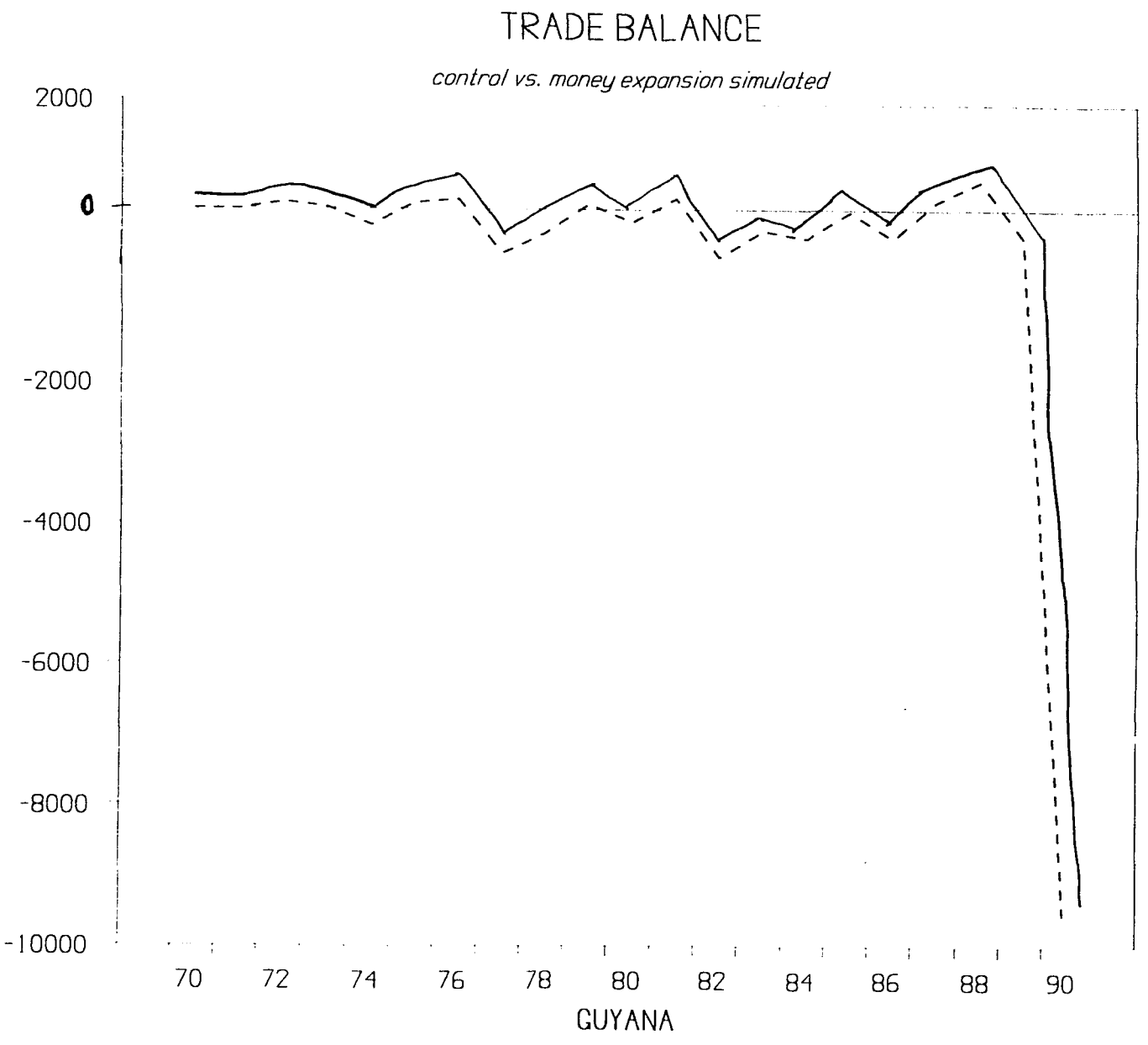

TRADE BALANCE
control vs. money expansion simulated
2000
0
-2000
-4000
-6000
-8000
-10000
70
72
74
76
78
80
82
84
86
88
90
GUYANA

Fig. 113

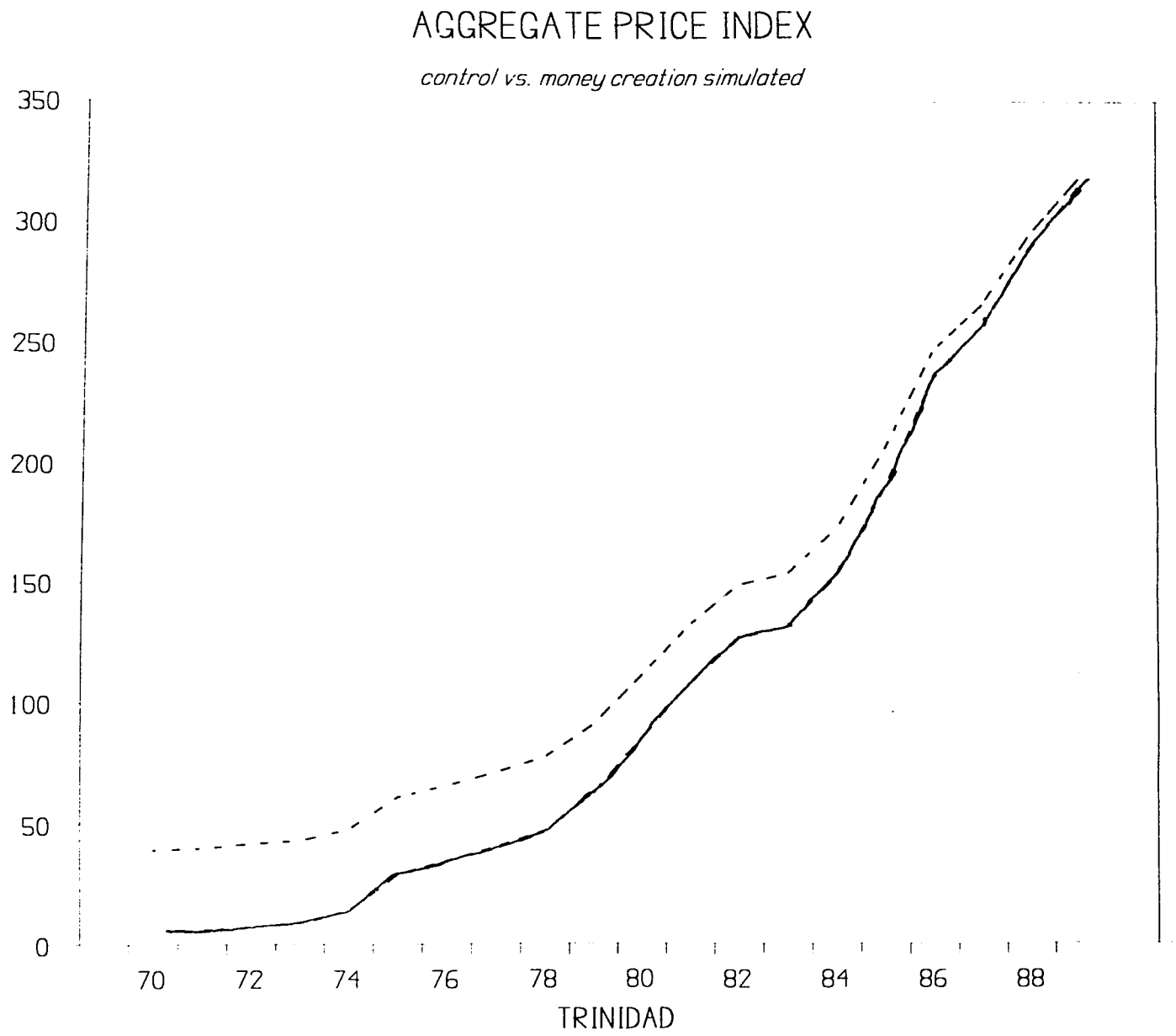

AGGREGATE PRICE INDEX
control vs. money creation simulated
350
300
250
200
150
100
50
0
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 114

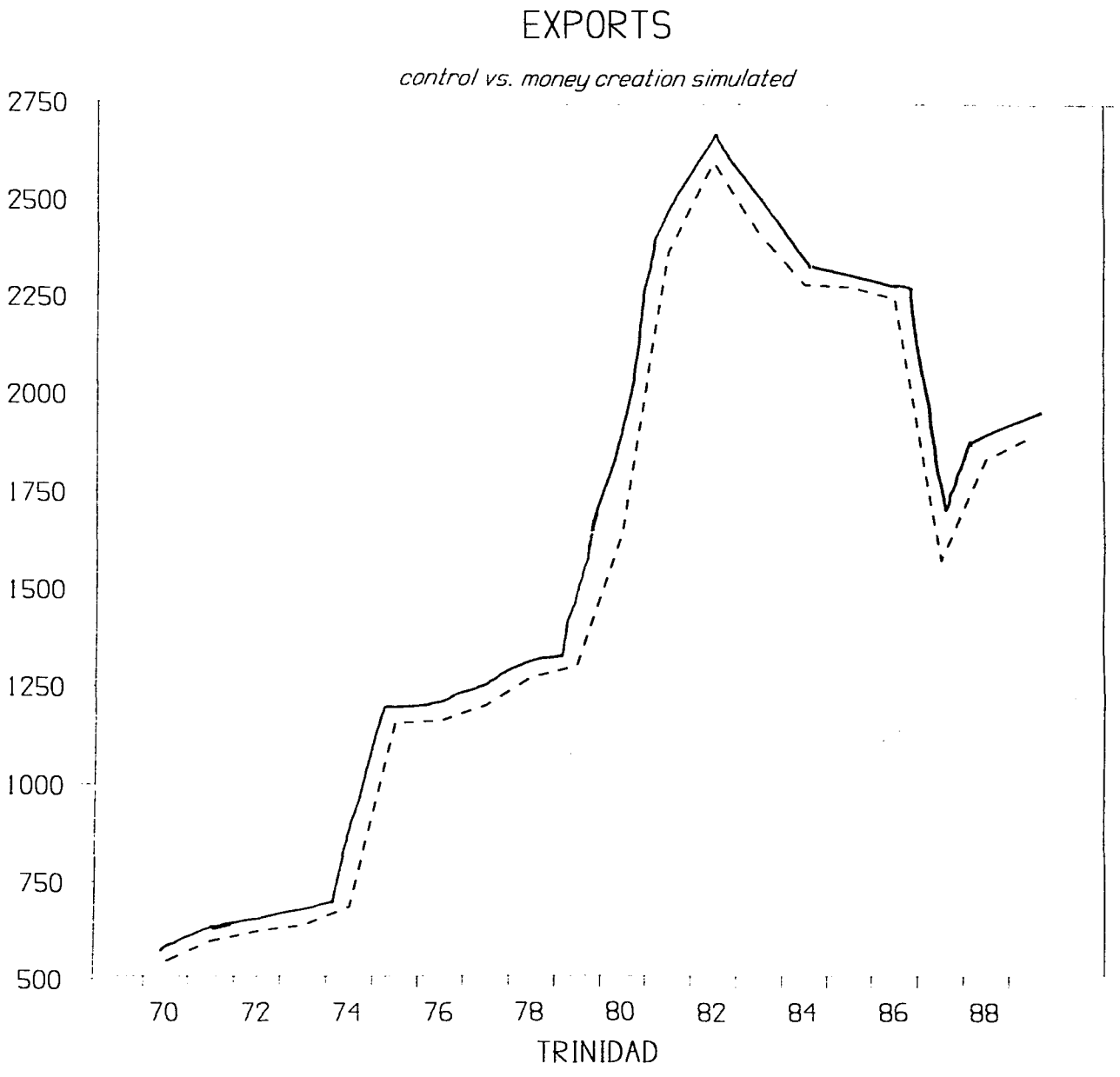
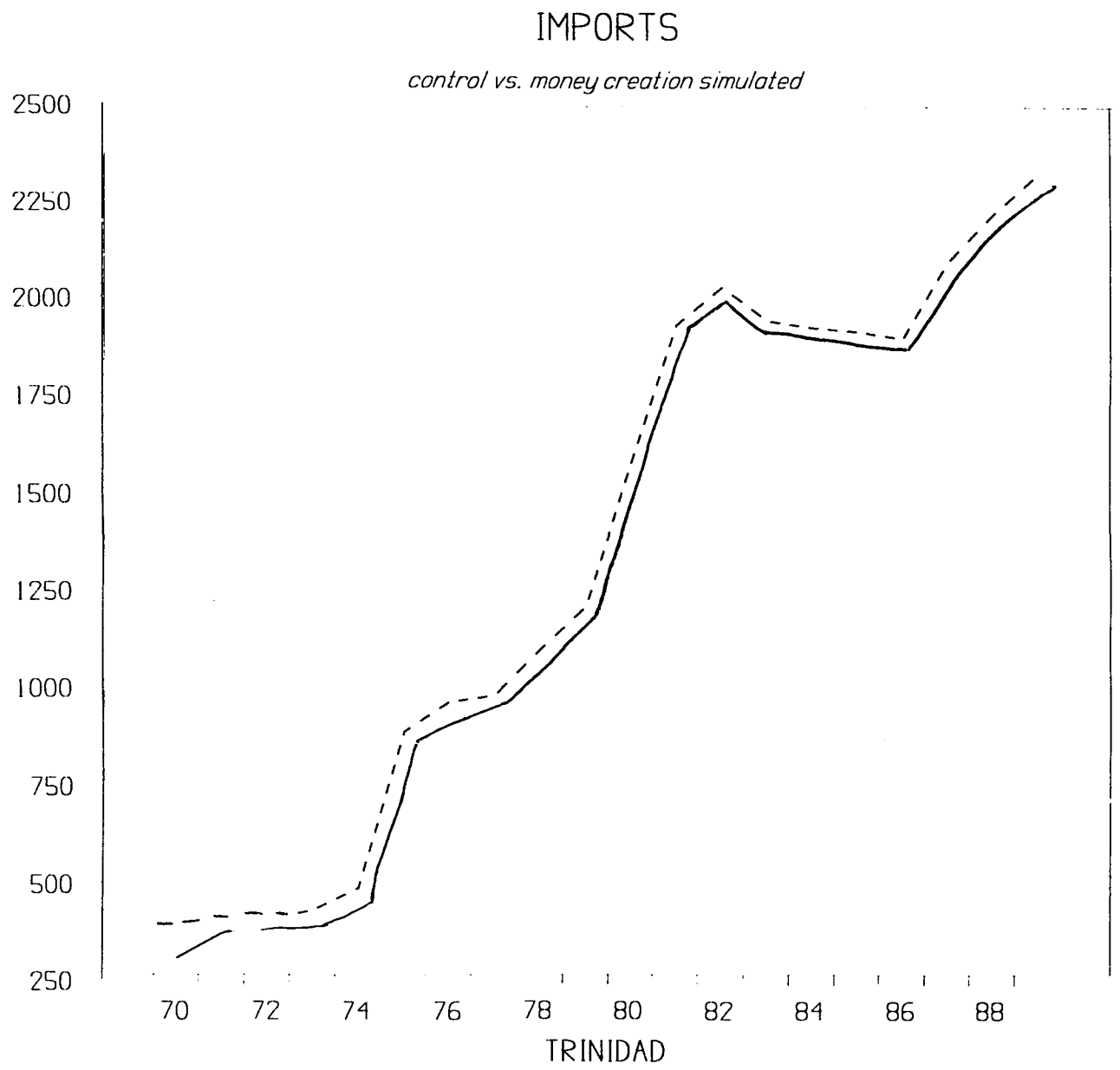
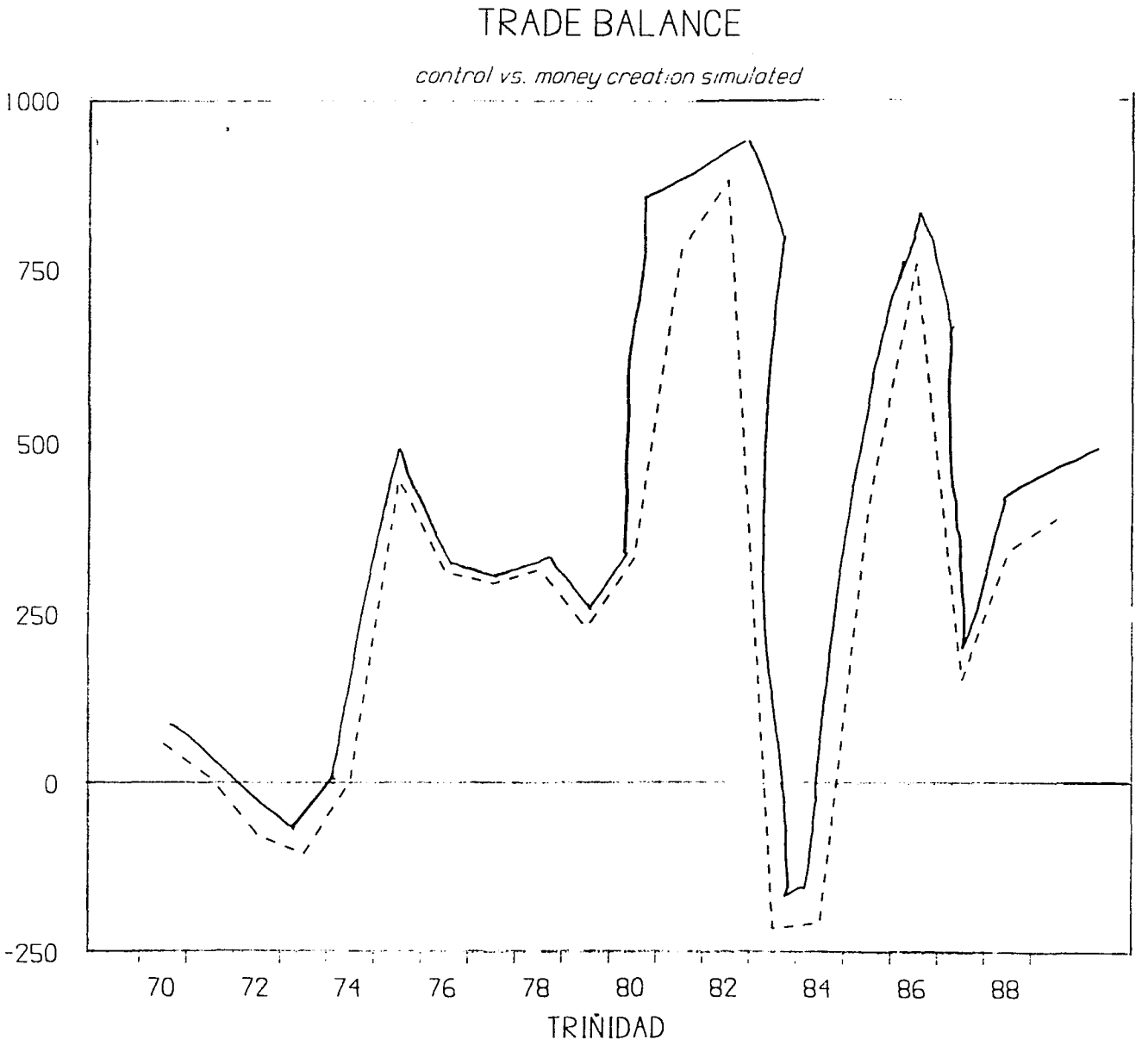

EXPORTS
control vs. money creation simulated
2750
2500
2250
2000
1750
1500
1250
1000
750
500
70
72
74
76
78
80
82
84
86
88
TRINIDAD

Fig. 115


IMPORTS
control vs. money creation simulated
2500
2250
2000
1750
1500
1250
1000
750
500
250
70
72
74
76
78
80
82
84
86
88
TRINIDAD


TRADE BALANCE
control vs. money creation simulated
1000
750
500
250
0
-250
70
72
74
76
78
80
82
84
86
88
TRIÑIDAD

Chapter 5

Concluding Comments

In the above chapter, the estimated model has been used for three policy simulations. These are:

(a) a 10% devaluation
(b) a 10% tariff on imports
(c) a 50% increase in domestic credit over and above actual increases in domestic credit.

We are interested in the effect of all three on real exports, real imports, the trade balance and prices (here measured as the price of traded goods relative to the price of non-traded goods). A summary of our findings is presented here.

As far as the experiment of a 10% devaluation in 1970 is concerned, the key findings are:

1) There is uniformly a substantial increase in real exports. This ranges from 60% in Guyana to 4% for Trinidad. This increase tends to die out with different speeds of adjustment being slowest in Guyana and fastest in Trinidad.

2) There is uniformly a decrease in real imports. This ranges from approximately 86% of what it would

be without a simulated devaluation in Jamaica, Barbados and Trinidad to 79% in Guyana. The rates of adjustment are different between countries ranging from 19 years in Guyana to less than 5 years in Trinidad. That is to say, adjustment back to the level of real imports if there were no simulated devaluation.

3) The devaluation causes some inflation initially (i.e. between a 10% and a 16% increase in the relative price of exportables over non-traded goods). Here the rate of adjustment differs between countries, but in all cases we note a tendency of the rate to adjust to what they would be otherwise is slow.

4) The model shows no short run nor long run improvement in the trade balance, contrary to what is expected and may be explained by government and trade rigidities.

As far as the simulated imposition of a 10% tariff is concerned, the key findings are:

1) Real exports are lower over the entire sample periods uniformly for all four countries. This ranges from initially 89% of what they otherwise would be for Trinidad and Jamaica, 87% for Guyana and 84% for Barbados. This falls to 86% for

Trinidad and Jamaica, 79% for Guyana and 80% for Barbados over the sample period. This implies that overall, real exports are permanently lowered.

2) Real imports are also lower. For Trinidad, Jamaica and Guyana, real imports decline initially by 50% of what they would be otherwise rising to about 70% over the entire sample period. For Barbados, the range is 46% to 60%. This indicates that real imports are also permanently lower.

3) There is initial overshooting in the domestic price of importables from 19% for Trinidad to 14% for Barbados. This adjusts downwards in all cases from 9% for Jamaica to 5% for Trinidad (adjustment implying here towards a price relative that would exist if there were no simulated tariff).

4) There is no short run or long run change in the trade balance induced by a simulated tariff. This appears to be unlikely and may be explained by government and trade rigidities.

As far as the simulated imposition of a 50% increase in domestic credit over actual increases, for the duration of the sample period, is concerned the key findings are:

1) Real exports fall uniformly for all four countries. They fall to 80%, 81%, 86% and 88% of what they

would be otherwise for Jamaica, Trinidad, Barbados and Guyana, respectively. They rise over the sample period to 96%, 97%, 87% and 89% for Jamaica, Trinidad, Barbados and Guyana, respectively. Thus the rate of adjustment appears to be quicker in the cases of Jamaica and Trinidad, but much slower in Barbados and Guyana.

2) Real imports rise uniformly for all four countries. They rise by approximately 50% for Jamaica and Trinidad, but by only 20% in Barbados and 26% in Guyana. The rates of adjustments vary. They fall to 5% in Jamaica, less than 1% in Trinidad, 9% in Barbados and 6% in Guyana. This effect appears too high, especially for Jamaica and Trinidad, and may be explained by government and trade rigidities.

3) There seems to be a moderate increase of approximately 6% in the price of non-traded goods which quickly adjusts to less than 1% for all countries over the sample period.

4) The trade balance uniformly and unambiguously deteriorates for all four countries. A small part of the increase in domestic credit is inflationary as stated in (3) above. A much larger effect appears to be the worsening of the trade balance. In this dissertation, we used a simple multisector general equilibrium model of a small open economy

developed by Clements. The parameters of the model were then estimated using data from four Caribbean countries, Jamaica, Trinidad, Barbados and Guyana. We then carried out their policy simulation experiments; a 10% devaluation, a 10% tariff on imports and a 50% simulated increase over actual increase in the domestic credit component of high powered money.

The model has proved useful in determining the effect of our three policy experimentations on the relevant endogenous variables. However, there are some limitations. First of all, the role of expectations is somewhat ignored due to the assumption of static rather than dynamic expectations. Secondly, because we treat employment (the aggregate factor endowment index) as exogenous, we are unable to determine the effect of simulated policy on employment. Thirdly, the assumption that exports and imports are disposed of in competitive markets, as opposed to markets hindered by government and trade rigidities, seriously restricts the ability of the model to effectively demonstrate the effect of policy simulations on some endogenous variables especially the trade balance.

This research could be extended in a number of ways. First of all, an explicit expectation scheme could be introduced along the lines proposed by Coulson and Robins [1], that is modelling a link between inflation volatility and some

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[1] See Coulson and Robins (1985) pgs. 72-77

key macroeconomic variables. This would allow for smoother adjustment mechanisms in the model. Secondly, we could model Aggregate Factor Endowment Index such that it would be possible to determine the effect of policy simulation on employment [2]. Thirdly, we could disaggregate exports and imports into autonomous components and variable(i.e. where levels of expenditure are strictly market determined) components so that we could isolate the effect of government and trade rigidities on exports via autonomous exports and imports, respectively. This would allow policy experimentation effects to be constrained only to influence the variable components of imports and exports [3].

It would also be useful to see what effect unemployment (i.e. an increase in unemployment) would have on relevant endogenous variables. This particular use of the model would require no extension or refinement of the model. This discussion will be submitted for future journal publication.

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[2] This would require modelling Aggregate Factor Index as an endogenous variable solvable in the model.

[3] Further research along these lines is upcoming.

APPENDIX

Below is a list of Caribbean publications that were used in constructing the sectorial data base for output, consumption, and investment. As was stated above[1] this was used as apriori information in data base construction, but primary data sources were:

a) International Financial Statistics 1969 - 1990, International Monetary Fund, Washington D.C.

b) World Debt Tables 1989 - 1990, International Bank for Reconstruction (World Bank) , Washington D.C.

c) World Population Prospects as assessed in 1968 Population Studies no. 53, Dept. of Economic and Social Affairs, United Nations , N.Y. 1973.

d) Bulletin of labor Statistics 1970 - 1990, International Labor Office, United Nations.

e) Handbook of International Trade and Development Statistics, UNCTAD(Geneva) N.Y., N.Y. 1970 - 1990.

These publications are:

1. Monthly Digest of Statistics 1984 -1990 , Barbados Statistical Service.
2. Overseas Trade 1965 - 78 , Barbados Statistical Service.
3. Bulletin of Overseas Trade 1983 - 1991 , Barbados Statistical Service.
4. Statistical Pocket Digest 1978, 1982 - 83 , Central Statistical Office (Trinidad).
5. Quarterly Economic Report 1965 - 1990 , Central Statistical Office (Trinidad).

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[1] See page 15 above.

6. Annual Economic Survey 1986 - 1990 , Central Statistical Office (Trinidad).

7. Financial Statistics 1971 - 1985 , Central Statistics Office (Trinidad).

8. Statistical Abstract 1968 -1987 , Statistical Institute of Jamaica.

9. Statistical Year Book 1973 - 1987 , Statistical Institute of Jamaica.

10. Quarterly Abstract of Statistics 1965 - 1975 , Statistical Institute of Jamaica.

11. Production Statistics 1972 - 1987 , Statistical Institute of Jamaica.

12. Annual Report 1969 - 1990 , Bank of Jamaica.

13. Statistical Digest 1972 - 1990 , Bank of Jamaica.

14. Monetary Statistics 1972 - 1986 , Bank of Jamaica.

15. Economic Survey 1970 - 1990 , Statistical Bureau, Ministry of Economic Development (Guyana).

16. Quarterly Statistical Digest 1969 - 1990 , Statistical Bureau, Ministry of Economic Development (Guyana).

17. Statistical Bulletin 1982 - 1990 Bank of Guyana.

18. Quarterly Review of Financial Statistics. 1966 - 1978 , Bank of Guyana.

19. Quarterly Economic and Financial Review 1980 - 1990 , Bank of Guyana.

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Carter, Nicholas G. " A Macroeconomic Model of Jamaica: 1959 - 1966 " in Social and Economic Studies Vol. 19 No. 2 , June 1970, pgs. 178 - 201.

Clements, Kenneth W. "Devaluation in a Empirical General Equilibrium Model" in " The Economics of Exchange Rates" edited by Jacob A. Frenkel and Harry G. Johnson ; Reading ,Mass : Addison-Wesley Pub. Co. 1978 ; pgs 193 - 211.

Coulson, N.E. and R.P. Robins "Aggregate Economic Activity and the Variance of Inflation" in Another Look, Economics Letters No. 17, 1985; pgs. 71 - 75.

Denoon, David B.H. "Devaluation under Pressure; India, Indonesia and Ghana" Cambridge Massachusetts, M.I.T. Press 1986.

Doan ,T., R. Litterman, and C.A.Sims "Forecasting and Conditional Projection Using Realistic Prior Distributions" in Econometric Reviews Vol 3, 1984; pgs. 1 - 100.

Dornbush, Rudiger "Devaluation, Money and Non-traded Goods" in American Economic Reviews Vol. 63 December 1973

pgs. 871-883

Edwards, Sebastian " Real Exchange Rate, Devaluation and Adjustment: Exchange Rate Policy in Developing Countries" Cambridge Mass., M.I.T. Press 1989.

Fair, R.C. "The Estimation of Simultaneous Equations Models with Lagged Endogenous Variables and First Order Serially Correlated Errors" in Econometria , Vol. 38 1970; pgs. 507 - 516.

Frenkel, Jacob A. " A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence" in Scandinavian Journal of Economics , Vol.78 No.2 1976, pgs. 200 - 231.

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