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NATIONAL ECONOMIC AND DEVELOPMENT AUTHORITY

CONSPECTUS

PROJECT NO. 34

TECHNICAL ASSISTANCE FOR THE DEVELOPMENT OF ECONOMETRIC MODELS FOR SELECTED NON-TRADITIONAL PRODUCTS

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This project was completed through the assistance of the Training and Development Issues (TDI) Project, a United States Agency for International Development (USAID) - assisted project being implemented by the NEDA. The TDI project aims to improve the capability of the Philippine government and other national institutions to analyze development -related issues and to make sound and timely development-related decisions.

The views, expressions and opinions as contained in this report are the authors' and are not intended statements of policy of either NEDA or USAID.

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I. SUMMARY DESCRIPTION OF PROJECT

This is the final report of the econometric modelling project prepared for the Bureau of Export Trade and Promotion of the Department of Trade and Industry.

The basic objective of the project is to explore the possibility of generating demand-forecasting models for selected Philippine nontraditional exports at as disaggregated level and as destination-specific basis as possible, using secondary data. After discussion with staff at the Bureau of Exports and Trade Promotion (BETP), it was decided to select specific products from among the following broad categories: (a) resource-based exports; (b) fish and fish products; (c) electronics and semiconductors; (c) fruits and nuts; (d) furniture; (e) footwear; (f) services. Data limitations prevented investigation of items covering all of these however, and the final list of commodities was narrowed down to the following: ramie fiber, fish kept alive, tuna, ferro-silicon, semiconductors, electronic microcircuits, diodes, bananas, and chairs and other seats of rattan.

The results are expected to serve two types of uses. These are: first, to identify long-run changes in demand for selected Philippine exports; second, if expanded far enough to cover almost all major export products, the results may be used to forecast export performance on a year-on-year basis. Owing to its experimental nature and small coverage, the present project

merely provides a basis for the latter.

The methodology adopted is a straightforward application of demand theory, in which quantity demanded of Philippine exports is specified as a function of relative prices, some scale variable such as income, and shift parameters or appropriate leads and lags. The parsimony of the specification is purposeful, since it is the aim to run the models with a minimum of data requirements.

The econometric results were satisfactory and tracked historical performance well despite the simplicity of the specifications. In general, and as expected, Philippine exports were found to be sensitive to own-price, incomes, and price-levels in the countries of destination, and for some, a time-trend as well. The econometric results give an idea of the degree of responsiveness (measured as elasticities at the mean) of the products to their own-price and aggregate economic activity in the countries of destination. The results regarding elasticity with respect to own-price are mixed: not all nontraditional exports investigated face a high degree of price competition. On the other hand, most of them have a high responsiveness to aggregate incomes or levels of economic activity.

Problems were encountered relating to the heterogeneity of products and truncated data owing to relatively recent penetration of certain export markets. Potential improvements lie in the inclusion of specific prices on competing products and, as

an alternative, the estimation of export revenues instead of quantities. Generally the results demonstrate the feasibility of specifying disaggregated export-demand relationships for both planning and forecasting purposes. It is suggested this would be worthwhile if pursued as a regular effort by the Bureau.

II. TECHNICAL REPORT

1 Models and Methods.

Let quantity demanded of good i in location j for period t be given by Q_{ijt}. Standard demand theory predicts this will be a function of own price, p_{it}, other prices $P_{jt} = [P_{1jt},\ldots,P_{kjt}]$ where we take P_{jt} to be the vector of prices prevailing in j for other goods 1,...,k which may be either substitutes for or complements of good i, and Yjt the appropriate income or scale variable in destination j. In all these t is the subscript for time. Then the following may be written:

$$(1) \qquad Q_{ijt} = F(p_{it}, P_{jt}, Y_{jt}, t, Q_{ijv}\cdots)$$

with v < t. Typical signs of the partials would be $F_1 < 0$, $F_3 > 0$, with F_2 being indefinite. The inclusion of t and lagged values of quantity demanded are meant to capture secular trends and cyclical influences, respectively, which are not otherwise accounted for by the other variables.

When one seeks to implement this in the context of location-specific demand for particular export products, however, some theoretical difficulties inevitably crop up. The most straightforward way to implement (1) is to interpret Q_{ijt} as total quantity demanded of product i in location (or country) j. The disadvantage of doing this, however, is that at best what

would be obtained is an estimate of total imports of good i by country j. There would then be no way of allocating the total amount thus obtained among the various country-suppliers without being arbitrary.

The ideal context in which the simple interpretation of (1) may be applied is the limiting case where the supplying country is a monopolist and, following standard theory, may be expected to confront a downward-sloping demand function. Then, if specified closely enough, the Q_{ijt} would be total imports of i by j and total exports to j by the supplier country as well. This condition is unlikely to be fulfilled for any of the country's exports, however.

To clarify the issues involved, we might begin from the viewpoint of the exporting country and consider the following simple specification of quantity of i exported to j, i.e. Q_{ij}:

$$(2) \qquad Q_{ij} = f(p_{i1}, p_{i2}, \ldots, p_{is}, P_j, Y_j, \ldots)$$

where p_{ih} is the price at which supplier h delivers the good Q_i (with h = 1,...,s), and the other variables have the same meaning as in (1), except that the time subscript has been omitted. Denote the Philippines by the supplier subscript h*.

Standard international trade theory gives us little to go by in predicting bilateral trade. If Q_i is a homogeneous good produced by suppliers h = 1,...,s, then one of the following

can occur: (a) $p_{ih*} = p_{ih}$, all h; (b) there exists h = h* such that $p_{ih} < p_{ih*}$; or (c) for all h = h*, $p_{ih} > p_{ih*}$. Only in cases (b) and (c) would the exports of h* be determinate; in (b) quantity demanded from h* would be zero, while in (c) it would be equal to the all imports of good i by j. The symmetric case (a), where all suppliers charge the same price, turns out to be the least comfortable, since again there is no non-arbitrary way of allocating total quantity demanded among different suppliers, for there is no means of distinguishing among them. Hence if there are s actual suppliers, there is no a priori reason for choosing one way of allocating total import demand over them. Homogeneity would imply that prices charged for the product should be identical across all suppliers of positive amounts. Slight deviations from the standard price would then result in large changes in the sources of supply. For a given constellation of prices charged by other suppliers h = h*, equation (2) would be discontinuous. This is what is meant when we say standard trade theoretic assumptions give us no handle on bilateral trade.

An alternative tack, and the one taken in this report, is to assume product-differentiation by source. This would imply that the goods supplied by different countries are only imperfect substitutes (a notion which is also known as the Armington (1969) assumption). Slight changes in prices charged by one supplier relative to others would have some perceptible, but not drastic effect on quantity demanded. In this way the problem of discontinuous demand is avoided. Hence a supplier confronts a

downward-sloping demand curve which is peculiar to it. Based on it the supplier may charge a particular price to the country of destination, which -- together with the other variables included in the model -- would then determine the amount of demand forthcoming. This permits prices to vary among various suppliers of positive amounts of a certain good. The idea of differentiation may then be coupled with varying degrees of competition: from pure monopoly (as discussed) to monopolistic competition which is distinguished by free entry and the absence of economic profits. (A simple treatment of monopolistic competition is given in Krugman and Obstfeld (1989:133-143).)

This procedure allows us to distinguish a bilateral pattern of trade, which was not possible under the homogeneous products assumption. In any event, in much empirical work it has been observed that, as Deardorff (1985:508) puts it, "estimated elasticities of demand for imports and exports are too low to be consistent with the more traditional assumption that all goods that enter international trade are perfect substitutes." This description also seems to accord well with the situation in some nontraditional export products, such as garments, furniture, and marine products, etc.

Returning now to (2), therefore, we may distinguish the own-price of the differentiated product and rewrite the demand function as follows:

$$(3) \qquad Q_{ij} = F(p_{ih*}, p_{ih}, P_j, Y_j, \ldots)$$
$$= F(p_{ih*}, P_{sj}, Y_j, \ldots)$$

where P_{sj} is some function of both p_{ih} and P_j. We would expect the $F_1 < 0$ and $F_3 > 0$.

Very often in the implementation, we shall take P_{sj} to be the wholesale price index (WPI) in destination j and expect $F_2 < 0$. This is admittedly a gross assumption, since it implicitly assumes i is competing in an aggregate sense. In practice, one suspects that the WPI would more likely reflect prices which are the equivalent of P_j rather than p_{ih}. In other words, the influence of prices charged by competing suppliers is only weakly captured here.

One case in which we might expect $F_2 < 0$ <u>not</u> to hold is where we can rule out the possibility that the importing country j produces (or imports) potentially competing products. Then the overall price level in country j will less validly reflect the price of substitutes. Instead, since the domestic price index typically moves pro-cyclically, it would have the same sign as the income variable, contrary to what we would expect. Equation (3) will then form the basic model to be estimated.

The behaviour of quantity demanded around the trend variable (t) must also be explained in this context. Ordinarily, the coefficient of the trend would indicate the magnitude of the shift through time of the entire function (3); it would therefore

reflect the influence on demand of other variables than prices and incomes, for example, tastes. However, to the extent the price variable P_{sj} only reflects imperfectly (if at all) the influence of p_{ih}, it might also capture losses or gains in share at the expense of competitors owing to changes through time in prices charged by competing suppliers. Clearly, in this case, the time trend would capture the influence of price variables as well. The inability to distinguish clearly between price and secular trends must be considered one of the major weaknesses of the model.

2 Data Used.

The data set used for all equations is given in Appendix 2. What will be explained here is the rationale for the choice of countries and commodities.

The first step consisted of identifying product lines to which the model may be applied. From the model-specification above, it was evident that price and quantity data were meaningful only for those commodities which were relatively homogeneous.

The major <u>destinations</u> of exports were identified on the basis of export receipts for the chosen commodities for the last four years. The original intent was then to obtain total import demand for these commodities by the countries of destination. Unfortunately, it did not prove possible to obtain data

disaggregated enough on the imports of these countries. Secondary data sources such as the U.N. Trade Statistics series could only yield a series that was too selective and at a level of aggregation too high for the purposes of the investigation. (Owing to time constraints, the use of information from the International Trade Center was precluded.) As a result we had to content ourselves with trade information obtained on the exporter's side, obtained mainly from Philippine Foreign Trade Statistics.

It was sought to obtain price data that were consistent and continuous, using different sources, among them, the Hongkong Foreign Trade Statistics, specialized agencies, such as the Fiber Industry Development Authority and Philippine Coconut Authority, and U.N. trade statistics. But finally, in most of the regressions, the most useful were the implicit-price series obtained from export data themselves. This series was generated by dividing total export values for by quantity from the same data set. Theoretically, this should give a fair estimate of unit-price if we have some assurance a priori that the quantity data (e.g. number, kilograms, etc.) pertain to more or less homogeneous products. For more heterogeneous products, the implicit-price series may be expected to contain less information. In most regressions, the implicit-price series used were those obtained from total exports of the product. For rattan chairs, however, destination-specific implicit-prices were used. This was owing to the greater heterogeneity of the

commodity lines.

Income and internal-price data for countries of destination were obtained from the International Financial Statistics series. In the case of the U.S. (but Hongkong and Saudi Arabia was well), the income variable used was nominal GNP denominated in U.S. dollars. For other countries, real GNP was selected instead. Since current export prices are typically quoted in U.S. dollars, the use of nominal GNP for the U.S. is justified; on the other hand, real GNP for other countries is the appropriate variable in order to avoid distortions in the series that might arise from changes in nominal exchange rates.

3 Discussion of Econometric Results.

The complete results of the econometric estimates are given in Appendix 1. Meanwhile Table 1 summarizes the implied price- and income-elasticities from the estimated equations. All are computed at the means of the relevant price and income data, according to: $b_i(z_i/q)$, where b_i is the relevant coefficient for i (= own-price, income), z_i is the mean of i, and q is the mean of quantity. In the case where quantities demanded are affected by both current and past levels of own-price, the coefficients for price added in order to obtain b.

3.1 . Semiconductors.

Equations were estimated for semiconductor exports to the U.S., West Germany, Hongkong, and Singapore, and these are given

as Appendices 1.1-1.4. It will be noted (See Table 1) that own-price and income-elasticities are greater than unity for countries in which they appear as explanatory variables. Own-price and income elasticities at the mean are respectively -3.50 and 4.98 for the U.S. and -1.40 and 2.98 for West Germany, indicating sensitivity to price and income changes. Income did not emerge significant for Singapore, although the own-price elasticity was -2.47. The coefficients for own-price are significant in the equations for both countries; on the other hand, the activity variable is significant at the 10 percent level for the U.S. but only at the 20 percent level for West Germany. For the U.S. there is a negative and significant time-trend, however, which indicates a possibility the country might be losing share in the market.

Plots indicating the performance of the equations for the U.S. and West Germany are given in Appendices 2.1=2.2.

The semiconductor equation for Hongkong is less satisfactory in terms of goodness of fit (adjusted R-squared is about 0.75); furthermore the only variables that proved significant were simply lagged quantities and a positive time trend. This circumstance might be due to the fact that the demand for semiconductors by Hongkong is itself simply a derived demand (Hongkong itself being an exporter) and hence less influenced by the internal scale of activity in that country. The same explanation might be applied in the case of Singapore where

income did not appear as a significant explanatory variable either.

Generally the relatively high price-elasticities suggest a high degree of competition confronted by the country's semiconductor exports.

3.2 Electronic microcircuits.

The reference is to the equations given in Appendices 1.2.1-1.2.4. As with semiconductors, electronic microcircuit exports confront a high income elasticity, although the price-elasticity is not uniformly large for the three countries investigated. This suggests that the scope for gains in share through independent price-lowering might not be large. In all three destinations (U.S., U.K., and West Germany) investigated, own-price and aggregate economic activity were highly significant, and the goodness-of-fit measures were satisfactory. Negative and significant time-trends were also evident, however, in the equations for the U.S. and West Germany.

The equation for Hongkong is reported as Appendix 1.2.4. The own-price variable has the correct sign but is insignificant. There is a positive and significant time trend, as well as a cyclical factor.

3.3 Diodes.

The reference is to the equations given in Appendices 1.3.1-1.3.2. The equation for the U.S. (A1.3.1) shows an almost unitary own-price elasticity of -0.99. On the other hand, the coefficient with respect to income is significant implies an income elasticity of 0.49 at the mean. The equation for Hongkong (A1.3.2) is less satisfactory. The strong positive effect of own-price lagged one period swamps the negative effect of current own-price (which is statistically insignificant) and leads one to suspect what is being captured is a supply rather than a demand phenomenon. This suspicion is bolstered by a strong positive time-trend.

3.4 Fish kept alive.

The relevant equation is given in Appendix 1.4, and the plot in Appendix 2.4.1. Here neither the own-price nor the income elasticity is particularly high. The structure of demand for the product is unique in that it seems to cater to a regular clientele which is not sensitive to price and whose incomes are not severely affected by fluctuations in aggregate economic activity. The signs of the own-price and income-coefficients are as expected and statistically significant.

3.5 Tuna.

In the equation for tuna demand from Japan (Appendix 1.5 with plot in Appendix 2.5) the income variable turns out to be

statistically weak. The general price-level (wholesale price index) is highly significant, although to what extent this reflects a procyclical effect through income is unclear. Own price performs acceptably, and there is also a negative and significant time trend, which should cause some concern. From Table 1, we find the own-price and income elasticities are -1.26 and 12.08, respectively, indicating appreciable responses to price and incomes.

3.6 Ramie Fiber.

In the equation for ramie fiber exports to Japan (Appendix 1.6) the own-price is not statistically significant. The scale-variable used is total Japanese imports of ramie; this is significant at the 10 percent level. There is a positive time trend which is statistically weak, however. A plot indicating the equation's performance is given in Appendix 2.6. The fit is not very close (Adjusted-R squared is only 0.76), but important turning points are captured.

3.7 Chairs and other seats made of rattan.

Initial attempts to use average implicit price across all destinations for this equation proved futile. On the other hand, this was to be expected, considering the heterogeneity of this group as compared with the others. Hence the alternative variable for price adopted was the destination-specific implicit price. (The disadvantage of this in future work is the relative difficulty of projecting such values.) The results for threee

countries (West Germany, Japan, the Netherlands, and the United Kingdom and France) are shown in Appendices 1.7.1 to 1.7.4. The plots are given in Appendices 2.7.1-2.7.4. Referring to Table 1, what is evident is the high income-elasticities of these products; own price-elasticities are also greater than unity, except for West Germany. (It should be noted, however, that the price variable for West Germany was not statistically significant.) There are significant positive time-trends in the equations for the Netherlands and France.

3.8 Bananas.

The results referred to here are in Appendices 1.8.1 to 1.8.2, with plots given in Appendices 2.8.1 and 2.8.2. Low price-elasticities on banana exports is evident for both Saudi and Japanese imports. In Japan, however, this is made up for by a rather high income elasticity. This is consistent with expectations, since bananas may be something of a luxury. This is not true of the equation for Saudi Arabia, however.

In the equation for Japan own-price and income are highly significant (at the 10 percent and one percent levels, respectively). For the Saudi equation, the effect of income is not as statistically significant, although own-price performs quite well. In both equations, however, there is a negative time trend which is highly significant.

3.9 Ferro-silicon.

Neither own-price nor real GNP emerges as a strong explanatory variable in the equation for ferro-silicon exports to Japan (Appendix 1.9 with plot in Appendix 2.9). Only the variable for other prices is highly significant. The equation's fit to actual data is not very close, but as the plot in Appendix 2.9 shows, it predicts most major turning points.

3.10 A Traditional Export.

For purposes of comparison we have also estimated demand equations for dessicated coconut, a traditional export, for three destinations (U.S., West Germany, and the U.K.). Except for the U.S. own-price, income, general price level, and time emerge significant, and the fit is quite good. The U.S. equation is less satisfactory: none of the variables is acceptable at anything less than the 20 percent level.

The relevant price and income elasticities are displayed in Table 1 as a Memo note. It will be seen that except for the U.S., quantities demanded are quite sensitive to both own-price and incomes. It will also be noted that for the most part, there is a significant negative secular trend for all three countries.

Comparing these results with those of nontraditional exports, it does not seem self-evident that they are substantially different. The implication is that the present composition of nontraditional exports presents no panacea for

the problems of Philippine export promotion, to the extent that these continue to be characterised by highly competitive markets. The large number of runs for nontraditionals for which there are negative time trends also suggests the need to improve competitiveness through price or quality if share is not to be lost. Perhaps the only advantage of nontraditionals over traditional exports in this respect is that, in the case of manufactures, there is probably greater room for differentiation and upgrading.

Table 1

OWN-PRICE AND INCOME ELASTICIES[1]

	Ep	Ey
1. Semiconductors		
U.S.	-3.50	4.98
West Germany	-1.40	2.98
Hongkong	-	-
Singapore	-2.47	-
2. Electronic Microcircuits		
U.S.	-2.07	30.11
West Germany	-0.71	163.06
United Kingdom	-0.14	18.25
Hongkong	*	-
3. Diodes		
U.S.	-0.99	0.49
Hongkong	*	-
4. Fish Kept Alive		
U.S.	-0.84	0.79
5. Tuna		
Japan	-1.26	*
6. Ramie fiber		
Japan	*	-

7. Rattan Chairs		
West Germany	*	8.70
Japan	-2.06	6.59
Netherlands	-1.16	27.64
8. Bananas		
Japan	-0.16	10.26
Saudi Arabia	-0.67	*
9. Ferro-silicon		
Japan	-	-
Memo:		
10. Coconut, dessicated		
U.S.	*	*
United Kingdom	-8.86	14.55
West Germany	-2.43	55.90

Legend:

* = coefficient for relevant variable is statistically insignificant.

- = relevant variable does not appear in estimated equation.

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[1]Elasticities are computed at the means.

IV PROBLEMS ENCOUNTERED AND RECOMMENDATIONS.

In general the results of the study show the feasibility of generating acceptable commodity- and destination-specific demand functions for exports using easily accessible secondary data. The validation of such equations allows them to serve as useful planning tools, given certain projected values of the independent variables.

Difficulties have emerged owing to the problem of heterogeneity of some nontraditional export products, especially those in metal manufactures. A way around these difficulties. though theoretically less satisfactory, would be to predict export revenues instead.

Another area for improvement is to obtain price-data from competing producers. These are less readily available, but if obtained can only improve the performance of the equations.

Finally a difficulty in extending the present methodology to a broader range of nontraditional products is that for some destinations, export penetration has been rather recent. In such cases not enough data exist to permit an econometric analysis. A related (though not unremediable) problem is the case when some data points are missing (such as when exports to some destinations are nil for some years). The problem would not be intractable, nonetheless, given enough observations.

It would be desirable if the Bureau were itself to implement a programme of estimating the demand for selected exports (nontraditional as well as traditional) in order to improve its planning capacity. This capacity might then be used to establish regular links with relevant export sectors, which might then be more interested in engaging in strategic thinking for their industries.

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APPENDIX 1.1.1

SMPL 1979 - 1986
8 Observations
LS // Dependent Variable is QUSSC
Convergence achieved after 8 iterations

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-9.6533675	1.8510025	-5.2152104	0.035
GNPUSA	0.0025685	0.0008582	2.9928122	0.096
WPIUS	0.1418116	0.0072999	19.426387	0.003
PSC	-0.0351755	0.0026842	-13.104682	0.006
TIME	-1.3868849	0.2489640	-5.5706232	0.031

R-squared	0.994388	Mean of dependent var	1.726762
Adjusted R-squared	0.980359	S.D. of dependent var	0.623869
S.E. of regression	0.087434	Sum of squared resid	0.015289
Durbin-Watson stat	2.453669	F-statistic	70.87773
Log likelihood	13.68864		

APPENDIX 1.1.2

SMPL 1978 - 1987
9 Observations
LS // Dependent Variable is QGERSC

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.9634920	0.3101235	-3.1068014	0.036
GNPGER	0.0005967	0.0003466	1.7214305	0.160
PSC	-0.0044213	0.0010686	-4.1373656	0.014
PSC (-1)	0.0022747	0.0008902	2.5551782	0.063
CPIGER	0.007718	0.0023636	3.2627833	0.031

R-squared	0.978668	Mean of dependent var	0.253144
Adjusted R-squared	0.957337	S.D. of dependent var	0.109050
S.E. of regression	0.022524	Sum of squared resid	0.002029
Durbin-Watson stat	2.117438	F-statistic	45.87884
Log likelihood	25.01714		

APPENDIX 1.1.3

SMPL 1979 - 1987
9 Observations
LS // Dependent Variable is QHKSC

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.1254224	0.0270313	4.6398985	0.006
QHKSC (-1)	0.3930467	0.1867026	2.1052024	0.089
QHKSC (-2)	-0.7907443	0.1713856	-4.6138321	0.006
TIME	0.0168113	0.0048966	3.4332990	0.019

R-squared	0.842177	Mean of dependent var	0.179500
Adjusted R-squared	0.747483	S.D. of dependent var	0.053583
S.E. of regression	0.026926	Sum of squared resid	0.003625
Durbin-Watson stat	1.697316	F-statistic	8.893670
Log likelihood	22.40658		

APPENDIX 1.1.4

SMPL 1979 - 1987
9 Observations
LS // Dependent Variable is QSINSC

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	0.1809999	0.6709703	0.2697585	0.801
PSC	0.0054138	0.0041588	1.3017752	0.263
PSC (-1)	-0.0178451	0.0055018	-3.2434797	0.032
PSC (-2)	0.0127947	0.0038222	3.3474607	0.029
QSINSC (-1)	0.4457187	0.1922852	2.3180087	0.081

R-squared	0.832297	Mean of dependent var	0.345511
Adjusted R-squared	0.664594	S.D. of dependent var	0.203378
S.E. of regression	0.117785	Sum of squared resid	0.055493
Durbin-Watson stat	2.532682	F-statistic	4.962921
Log likelihood	10.12880		

APPENDIX 1.2.1

SMPL 1980 - 1986
7 Observations
LS // Dependent Variable is QUSEM

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-2964.5989	917.65019	-3.2306416	0.084
GNPUSA	0.5795529	0.2550330	2.2724628	0.151
PEM	-186.07241	43.310686	-4.2962241	0.050
WPIUS	23.793333	6.9285927	3.4340788	0.075
TIME	-282.02263	91.200090	-3.0923504	0.091

R-squared	0.917757	Mean of dependent var	66.98911
Adjusted R-squared	0.753270	S.D. of dependent var	56.35821
S.E. of regression	27.99422	Sum of squared resid	1567.353
Durbin-Watson stat	2.966508	F-statistic	5.579514
Log likelihood	-28.87189		

APPENDIX 1.2.2

SMPL 1981 - 1986
6 Observations
LS // Dependent Variable is QGEREM

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-2435.3641	134.94282	134.94282	0.035
PEM	-59.483677	4.5155508	-13.173072	0.048
PEM (-1)	44.152684	3.5851949	12.315281	0.052
GNPGER	1.8280704	0.1009711	18.104894	0.035
TIME	-52.044782	3.3531788	-15.521028	0.041

R-squared	0.998664	Mean of dependent var	17.20018
Adjusted R-squared	0.993321	S.D. of dependent var	25.04296
S.E. of regression	2.046715	Sum of squared resid	4.189043
Durbin-Watson stat	3.077607	F-statistic	186.8899
Log likelihood	-7.435770		

APPENDIX 1.2.3

SMPL 1981 - 1986
6 Observations
LS // Dependent Variable is QUKEM

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-49.303348	6.8931108	-7.1525542	0.019
GNPUK	0.1638856	0.0214458	7.6418319	0.017
PEM (-1)	-0.5319251	0.9234708	-0.5760064	0.623
QUKEM (-1)	-1.2257381	0.3563354	-3.4398435	0.075

R-squared	0.967938	Mean of dependent var	3.046283
Adjusted R-squared	0.919846	S.D. of dependent var	2.215137
S.E. of regression	0.627138	Sum of squared resid	0.786604
Durbin-Watson stat	1.214078	F-statistic	20.12664
Log likelihood	-2.418262		

APPENDIX 1.2.4

SMPL 1981 - 1986
6 Observations
LS // Dependent Variable is QHKEM

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-77.025594	36.450729	-2.1131428	0.169
PEM (-1)	-7.5171088	18.452249	-0.4073817	0.723
QHKEM (-1)	-4.3869239	2.4513050	-1.7896280	0.215
TIME	22.836725	7.7570288	2.9440041	0.099

R-squared	0.848914	Mean of dependent var	21.41077
Adjusted R-squared	0.622286	S.D. of dependent var	24.94319
S.E. of regression	15.32970	Sum of squared resid	469.9992
Durbin-Watson stat	2.043625	F-statistic	3.745842
Log likelihood	-21.59655		

APPENDIX 1.3.1

SMPL 1979-1986
8 Observations
LS// Dependent Variable QUSDD

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT	2-TAIL SIG.
C	-226.46162	697.06784	-0.3248774	0.767
PDD	-2467.6625	887.28171	-2.7811175	0.069
PDD(-1)	-690.14070	960.74184	-0.9265139	0.423
GNPUSA	2.8625902	1.1671459	2.4526412	0.091
GNPUSA(-1)	-2.8122764	1.1560638	-2.4326307	0.098

R-squared	0.928610	Mean of dependent var.	332.5000
Adjusted R-squared	0.833424	S.D. of dependent var.	370.6384
S.E. of regression	151.2712	Sum of squared resid.	68648.95
Durbin-Watson stat.	2.253262	F-statistic	9.755732
Log-likelihood	-47.58079		

APPENDIX 1.3.2

SMPL 1979-1987
9 Observations
LS// Dependent Variable is QHKDD

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT	2-TAIL SIG.
C	-282.83864	952.86380	-0.2968301	0.786
PDD	-165.23099	1383.5216	-0.1194278	0.912
PDD(-1)	1880.5359	1206.3208	1.5589020	0.217
QHKDD(-1)	1.4515988	0.5436690	2.6700046	0.076
TIME	53.004697	116.86612	0.4535506	0.681

R-squared	0.920723	Mean of dependent var.	346.8889
Adjusted R-squared	0.788595	S.D. of dependent var.	499.0778
S.E. of regression	229.4699	Sum of squared resid.	457969.4
Durbin-Watson stat.	2.185591	F-statistic	6.963412
Log likelihood	-56.74864		

APPENDIX 1.4

SMPL 1979 - 1986
8 Observations
LS // Dependent Variable is QUSAFK

VARIABLE	COEFFICIENT	STD. ERROR	T. STAT.	2-TAIL SIG.
C	832966.49	293831.72	2.8348420	0.036
PFKA	-339840.99	98817.520	-3.4390763	0.018
GNPUSA	187.04309	47.938266	3.9017492	0.011

R-squared	0.892317	Mean of dependent var	791827.6
Adjusted R-squared	0.849244	S.D. of dependent var	186836.1
S.E. of regression	72543.30	Sum of squared resid	2.63D+10
Durbin-Watson stat	2.548736	F-statistic	20.71640
Log likelihood	-99.00700		

APPENDIX 1.5

SMPL 1978 - 1986
9 Observations
LS // Dependent Variable is QJTU

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-191.34879	79.038791	-2.4209479	0.073
PTUNA	-3.7820105	1.6160587	-2.3402680	0.079
GNPJPN	0.1705657	0.1418545	1.2023988	0.296
WPIJ	1.8885374	0.7208353	2.6199291	0.059
TIME	-10.376024	4.4026349	-2.3567759	0.078

R-squared	0.918671	Mean of dependent var	3.648922
Adjusted R-squared	0.837342	S.D. of dependent var	1.706945
S.E. of regression	0.688425	Sum of squared resid	1.895717
Durbin-Watson stat	1.862943	F-statistic	11.29576
Log likelihood	-5.761123		

APPENDIX 1.6

SMPL 1981 - 1988
8 Observations
LS // Dependent Variable is XRJ
Convergence achieved after 25 iterations

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	418.74916	994.92988	0.4208831	0.702
FP	-2.4319460	2.9326926	-0.8292536	0.468
TJIR	86.371632	33.277931	2.5954628	0.081
T	53.476509	98.854469	0.5409620	0.626

R-squared	0.898514	Mean of dependent var	1438.500
Adjusted R-squared	0.763199	S.D. of dependent var	531.8695
S.E. of regression	258.8196	Sum of squared resid	200962.8
Durbin-Watson stat	2.029384	F-statistic	6.640160
Log likelihood	-51.87724		

APPENDIX 1.7.1

SMPL 1978 - 1987
10 Observations
LS // Dependent Variable is QGERCH

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-51186.874	13337.460	-3.8378278	0.006
PGERCH	-41.006291	108.31129	-0.3785966	0.716
GNPGER	38.187138	9.9232830	3.8482363	0.006

R-squared	0.794474	Mean of dependent var	5865.900
Adjusted R-squared	0.735753	S.D. of dependent var	2951.743
S.E. of regression	1517.342	Sum of squared resid	16116295
Durbin-Watson stat	2.228048	F-statistic	16116295
Log likelihood	-85.65317		

APPENDIX 1.7.2

SMPL 1978 - 1987
10 Observations
LS // Dependent Variable is QJACH

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-82578.212	44090.910	-1.8729079	0.103
PJACH	-1931.1379	1191.0695	-1.6213478	0.149
GNPJPN	584.54047	84.448498	6.9218575	0.000

R-squared	0.912463	Mean of dependent var	23381.60
Adjusted R-squared	0.887452	S.D. of dependent var	21017.04
S.E. of regression	7050.829	Sum of squared resid	3.48D+08
Durbin-Watson stat	1.886828	F-statistic	36.48297
Log likelihood	-101.0150		

APPENDIX 1.7.3

SMPL 1979 - 1987
9 Observations
LS // Dependent Variable is QNETCH

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-338922.36	70374.323	-4.8159947	0.009
PNETCH	-198.19169	101.19023	-1.9586050	0.122
GNPNET	1033.4179	919.27321	2.1293915	0.100
TIME	1957.4926	919.27321	2.1293915	0.100

R-squared	0.955874	Mean of dependent var	11234.56
Adjusted R-squared	0.911748	S.D. of dependent var	13403.56
S.E. of regression	3981.822	Sum of squared resid	63419622
Durbin-Watson stat	2.084556	F-statistic	21.66239
Log likelihood	-83.72671		

APPENDIX 1.7.4

SMPL 1979 - 1987
9 Observations
LS // Dependent Variable is QFRCH

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-712301.08	276524.00	-2.5759105	0.050
GNPFR	265.40510	104.08897	2.5497907	0.051
PFRCH (-1)	-152.43907	247.76696	-0.6152518	0.565
TIME	-9969.9222	4874.0102	-2.0455276	0.096

R-squared	0.829177	Mean of dependent var	6020.444
Adjusted R-squared	0.726683	S.D. of dependent var	8064.288
S.E. of regression	4215.988	Sum of squared resid	88872772
Durbin-Watson stat	2.364682	F-statistic	8.090014
Log likelihood	-85.24516		

APPENDIX 1.8.1

SMPL 1979 - 1986
8 Observations
LS // Dependent Variable is QJBAN

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-2118613.0	530242.40	-3.9955556	0.016
PBAN (-1)	-398.78451	182.44410	-2.1857901	0.094
GNPJPN (-1)	11503.087	2689.6017	4.2768737	0.013
TIME	-91667.471	26758.936	-3.4256769	0.027

R-squared	0.969142	Mean of dependent var	252546.9
Adjusted R-squared	0.945998	S.D. of dependent var	61104.57
S.E. of regression	14199.70	Sum of squared resid	8.07D+08
Durbin-Watson stat	2.534909	F-statistic	41.87486
Log likelihood	-85.06673		

APPENDIX 1.8.2

SMPL 1979 - 1986
8 Observations
LS // Dependent Variable is QSABAN

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	1088.1342	172.95838	6.2913064	0.008
GNPSA	0.3099840	0.1871553	1.6562931	0.196
TIME	-17.959427	2.2101258	-8.1259749	0.004
WPISA	-8.5370608	1.7591422	-4.8529679	0.017
PBAN	-0.6950989	0.2206890	-3.1496759	0.051

R-squared	0.982734	Mean of dependent var	103.7435
Adjusted R-squared	0.959712	S.D. of dependent var	31.09081
S.E. of regression	6.240500	Sum of squared resid	116.8315
Durbin-Watson stat	3.422452	F-statistic	42.68735
Log likelihood	-22.07667		

APPENDIX 1.9

SMPL 1978 - 1986
9 Observations
LS // Dependent Variable is QJFERS

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-1853.6834	624.33561	-2.9690497	0.041
PFERS	-20.607009	24.521663	-0.8403393	0.448
WPIJ	19.773792	5.5103948	3.5884529	0.023
GNPJPN	0.9549312	1.0052799	0.9499157	0.396
TIME	-107.17545	35.139924	-3.0499626	0.038

R-squared	0.862713	Mean of dependent var	16.22323
Adjusted R-squared	0.725425	S.D. of dependent var	7.267194
S.E. of regression	3.808000	Sum of squared resid	58.00345
Durbin-Watson stat	2.987381	F-statistic	6.283995
Log likelihood	-21.15520		

APPENDIX 1.10.1

SMPL 1979 - 1986
8 Observations
LS // Dependent Variable is QUSCD

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	5.5042503	37.706480	0.1459762	0.893
PCOCOD (-1)	-0.1102960	0.0664864	-1.6589257	0.196
WPIUS (-1)	0.3473527	0.2654635	1.3084764	0.282
GNPUSA (-1)	-7.3149568	0.0177084	0.8367930	0.464
TIME	-7.3149568	4.9357285	-1.4820420	0.235

R-squared	0.849373	Mean of dependent var	39.95692
Adjusted R-squared	0.648538	S.D. of dependent var	3.703990
S.E. of regression	2.195883	Sum of squared resid	14.46570
Durbin-Watson stat	2.062831	F-statistic	4.229197
Log likelihood	-13.72086		

APPENDIX 1.10.2

SMPL 1980 - 1986
7 Observations
LS // Dependent Variable is QUKCD

VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-4.7012394	0.3432905	-13.694641	0.046
PCOCOD	-0.2602175	0.0026508	-98.164935	0.006
PCOCOD (-1)	0.0484473	0.0010757	45.036682	0.014
PCOCOD (-2)	-0.3224937	0.0029923	-107.77536	0.006
GNPUK	0.2193169	0.0014252	153.88401	0.004
TIME	-3.4864697	0.0198938	-175.25389	0.004

R-squared	0.999992	Mean of dependent var	5.084243
Adjusted R-squared	0.999954	S.D. of dependent var	1.767272
S.E. of regression	0.011990	Sum of squared resid	0.000144
Durbin-Watson stat	3.634309	F-Statistic	26070.99
Log likelihood	27.84398		

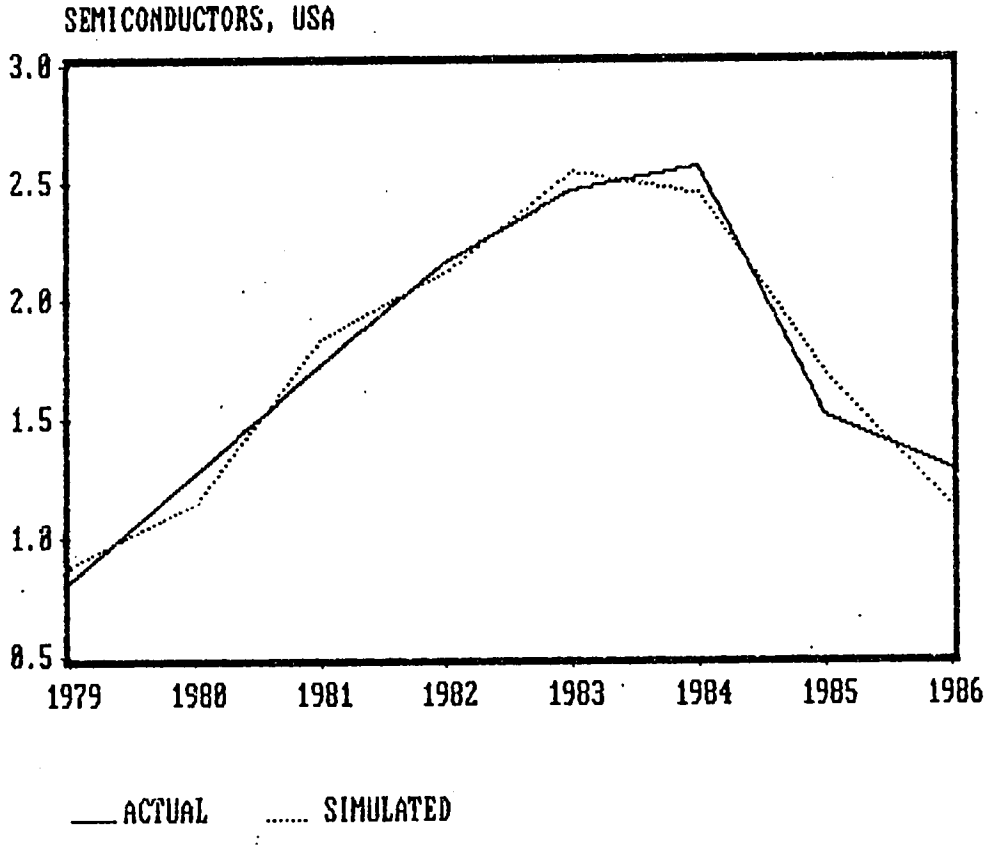
APPENDIX 1.10.3

SMPL 1979 - 1986
8 Observations
LS // Dependent Variable is QGERCD
Convergence achieved after 12 iterations

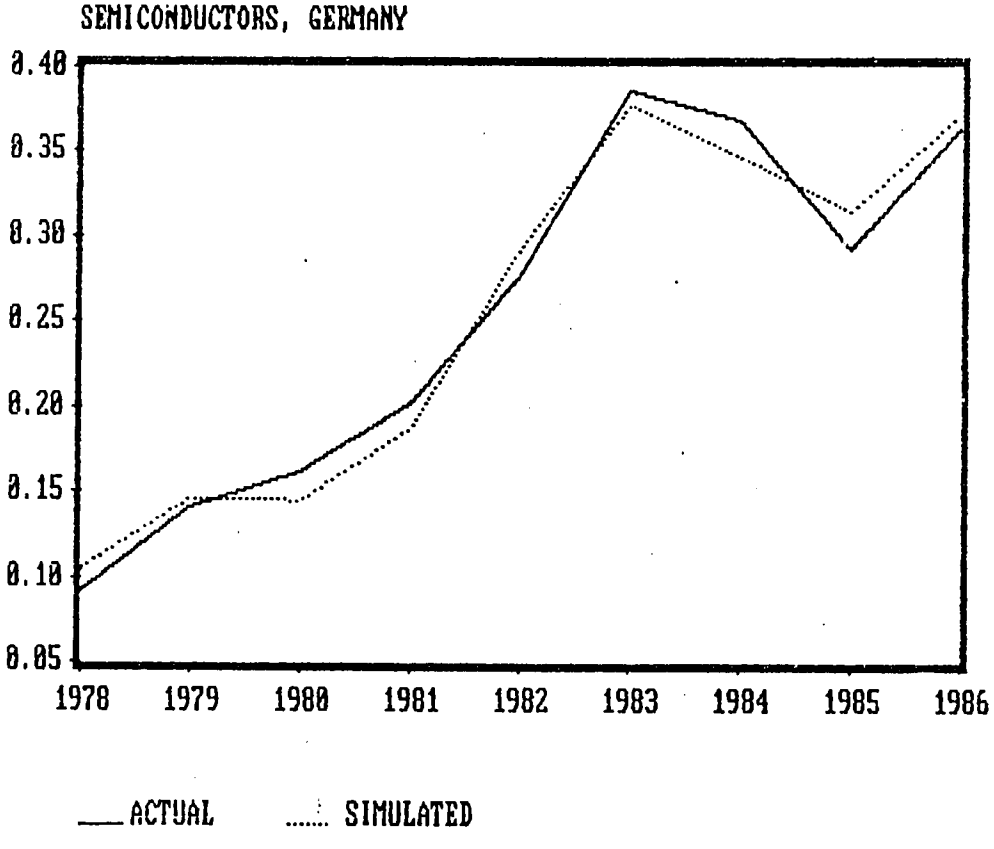
VARIABLE	COEFFICIENT	STD. ERROR	T-STAT.	2-TAIL SIG.
C	-454.58179	99.085068	-4.5877931	0.137
PCOCOD	-0.0840087	0.0106170	-7.9126511	0.080
GNPGER	0.2649459	0.0337197	7.8573057	0.081
WPIGER	1.4208722	0.4605214	3.0853554	0.200
TIME	-13.791786	1.2018329	-11.475627	0.099
PCOCOD (-1)	-0.1341751	0.0210160	-6.3844384	0.099
AR (1)	0.6503529	0.2063805	3.1512330	0.196

R-squared	0.999068	Mean of dependent var	7.189700
Adjusted R-squared	0.993474	S.D. of dependent var	2.022239
S.E. of regression	0.163367	Sum of squared resid	0.026689
Durbin-Watson stat	3.150621	F-Statistic	178.5992
Log likelihood	11.46032		

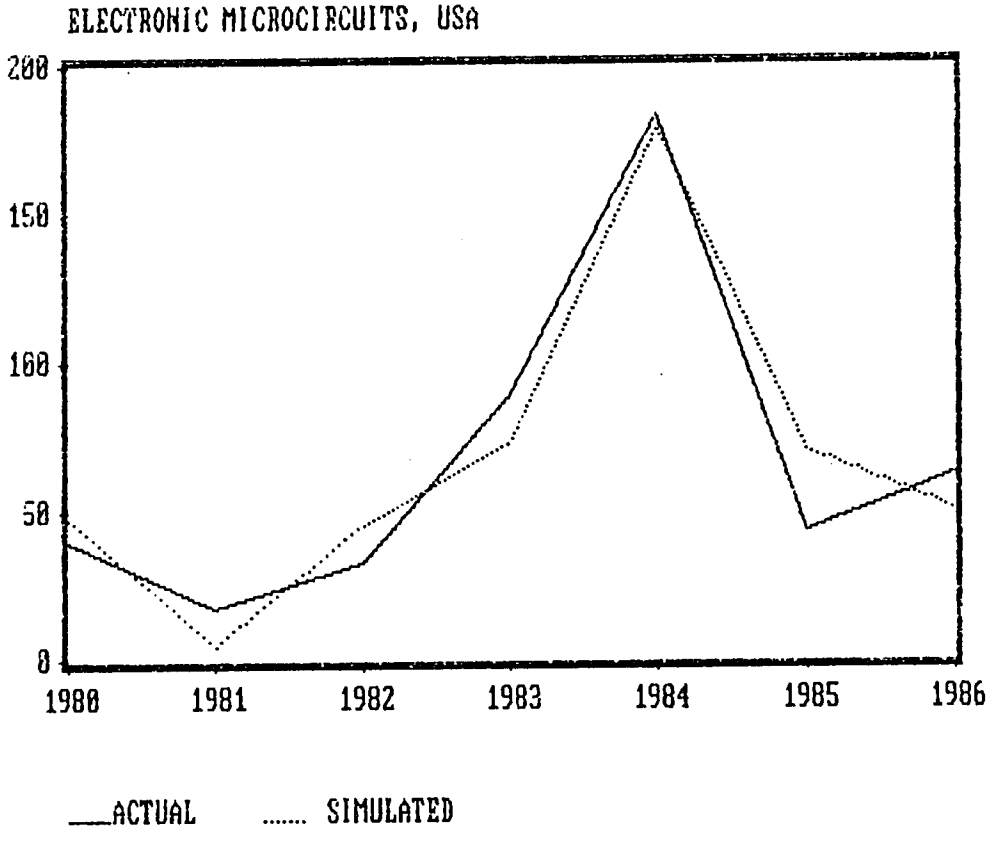
APPENDIX 2.1.1



APPENDIX 2.1.2



APPENDIX 2.2.1



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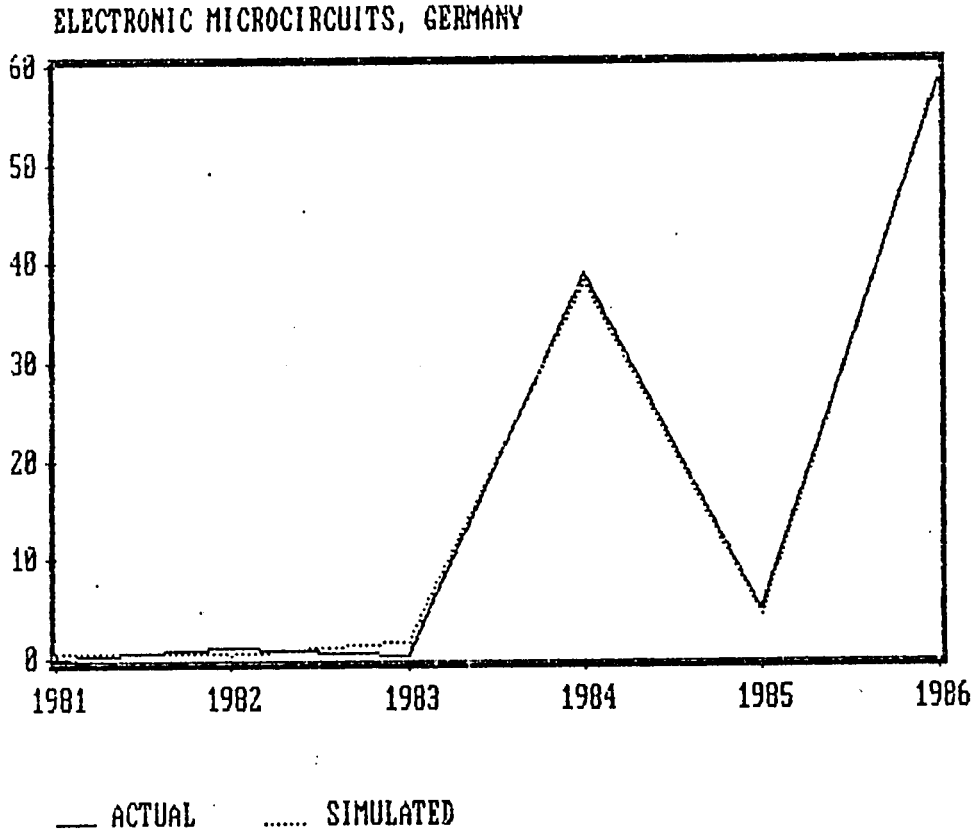
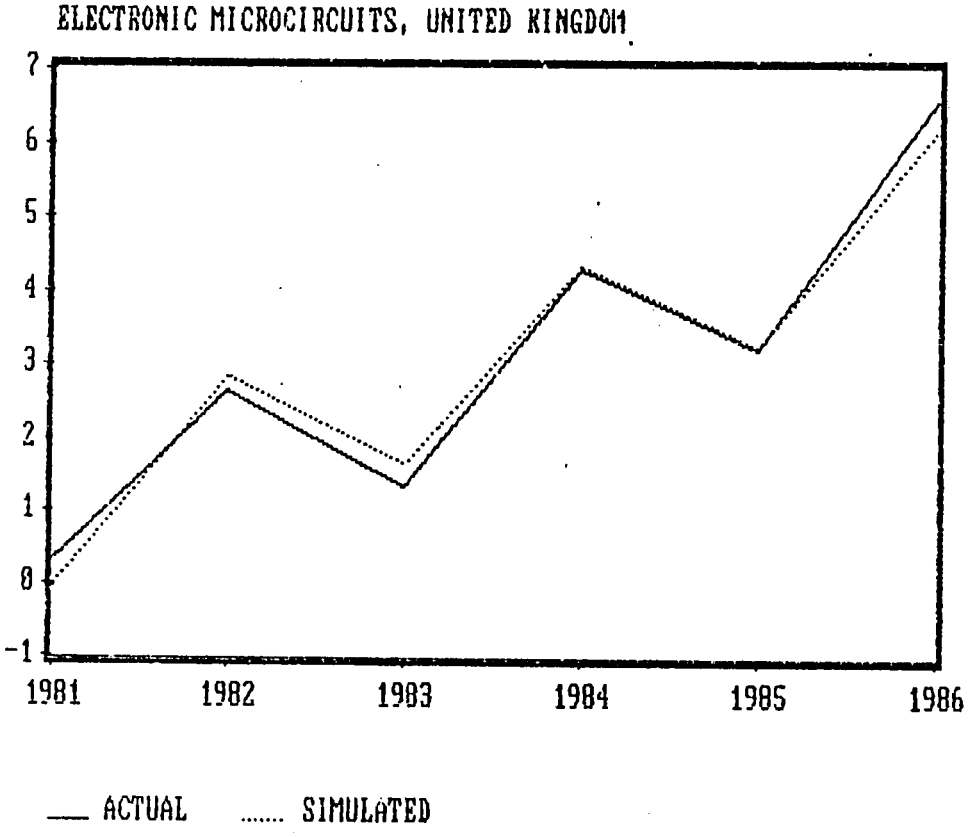
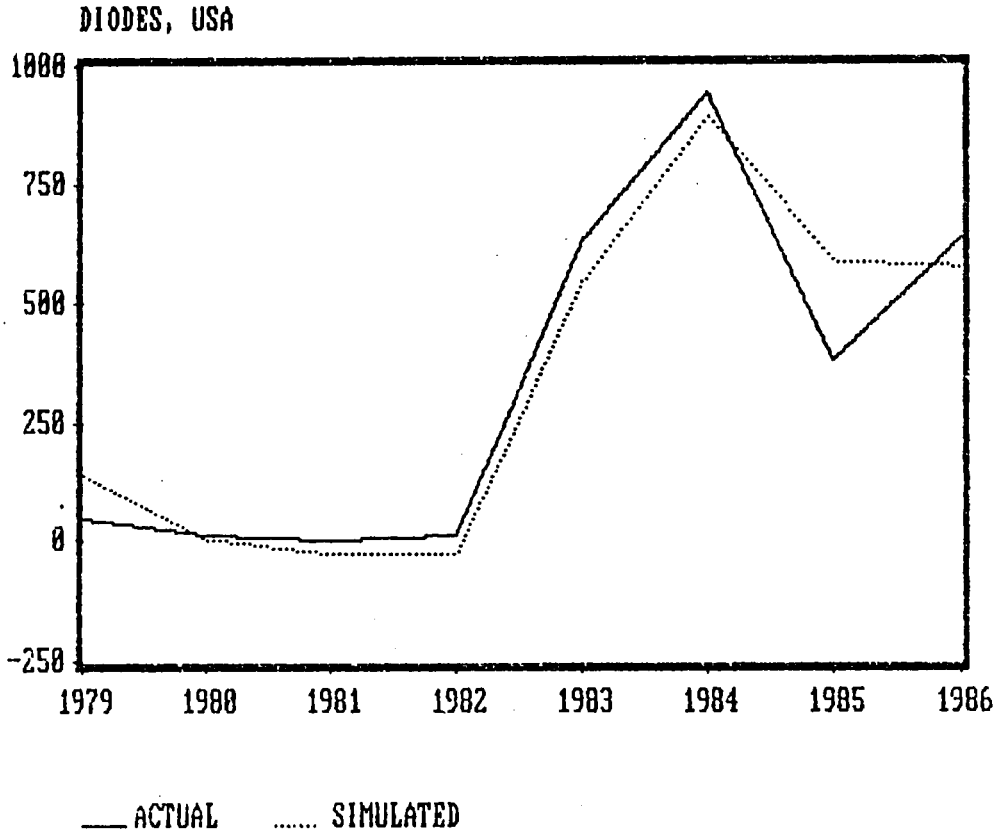


APPENDIX 2.2.3



APPENDIX 2.3.1



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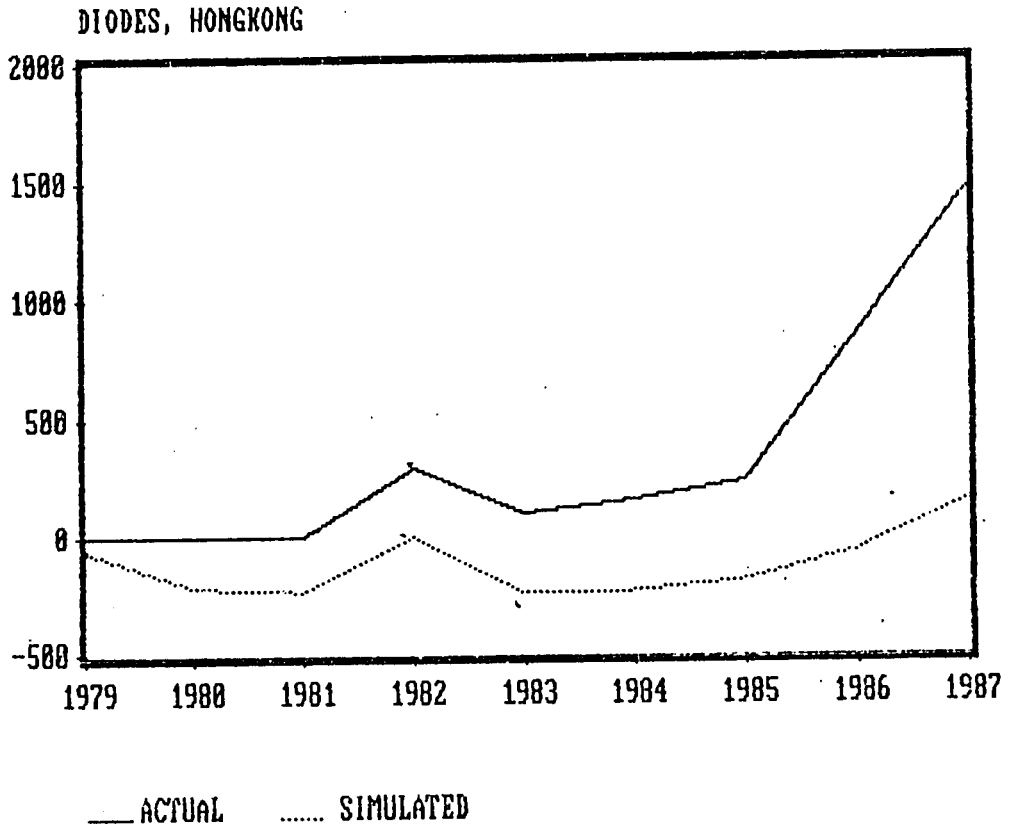
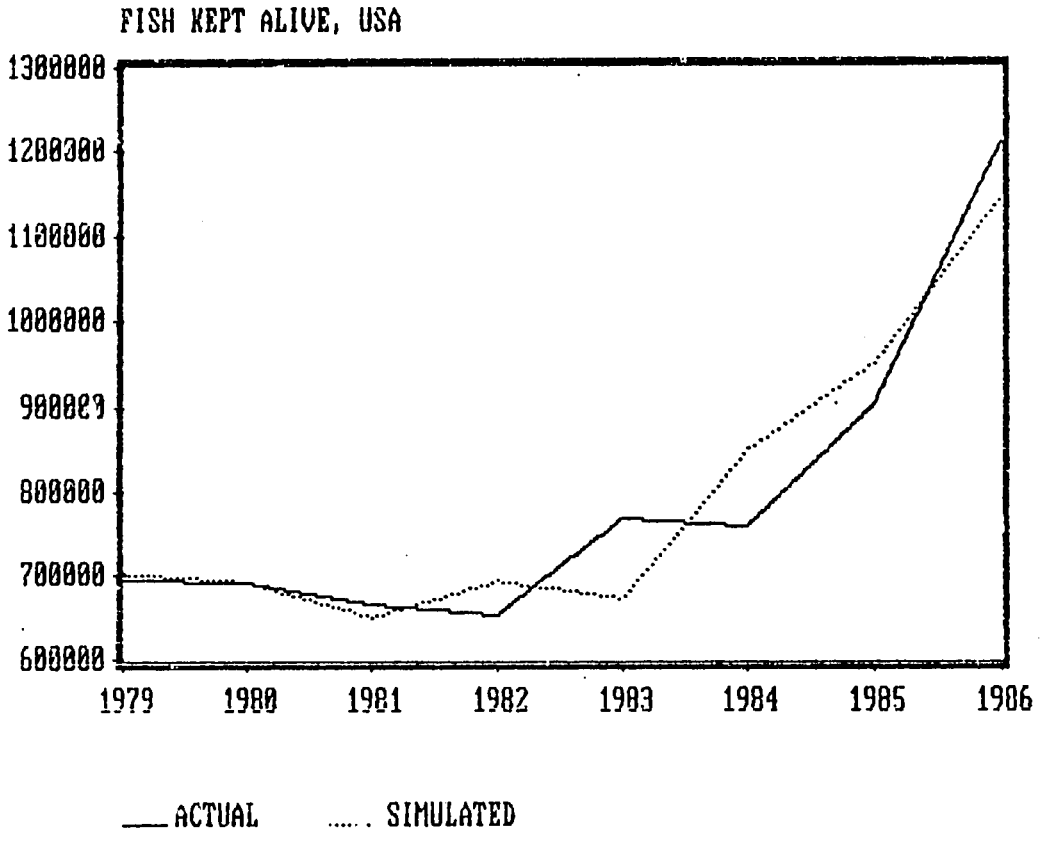


APPENDIX 2.4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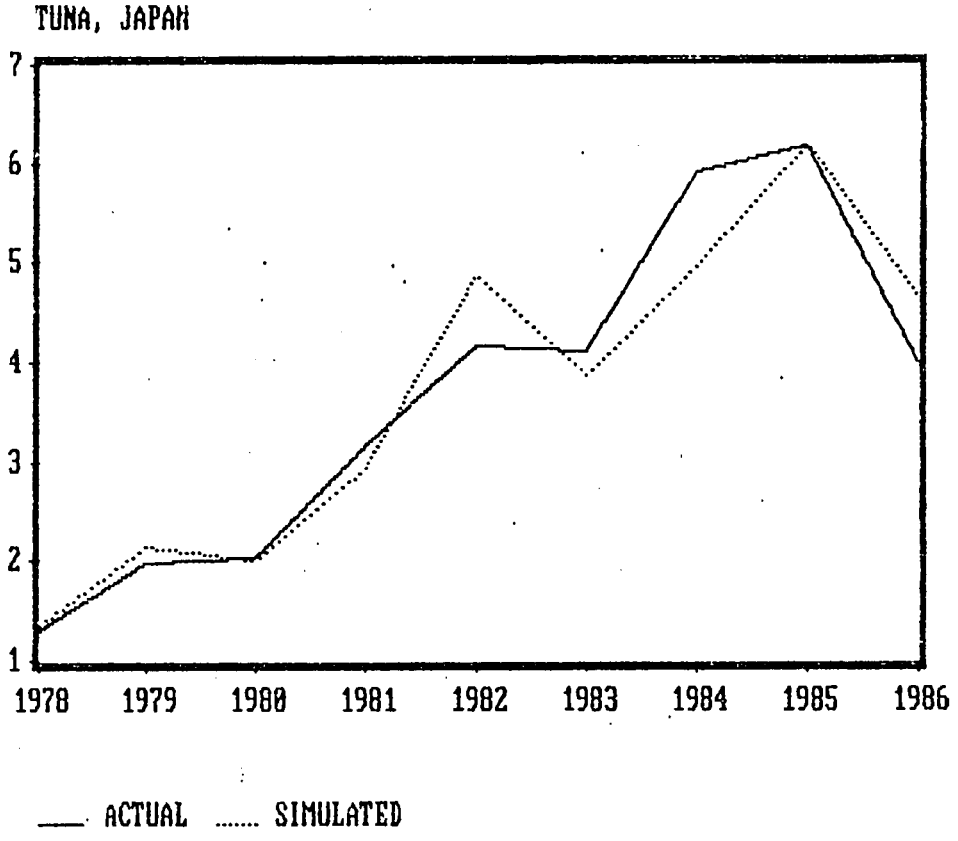
1985
1986
ACTUAL
SIMULATED

APPENDIX 2.5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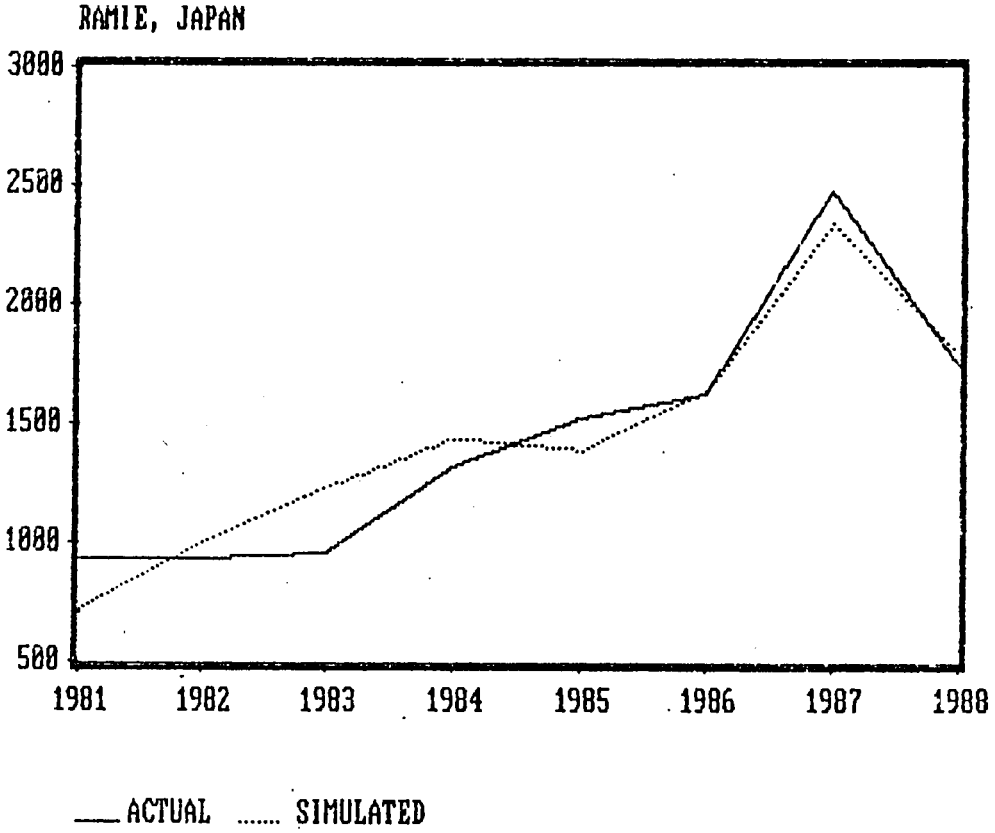
1984
1985
1986
ACTUAL
SIMULATED

APPENDIX 2.6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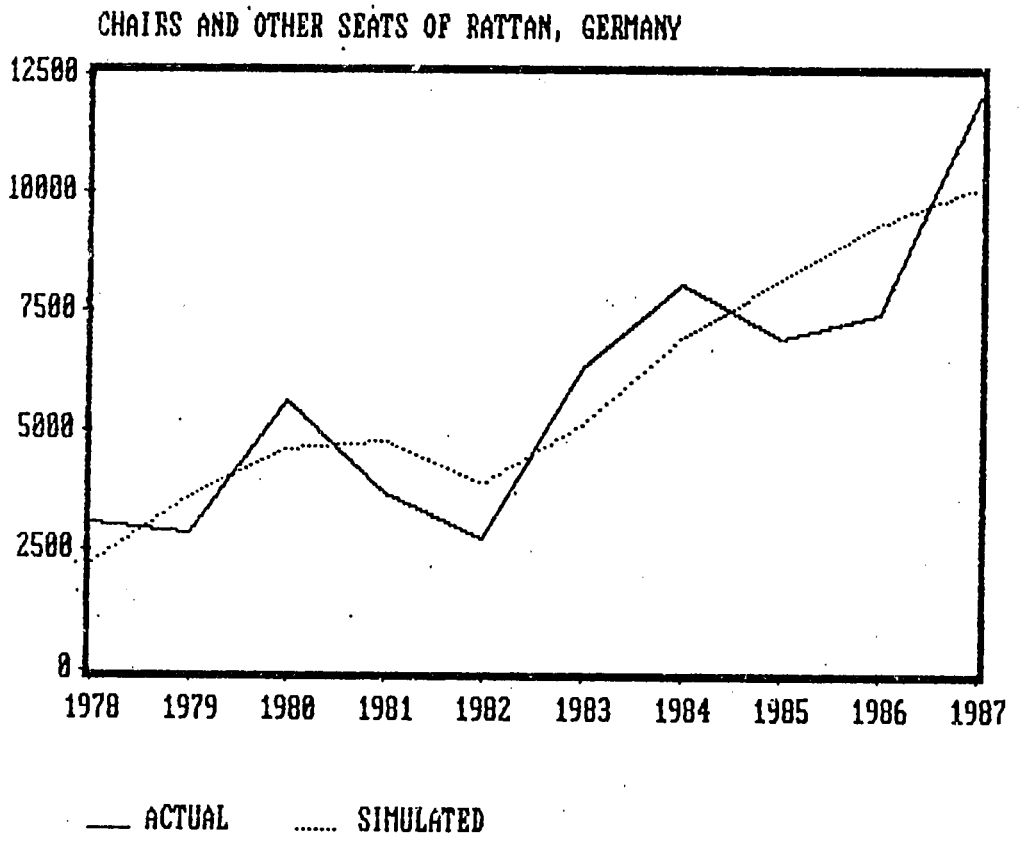
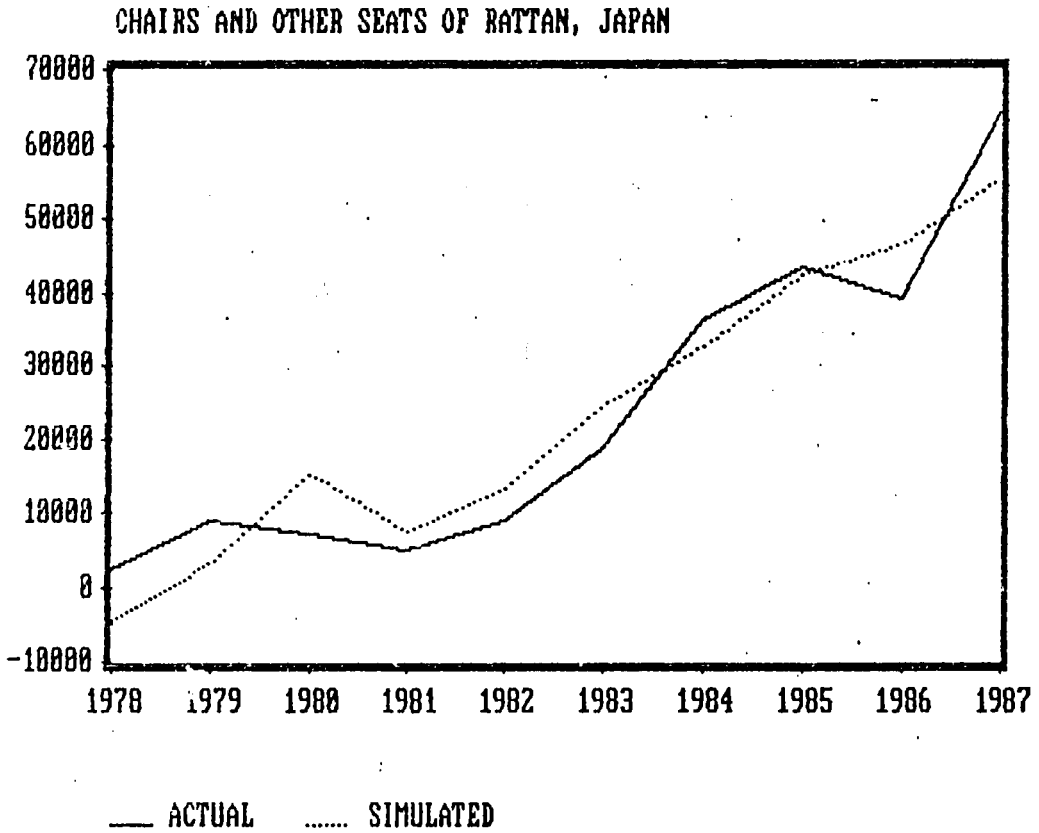
1988
ACTUAL
SIMULATED

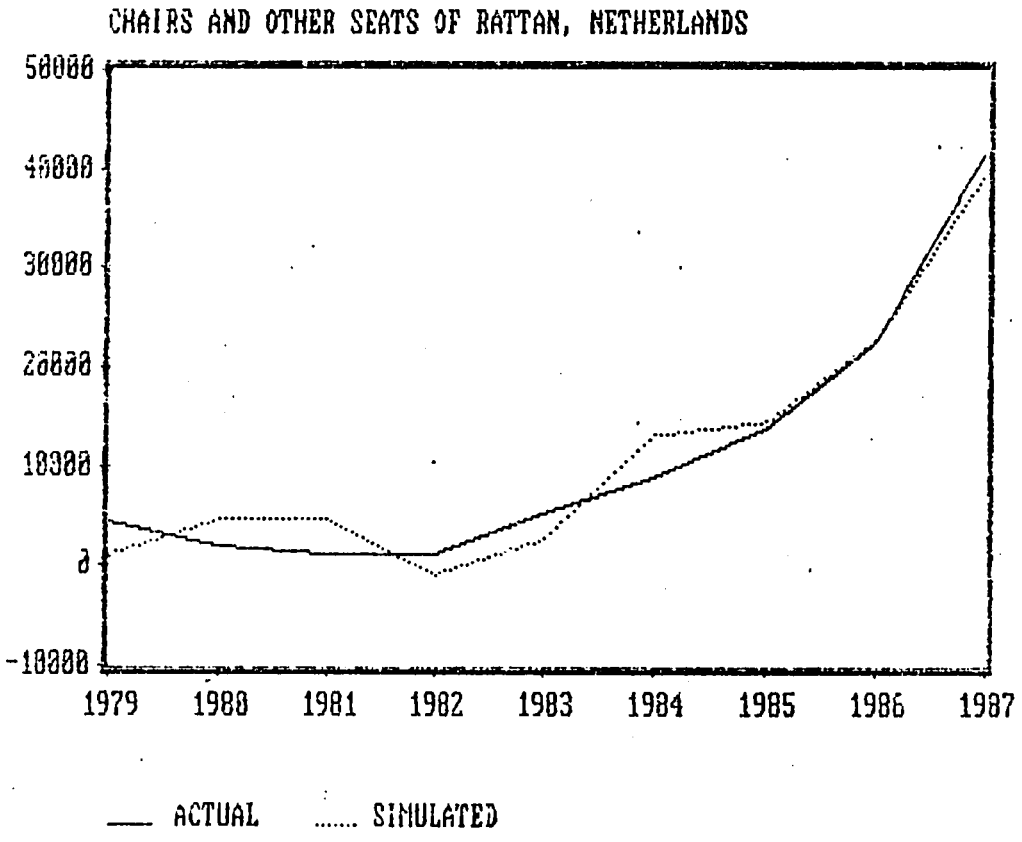
APPENDIX 2.7.1



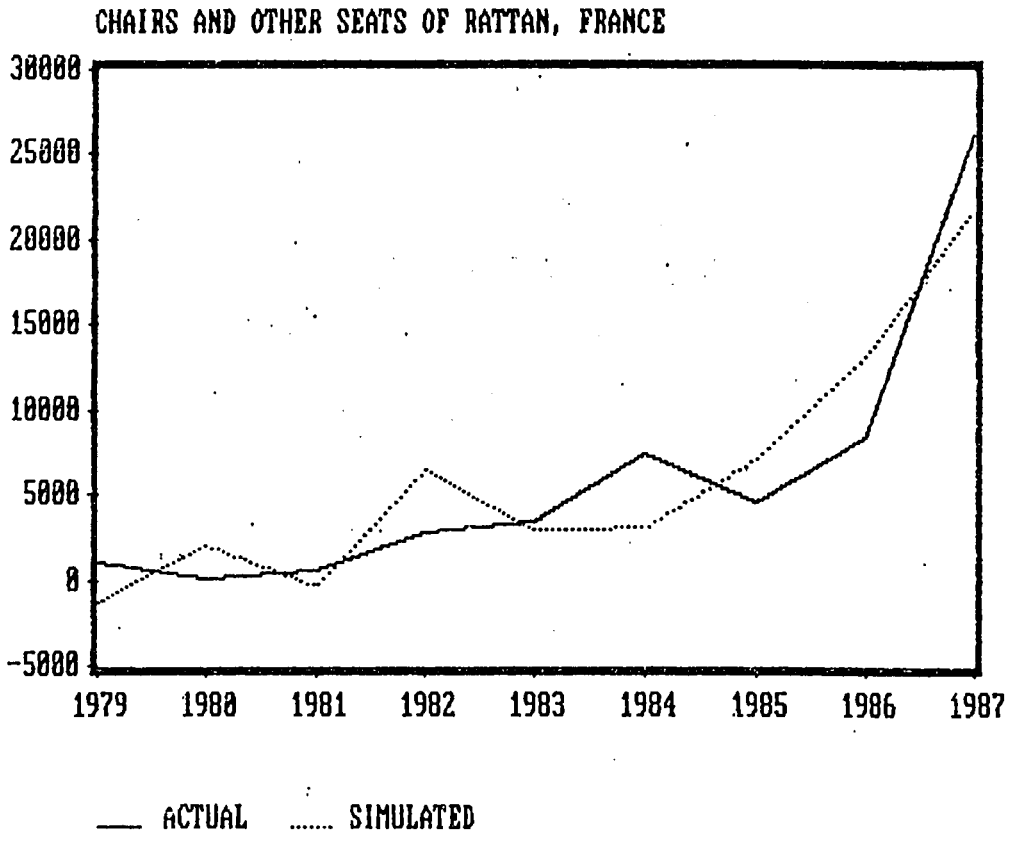
APPENDIX 2.7.2



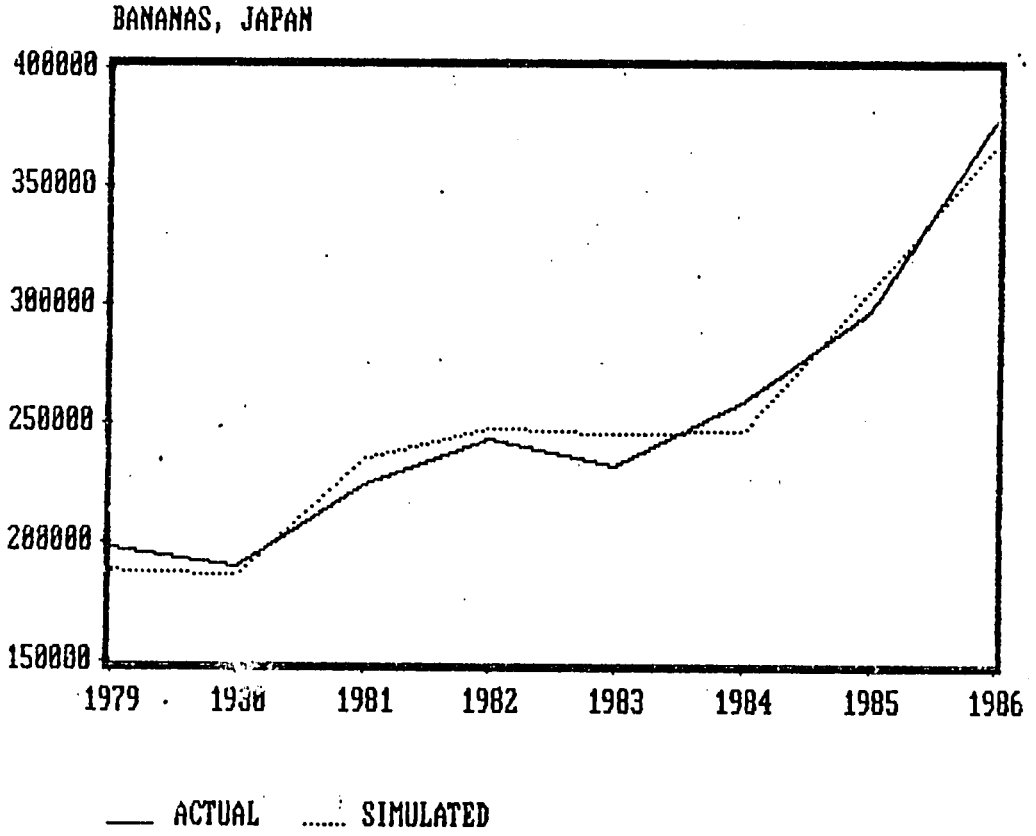
APPENDIX 2.7.3



APPENDIX 2.7.4



APPENDIX 2.8.1



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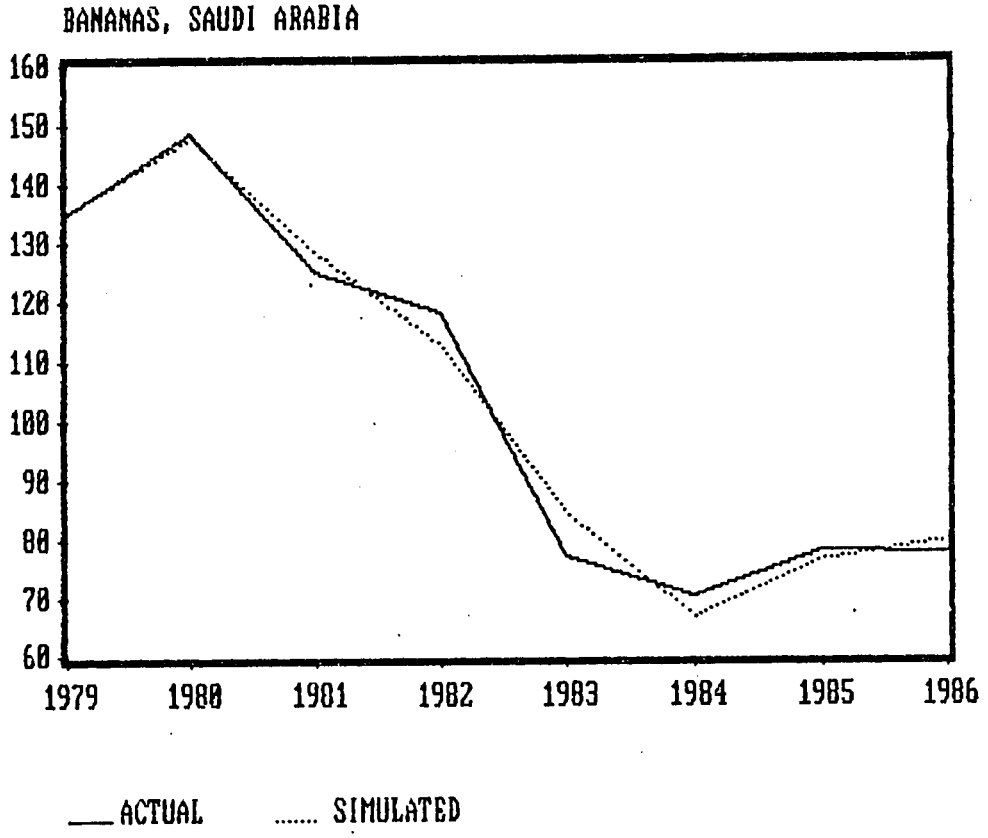
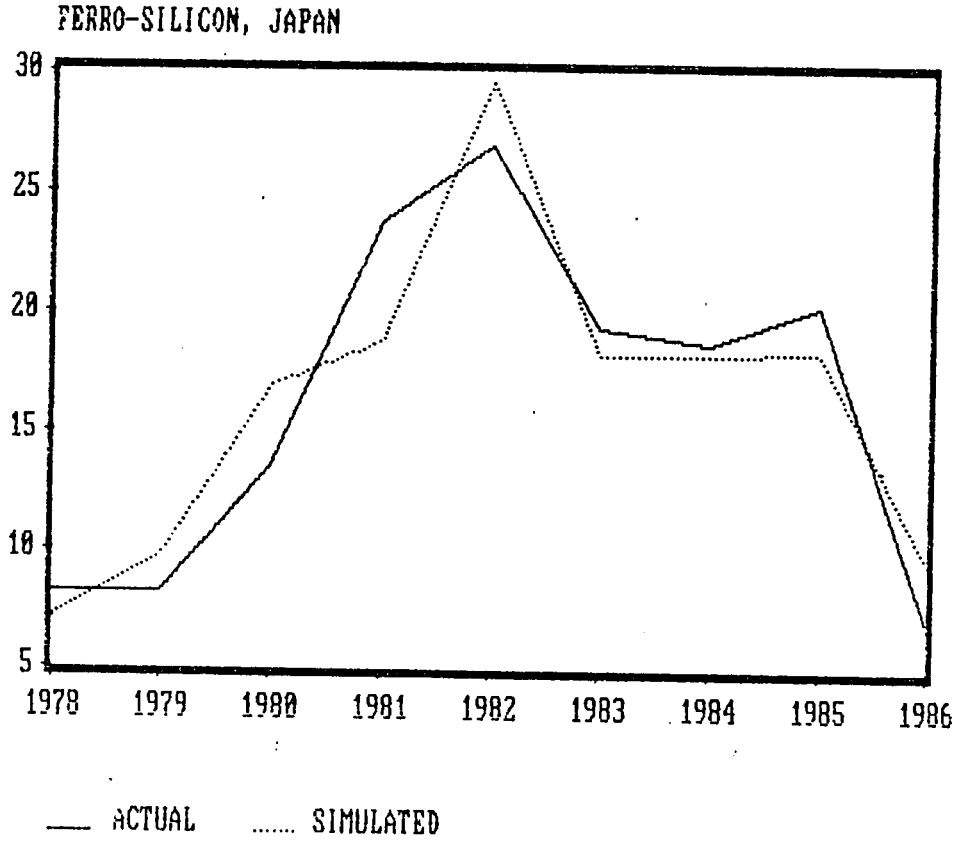


APPENDIX 2.9


FERRO-SILICON, JAPAN
30
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1982
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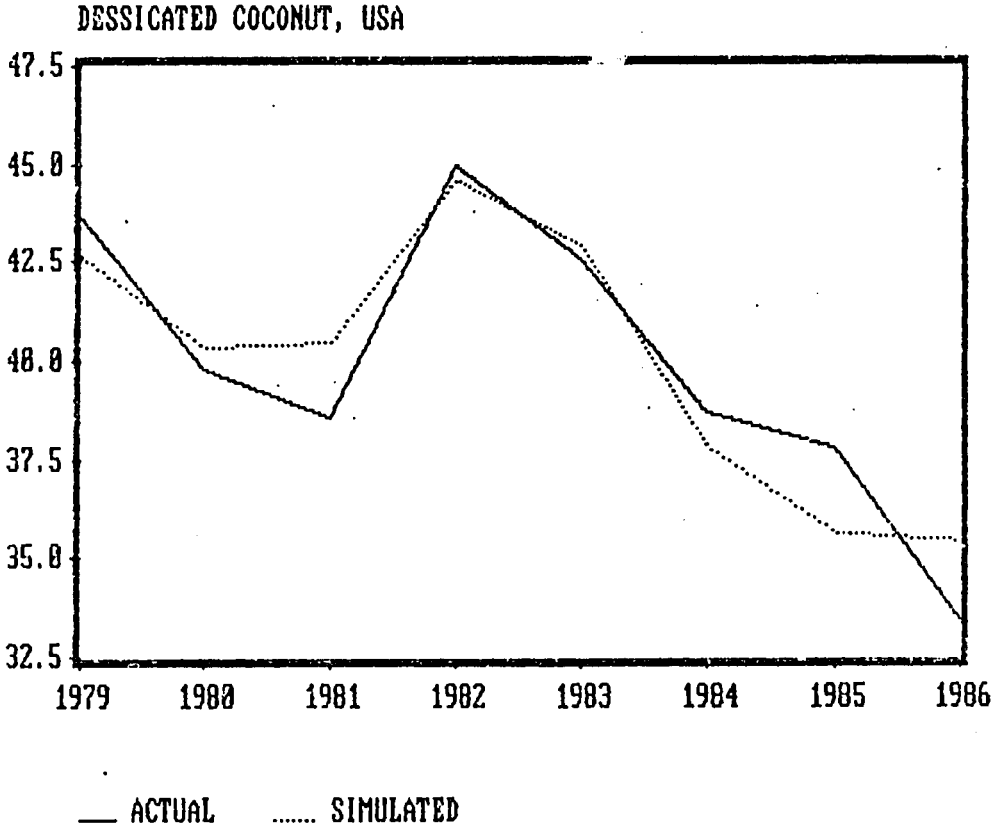
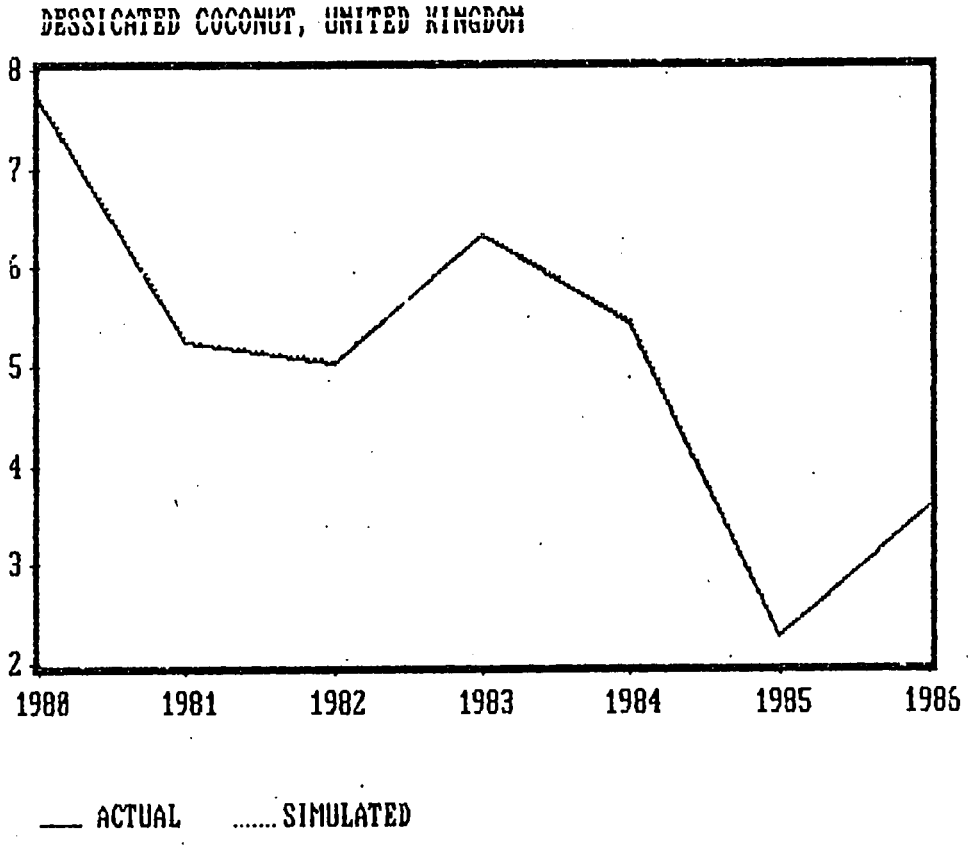
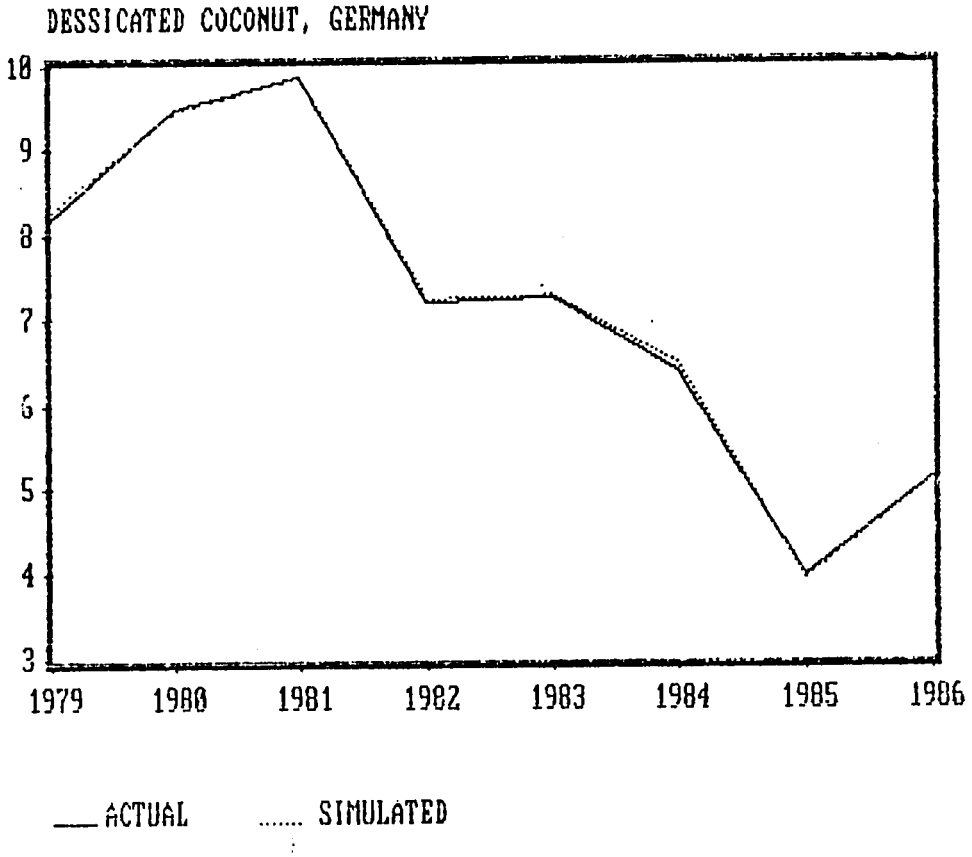
1986
ACTUAL
SIMULATED

APPENDIX 2.10.1



APPENDIX 2.10.2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