Policy, Planning, and Research

WORKING PAPERS

Macroeconomic Adjustment and Growth

Country Economics Department
The World Bank
November 1989
WPS 311

Macroeconomic Performance Before and After Disinflation in Israel

Leonardo Leiderman
and
Nissan Liviatan

Israel's successful 1985 stabilization program brought sharp, immediate disinflation, a private consumption boom, increased economic activity, relatively high real wages and interest rates, and a low (appreciated) exchange rate. Only in the fourth year did the boom stop and unemployment rise. What lessons from that experience can be applied elsewhere?

Policy, Planning, and Research

WORKING PAPERS

Macroeconomic Adjustment and Growth

The Israeli stabilization program of 1985 is generally considered one of the most successful such programs in years. Under it, the inflation rate plummeted from about 400 percent a year to about 15-20 percent a year.

Leiderman and Liviatan examined how stabilization affected other key economic variables after 1985. They were particularly struck by the immediate, abrupt reduction in the rate of inflation and the timing and impact of disinflation on other real variables.

For more than two years after the program, a private consumption boom was accompanied by increased economic activity, relatively high real wages and real interest rates, and a low (appreciated) real exchange rate.

Only in the beginning of the fourth year after the program did the consumption boom stop, economic activity become stagnant, and the rate of unemployment rise.

The consumption boom seems closely related to the possibility that the program and the fixed exchange rate policy partially lacked credibility. Apparently the public perceived the changes as mainly temporary.

The recent rise in unemployment seems largely to reflect the beginning of a process of *structural adjustment* whereby resources are reallocated across the economy to conform to the new low inflation equilibrium. This process may involve less growth in the transitional stage but will allow an increase in long-term growth after adjustment is completed.

What implications does the Israeli program — a laboratory experiment in heterodox policy — have for the debate about gradualism versus shock treatment in the process of stabilization?

In reducing inflation, the program seems to have had the same effectiveness as other shock treatment programs: there was a sharp and immediate disinflation. This was probably because multiple nominal targets (such as a fixed exchange rate and price-wage controls) were used in conjunction with adjustments in fundamentals, right from the start. This mix makes the program heterodox.

In terms of the real costs of disinflation, the program may seem more gradualist. The real costs, in terms of increased unemployment, were postponed for several years and in the transition there was actually a boom in economic activity.

Which of these results are peculiar to Israel and which are common to heterodox policies generally is a question worth addressing.

Method: Using simple times series techniques applied to monthly data for 1980-88, Leiderman and Liviatan investigated changes in the time series properties of key macroeconomic variables in 1985 and after. They focused especially on changes in the tradeoff between inflation and unemployment.

This paper is a product of the Macroeconomic Adjustment and Growth Division, Country Economics Department. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Raquel Luz, room N11-059, extension 61588 (56 pages with figures and tables).

TABLE OF CONTENTS

The authors would like to thank Elhanan Helpman, Miguel Kiguel, and participants at a World Bank seminar for their comments and suggestions. This paper is part of World Bank RPO 674-24.

I. INTRODUCTION

The Israeli stabilization program of 1985 is generally considered as one of the most successful programs of recent years, in that it rapidly disinflated the economy from inflation rates of about 400 percent per year to rates between 15-20 percent per year. While much attention has been devoted to the heterodox components of the program and their analytical foundations,[1] relatively little work has been done quantitatively comparing the structure and performance of the macroeconomy before and after the program. Yet, such a comparison can be regarded as a key ingredient in an overall evaluation of the pros and cons of programs such as that of Israel.

Accordingly, the main objective of this paper is to examine how macroeconomic performance has changed after the implementation of the stabilization program and to determine whether these changes conform with the predictions of standard macroeconomic models. We investigate, using simple time series techniques applied to monthly data for 1980-88, the changes that have taken place in the time series properties of key macroeconomic variables after the stabilization program of 1985. Special attention is given to changes in the tradeoff between inflation and unemployment which are apparent after the program.

The notion that a change in the policy regime should cause changes in the relationships among macroeconomic variables is quite familiar since Lucas' (1976) critique. We focus here on some of the empirical implications of this critique. Comparing policy regimes before and after 1985 suggests that the post-program regime is characterized by a tight fiscal policy, and by a

---

[1] See, e.g., Blejer and Liviatan (1987), Bruno (1986), Bruno and Piterman (1988), Fischer (1987), Helpman and Leiderman (1988), Kiguel and Liviatan (1988), and Liviatan (1989).

sharp decrease in the degree of exchange rate accommodation as reflected in the fixing of the exchange rate, which was viewed as the main anchor for the nominal system. For other nominal variables it is less clear whether and how their rules of behavior have changed after the program. Prices of controlled goods and services were periodically adjusted to changes in the rate of inflation. Monetary policy was mainly conducted so as to provide indirect support for the exchange rate anchor and it did not target directly monetary aggregates such as M_1 or M_2. Wage policy resulted in slow transition of COLA and of other institutional features of the wage setting process toward a low inflation position. The upshot of this discussion for the analysis that follows is that it seems plausible to hypothesize that the program brought a decrease in the degree of accommodation of nominal policy variables, effected mainly through a decrease in exchange rate accommodation.

Policy regime changes such as the above can be expected to have affected relations between key macro variables. First, less accommodative exchange rate and nominal policies can cause changes in the form of the tradeoff between inflation and unemployment. Second, these less accommodative policies are likely to result in changes in the persistence (or inertia) of inflation and other nominal variables. Third, to the extent that after the program there is a more dominant role of real shocks relative to nominal shocks, as it is likely to be the case given the less active role of nominal policy variables after the program, it is likely that there would be changes in the relations between variabilities of relative prices, relative wages, and relative outputs across sectors in the economy. Moreover, this enhanced importance of real vs. nominal shocks can, by itself, result in changes in the form of the inflation/unemployment tradeoff. Fourth, lack of credibility of

the new policies can result in high real wages, high real interest rates, and a consumption boom at the start of the stabilization program and thus importantly affect the transition of the economy to its new equilibrium. Identifying these types of changes in macroeconomic performance is the focal point of this research.

The paper is organized as follows. Section II briefly describes the main changes in the behavior of nominal policy variables brought about by the stabilization program. It also discusses the predictions of standard macro models for the likely impact of these changes on the economy. Section III provides evidence on macroeconomic performance in the Israeli economy before and after the disinflation program. We investigate and interpret the time series behavior of key macro variables and characterize their changes in terms of means, standard deviations, correlations, responses to shocks, and degree of persistence. We also examine changes in the co-movements of cross sectional variabilities of relative prices, wages, and outputs. Changes in the tradeoff between inflation and unemployment (Phillips curve) are discussed and analyzed in section IV. Section V concludes the paper.

II. THE CHANGE IN REGIME: FACTS AND MODELS

We begin this section by describing briefly the main nominal policy rule changes brought about by the 1985 program. Later on, we turn to a discussion of standard macroeconomic models in order to get analytical guidance as to what to expect when comparing the Israeli economy before and after the program.

A. Some Facts

Since the Israeli program has been described in detail elsewhere (see Fn.1 on page 1), we focus here briefly on its main aspects that are relevant for analysis of the effects of changes in the rules governing the evolution of nominal policy variables. Comparing the policy regimes before and after the program suggests that there were at least five main changes brought about by the disinflation program. First, there was a fiscal contraction as the public sector sharply reduced its fiscal deficit by about 9 % of GNP. About half of this reduction was effected by a decrease in public sector consumption and the remaining half by increasing taxes.

Second, the government adopted a fixed exchange rate regime.[2] Fixing the exchange rate was conceived as a key element in anchoring the nominal system at a low inflation equilibrium. The Israeli Shekel was initially pegged to the U.S. dollar, but later on (August 1986) the pegging was done relative to a basket of foreign currencies.[3] Thus, the authorities abandoned the previous policy of using devaluations in a one-sided manner to affect real wages and external balance, and adopted the view that further changes in exchange rate policy would have to reflect cooperative agreements between government, labor, and employers. It is in this spirit that the devaluations of January 1987 and of December/January 1988/89 have to be interpreted. Since the fixed exchange rate policy, coupled with other internal and external developments, resulted in marked real appreciation trends of real exchange rates, it was changed early in 1989 toward more flexibility. That is, the

---

[2] The shekel was devalued by 10% in January 1987 and by 13% in January 1989. Since the latter date the exchange rate is targeted within a band of ±3%.

[3] This was facilitated by a 1.5 billion US$ grant from the U.S. government

exchange rate is being targeted now within a relatively fixed band rather than at a specific fixed rate.

Third, there have been changes in wage policy toward disinflation. It appears that after the program there was an increase in the importance and length of nominal contracts and an increase in the fraction of wage changes that are due to agreements at the company or plant level as opposed to centralized collective agreements.[4] Of special interest in this context is the evolution of the cost of living agreement (COLA). COLA's structure has been gradually changed so that the trigger level of inflation (for actual payment of indexation) has been raised and the frequency of COLA payments has been reduced. The agreement reached in February 1989 stipulates wage indexation payments once every six months (and not every three months as before), at a rate of 85 percent of the excess of the inflation rate beyond 3 percent during these six months. Though these changes represent important adjustments in the transition to a low inflation economy, one can certainly question why progress in this direction has been relatively slow in the face of the fast disinflation that took place and whether the present agreement is indeed appropriate under the current rates of inflation of less than 20% per year. The slow adjustment of COLA's structure may well reflect partial lack of credibility of the stabilization program.

Fourth, there was a shift to a tight monetary policy. Immediately after the program the monetary authority targeted commercial bank credit to the pri-vate sector, which was considered as an additional nominal anchor. Later on, there was a shift toward targeting real M3 with a view toward the economy's international reserves' position. In addition, real interest rates

---

[4] For a detailed discussion, see Artstein and Sussman (1988).

were kept high to affect the current account and the state of aggregate demand. Obviously, some of the observed increases in M1 and other shekel-denominated assets capture the effects of disinflation on the composition of private portfolios. Fifth, in Israel government directly determines prices of goods and services whose weight in the consumer price index is of about 20-30 percent; e.g., prices of public transportation, gasoline, and basic foodstuff. Given the sizable weight of these controlled prices, and their importance in government (subsidies) budget, the stabilization program stipulated a government policy of changing them at a rate compatible with the attempted low inflation.

Overall, the policy regime after the program features a decrease in the degree of exchange rate accommodation. This decrease was supported by a tight fiscal policy. Whether and how the degree of accommodation of other nominal policy variables changed after the program remains as an open question.

B. Models

What are the possible implications of these facts for macroeconomic performance? Here we attempt to answer this question in the light of two classes of standard macro models: contracting models and imperfect information models.[5]

i. Contracting Models

Models of the Fischer (1977)-Taylor (1979) variety emphasize the role of contractual rigidities in generating real costs of disinflation. In

[5] We do not examine here the more recent real business cycle approach because its implications for short run impacts of stabilization policies remain yet to be analyzed.

particular, the models posit a nonstate contingent structure of overlapping multi-period wage contracts. As a result, ending inflation is generally costly (in terms of unemployment) because firms and workers are locked into long term nominal contracts that were negotiated on the basis of price and wage expectations formed in the past.[6] A tradeoff between the variance of inflation and the variance of output arises from these frameworks. In these models, the degree of accommodation of nominal policy variables plays a key role in determining the shape of this tradeoff between output and inflation variabilities. For example, high monetary accommodation to nominal wage shocks generally results in higher output stability but at the cost of generating higher price instability.

To sharpen the discussion, consider the impacts of a decrease in the degree of nominal exchange rate accommodation in the context of Dornbusch's (1982) open economy analysis of contracting models. The exchange rate is postulated to affect both demand and supply sides of the macroeconomy, and some of the results are ambiguous depending on the relative strength of these two effects. The analysis indicates that a decrease in exchange rate accommodation lowers the variability of prices and has ambiguous effects on the variability of output. The latter is decreased when the cost channel of exchange rates dominates, but it is increased if the aggregate demand role of the real exchange rate dominates. To the extent that the move toward lower exchange rate accommodation is accompanied by decreased monetary accommodation, there is a further decrease in price variability and a

---

[6] This class of models implies that there can be a costless disinflation only if there is a gradual tightening of fiscal and monetary policies with a timing that pays attention to the persistence in nominal wages that was built in by old wage contracts.

dampening or even offset of the effects on output variability that arise from the supply side effects of the exchange rate. Numerical examples provided by Dornbusch (1982) indicate that starting with high degrees of exchange rate and monetary accommodation, a decrease in the former accompanied by no major change in the latter leads to a marked reduction in price variability with only a minor change in output variability. The model has also implications for persistence[7] and for the impact of unanticipated disturbances on output. Specifically, when the aggregate demand effect dominates, a decrease in monetary or exchange rate accommodation lowers the persistence of wages and prices through time and raises the impact of unanticipated disturbances on output. This discussion of persistence has to be qualified, however, in that it assumes no change in the frequency of wage and exchange rate adjustments. To the extent that a disinflation program results in less frequent exchange rate and wage adjustments, it can contribute toward higher and not lower persistence of nominal disturbances. Thus, a more complete analysis would indicate ambiguous effects of exchange rate accommodation on persistence. Taking into account changes in the frequency of exchange rate and wage adjustments following disinflation would strengthen the above described rise in the impact of unanticipated disturbances on output in response to a decrease in exchange rate accommodation.

ii. Imperfect Information Models.

These models posit that agents' imperfect information about current and future real and nominal shocks is the main factor explaining observed Phillips curves. Movements in output and other real variables can result from

---

[7] In this model persistence is defined as the first order autoregressive coefficient of a given dynamic variable.

changes in nominal variables only to the extent that the latter are not fully known with certainty. In Lucas' (1973) setup, producers cannot fully determine the extent of relative price change from current information about their own nominal price. Under these conditions, the slope of the aggregate supply schedule (inverse Phillips curve) depends on the relative importance of real (relative) vs. nominal (aggregate) shocks. The higher the importance of real (relative) shocks, the flatter becomes the aggregate supply schedule in the [price, output] plane, and the stronger is probably the tradeoff between inflation and unemployment.

To the extent that following a disinflation program there is a diminished role of nominal shocks, and other things equal, it can result in a more pronounced observed tradeoff between inflation and unemployment. While there are some methods for measuring the relative importance of real vs. nominal shocks, additional information on this issue can be obtained by examining the comovements between the variabilities of prices and outputs across sectors in the economy. As shown by Cukierman (1983), imperfect information models imply (under some restrictive assumptions regarding parameter values) that when nominal aggregate shocks dominate, these variabilities can be expected to move in opposite directions. That is, an increase in the variance of nominal aggregative shocks reduces demand and supply relative price elasticities in each market and thus results in higher relative price dispersion but lower output variability across sectors. However, cross sectional output and price variabilities would move in the same direction in the presence of dominant real shocks. Thus, under the maintained hypothesis of these models it may be expected that while before a major disinflation program these output and price variabilities moved in opposite

directions, they moved in unison after disinflation.

III. TIME SERIES EVIDENCE AND COMPARISONS

In this section, we present time series evidence on changes in the relations between key macro variables that occurred after the program. We assemble and interpret the evidence in the light of the models discussed in the previous section. We start by looking at summary statistics such as means and standard deviations -- the latter taken here as a measure of the degree of variability of different variables -- as well as by examining changes in contemporaneous cross correlations. Then, we investigate how the dynamics of selected variables changed after the program by studying their responses to shocks. We first consider responses to own shocks and later on responses to shocks in other variables. Then, we turn to evidence on the cross sectional variabilities of output growth, real wage growth, and relative prices which provide indication as to whether there has been a change in the type of shocks that are dominant. Last, we investigate whether the persistence of economic fluctuations changed after the program. We conclude the section by summarizing the key findings and by discussing the extent to which they conform with the models.

A. Summary Statistics

Our discussion in this subsection is mainly based on Table 1 and Figures 1 to 4.

i. Means

The first two columns of panel 1a in Table 1 report monthly means for a set of macroeconomic variables before (i.e., 1980:2-1985:6) and after (i.e., 1986:1-1988:12) the disinflation program of 1985. It can be seen that before

the program prices, money, wages, and nominal exchange rates were increasing at a rate of about 9 percent per month. The stabilization program resulted in a remarkable reduction in the rate of inflation to a rate of about 1.3 percent per month. Growth rates for other nominal variables changed in different patterns. Some variables feature a lower rate of growth than the rate of inflation in the post stabilization period, but others increased at much higher rates than inflation. Specifically, while exchange rates for the dollar and the basket of foreign currencies depreciated at a lower rate than inflation, there were relatively high rates of growth of nominal wages, M1, and credit in the later period. Overall, and as transparent from Figures 1 and 2, there have been two patterns. Some nominal variables have shown movements that have been aligned well in the later period with those in the rate of inflation; see Figure 1 for evidence on the growth rates of the nominal exchange rate, controlled prices, and M3 money. However, there has been some nonsynchronization after the program between the growth rates in wages, M1 money, and credit and the rate of inflation; see Figure 2.

Turning to real variables, there has been a slowdown in the rate of growth of industrial production[8] and of employment after the disinflation, from monthly growth rates of .73 and .20 percent respectively before the program to rates of .51 and .16 after the program. These, however, have not been major changes; see Figure 3. Quantitatively more important changes show up for the rate of unemployment, which increased from 5.13 percent to 6.58 percent, and in private consumption purchases, which have increased at a more rapid rate in the later period; see Figure 4. Though the rate of unemployment

---

[8] Domestic gross investment increased significantly in 1986 but its rate of growth fell.

increased immediately after the implementation of the program, this increase partly represents a continuation of existing trends from before the program. In addition, from the first quarter of 1986 on there was a downward trend in unemployment -- a trend that was reversed in 1988 and early 1989 and has resulted in a rate of unemployment of about 8 percent.

It is straightforward to translate the evidence in the first panel of Table 1 into evidence regarding relative price type variables. Some of these calculations are reported in the third panel of the table. Two key features of the data are the almost tripling in the rate of growth of the real wage in the later period and the real appreciation of the Israeli shekel, as inflation exceeded the rate of devaluation during that period. Despite the sharp increase in the real interest rate at the start of the program, the real interest rate for the 1985-88 period is only slightly higher (on average) than in the previous period. However, since it is likely that there has been a fall in the risk premium component of the interest rate, associated with a decrease in inflation uncertainty, the "net" real interest rate may well be much higher after the program than before it.

The evidence on the monthly trade deficit indicates that, despite some reduction immediately after the program, in dollar terms the deficit has remained quite unchanged after the program at a level of about $240 million; see Figure 3. However, the deficit was somewhat reduced in real terms and relative to GDP.

ii. Standard Deviations

The middle two columns of Table 1, panel 1a, can be used to analyze changes in the variability of these variables, measured by their standard deviations. For most nominal variables, there has been a decrease in their

standard deviations, along with the above discussed decrease in mean rates of growth. In particular, the standard deviations of inflation and most other nominal variables after the program are at levels of about 20-30 percent their previous levels; a similar pattern holds generally for coefficients of variation also reported in Table 1.[9]

In contrast to this general pattern, there has been a relatively minor change in the variability of the rates of growth of nominal wages and of M1 after the program. Thus, for these variables the observed decreases in their mean rates of growth were not accompanied by a decline in their standard deviations -- a somewhat puzzling finding. We have checked changes in the standard deviations of these two variables for each one of the three years from 1986 to 1988. It appears that the standard deviations of the rate of growth of nominal wages and of M1 have remained high for each one of these years. Specifically, the standard deviation of movements in wage growth were 8.05, 5.99, and 5.63 in 1986, 1987, and 1988 respectively, and those for M1 growth were 7.52, 8.15, and 8.56 respectively. This evidence indicates that the relatively high variabilities of these variables during 1986-88 are not the result of particularly high variability in a given year. Not only that changes in the mean growth rates of wages and M1 have not been synchronized with the rate of inflation, but nonsynchronization has also been present when comparing changes in the standard deviations of inflation and of these two variables; see again Figure 2 for general evidence on such nonsynchronization. Among the possible reasons for these phenomena we can mention the following: (i) the adjustment of M1 may well be the net result of gradual

---

[9] Notice that coefficients of variation would not be well defined measures of variability for variables whose means are close to zero.

and time varying shifts in agents' portfolios toward shekel denominated assets; (ii) the adjustment of wages may reflect increased staggering and sectorial variability as well as interference of economy-wide wage norms with sectorial adjustments toward equilibrium; see Artstein and Sussman (1988).

The volatilities of real variables have changed less markedly, if at all, after the program than those of the nominal variables. The standard deviations of the rate of growth of industrial production and of the rate of unemployment increased in the later period. On the other hand, the standard deviations of the rates of growth of employment and of consumption decreased in the later period. The variability of the trade deficit has not changed much after the program. For relative-price type variables there is generally some decrease in their variability after the program.

These findings suggest that generally there has been a decrease in the relative variability of nominal vs. real quantity variables in the post stabilization period. This conclusion would not be incompatible with characterizing the later period as one in which there has been an increase in the quantitative importance of real shocks as compared to that of nominal shocks. In addition, the notion that when inflation is sharply reduced this induces less variability, both over time and across sectors, in relative-price variables is supported by the data.

iii. Cross Correlations

Cross correlations between monthly movements in inflation and in other key nominal variables are reported in panel 1b of Table 1 for the periods before and after the disinflation program. Before the 1985 stabilization program, there were relatively large correlations between inflation, rates of growth of monetary aggregates (M1, M3, and credit), the

nominal interest rate and the rate of change of the exchange rate. These monthly cross correlations generally reached values in the [.65, .80] range. The period after 1985 features a marked reduction in these correlations. In fact, some of them became negative, such as the correlations between inflation and monetary aggregates. This may well capture a shift toward a less indexed nominal side of the economy and toward smaller accommodation after the program.

The evidence supports the notion that before the plan there was a strong and close association between monthly movements in key nominal variables. This has changed after the implementation of the plan, in that there are now much weaker links within the nominal side of the system.

Cross correlations between monthly movements in inflation and selected real variables are reported in panel 1c of Table 1. Not surprisingly, the correlations between monthly movements in inflation and in real variables are much smaller than those reported in part 1b of the Table. Upon comparing correlations before and after the program, notice that while before mid-1985 there was a positive link between inflation and the rate of unemployment, the relation between these variables becomes negative in the later period. Thus, the statistical (monthly) Phillips curve appears to have changed as a result of the program.

Considering jointly the evidence in panels 1b and 1c of Table 1 reveals that the signs and sizes of cross correlations between monthly movements in inflation and in other macroeconomic variables have generally changed after the disinflation plan. These changes are more pronounced for the nominal variables than for the real variables -- a pattern that held also generally for comparisons involving means and standard deviations.

B. Responses to Shocks

Having discussed the evidence on some summary statistics, we turn now to an examination of whether and how the dynamics of key macroeconomic time series have changed after the implementation of the disinflation program. To achieve this goal, bivariate autoregressions are estimated and transformed into moving average form (or impulse response functions) in which the impact of shocks can be measured. The estimated equations are of the form

$$(1) \qquad x_t = \sum_{i=1}^{4} A_i x_{t-i} + e_t \ ,$$

where $x_t = (\pi_t, y_t)'$, with π denoting the rate of inflation and y denoting any other variable entering the autoregression (e.g., y may denote the rate of growth of money). The moving average for this system is given by

$$(2) \qquad x_t = \sum_{i=0}^{\infty} B_i e_{t-i} \ ,$$

where the B_i matrices can be obtained from the A_i matrices; see Sims (1980). For our purposes, it is convenient to orthogonalize the covariance matrix of the e's thus yielding the representation

$$(3) \qquad x_t = \sum_{i=0}^{\infty} C_i e^*_{t-i} \ ,$$

where e^* denotes the orthogonalized disturbances.

Bivariate autoregressions such as in equation (1) were estimated for the rate of inflation and another variable selected those appearing in Table 1. Each such run was implemented on monthly data twice: for the 80:6-85:6 period, i.e. before the disinflation program, and for the 85:12-88:12 period. Before we discuss changes in the impacts of shocks, it is well to turn to Table 2 which reports evidence on the size of the shocks in both time periods. The shocks in the system are measured by the estimated disturbances in the econometric equations; thus, wage shocks are the disturbances to the bivariate regression of the rate of change of wages on four own lagged values, four lagged values of the rate of inflation, and a constant. For inflation shocks, we used the disturbances from the autoregression including lagged inflation and wage growth as explanatory variables. The size of the shocks is measured by the standard error of the estimated disturbances.

The evidence reported in Table 2 is quite consistent with that reported in Table 1. That is, the size of most nominal shocks has generally decreased by a large extent. Standard deviations of nominal shocks in the post 1985 period are at about 25-35 percent of their levels before the program. The exceptions are shocks to nominal wage growth and to M1 growth, which had in the later period standard deviations of the same order of magnitude as in the first period. For real variables, the picture is somewhat different in that for most shock-type quantity variables there have been only relatively minor changes in standard deviations. Thus, this evidence tends to support the notion that real shocks have become more important relative to nominal shocks in the period after the 1985 stabilization program.

To examine the nature of the changes in the dynamic responses to shocks we use Figures 5 to 8 and begin by looking at the responses of each variable of interest to its own shocks. The first chart in Figure 5 depicts the response of inflation through time to a unit shock (i.e., one standard deviation) in the rate of inflation in period 1 as calculated for the periods before and after the disinflation program. The Figure also reports responses of wage growth and of M1 growth to respective own unit shocks. Two main features are salient in Figure 5. First, there is generally less own-persistence in the impact of the shocks in the first 2-3 periods. For example, against the same unit shock to the inflation rate there is a smaller rate of inflation by period 4 after the program than before. Second, there has been an increase in the variability of the responses through time after the program. There is now more pronounced cyclicality in the process of convergence following the shocks.

Figure 6 presents evidence on responses to own shocks for variables that have been subject to greater control by policymakers than those in the previous figure. These are the rate of change of the exchange rate (basket), the rate of change of controlled prices, and the rate of change of credit. It is seen that for each one of these variables responses to own shocks show less persistence after the program, especially in the first few periods immediately after the shocks and there is a somewhat faster convergence back to the steady state or control values of zero. This seems to be consistent with stronger attempts by policy makers to bring these nominal variables back to their pre-shock levels more rapidly than in the period before the program.

Responses of real variables to unit shocks in their values are presented in Figure 7. Shocks to the rate of growth of employment and to the

rate of unemployment seem to have slightly larger persistence in the first periods after the shocks. Altogether, however, there are no major changes in the responses of real variables to their own shocks after the 1985 program.

Some evidence regarding changes in cross effects before and after the program is provided in Figure 8. In all cases we consider the effects of inflation shocks on other variables. The first two charts depict the responses of wage growth and M1 money growth to unit shocks in inflation. It can be seen that these shocks generate a less accommodating short term response of nominal wages and M1 in the post-program period. These responses show a greater degree of volatility, or cyclicality, in the later period. Considering the effects of inflation shocks on the rate of change of the exchange rate, in the third chart of the figure, indicates that the shocks have a much smaller impact and result in somewhat less variability of the rate of change of the exchange rate than before the program. This probably reflects the decrease in exchange rate accommodation implied in the use of the exchange rate as a policy variable in the process of disinflation. The last chart in the figure gives the responses of employment growth to inflation shocks. After the program, there is a stronger short run impact of inflation shocks on the rate of change of employment and the latter's responses show higher volatility than before -- this last finding is similar to that reported above for wage and M1 growth.

Another type of cross effects arises from considering the response of inflation to shocks in the other variables. The evidence, not reported here in charts for brevity, is straightforward: shocks in other variables have a much smaller impact on the rate of inflation after the program. Thus, the

disinflation program appears to have weakened the link going from shocks to key macro variables to the process of inflation.

C. Cross-Sectional Variabilities

The conclusion, based on Tables 1 and 2, that it appears that there is a less important role of nominal vs. real shocks after the program is now further verified by turning to cross sectional variabilities. We discussed in the previous section the predictions of imperfect information models regarding the direction of comovement between price and output cross sectional variabilities. Figure 8a plots three measures of variability: of relative prices (across 10 broad categories in the CPI), relative growth rates of output (across 6 main sectors such as industry, agriculture, construction, etc.), and relative rates of growth of real wages (across 9 main sectors). We consider the latter two measures at applying to real variables. In each case, variability is measured by weighted cross sectional variances.[10]

There are two salient features of Figure 8a. First, there has been a decrease in cross sectional variabilities after the 1985 program. In particular, the index of dispersion of relative prices after the disinflation has become about one-third of its value before the program. This finding is in line with the observed positive correlation between inflation and relative price dispersion that has been documented for several countries. Similarly, there has been a decrease of about 20 percent in the variability of real wage growth rates after 1985. There has been a somewhat slower downward adjustment

[10] The data source for our calculations is Bank of Israel's Annual Report (various issues).

of relative real wage growth variability than that of relative prices.[11] Second, notice the form of comovement between these three measures of dispersion before and after the program. Up to 1984 there was generally a common movement of the variabilities of output growth and real wage growth, in opposite direction to that of the variability of relative prices. Thus, periods with high price variability were typically also periods of low variability of output growth and wage growth across different sectors. This pattern changed after 1985, in that the three variabilities appear to be positively correlated since then. Using these patterns to classify time periods according to the relative importance of real vs. nominal shocks, as suggested in the previous section, provides further support to the hypothesis that real shocks have become more dominant after the program. Notice also that while 1987 was a year with remarkably low values of our three measures of dispersion, they all show increases in 1988 and especially so the variability of output growth rates.

D. Persistence of Fluctuations

Has there been a change in the degree of persistence of macroeconomic fluctuations after the disinflation program? We interpret persistence in a time series sense and measure it by the variance ratio, used recently by Cochrane (1988). Consider time series for a given variable, say the rate of inflation π_t. The variance ratio consists of dividing (1/k) times the variance of k-differences in π by the variance of its first differences:

---

[11] This may partly reflect the interference of economy wide range wage norms imposed by the program with different stages of adjustment to long term equilibrium of different sectors. See Artstein and Bussman (1988).

$$(4) \qquad V(k) = (1/k)[\mathrm{var}(\pi_t - \pi_{t-k})/\mathrm{var}(\pi_t - \pi_{t-1})].$$

One extreme case of persistence is when π_t follows a random walk. In this case, the variance of k-differences in π grows linearly with k and the variance ratio is equal to one. Under these conditions fluctuations in π are permanent and the underlying process is nonstationary. At the other extreme is the case in which π_t follows a stationary (mean reverting) process. The variance of k-differences in π_t approaches then a constant equal to twice the variance of the series and the variance ratio approaches zero for large k; in this case, fluctuations in π are transitory. Between these two extremes there are cases in which fluctuations in π are partly permanent and partly temporary, as when the series are a combination of a random walk and a stationary component. In these more general cases the variance ratio provides a measure of the relative importance of the permanent component, in that for large k it settles down to the ratio of the innovation variance of the random walk component to the variance of first differences.

Variance ratios adjusted for small sample bias are reported in Table 3 and Figure 9 provides plots of the ratios for four variables: the rate of inflation, the rate of unemployment, the rate of change of the real exchange rate, and the real interest rate. For each variable the ratios are reported for periods before and after the disinflation program. In each case we used monthly data and $k = 13$. Caution is suggested in regarding the findings as definitive because small samples are being used and standard errors are not provided.

Comparing persistence before and after the program yields two main patterns. On the one hand, no major change in variance ratios shows up for

the nominal variables such as the rate of inflation, and the rates of growth of M1, wages, controlled prices, the nominal exchange rate, etc. See in this context the first chart in Figure 9 which gives the variance ratio for the rate of inflation. It is seen that before and after the program fluctuations in inflation were primarily transitory, as indicated by the variance ratios of .16 and .12 respectively (for k = 13).[12]

Variance ratios for real variables, on the other hand, yield a somewhat different pattern. The ratios reported in Table 3 indicate that there has been an increase in the degree of persistence of fluctuations in some real variables after the program, especially so for the rate of unemployment, the rate of change of the real exchange rate, and the real interest rate (see their variance ratios plotted in Figure 9). This increased persistence of unemployment after the program may well reflect a process of structural adjustment and reallocation of resources across sectors; see Section IV below.

E. Relating the Findings to the Models

In summarizing and interpreting the evidence presented above we would like to highlight six main results. First, it seems safe to characterize the post 1985 regime as one with a lower degree of exchange rate, and perhaps overall nominal accommodation. That is, there is weaker transmission of changes in the rate of inflation into changes in other nominal variables after the program. This finding is especially relevant for contracting models, where changes in the degree of accommodation of nominal policy variables play

---

[12] Notice, however, that there are subperiods before the program in which inflation persistence may have well increased, as in the inflation outburst that occurred from late 1983 to mid 1985; see again Figure 1.

an important role in changing macroeconomic performance. We discussed earlier (in Section II) the predictions of these models regarding the effects of lowering the degree of nominal accommodation and will explain shortly how these predictions fit the data. Second, changes in the size of the shocks and in the direction of comovements of cross-sectional variabilities generally indicate a larger role of real vs. nominal shocks after disinflation. To the extent that this enhanced importance of real shocks can be associated with a greater role of relative disturbances, then imperfect information models would predict that this will induce an increase in economic agents' responsiveness to perceived relative prices -- an effect that may result in a flatter Phillips curve. Third, there appears to be a more pronounced tradeoff between inflation and unemployment in the later period. This is consistent with the analysis of contracting models, which predict that lowering the degree of nominal policy accommodation should result in a larger impact of unanticipated disturbances on output and on other real variables. This finding is also in line with imperfect information models, as discussed above. In the next section we will discuss the statistical links between inflation and unemployment in the transition from high to low inflation. Fourth, the tradeoff between output variability and inflation variability, if existent, has shifted downward such that inflation variability has diminished and output variability shows very little change. Interestingly, this pattern conforms quite well with the outcomes from numerical examples applied to open economy contracting models by Dornbusch (1982); see our discussion in Section II above. Fifth, the evidence on changes in persistence is not clearcut. Perhaps this is not surprising given the theoretical ambiguities that arise when analyzing the impact of lower nominal accommodation on persistence in

contracting models. Sixth, after the program there has been a decrease in the dispersion of relative prices across different sectors. Thus, the idea that reducing inflation leads to a decrease in the high-inflation induced "noise" component of relative prices seems to be supported by the evidence. Also, real relative price type variables such as real exchange rates and real interest rates exhibit lower variability through time after the program.

While we obviously recognize that our findings are not based on definitive tests of a model or set of models, we regard the evidence presented thus far as harmonious with the predictions of standard macroeconomic models.

IV. THE CHANGING OF THE NATURE INFLATION/UNEMPLOYMENT TRADEOFF

This section provides further evidence on the inflation/unemployment tradeoff before and after the program. We begin by examining statistical and econometric Phillips curves before and after the program and move on to investigate the relations between the rate of unemployment and three important variables: the real exchange rate, the real interest rate, and the real wage. We focus on the timing of changes in unemployment and on the difficulties in attempting to account for the observed timing with standard macro models.

Four years after the implementation of the stabilization program it has become clear that the remarkable disinflation that took place, from inflation rates of about 9.3 percent per month to rates of about 1.3 percent per month, has been accompanied by an increase in the rate of unemployment from about 5 percent per month before the program to about 8 percent in early 1989; see Figure 10 for half-yearly data.

The observed empirical relation between inflation and unemployment exhibits a positive association between these variables in the high inflation

period and practically no systematic relation after stabilization. By contrast, inflation and unemployment appear to be strongly negatively related when comparing the means of these variables before and after stabilization. Thus, with the benefit of hindsight, the empirical Phillips curve for the high inflation period had no predictive value with regard to what was to be anticipated for after the program.

These facts raise the question of why the empirical relation between these two variables is so different within regimes as compared with the transition between regimes, and especially what are the causes for the negative relation in the latter case. The case of the transition is of course the more important aspect of this discussion since it is only in this case that a tradeoff is indeed observed. In what follows, we suggest some answers to these questions.

A. The High Inflation Period

In this period the behavior of inflation and unemployment seems to reflect the economy's reaction to policy makers' actions intended to influence another policy target: the economy's external balance. When the balance of payments gets into a crisis and international reserves are being depleted -- as in 1979-80 and 1983-84 -- this consideration probably takes precedence over the targets of having low inflation and unemployment. In fact, both inflation and unemployment may become instruments in dealing with such a crisis. Under these circumstances, and assuming an indexed economy, a positive association may emerge between inflation and unemployment. Yet this association has nothing to do with the tradeoff between these variables that is relevant in the context of a disinflation program. When the stress on the balance of

payments is relieved, there is probably room for policy makers to shift attention toward stabilizing inflation. However, this shift did not materialize in the period before 1985. Although an attempt was made to combat inflation back in 1982-83, it was not supported by an adjustment in fiscal and monetary fundamentals. Therefore, it seems plausible that such attempt did not confront a tradeoff between inflation and unemployment.

The reasoning behind a positive association between inflation and unemployment in periods of balance of payments crises is as follows. Handling these crises normally requires improving competitiveness by effecting a real devaluation and a drop in real wages. In principle, the latter could be accomplished by a reduction in nominal wage growth which possibly will also induce a decrease in inflation. However, in a highly indexed economy in which workers are not willing to make wage concessions the adjustment is somewhat different. Put a bit more formally, we can express the average real wage over a given period (say a year), w^R, in such an economy as

$$(5) \qquad w^R = g(w^P, \underset{(+)}{\pi}, \underset{(-)}{} \underset{(+)}{n})$$

where w^P denotes the peak real wage (i.e., at the time of the COLA payment) and n denotes the frequency of COLA's per year. When improving competitiveness requires at least some drop in real wages, and unless workers are willing to change the wage agreement as reflected in w^P and in n, the only viable alternative is to raise π. This can be accomplished by raising the rate of devaluation (as in the 1984 crisis) and by raising public sector prices (as in 1980). In fact, the evidence provided in Figure 12 indicates that there were severe cuts in real wages in the context of the upward

adjustments in the rate of inflation that followed the 1979 and 1984 balance of payments crises.

So far for the increase in inflation in coping with a deterioration in external balance. What about unemployment? Since the solution of a balance of payments crisis typically involves also contractionary fiscal and monetary policies, in order to reduce spending and imports, there may be a tendency for the rate of unemployment to rise. This is intensified by government's direct attempts to restrict growth of employment in the public sector. These combined policies may contribute toward increased unemployment; see Figure 12 for evidence in this regard for the 1979 and 1984 episodes. The overall outcome of these policies is compatible with observing a positive link between inflation and unemployment. This link is somewhat confirmed by the regression equations (1) and (2) in Table 4. These are univariate and multivariate Phillips curve type equations. In both cases, the coefficient on the rate of unemployment is positive, and in equation (1) it is significantly different from zero.

In between these two balance of payments crises, the exchange rate was used, especially for about one year after September 1982, as a means to reduce inflation by adopting a policy of devaluing at a rate of 5 percent per month which was about 2 percent below the ongoing rate of inflation. The fact that now inflation was used as a target was not sufficient to create a tradeoff in the course of the policy. Thus, the point 83/1 in Figure 10 is one with relatively low inflation and low unemployment. What appears to be a main explanation for this outcome is the combination of the direct effect of slowing down devaluations on the rate of inflation, and the lack of credibility of the policy which stimulated consumption spending and hence

economic activity. These effects of perceived temporariness and of lack of credibility of government policies are further explored in what follows.

B. The Post Stabilization Period

For the period after the stabilization program, Figure 10 indicates no clear pattern of relation between inflation and unemployment. There were two peaks for the rate of unemployment; one in the second half of 1985, immediately after the program, and the other one in the second half of 1988. In early 1989, the rate of unemployment reached an overall peak level of about 8 percent. It is evident that disinflation was achieved quite rapidly, yet unemployment increased only gradually through time. In fact, the points for 1986 through 1988 in Figure 10 suggest movements in the rate of unemployment that were not accompanied by changes in the rate of inflation. Consequently, the statistical Phillips curve for this period is approximated by a horizontal line.

C. The Tradeoff in the Transition

Despite these mixed patterns within subperiods, it is evident that comparing the economy's position before and after the program (see the broad averages plotted in points B and A of Figure 10) yields a statistical tradeoff between the rates of inflation and unemployment. This is somewhat confirmed by the econometric evidence provided in Table 4, equations (3) and (4). Both the latter suggest that when one considers the entire 1980-1988 period for estimation purposes, the coefficient describing the inflation/unemployment tradeoff becomes negative and marginally significant. Thus, while a positively sloped statistical Phillips curve may have prevailed in the period

up to mid-1985, and no clearcut relation emerged for the post 1985 period, the statistical tradeoff emerges when comparing the pre and post program periods. It is precisely when a strong disinflation is attempted and achieved that we see an inverse relation between inflation and unemployment arising from the data.

Modern macroeconomic theory treats the Phillips curve as a reduced-form relation. Behind it there is a set of fundamental factors that determine its shape. Changes in these factors can lead to changes in the reduced form. Key among these fundamental factors are the existing macroeconomic policies, their credibility, private sector's expectations, the type of shocks affecting the economy, the existing rigidities in the system, etc. To further examine how some of these factors are captured in the inflation/unemployment tradeoff in the transition from high to low inflation, we present in Figure 11 the relations in the data between the rate of unemployment and three important relative-price type variables: the real exchange rate, the real interest rate, and the real wage. Comparing the half-year averages in Figure 11 before and after the stabilization program suggests a clearcut pattern: the increase in the rate of unemployment after the program was accompanied by a real exchange rate appreciation, by an increase in the real interest rate, and by an increase in the real wage. And, as in the case of Figure 4.1, these links are more pronounced when comparing performance across the pre and post periods than when looking at the relations within each subperiod.

Examining the figures and the data suggests that the behavior of the rate of unemployment after the program followed a cycle consisting of three phases. In the initial stage of six to nine months inflation was simply reduced by a combination of orthodox and heterodox policies. This was

accompanied by an increase in unemployment for about a year and a drop in industrial production for about two to three quarters. However, the size of these recessionary tendencies was relatively small: a spectacular disinflation was then effected without major losses in output.

The second phase is characterized by a boom in private consumption spending in 1986-87 which stimulated economic activity. The main features and explanations for this boom have been analyzed in more detail in an earlier paper by Liviatan (1989). The data indicate that while private consumption spending amounted to 53 percent of GDP in 1984-84, this ratio increased to 59 percent during 1986-88. Though partially offset by decreases in private investment and public consumption, these changes in consumption dictated the direction of change in total domestic uses which increased by 9 percent in 1986 and by 6.1 percent in 1987. GDP growth for these years was 3.6 and 5.2 percent respectively. Overall, then, the 1986-87 period was one of booming private consumption and economic activity, high real wages[13] and real interest rates, and a low real exchange rate.[14] Liviatan (1989) discussed several explanations for the consumption boom after stabilization and reached the conclusion that the boom is most probably due to an initial perception that stabilization is only temporary[15] -- an argument which is in line with recent theoretical work by Calvo (1987) and by Helpman and Razin (1987).

---

[13] The fact that output growth accelerated in spite of the growth of real wages suggest that the economy was driven by demand factors.

[14] Helpman (1988) has argued that some of these comovements cannot be accounted for by models of pure competition. Instead, they can be explained by using a framework of oligopolistic competition.

[15] Similar booms have been documented for several Latin American countries after the implementation of stabilization programs; see e. g. Liviatan (1989).

Phase three started in 1988, when there was a slowdown in private consumption growth and in the growth of GDP, which was about 1.6 percent for that year. Industrial production started to fall and unemployment reached unprecedented levels in 1989. While these recent developments have not yet been fully analyzed, it appears that an important part of the recent increase in unemployment can be explained by a combination of factors that resulted in a profit squeeze for the business sector in recent years. First, the cycle discussed above was such that it resulted in persistently high real interest rates, high and increasing real wages, and continuous real appreciation of the Israeli shekel. Second, there were decreases in subsidies to the corporate sector, and an increase in tax rates on corporate profits. Third, there was a decrease in public sector's demands for goods and services from the private sector -- a decrease that was probably perceived by the business sector as permanent. Fourth, the uprising in the occupied territories contributed to a downturn in economic activity.

In addition to these factors, it appears that the recent increase in unemployment reflects a slow adjustment of the economy's structure to the new economic environment with low inflation. This adjustment entails major reallocations of resources among sectors. Thus, factors of production had to be reshuffled between financial and nonfinancial activities to accommodate the decrease in the intensity of the former. Similarly, in the high inflation regime many large combines (such as government and labor union enterprises and transportation cooperatives) relied on government support in periods of financial and liquidity crises. Such support was gradually eliminated after the program and therefore these combines had to contract their activities.

Interestingly, these allocative effects of disinflation have great similarity with those in the aftermath of the German hyperinflation; see Garber (1982). During the hyperinflation in Germany, there was a policy of subsidizing the capital goods industry through the inflation tax revenue. When this source of revenue was terminated and a "Rationalization Period" was started, a major reallocation of resources was required, with capital and labor moving out of the capital goods industry. It is this reallocation that, in Garber's (1982) view, generated the transitional costs of disinflation which showed up in a decrease of industrial production by about 20 percent in less than one year and an increase in the rate of unemployment to 22 percent of union members. Similarly to the case of Israel, these developments did not occur immediately after disinflation but instead emerged with a lag (that is, one and a half years after the November 1923 reform).

Finally, we relate these developments to standard macroeconomic models such as those discussed in Section II. In these models, imperfect information and contractual rigidities determine the transition path of the economy from high to low inflation. Once these imperfections and rigidities are removed, disinflation is not predicted to have an impact on real output, unemployment, and other real variables. The fact that the rate of unemployment has markedly increased to about 8 percent only three years after the program does not appear to be explained by the existence of these imperfections and rigidities. Thus, even if agents correctly perceive and predict the new policy regime and even under an heterodox policy package there may be real costs associated with disinflation to the extent that the latter entails a process of structural adjustment consisting of major reallocations of resources across sectors.

V. CONCLUSIONS

Much of the evidence obtained from comparing macroeconomic performance in Israel before and after the stabilization program of 1985 conforms well with standard macro models. The decreases in exchange rate and nominal accommodation and the enhanced importance of real, as opposed to nominal, shocks that characterize the post-program regime appear to have strengthened the tradeoff between inflation and unemployment. They have also been associated with a decrease in inflation variability and no major change in the stability of output or other real variables. Cross-sectional variabilities, of relative prices, outputs, and real wages, have changed in a direction compatible with the notion that indeed real shocks have become more dominant in the low inflation economy.

What are less standard from the standpoint of conventional theories are the immediate and abrupt reduction in the rate of inflation, and the timing and form of the impact of disinflation on real variables. For more than two years after the program there was a private consumption boom that was accompanied by increases in economic activity and by relatively high real wages and real interest rates and a low (appreciated) real exchange rate. It is only in the beginning of the fourth year after the program that the consumption boom stopped, economic activity was stagnant, and there was a rise in the rate of unemployment. It seems difficult to explain these developments solely on the basis of models stressing the role of imperfect information and contractual rigidities. The consumption boom appears to be closely related to partial lack of credibility of the program and of the exchange rate policy. Apparently the public perceived the changes as mainly temporary. In addition,

the recent rise in unemployment seems to reflect, to an important extent, the beginning of a process of structural adjustment whereby resources are reallocated across the economy to conform with the new low inflation equilibrium. This process may involve a reduction of growth in the transitional stage, but will enable an increase in long term growth after the completion of the adjustment.

Considering the Israeli program as a laboratory experiment in heterodox policy, we can address its implications so far for the well-known debate between gradualism vs. shock treatment in the process of stabilization. From the point of view of reducing inflation, the program seems to have had the same advantage as of shock treatment policies: There was a sharp and immediate disinflation after mid-1985. This was probably due to the use of multiple nominal targets (such as a fixed exchange rate and price-wage controls) in conjunction with adjustments in fundamentals right at the start of the program -- a mix that makes the program heterodox. From the perspective of the real costs of disinflation, the program resembles more a gradualist policy. The real costs, in the form of increased unemployment, were postponed for several years and in the transition there was actually a boom in economic activity. Which of these features of the results of the program are specific to Israel and which ones are common to heterodox policies applicable to other countries is an important question that needs to be addressed in the future.

VI. REFERENCES

Artstein, Y. and Z. Sussman (1988), "Wage Policy During Disinflation: the Israeli Stabilization Program of 1985," Discussion Paper 88.07, Research Department, Bank of Israel.

Blejer, M. and N. Liviatan (1987), "Fighting Hyperinflation - Stabilization Strategies in Argentina and Israel 1985-86," IMF Staff Papers, Vol. 34, no. 3, pp. 403-38.

Bruno, M. (1986), "Sharp Disinflation Strategy: Israel 1985," Economic Policy 2, pp. 379-402.

_____ and Sylvia Piterman (1988), "Israel's Stabilization: a Two Year Review" in Inflation Stabilization ed. Bruno et.al., pp. 1-47.

Calvo, G. A. (1986), "Temporary Stabilization: Predetermined Exchange Rates," Journal of Political Economy, 94, pp. 1319-1329.

Cochrane, J. (1988), "How Big Is the Random Walk in GNP?' Journal of Political Economy 96, pp. 892-919.

Cukierman, A. (1983), "Relative Price Variability and Inflation: a Survey and Further Results," Carnegie-Rochester Series on Public Policy 19, pp. 103-138.

Dornbusch, R. (1982), "PPP Exchange Rate Rules and Macroeconomic Stability," Journal of Political Economy 90, pp. 158-165.

Fischer, S. (1977), "Long Term Contracts, Rational Expectations, and the Optimal Money Supply Rule," Journal of Political Economy 85, 191-206.

_____ (1987), "The Israeli Stabilization Program 1985-86," American Economic Review 77, pp. 275-278.

Garber, P. (1982), "Transition From Inflation to Price Stability," Carnegie-Rochester Series on Public Policy 16, pp. 11-42.

Helpman, E. (1988), "Macroeconomic Effects of Price Controls: the Role of Market Structure," Economic Journal 98, pp. 340-354.

_____ and L. Leiderman (1988), "Stabilization in High-Inflation Countries: Analytical Foundations and Recent Experience," Carnegie-Rochester Series on Public Policy 28, pp. 9-84.

_____ and A. Razin (1987), "Exchange Rate Management: Intertemporal Tradeoffs," American Economic Review 77, pp. 107-123.

Kiguel, M. and N. Liviatan (1989), "The Old and the New Heterodox Stabilization Programs: a Study of the Sixties with Perspective of the Eighties," unpublished manuscript, The World Bank.

Liviatan, N. (1989), "Israel's Stabilization Cycle with Some Reference to Latin American Experience," preliminary manuscript, The World Bank.

Lucas, R. E. Jr. (1973), "Some International Evidence on Output Inflation Tradeoffs," American Economic Review 63, pp. 326-335.

_____ (1976), "Econometric Policy Evaluation: a Critique," Carnegie-Rochester Series on Public Policy 1, pp. 19-46.

Sims, C. A. (1980), "Macroeconomics and Reality," Econometrica 48, pp. 1-48.

Taylor, J. B. (1979), "Staggered Wage Setting in a Macro Model," American Economic Review 69, 108-113.

Table 1 - Summary Statistics - Israel: 1980-1988 (Monthly Data)

1a. Means, Standard Deviations, and Coefficients of Variation[a]

Variable (% rate of change)	Mean[b] (B)	Mean[b] (A)	Standard Deviation[b] (B)	Standard Deviation[b] (A)	Coefficient of Variation[b] (B)	Coefficient of Variation[b] (A)
CPI	9.36	1.34	5.03	0.89	2.70	0.59
Price of Controlled Goods	9.48	1.39	6.44	1.04	4.38	0.78
Price of Free Goods	9.32	1.33	4.95	0.98	2.63	0.71
Nominal Wage	9.83	2.46	7.85	6.50	6.27	17.18
Exchange Rate (Basket)	8.71	0.70	5.29	1.55	3.21	3.43
Exchange Rate (Dollar)	9.37	0.21	5.05	1.35	2.72	8.67
M1 Money	8.23	3.81	7.90	8.30	7.58	18.08
M3 Money	10.03	1.67	6.27	2.74	3.92	4.50
Credit	9.20	3.22	5.26	1.64	3.01	0.84
Interest Rate[c]	11.44	3.75	5.12	0.62	2.29	0.10
Industrial Production	0.73	0.51	8.78	9.62	105.60	181.46
Employment	0.20	0.16	1.52	1.31	11.55	10.73
Rate of Unemployment[c]	5.13	6.58	0.78	0.97	0.12	0.14
Consumption	0.69	0.91	7.16	5.05	74.30	28.03
Real Wage	0.47	1.11	7.80	6.48	129.45	37.83
Real Exchange Rate (Basket)	-0.64	-0.64	3.25	1.78	-16.50	-4.95
Real Exchange Rate (Dollar)	1.43	-1.13	3.35	1.73	7.86	-2.64
Real Relative Price of Controlled Goods	0.13	0.05	3.24	0.85	80.75	14.45
Real Interest Rate[c]	2.09	2.41	3.79	1.22	6.87	0.62
Trade Deficit[d]	244.91	237.46	62.65	66.09	16.03	18.40
Trade Deficit/GDP[e]	0.12	0.08	0.031	0.023	0.008	0.006

Notes:

a) Data definitions and sources are provided in Appendix 1.
b) Columns (B) refer to the period 1980:2-1985:6; i.e., before the implementation of the 1985 stabilization program. Columns (A) apply to the 1986:1-1988:12 post stabilization period.
c) Level (and not rate of change).
d) Level, in millions of dollars.
e) Trade deficit in domestic currency units divided by a monthly measure of GDP.

(Table 1 - cont.)

1b. Correlations Matrix for Inflation and Selected Nominal Variables[a]

	DP	DW	DM1	DM3	DC	DPC	DER	INT
DP	1.00							
DW	.33	1.00						
	(.08)							
DM1	.17	.46	1.00					
	(-.27)	(.33)						
DM3	.66	.28	.48	1.00				
	(-.33)	(.12)	(.60)					
DC	.66	.40	.41	.64	1.00			
	(-.10)	(.34)	(.32)	(.32)				
DPC	.87	.19	.19	.61	.55	1.00		
	(.62)	(.04)	(-.19)	(-.39)	(.04)			
DER	.80	.34	.32	.73	.80	.67	1.00	
	(-.00)	(-.19)	(-.09)	(.15)	(.33)	(.10)		
INT	.72	.40	.37	.58	.78	.59	.75	1.00
	(-.27)	(.04)	(.31)	(.46)	(.24)	(-.17)	(.23)	

Notes: a) The variables DP, DW, DM1, DM3, DC, DPC, and DER denote the rates of change of the CPI, nominal wage, M1, M3, credit, controlled prices, and nominal (basket) exchange rate. INT denotes the nominal interest rate. Each entry gives a correlation coefficient for the period 1980:2-1985:6. Figures in parentheses are correlation coefficients for the period 1986:1-1988:12.

(Table 1 - cont.)

1c. Correlations Matrix for Inflation and Selected Real Variables[a]

	DP	UNE	DIP	DEMP	DCON	DRER	RIR	DRW
DP	1.00							
UNE	.38	1.00						
	(-.21)							
DIP	-.17	.23	1.00					
	(-.10)	(.19)						
DEMP	-.26	.14	.49	1.00				
	(-.25)	(-.00)	(.54)					
DCON	-.27	.06	.34	.12	1.00			
	(.02)	(.09)	(.19)	(.04)				
DRER	-.24	.17	.50	.29	.25	1.00		
	(-.50)	(.07)	(-.03)	(.14)	(.05)			
RIR	-.35	.35	.21	.23	.27	.45	1.00	
	(-.87)	(.07)	(.00)	(.16)	(-.00)	(.54)		
DRW	-.31	-.05	.17	.40	.30	.19	.33	1.00
	(-.05)	(-.01)	(.39)	(.35)	(.06)	(-.14)	(.08)	

Notes: a) The variables DP, DIP, DEMP, DCON, DRER, and DRW denote the rates of change of the CPI, industrial production, employment, consumption, real exchange rate, and real wage. UNE and RIR denote, respectively, the rate of unemployment and real interest rate. Each entry gives a correlation coefficient for the period 1980:2-1985:6. Figures in parentheses are correlation coefficients for the period 1986:1-1988:12.

Table 2 - The Size of the Shocks:

Standard Deviations of Estimated Disturbances*

	1980:6-1985:6	1985:12-1988:12
Inflation	3.85	0.68
Wage Growth	7.18	5.55
M1 Growth	6.48	7.91
M3 Growth	5.08	2.45
Credit Growth	4.15	1.57
Devaluation (Basket)	4.08	1.53
Devaluation (Dollar)	3.57	1.26
Controlled Prices' Inflation	5.79	0.96
Nominal Interest Rate	1.22	0.20
Unemployment	0.49	0.77
Industrial Production Growth	6.46	6.29
Employment Growth	1.38	1.00
Consumption Growth	6.25	3.96
Trade Deficit/GDP	0.026	0.024

* Note: Each entry is the standard deviation of the estimated disturbance from bivariate autoregressions that used four lagged values of inflation and of the other relevant variable and a constant. The figures for inflation are based on autoregressions that had lagged inflation and wage growth as explanatory variables.

Table 3 - Variance Ratios [V(k); Equation (4) in Text]

k	Inflation		Wage Growth		Devaluation		Controlled Prices		M1 Growth	
	B	A	B	A	B	A	B	A	B	A
1	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
2	0.73707	0.58874	0.38268	0.53662	0.71366	0.67048	0.69781	0.71828	0.38670	0.51536
3	0.50000	0.69351	0.20042	0.17209	0.52785	0.50835	0.54636	0.54833	0.24433	0.27167
4	0.42241	0.40828	0.21089	0.28132	0.46580	0.40733	0.33400	0.42852	0.18247	0.26406
5	0.36293	0.31361	0.16061	0.19863	0.30140	0.24658	0.20838	0.33582	0.18539	0.14228
6	0.16379	0.13609	0.11453	0.10500	0.28583	0.24872	0.19766	0.32976	0.11433	0.13555
7	0.23045	0.14793	0.12709	0.15639	0.28687	0.23060	0.20184	0.24679	0.12373	0.14792
8	0.20776	0.17751	0.13757	0.13618	0.22598	0.22258	0.21346	0.23018	0.10939	0.15681
9	0.16810	0.20710	0.07542	0.09611	0.20930	0.23357	0.17373	0.10757	0.07666	0.10752
10	0.15948	0.19507	0.10824	0.13060	0.18554	0.17257	0.13295	0.14290	0.12047	0.10619
11	0.13793	0.16568	0.09776	0.10804	0.17763	0.18878	0.12852	0.12978	0.08487	0.11527
12	0.09483	0.11834	0.05168	0.03904	0.15859	0.18768	0.13032	0.10757	0.05750	0.05837
13	0.16379	0.11834	0.10265	0.10214	0.16933	0.19087	0.16921	0.12669	0.07757	0.11292

k	Real Interest Rate		Real Exchange Rate		M3 Growth		Trade Deficit	
	B	A	B	A	B	A	B	A
1	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
2	0.68221	0.85366	0.59958	0.90368	0.19266	0.51014	0.67213	0.53362
3	0.42582	0.81460	0.36146	0.79649	0.21137	0.32540	0.29946	0.29464
4	0.35292	0.70741	0.29204	0.54128	0.15831	0.30281	0.27400	0.29246
5	0.19905	0.65854	0.12783	0.31707	0.14188	0.20196	0.28037	0.27303
6	0.13669	0.71494	0.13341	0.19207	0.10033	0.20079	0.18835	0.18391
7	0.19244	0.74586	0.18042	0.21744	0.13165	0.18361	0.18890	0.18956
8	0.20529	0.76572	0.15791	0.26867	0.08900	0.21716	0.20058	0.21099
9	0.15381	0.67311	0.11462	0.32048	0.08475	0.15512	0.17194	0.11565
10	0.15823	0.63091	0.10623	0.27551	0.08116	0.14415	0.16209	0.14587
11	0.13612	0.59823	0.11007	0.25110	0.07961	0.15733	0.15144	0.13975
12	0.09459	0.64258	0.06904	0.18555	0.06362	0.10906	0.15678	0.11685
13	0.15113	0.68555	0.10982	0.20703	0.08779	0.13237	0.13547	0.10997

k	Employment Growth		Unemployment Rate		Industrial Production Growth		Credit Growth	
	B	A	B	A	B	A	B	A
1	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
2	0.38710	0.77404	0.70774	0.82031	0.30294	0.34508	0.60812	0.67387
3	0.34441	0.47957	0.68333	0.79279	0.23441	0.20635	0.42183	0.27260
4	0.20406	0.23888	0.62857	0.70579	0.17457	0.18977	0.43200	0.31657
5	0.13763	0.18269	0.64286	0.71591	0.13388	0.15483	0.33465	0.21801
6	0.14860	0.22716	0.51786	0.67614	0.08461	0.07901	0.26656	0.09434
7	0.10332	0.15018	0.50833	0.66104	0.11530	0.15599	0.32297	0.20960
8	0.11677	0.15535	0.40923	0.57582	0.09399	0.07479	0.26259	0.21405
9	0.13610	0.20282	0.33542	0.45543	0.07784	0.08338	0.18055	0.12913
10	0.09435	0.23128	0.28155	0.34357	0.08954	0.10747	0.20625	0.15762
11	0.10406	0.14135	0.25000	0.32067	0.08396	0.07277	0.16418	0.14307
12	0.03600	0.06653	0.20923	0.30575	0.03030	0.04631	0.16625	0.07059
13	0.09064	0.13552	0.24881	0.32031	0.00840	0.10196	0.19000	0.17230

Table 4 - Simple Phillips-Curve Regressions

I. Before the Program (1980:4-1985:6)

(1) $INF_t = -2.625 + 0.455INF_{t-1} + 4.813Log(UNE)_t$
(6.171) (0.126) (4.080)

$R^2 = 0.293$ DW = 2.029 SER = 4.327

(2) $INF_t = 0.389 + 0.056INF_{t-1} + 0.467DPC_t + 0.345DER_t + 0.623Log(UNE)_t$
(2.907) (0.069) (0.053) (0.079) (1.938)

$R^2 = 0.851$ DW = 1.876 SER = 2.021

II. Entire Sample (1980:4-1988:12)

(3) $INF_t = 8.953 + 0.672INF_{t-1} - 3.950Log(UNE)_t$
(3.776) (0.072) (2.113)

$R^2 = 0.488$ DW = 2.22 SER = 4.279

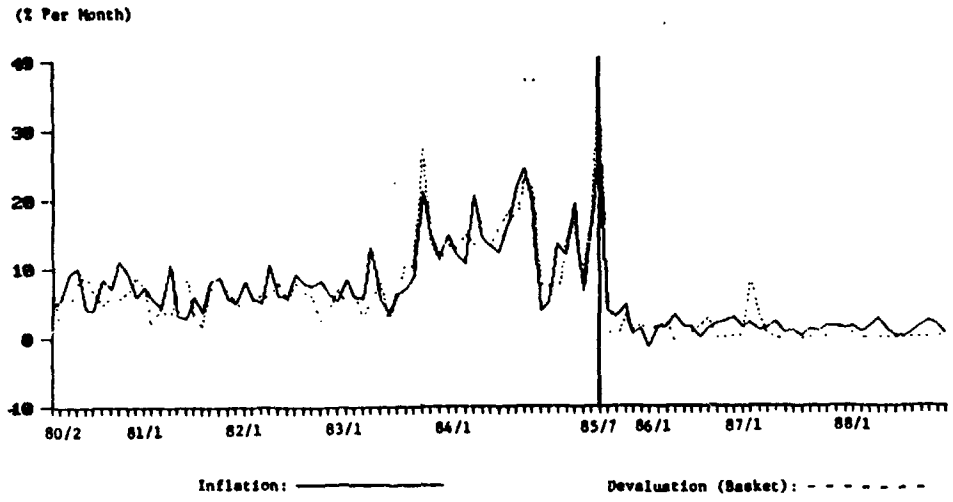
(4) $INF_t = 4.053 + 0.151INF_{t-1} + 0.424DPC_t + 0.296DER_t - 1.799LOg(UNE)_t$
(1.649) (0.043) (0.044) (0.061) (0.919)

$R^2 = 0.906$ DW = 1.894 SER = 1.850

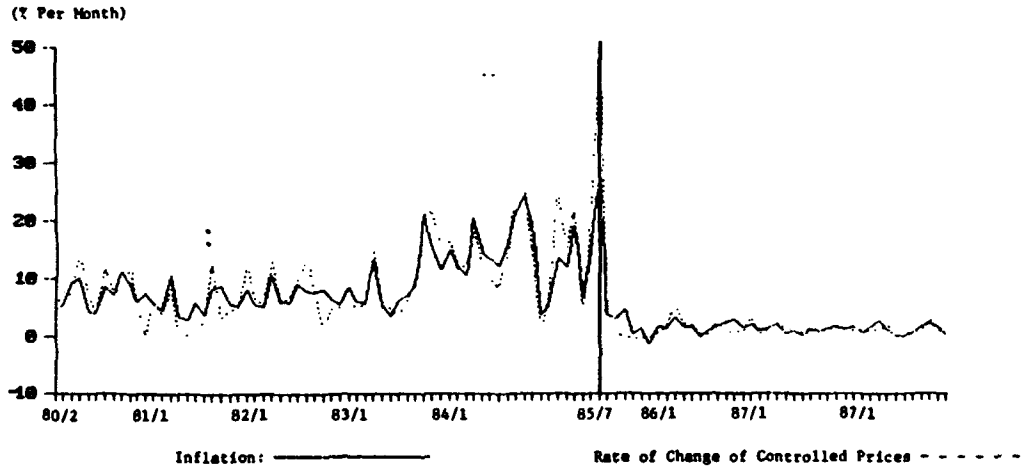
Notes: The notation is as follows: INF: Rate of inflation; UNE: Rate of unemployment; DPC: Rate of inflation of controlled prices; DER: Rate of change of exchange rate. Figures in parentheses are standard errors.

Figure 1

THE RATE OF INFLATION AND THE RATE OF DEVALUATION (BASKET)



THE RATE OF INFLATION AND THE RATE OF CHANGE OF CONTROLLED PRICES



THE RATE OF INFLATION AND MONEY (M3) GROWTH

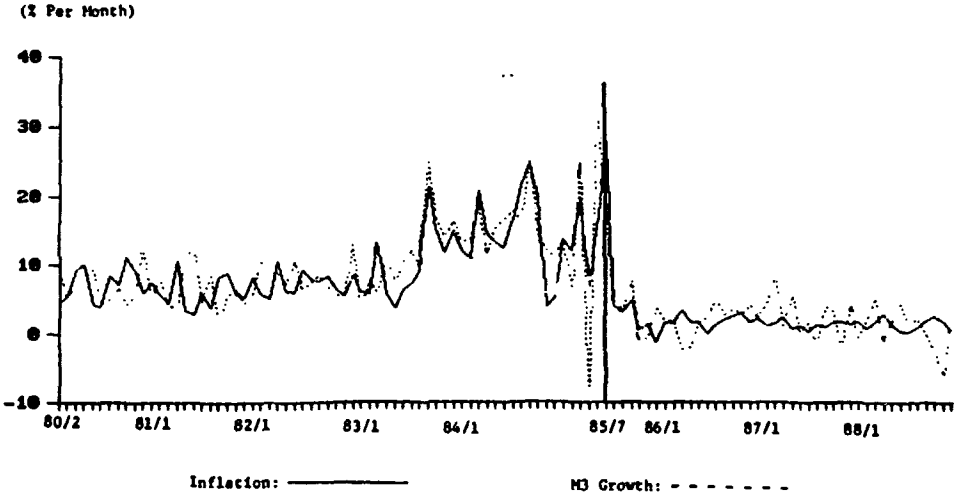
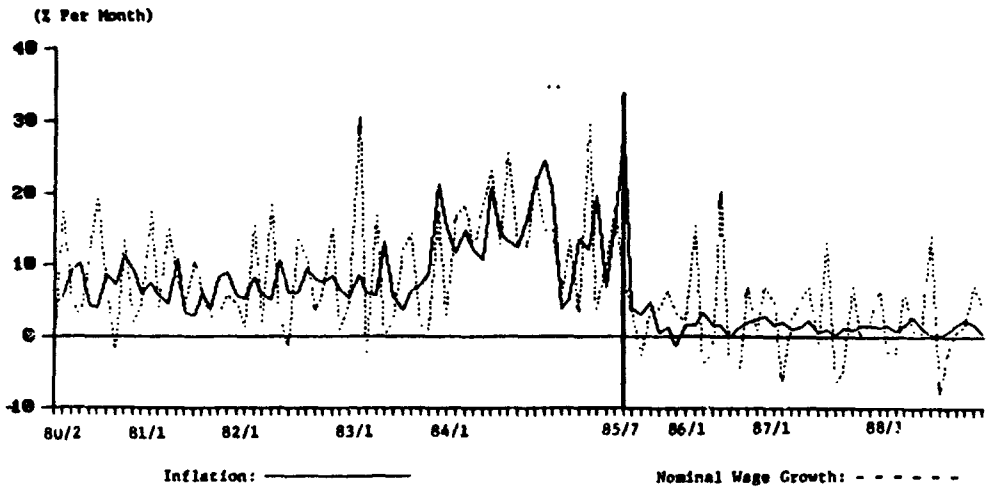
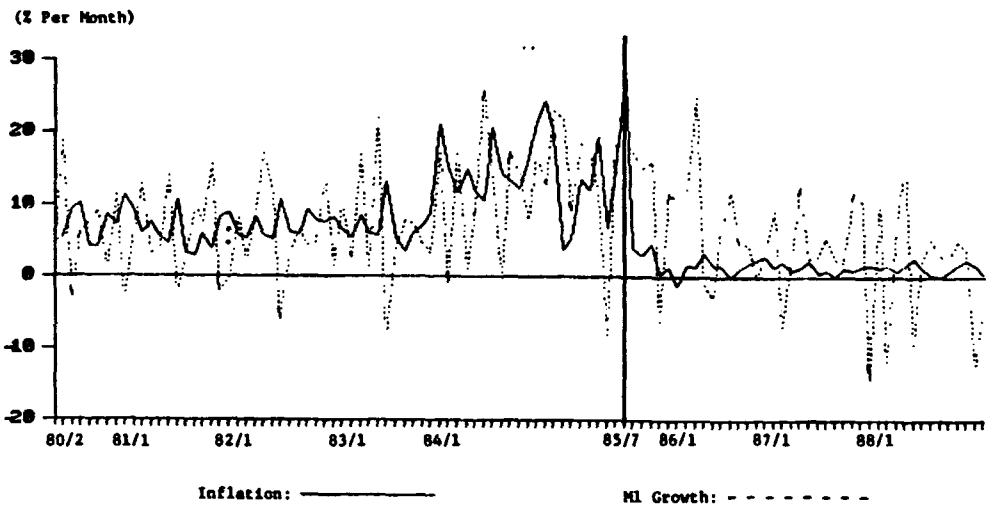


Figure 2

THE RATE OF INFLATION AND NOMINAL WAGE GROWTH



THE RATE OF INFLATION AND MONEY (M1) GROWTH



THE RATE OF INFLATION AND THE RATE OF CHANGE OF CREDIT

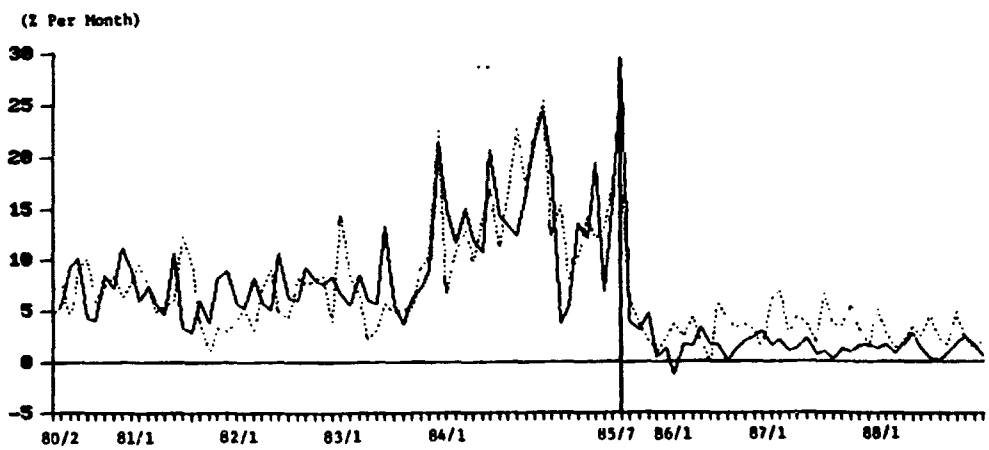
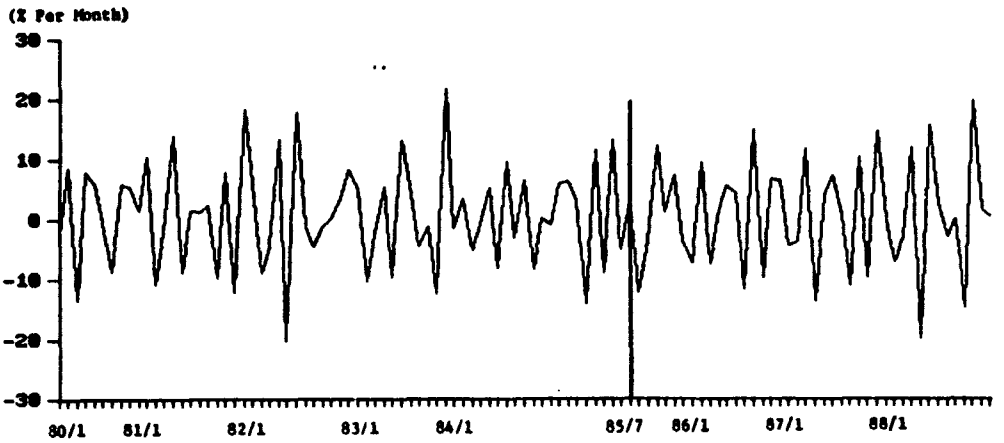
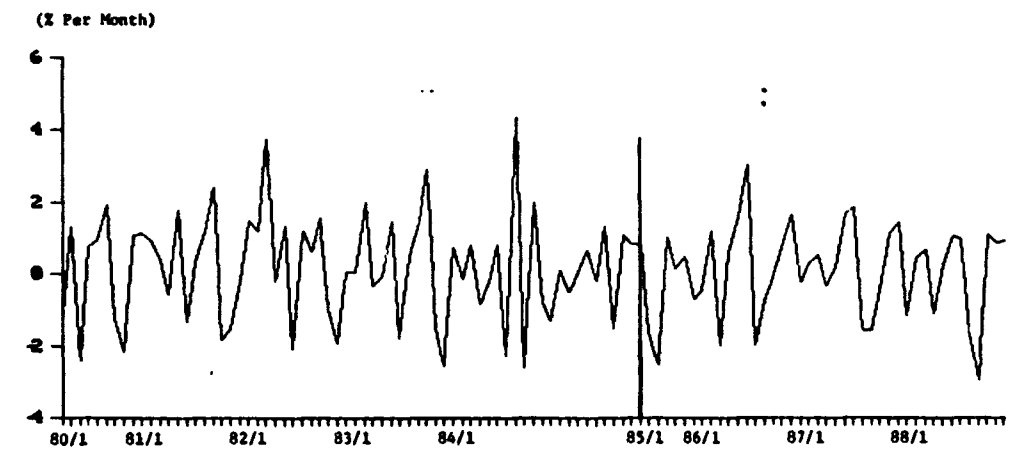


Figure 3

THE RATE OF GROWTH OF INDUSTRIAL PRODUCTION



THE RATE OF GROWTH OF EMPLOYMENT



THE TRADE DEFICIT

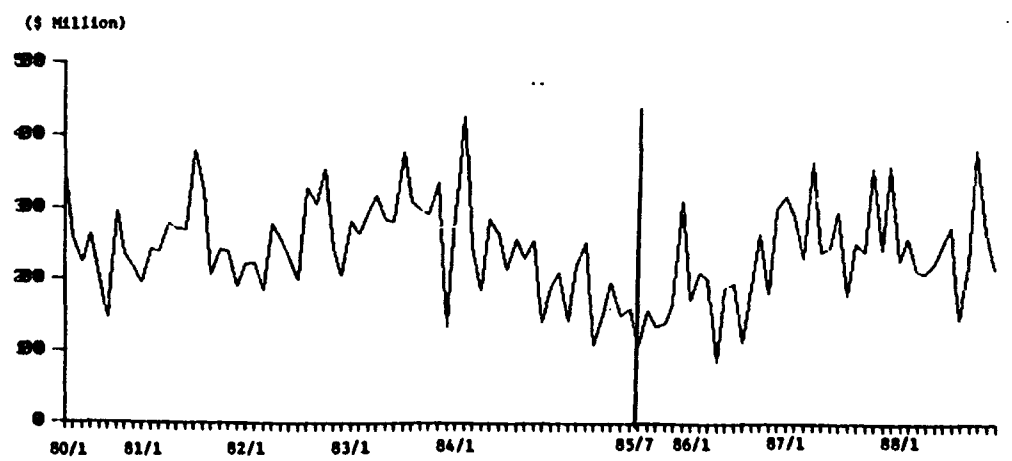
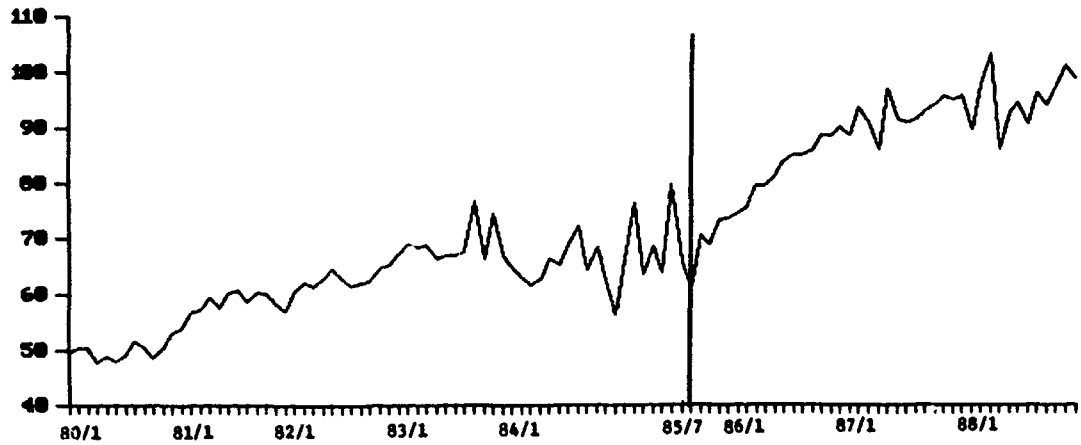


Figure 4

Private Consumption Spending



THE RATE OF UNEMPLOYMENT

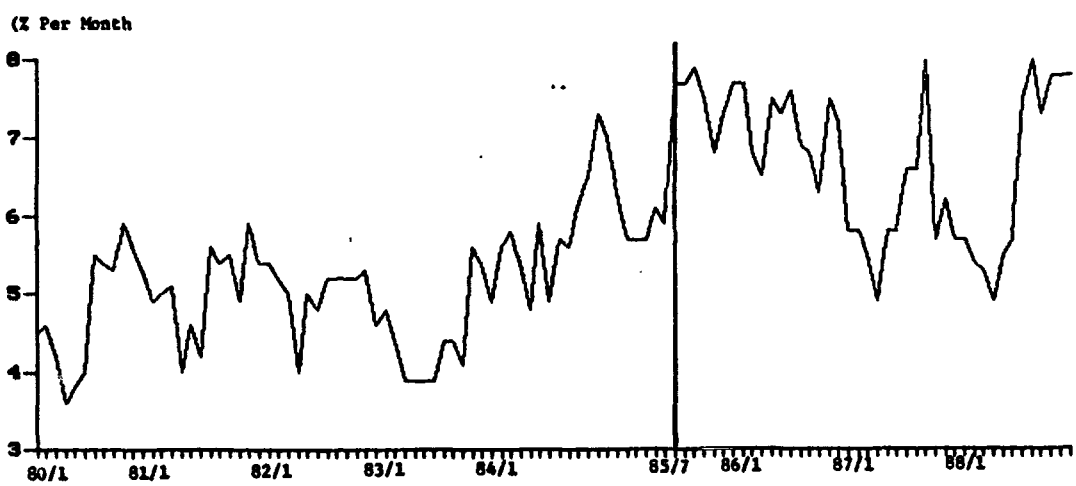
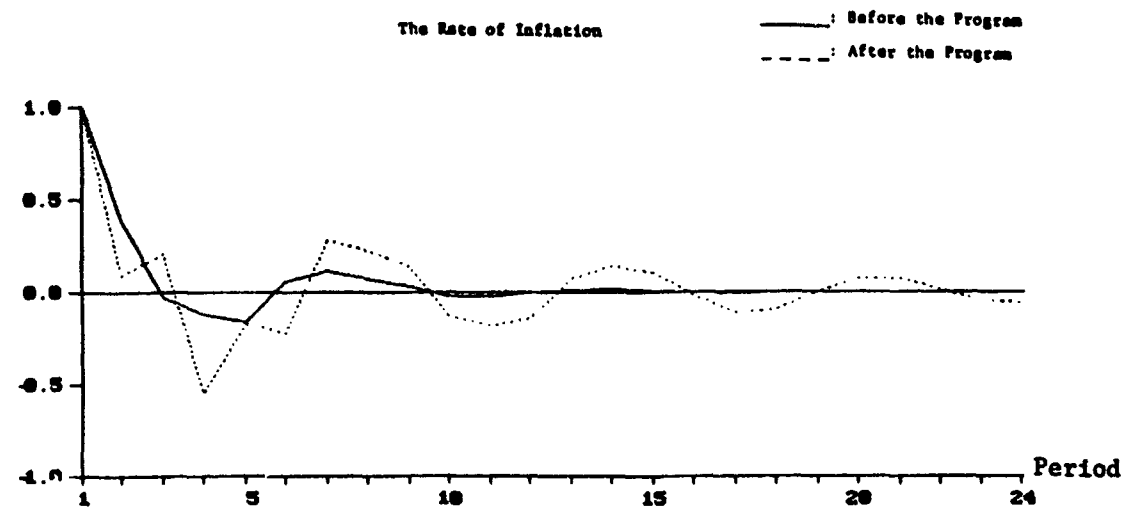


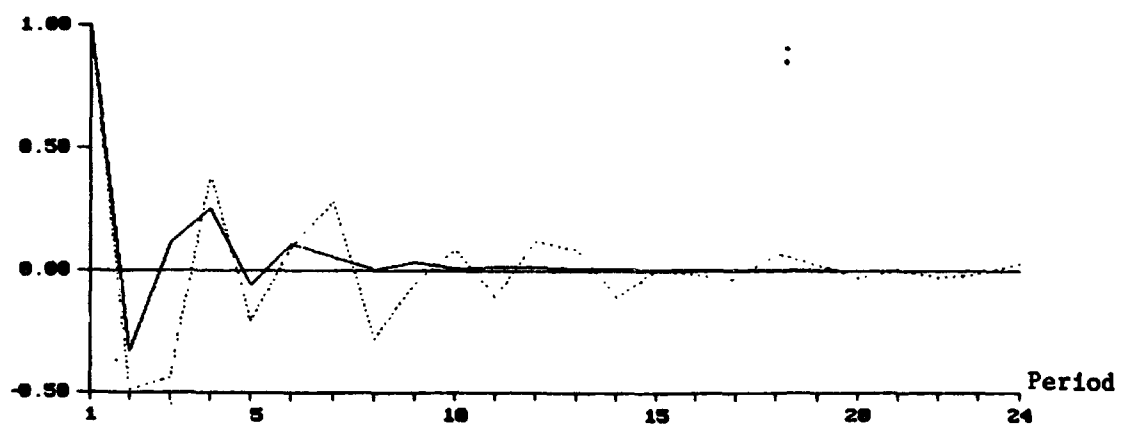
Figure 5

Responses to Own Shocks: Inflation, Wage Growth, and M1 Growth

The Rate of Inflation



The Rate of Change of the Nominal Wage



The Rate of Change of M1

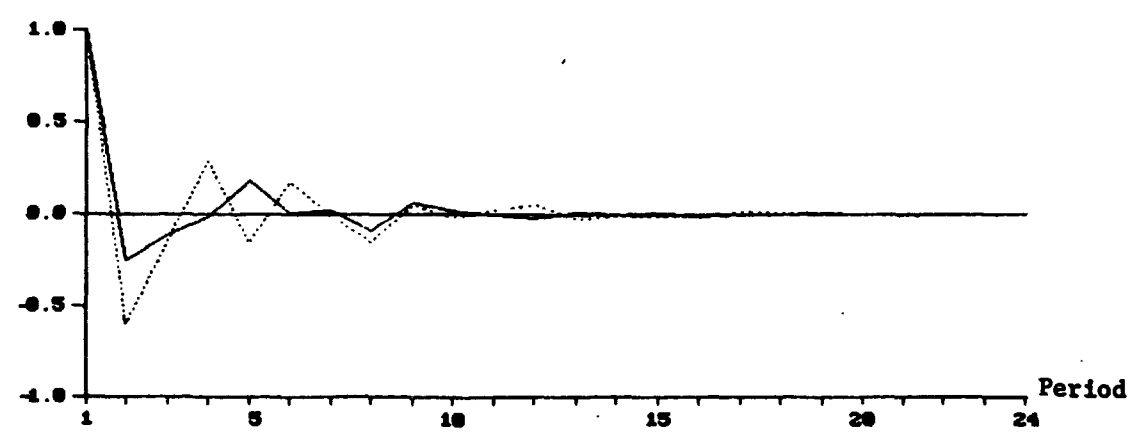


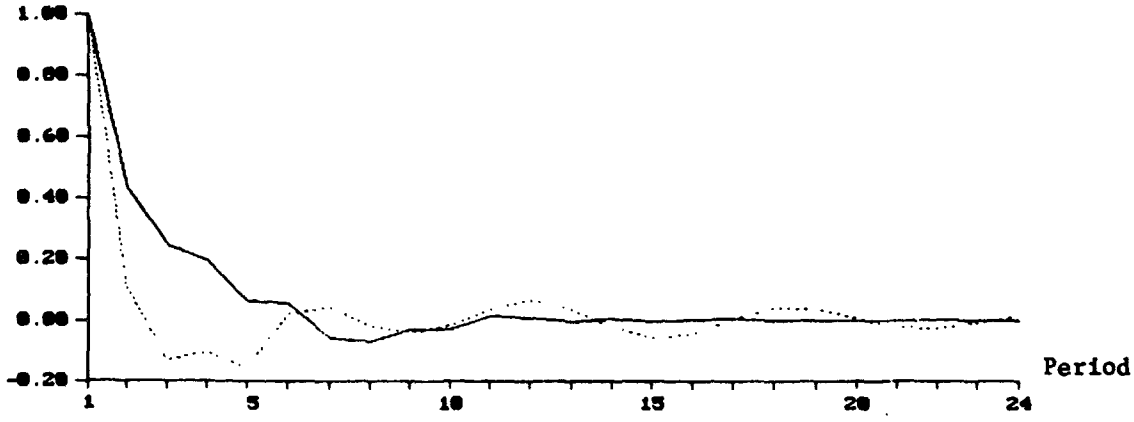
Figure 6

Responses to Own Shocks: Exchange Rate, Controlled Prices, and Credit

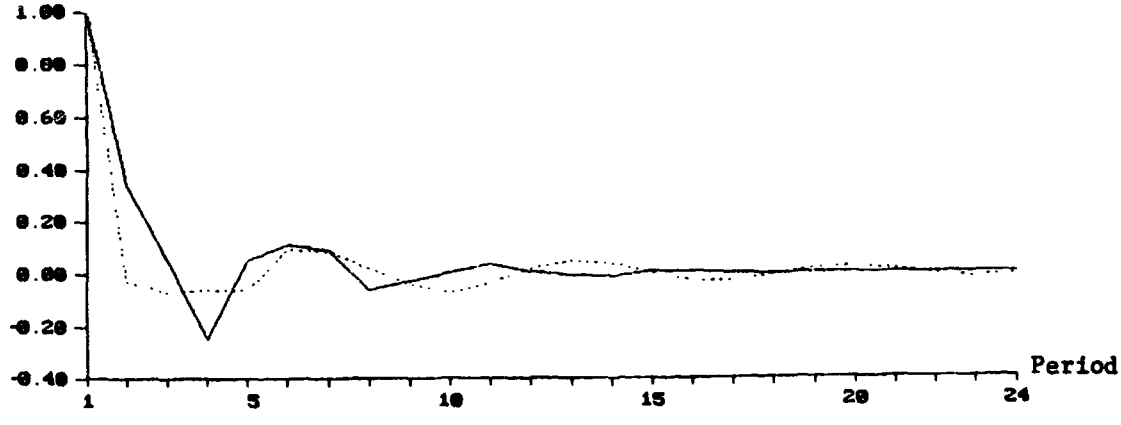
———: Before the Program

– – – –: After the Program

The Rate of Change of the Basket Exchange Rate



The Rate of Change of Controlled Prices



The Rate of Change of Credit

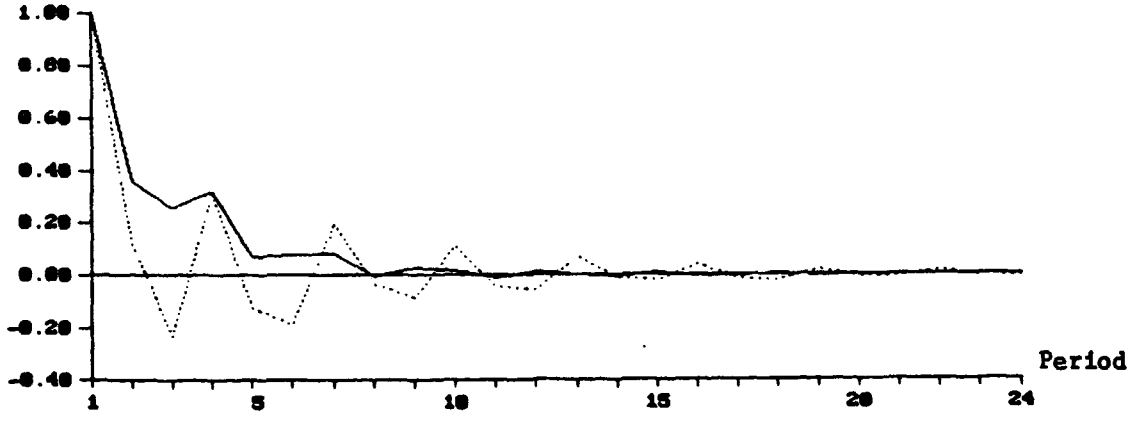


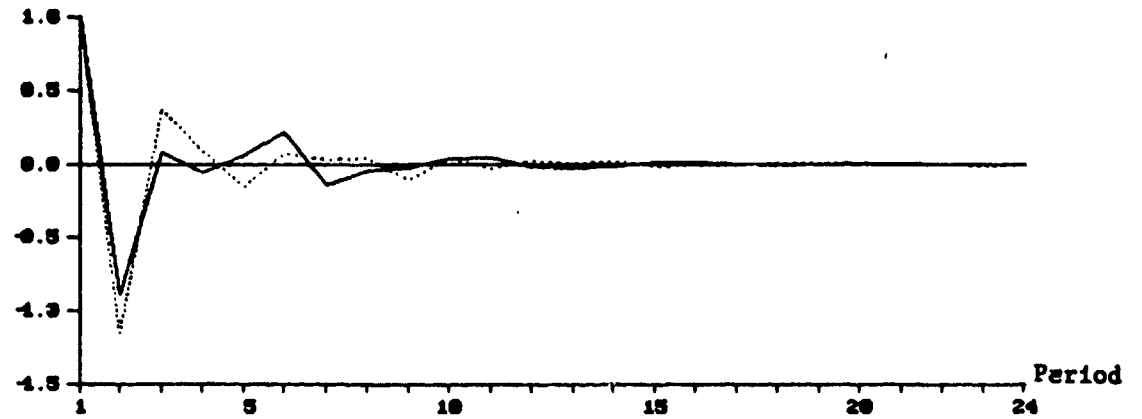
Figure 7

Responses to Own Shocks: Industrial Production, Employment, and Unemployment

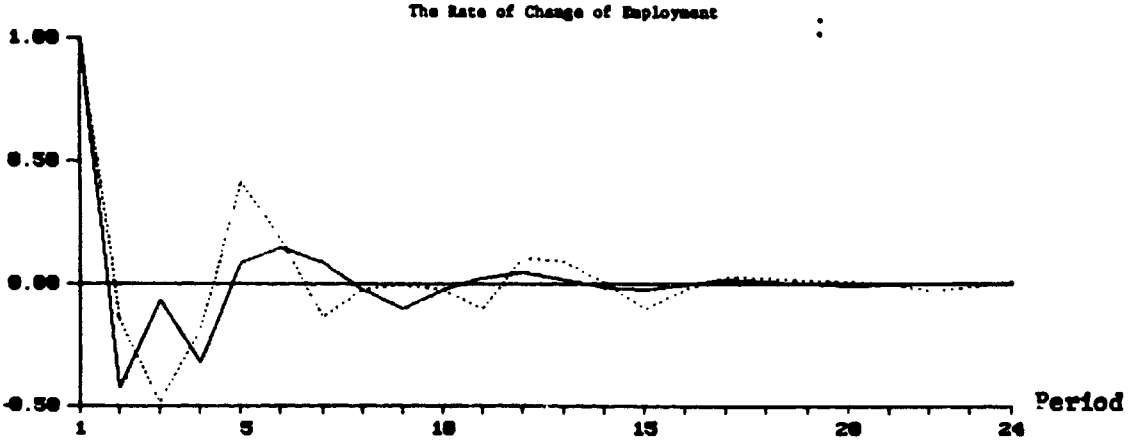
———: Before the Program

- - - -: After the Program

The Rate of Change of Industrial Production



The Rate of Change of Employment



The Rate of Unemployment

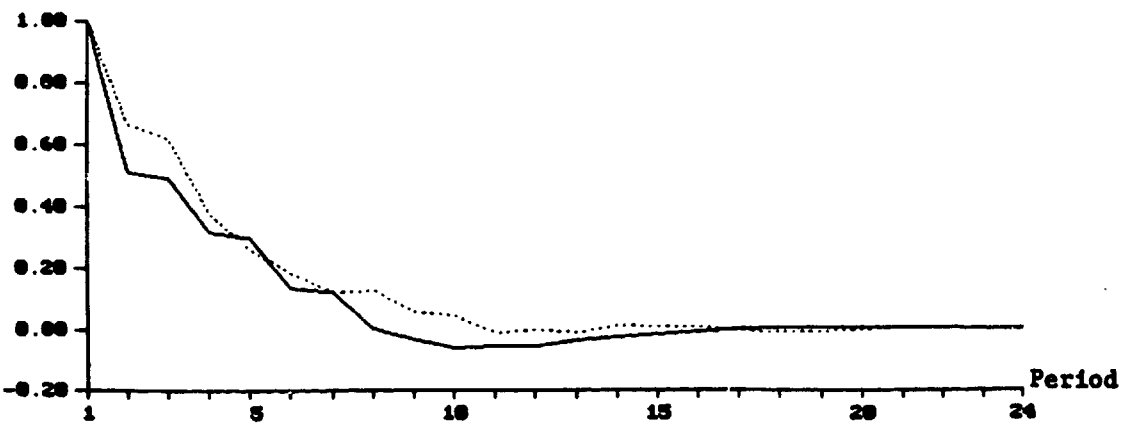


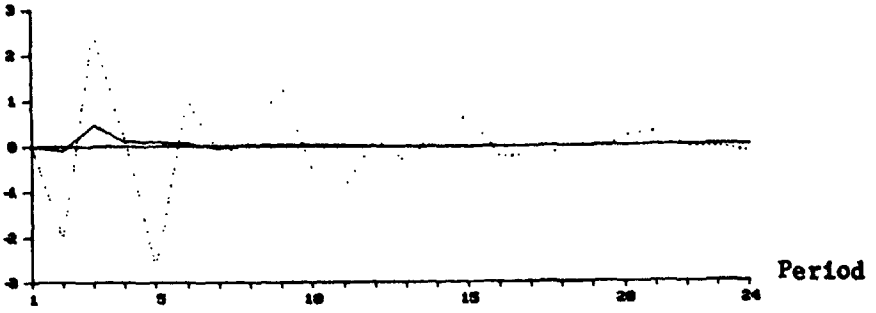
Figure 6

Cross Effects of Inflation Shocks on:

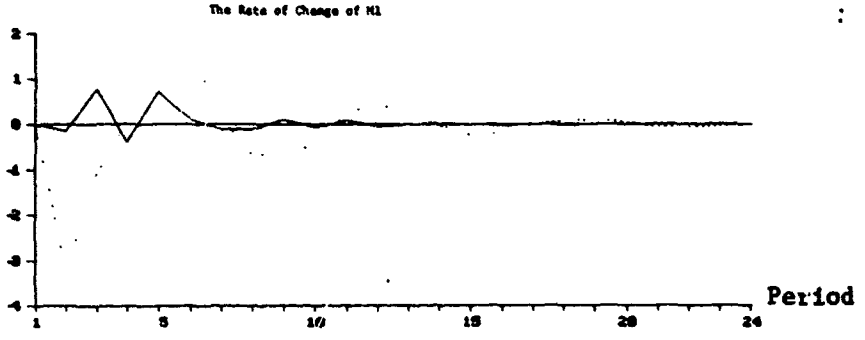
Before the Program

After the Program

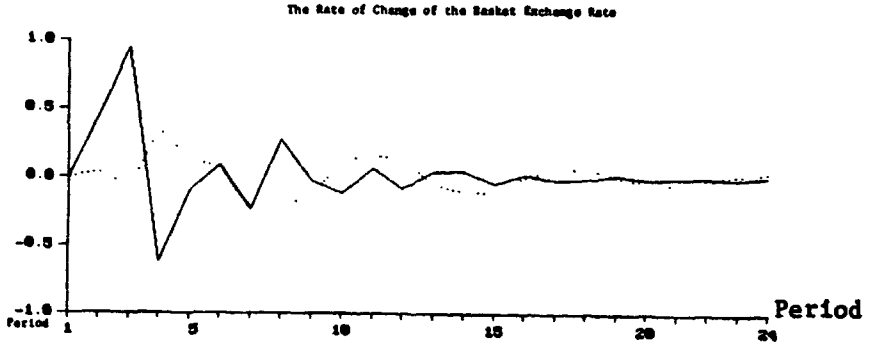
The Rate of Change of Wages



The Rate of Change of M1



The Rate of Change of the Basket Exchange Rate



The Rate of Change of Employment

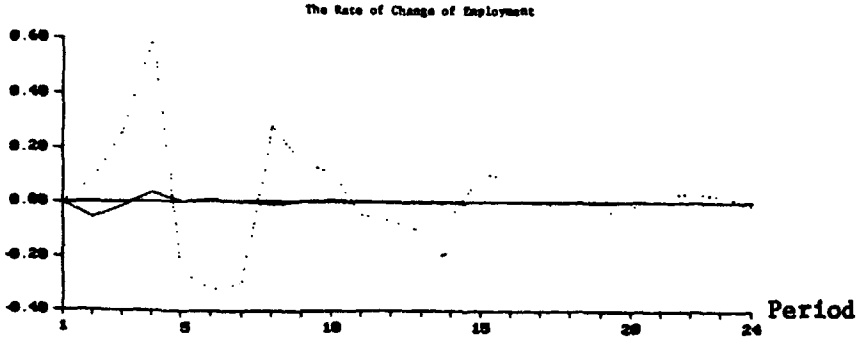


Figure 8A - Cross-Sectional Variabilities

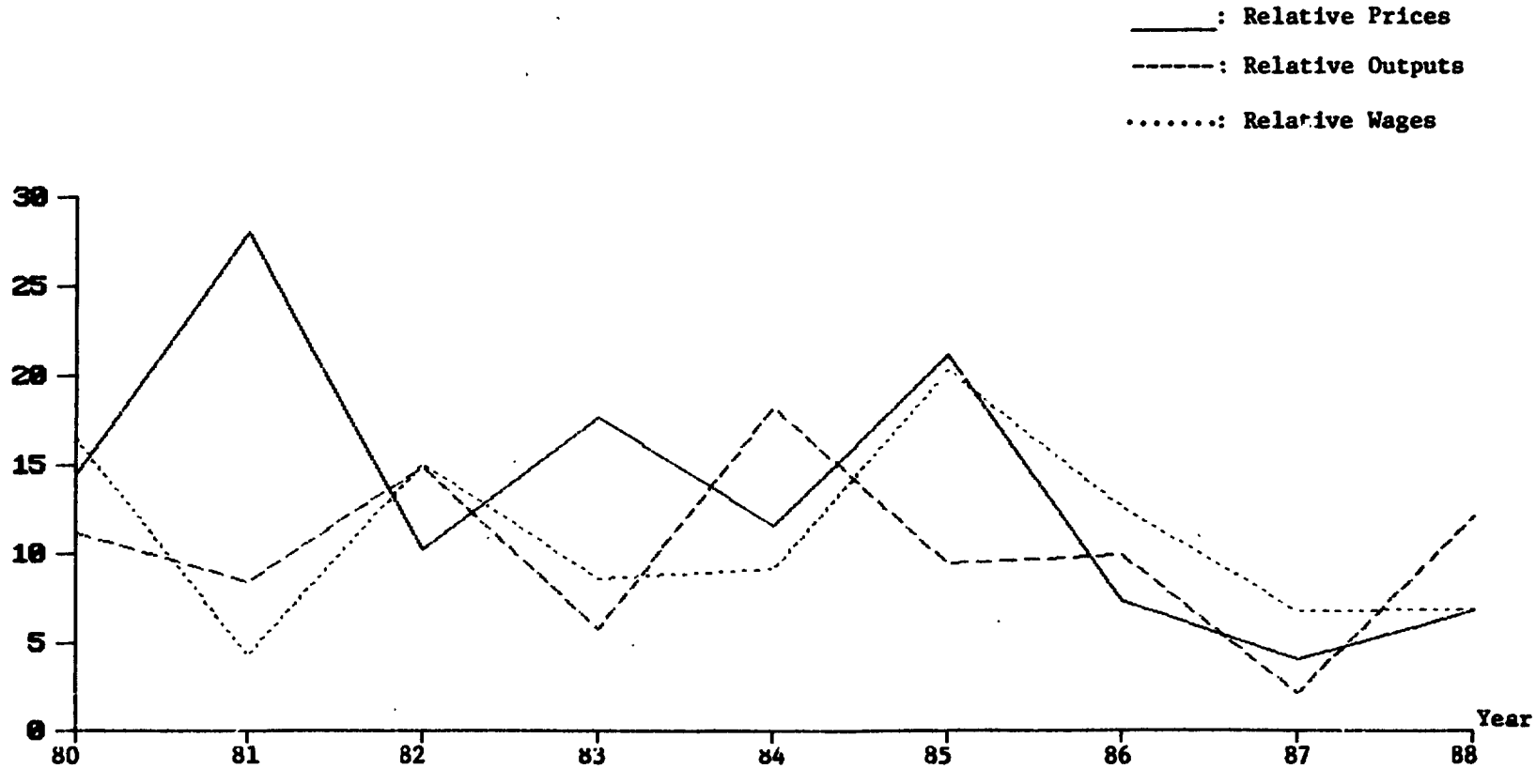


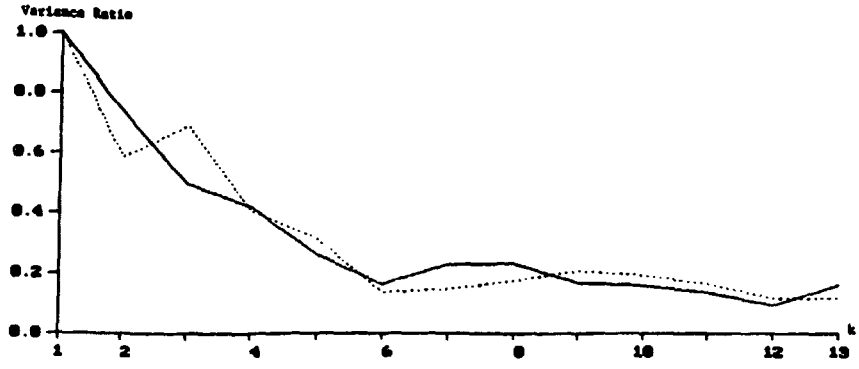
Figure 9

Selected Variance Ratios

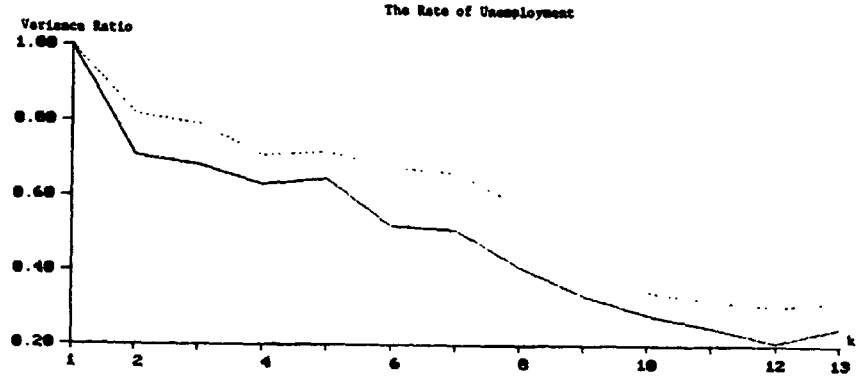
——: Before the Program

– – – –: After the Program

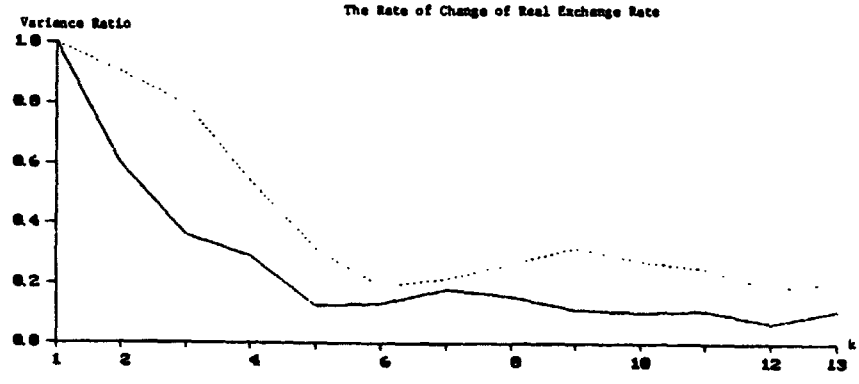
The Rate of Inflation



The Rate of Unemployment



The Rate of Change of Real Exchange Rate



Real Interest Rate

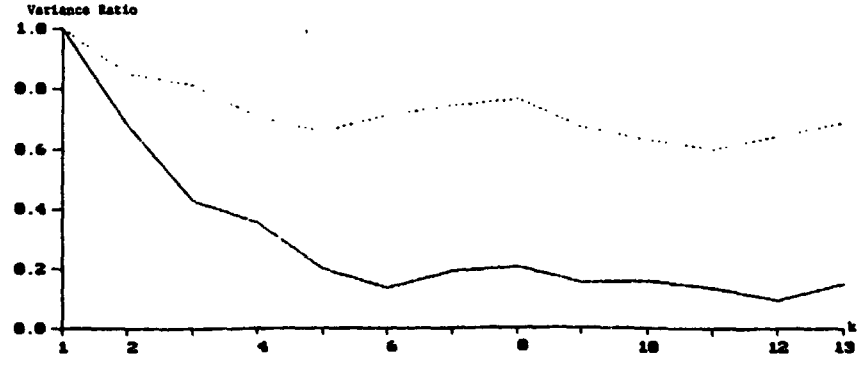
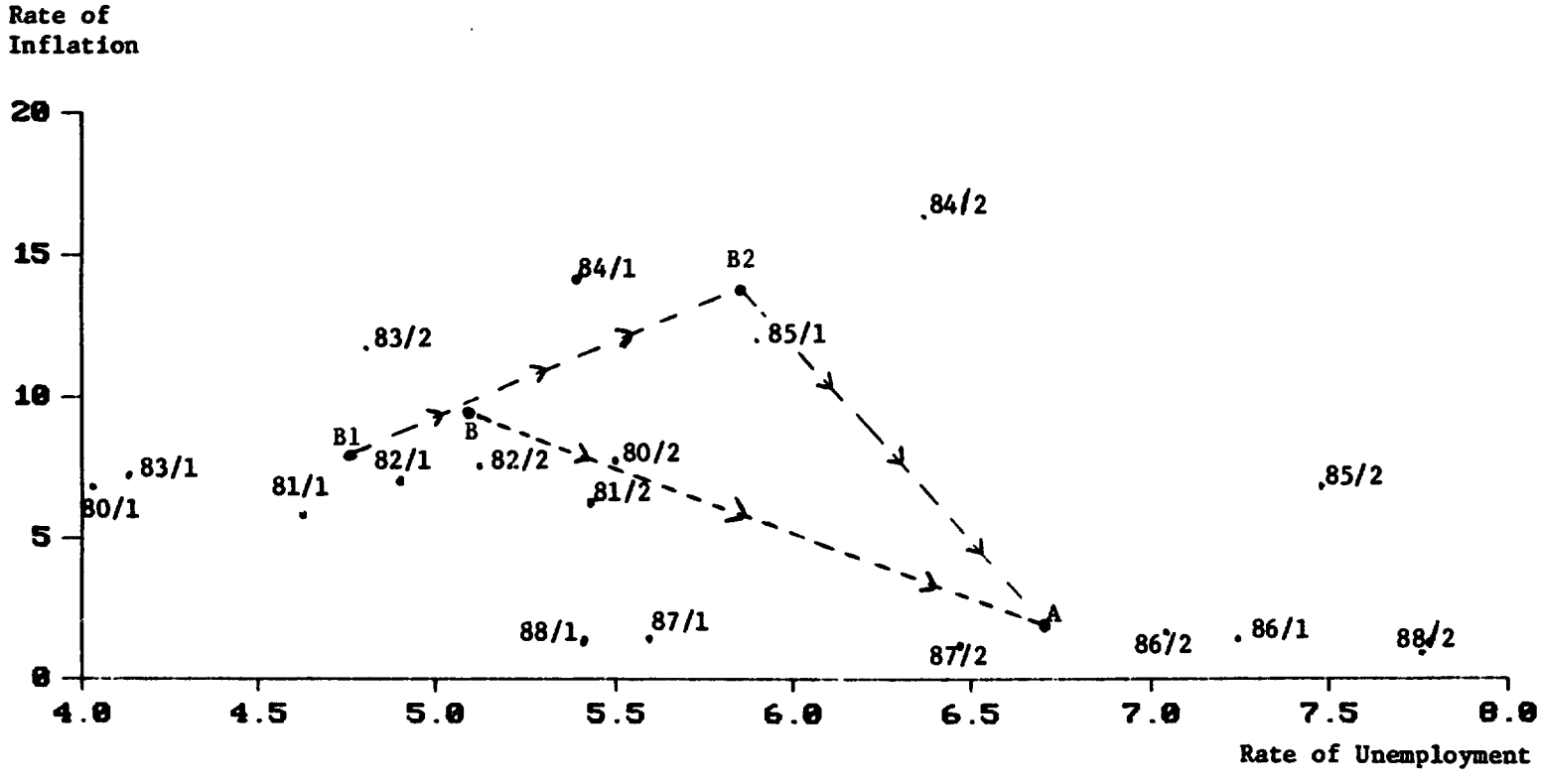


Figure 10

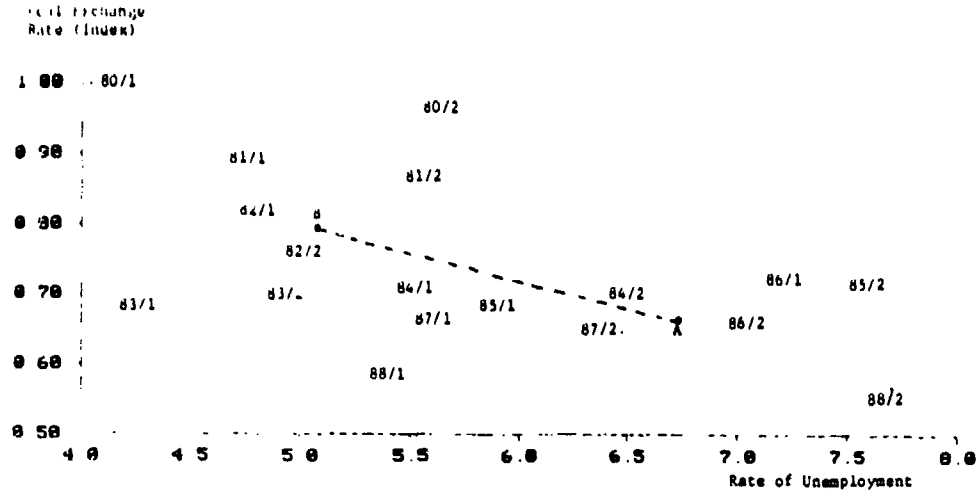
THE INFLATION/UNEMPLOYMENT TRADEOFF
(Correlation Coeff. = -0.32)



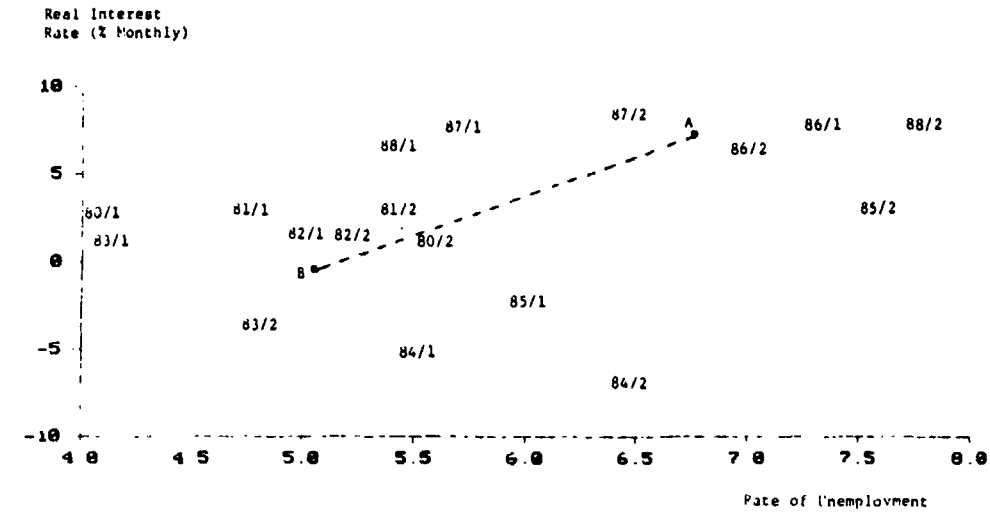
Note : The data plotted are half-yearly averages. B indicates the averages before the program and A after the program. B1 indicates the averages for the 1980-83 period and B2 those for the 1984-85:1 period.

Figure 11

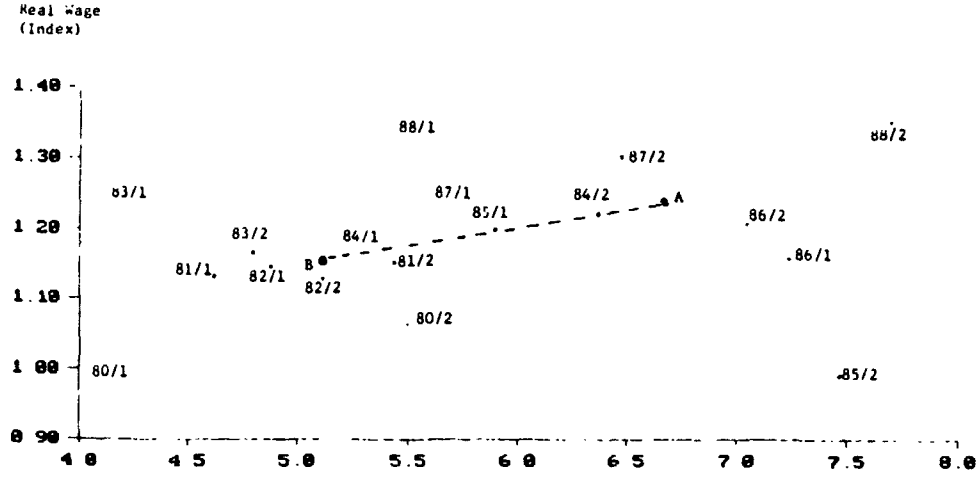
THE REAL EXCHANGE RATE AND THE RATE OF UNEMPLOYMENT
(Correlation Coeff. = -0.54)



THE REAL INTEREST RATE AND THE RATE OF UNEMPLOYMENT
(Correlation Coeff. = .35)



THE REAL WAGE AND THE RATE OF UNEMPLOYMENT
(Correlation Coeff. = 0.22)



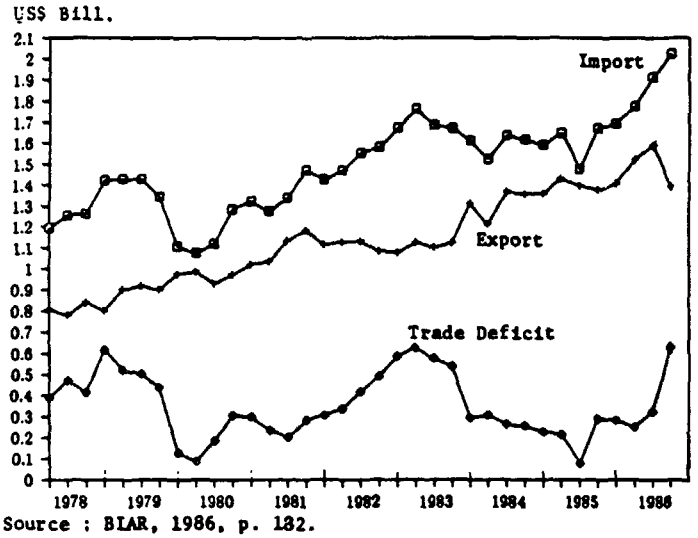
Note See note to Figure 10.

Figure 12

Trade Balance, Real Labor Cost, and Unemployment

Trade Balance (Seasonally Adjusted) 1978-86

(US$ Bill., 1980 Prices)



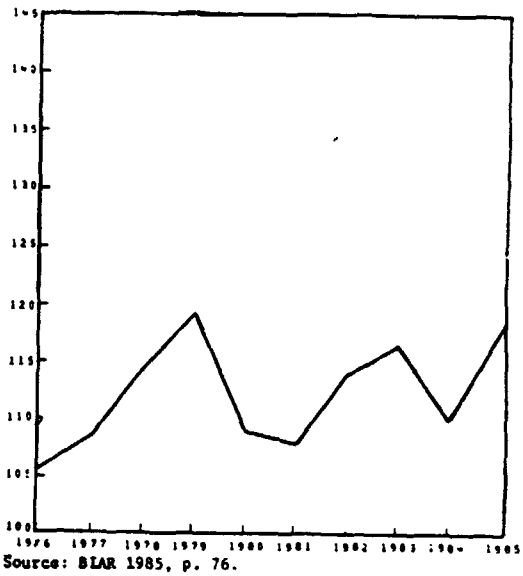
Source : BIAR, 1986, p. 132.

BIAR stand for Bank of Israel Annual Report.

Real Labor Cost per Unit of Output in Business Sector

1975-1985

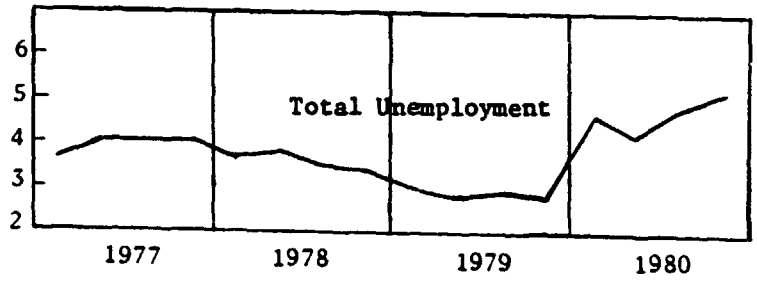
(Average 1971-75=100)



Source: BIAR 1985, p. 76.

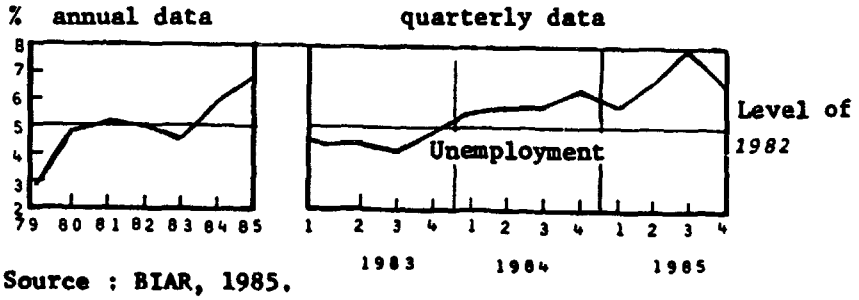
Rate of Unemployment 1977-80

(Quarterly, Seasonally Adjusted)



Source : BIAR, 1980.

Employment and Unemployment, 1974-85



Source : BIAR, 1985.

PPR Working Paper Series

	Title	Author	Date	Contact for paper
WPS294	Irreversibility, Uncertainty, and Investment	Robert S. Pindyck	October 1989	N. Carolan 61737
WPS295	Developing Country Experience in Trade Reform	Vinod Thomas	October 1989	S. Fallon 61680
WPS296	How Serious is the Neglect of Intrahousehold Inequality?	Lawrence Haddad Ravi Kanbur	November 1989	J. Sweeney 31021
WPS297	Effects of the Multi-Fibre Arrangement on Developing Countries' Trade: An Empirical Investigation	Refik Erzan Junichi Goto Paula Holmes	November 1989	L. Tan 33702
WPS298	Evaluation and Validation of a Multi-Region Econometric Model: A Case Study of MULTIMOD: A Forward-Looking Macroeconometric Model	Ahmad Jamshidi		
WPS299	The External Effects of Public Sector Deficits	Carlos Alfredo Rodriguez	November 1989	R. Luz 61588
WPS300	How the 1981-83 Chilean Banking Crisis was Handled	Mauricio Larrain		
WPS301	Myths of the West: Lessons from Developed Countries for Development Finance	Collin Mayer	November 1989	WDR Office 31393
WPS302	Improving Support Services for Rural Schools: A Management Perspective	Sherry Keith		
WPS303	Is Undernutrition Responsive to Changes in Incomes?	Martin Ravallion	November 1989	C. Spooner 30464
WPS304	The New Political Economy: Positive Economics and Negative Politics	Merilee S. Grindle		
WPS305	Between Public and Private: A Review of Non-Governmental Organization Involvement in World Bank Projects	Lawrence F. Salmen A. Paige Eaves		
WPS306	A Method for Macroeconomic Consistency in Current and Constant Prices	Ali Khadr Klaus Schmidt-Hebbel		

PPR Working Paper Series

	Title	Author	Date	Contact for paper
WPS307	On the Accuracy of Economic Observations: Do Sub-Saharan Trade Statistics Mean Anything	Alexander J. Yeats	November 1989	J. Epps 33710
WPS308	Harmonizing Tax Policies in Central America	Yalcin M. Baran	November 1989	T. Watana 31882
WPS309	Honduras-Public Sector Finances, Issues, and Policy Suggestions to Resolve Them	Yalcin M. Baran	November 1989	T. Watana 31882
WPS310	A Macroeconomic Consistency Framework for Zimbabwe	Ali Khadr Klaus Schmidt-Hebbel		
WPS311	Macroeconomic Performance Before and After Disinflation in Israel	Leonardo Leiderman Nissan Liviatan	November 1989	R. Luz 61588
WPS312	Improving Public Enterprise Performance: Lessons from South Korea	Mary M. Shirley	October 1989	R. Malcolm 61708
WPS313	The Evolution of Paradigms of Environmental Management in Development	Michael E. Colby	November 1989	C. Evangelista 32645
WPS314	Primary Commodity Prices and Macroeconomic Variables: A Long-run Relationship	Theodosios Palaskas Panos Varangis	November 1989	D. Gustafson 33714
WPS315	Notes on Patents, Distortions, and Development	Julio Nogués		
WPS316	The Macroeconomics of Populism in Latin America	Rudiger Dornbusch Sebastian Edwards		
WPS317	Price and Quality Competitiveness of Socialist Countries' Exports	Zdenek Drabek Andrzej Olechowski		
WPS318	Debt Buybacks Can Indicate Sovereign Countries' Willingness to Raise Investment and Repay Debt When Partial Debt Relief is Offered: Theory and Tests	Sankarshan Acharya Ishac Diwan		
WPS319	Trends in South-South Trade and the Potential in Non-Discriminatory Liberalization of Barriers	Refik Erzan		