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STAGFLATION AND PRODUCTIVITY DECLINE IN CANADA, 1974-1982

John F. Helliwell

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ABSTRACT

The MACE model of Canada employs a nested production structure in which there is a vintage bundle of capital and energy that is combined with efficiency units of labour to define potential output for given quantities of employed factors. The actual level of output is derived from an estimated utilization-rate equation, in which the ratio of actual to potential output depends on unexpected sales, profitability, and the gap between actual and desired inventories. Using this production structure, it is possible to attribute 30% of the decline in labour productivity between 1973 and 1982, relative to a steady growth case, to desired substitution of labour for energy, one-third to unexpectedly low demand, and one-fifth to low profitability. The unexplained residual is less than one-fifth. The macroeconomic structure of the model is then used to trace the underlying reasons for the differences between steady growth and actual history. It is concluded that most of the changes in factor proportions, demand, and profitability in Canada were due to the changes in world oil prices and the parallel changes in inflation and real output in other industrial countries.

John F. Helliwell
Department of Economics
University of British Columbia
Vancouver, B.C, Canada V6T 1Y2

(604) 228-4953

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John F. Helliwell[1]

1. Introduction

This paper is an exercise in cliometrics, the name coined to describe the application of econometrics to the interpretation of history. It differs from most other quantitative economic history in both topic and methodology. The topic is unusual in its breadth and its currency; indeed it may be stretching things a bit to treat 1982 as history when the complete national accounts data are not yet published. In this regard, I am heartened that W. A. Mackintosh himself completed the first draft of his insightful historical chapter on "The Course of Depresssion and Recovery, 1929-1938" (Chapter 6 of Mackintosh, 1964) in August 1938, and had the work in final form by the spring of 1939.

In terms of scope, I am trying to explain why the Canadian history of growth, unemployment, inflation and productivity from 1974 through 1982 was so different from that of the preceding twenty years.

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[1]Department of Economics, University of British Columbia. An earlier version of this paper was given as a W.A. Mackintosh Lecture at Queen's University, on March 10, 1983. I am grateful to the members of the Economics Department at Queen's for their hospitality, encouragement and helpful comments. In preparing the paper, I have had invaluable collaboration and research assistance from Mary MacGregor, Andre Plourde, and Alan Chung. I am also grateful for financial assistance from the Social Sciences and Humanities Research Council of Canada.

The usual procedure in quantitative studies of economic history is to establish an empirical framework, most often partial in nature, in which the effect of a particular policy or event can be assessed. If one starts, as I do, with a quantitative model[2] that pretends to explain all of the main economic aggregates by means of estimated behaviour equations and relatively few exogenous variables, then it is tempting to take a more ambitious approach. This involves first the creation of a hypothetical history in which all of the foreign variables and domestic policies are set on smooth surprise-free paths from 1974 to 1982, and second deriving results showing how the Canadian economy would have evolved over the past nine years. It is then possible to add back, either separately or in groups, the various external and internal disturbances that have taken place since 1973, and thus to explain their likely impact on the economy. To the extent that the final results differ from history, even after all of the identified shocks have been accounted for, there remains a puzzle for future research.

If the hypothetical history with smoothly growing exogenous variables settles down to a smooth growth path, and

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[2] I shall be using the MACE model, for which the fullest description of structure and properties is Helliwell et al (1983). Helliwell, Boothe and McRae (1982) also contains all the equations of the model and an assessment of the macroeconomic effects of alternative Canadian energy pricing policies during the 1970s. The Appendix to this paper contains the model's equations for output, potential output and factor demands. These equations make up almost half of the model's structure, and are especially important for the analysis of productivity.

if adding the effects of identified shocks should serve to explain most of the gyrations of actual history, then a case can be made that the basic behavioural structure of the Canadian economy has not altered dramatically. If that is what the evidence should indicate, there are important implications for economic policy and for the interpretation of history. It would mean, for example, that the stagflation of the 1970s was not an inexplicable phenomenon rendering obsolete any quantitative models based on the experience of the 1950s and 1960s. It would also mean that the sharp post-1973 drops in productivity growth, as measured by output per employee, do not represent a collapse in the rate of technical progress, or a drop in the competitiveness and efficiency of Canadian industry, but are the expected result of the external shocks and internal policies that have occurred since 1973.

I shall first present some key features of the Canadian economy from 1974 to 1982 under three alternative histories: the hypothetical shock-free economy, actual history, and the model results including the effects of identified shocks. Section 3 examines the sources of productivity change in some detail, separates the effects of capacity utilization from those of changes in factor prices, and assesses the extent to which there remains, at the aggregate level, a productivity problem or puzzle to be explained. The results in that section will be mainly drawn from the supply side of the MACE model, the equations of which are contained in the Appendix.

Section 4 digs deeper into the external causes of the stagflation and productivity decline by using the whole MACE model to assess the separate and joint effects of the OPEC oil price shocks and the post-1973 stagflation in the industrial countries of the OECD.

Section 5 turns to the impact of domestic policies, including the 1976-78 Anti-Inflation Board, fiscal policies, monetary and exchange rate policies, and Canadian energy pricing policies. The results obtained by adding all of the shocks and policies to the steady growth environment are described in section 2 as "model with shocks". Any differences between these results and what actually happened (called "Actual History" in the tables) represent the failure of the model to explain all that happened. These errors may be due to structural changes, measurement errors, specification errors, or random disturbances, and provide an interesting menu for further research.

2. Alternative Histories

To construct a complete picture of how the Canadian economy would have evolved in the absence of OPEC and other 1970s shocks to the domestic and world economies, one needs an estimated econometric model plus a certain amount of artistic licence. The latter is required because there are a number of particular features of the economy that were well out of equilibrium in 1974, the first year of the new "steady growth" regime, and there are always a number of relatively minor aspects of the model (e.g., exogenous determination of energy exports, the setting of pipeline tariffs, etc.) that are not completely applicable to the no-OPEC world. The policy assumption adopted for the transition to steady growth was one of the "cold shower" rather than of policy gradualism. All government spending was set to grow from 1974 on at 2%, in real terms, or roughly 1% per capita. World oil prices, and all prices of energy imports and exports, in terms of U.S. dollars, are set to grow at 2% plus the U.S. rate of inflation. United States and OECD real incomes and prices are set to grow at their 1952-73 averages. Direct and indirect tax rates are set at their 1973 values, interest rates are determined by an estimated monetary policy reaction function (in which the target interest rate depends chiefly on U.S. interest rates, with additional impacts from the stock of foreign reserves and the rate of growth of the money supply), and the exchange rate is determined by market-clearing forces modified by an official intervention policy based on "leaning against the wind". Given the policy-determined interest rate, the government deficit is then financed by whatever mix of bonds and money is needed to satisfy the demand for money. Domestic city-gate crude oil and natural gas prices are set throughout the 1974-82 period at 100% of btu parity with imported crude oil.

This combination of spending and world price assumptions requires a fairly sharp deceleration of the 1971-73 rates of growth of income and prices. After a "hangover" year in 1974, with below average real growth and above average inflation, the rate of real GNP growth fairly quickly settles down to an average of about 4.5%, with an inflation rate of about 3.5% and monetary growth of about 7%. The unemployment rate varies narrowly in the 5.1% to 5.25% range. The wage equation involves a real wage that grows about 1% faster than the 2% constant annual rate of growth of the labour efficiency index. If the steady growth simulation is extended through the rest of the 1980s this "real wage creep" eventually leads to somewhat higher rates of inflation, interest rates, and unemployment, but these changes are not dramatic, and do not affect the results over the 1974-82 period.

The current account of the balance of payments in the steady growth case has an annual deficit, which is matched by private capital inflows, that varies in the $2.1 to $3.3 billion range (measured in current dollars). This involves a foreign debt that grows (like the government debt) less fast than GNP, causing the ratio of foreign debt (at market value) to nominal GNP to fall from about 50% in 1974 to just under 40% at the end of 1982.

Although the world price of crude oil is assumed to grow annually at 5% per annum from its 1973 base (reaching the lofty level of $US 3.43 per barrel by 1982), the domestic markups for oil and natural gas do not rise as fast as the rate of inflation, so that the overall price index for energy rises slightly less fast than the general price index and substantially less fast than the real wage. This leads to a continuation of the pre-1973 trend of increasing use of energy relative to capital and, especially, the continuing substitution of energy for labour. Between 1974 and 1982 the use of energy per employee in the steady growth case increases by 38%, while the use of energy per unit of GNP rises by 17%.

As can be seen from the summary statistics presented in Table 2.1, steady growth gives remarkably better performance than was actually obtained. By 1981, actual GNP was more than 11% below the steady growth path, and in 1982 this gap widened to 18%. Cumulated actual real GNP between 1974 and 1982 was 91 billion 1971$ less than in the steady growth alternative. This shortfall amounts to more than 8 months of GNP at 1982 production levels. The 1982 steady growth unemployment rate is 5.1%, less than half the 10.8% rate actually experienced. The steady growth case also has much less inflation, with a 1982 price level 40% below the actual one.

The natural reaction to the comparison of the actual and the steady growth results is to treat the steady growth numbers as pie-in-the-sky projections based on blind extrapolation of past relationships that have no reference to the 1970s and 1980s. In one important sense, that reaction is justified, in that there is no way that Canada could have escaped or even materially altered the world economic conditions of the time, and hence no means whereby the steady growth path could actually have been achieved. However, the purpose of the projections is to show what the 1970s and 1980s would have been like if world conditions and domestic policies had followed stable paths. The realism of the hypothetical path cannot be disputed on the grounds that actual history has been different. A more appropriate test is to add back the effects of the external and internal disturbances, and then see to what extent the resulting figures capture the broad features, and even the detail, of what has actually happened.

The figures in the right-hand column of Table 2.1 show the extent to which allowing for specific external disturbances and internal policies helps to explain the large divergences between the steady growth case and what actually happened. The figures are calculated by taking the difference between the steady growth and "model with shocks" results as a percentage of the difference between the steady growth and actual results. The figures show that the largest parts of the changes are attributable to the various shocks and policies. Since the real declines are slightly under-explained, while the price level differences are over-explained, it can be inferred that the overall impact of excluded or residual factors has been to reduce both output and inflation below what they otherwise would have been.

The figures are reported for both 1981 and 1982, in part because final figures for 1982 are not yet available, but also to show that the model mechanisms and the external shocks are better able to explain the 1974 to 1981 period than the sharp drop in demand and output between 1981 and 1982. Both years are outside the model's estimation period, which ended in 1980. Even in 1982, domestic final spending (made up of C + I + G, but excluding inventory investment) is more closely captured than is output. The reason, as will be discussed further in the next section, is that the actual inventories decreased by 2.8 billion 1971$ in 1982, while the model with shocks forecasted that they would have risen by 3.7 billion 1971$ in the face of the largely unexpected drop in sales.

The next section will deal in more detail with output and factor inputs. It is a prelude to section 4 which disentangles the effects of the various shocks and policies.

3. Productivity, Factor Demands, and Capacity Utilization

The most commonly quoted measure of productivity is that of output per employee. At the aggregate level, it is common to use GNP as the output measure. However, as has been pointed out often (e.g., Department of Finance, 1980), gross domestic product is more appropriate, since it measures the output of factors employed in Canada. For Canada, GDP is larger than GNP, since Canada is a net debtor. In developing the production structure of the MACE model, which is shown in detail in the appendix, we further refined the output measure to remove indirect taxes and to add net energy imports to give the gross output, at factor cost, of the energy-using sectors.

The production function includes three factors: energy and capital are bundled together in a vintage CES sub-function, and this capital-plus-energy bundle is combined with efficiency units of labour in a Cobb-Douglas outer function. Because changes in utilization rates for employed factors are important in our sample period, we could assume only that the functions held on average over the sample period. We chose a relatively simple functional form, and introduced additional flexibility and accuracy by bundling capital and energy in the manner supported by other research results (e.g., Berndt and Wood, 1979). We were then able to use sample averages, trends, factor share ratios, and the requirement that relative factor use ratios should equal their optimal values on average over the sample period, to determine many of the parameters. We used direct econometric estimation of the factor demand equations to determine two key unknown parameters, as well as to establish the adjustment speeds and expectations processes that play such an important role in factor demands. The two key parameters are the elasticity of substitution (sigma=0.6) between capital and energy, and the annual rate (delta2=0.72) at which energy/capital proportions become malleable in the vintage bundle.

Since many analysts have concluded that there has been a post-1973 drop in productivity growth, measured in one or more ways, we attempted to see whether any such break appeared in our production structure. A sequence of tests was done using secondary technical progess terms starting in each year from 1971 to 1978. The tests were done (as described in Helliwell et al, 1983) both with and without the other variables determining the level of production, and in no case was there a break in technical progress that was either large or significant. Thus it would appear that our separation of the energy and non-energy sectors, along with the explicit inclusion of energy in the production function of the non-energy sector, eliminates any significant 1970s break in total factor productivity in the energy-using sector.

The synthetic output measure (qsv) is obtained by combining actual employment with the vintage capital/energy bundle (kev). The MACE model contains an explicit equation for the production decision, with inventory change determined residually. The production decision is estimated as a utilization rate decision (q/qsv is the utilization rate), with the determining variables being the ratio of final sales to qsv, the ratio of desired to actual inventories, and the ratio of current costs to the price of output. The latter variable, cq, is an inverse measure of profitability.

Both sales and profitability have had strong impacts on the output decision, thereby supporting our initial assumption that there were significant economically determined departures of output from the level indicated by a production function based on measured factor inputs. Given the production and factor utilization structure described above, it is natural and potentially rewarding to use it to attempt to disentangle the causes of the drop in productivity growth in the post-1973 period. In this section, we shall divide the causes among changes in factor proportions, changes in demand conditions, and changes in profitability, and shall leave the explanation of the causes of the changes in demand conditions and profitability until the next section.

As can be seen from Figure 3.1 and Table 3.1, actual output per employee was 10% below the steady growth case in 1981, and 13.4% below in 1982. The productivity definition can conveniently be decomposed into two parts, one reflecting the mix of factors and the second being the overall factor utilization rate:[3]

$$q/ne = (qsv/ne)*(q/qsv)$$

As is shown in Figure 3.1 and Table 3.1, 4.4% of the 10% 1981 productivity drop, relative to the steady growth case, was due to changes in the factor mix, and the rest to lower

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[3] The overall utilization rate thus shows the extent to which measured total factor productivity differs from its trend.

capacity utilization. In 1982, 3.8% of the 13.4% was due to changes in the factor mix, and the rest to changes in capacity utilization. Thus about 3.5 to 4.5 percentage points of the post-1973 productivity decline (as before, relative to the steady growth case) are due to changes in the mix of energy, capital, and labour.

As is well known, the major reason for changes in the factor mix since 1973 has been the sharp increase in the price of energy. Given the lags and costs in adjusting factor proportions, the full effects take time to work out, but they have been very important over the 1974 to 1982 period. The actual 1982 user price of energy, relative to the actual 1982 wage rate was 2.27 times as high as the corresponding 1982 ratio in the steady growth case. If desired output and all other prices were held constant, this would lead eventually to a 64% increase in the equilibrium ratio of labour to energy. The actual 1982 increase, relative to the steady growth case, was, at 42%, less than that, partly because the effects of the higher energy prices have not fully worked themselves out, and partly because of cyclical factors combined with different adjustment speeds for capital, labour, and energy. The model with shocks captures almost all of these effects, since it gives a 1982 ratio of labour to energy that is 44% higher than in the steady growth case. This compares very closely with the actual increase of 42% in the labour/energy ratio relative to the steady growth case.

Some have suggested (e.g. Lindbeck 1983) that capital-labour substitution may have been responsible for lower post-1973 rates of growth of labour productivity in several countries. In the Canadian case, the figures in Table 3.1 show that the capital intensity of production, as measured by the ratio of the capital stock to potential output, is the same as it would have been in the steady growth case. There has been a decline in the capital-labour ratio, but it has been due to the substitution of labour for energy, with capital intensity unchanged. In the MACE production structure, a higher energy price leads to substitution of capital for energy in the capital-plus-energy bundle, while the higher price of the capital-plus-energy bundle leads to the use of more labour and less of the capital-plus-energy bundle. For given levels of desired output, the net effect of an increase in the energy price is to lower the demand for energy and to raise the demand for labour, leaving the demand for capital unaffected[4]. It is for this reason that the factor substitution portions of the productivity pies in Figure 3.1 have been labelled as 'energy saving', since the additional labour used was in substitution for energy rather than capital.

How well does the production sector of MACE explain the productivity slowdown, and what are the factors responsible?

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[4] Naturally there is a decline in the profitability of using old energy-using capital. This then contributes to a temporary drop in production, labour productivity and investment.

The various elements of the MACE explanation are drawn together in Figure 3.1, which shows the factors directly responsible for differences between actual and steady growth output per employee in 1981 and 1982. Both years lie outside the estimation period for the equations.

The pie segments labelled "energy saving" show the factor substitution effects described above, while the other segments are derived from the equation explaining q/qsv in terms of unexpected sales, profitability and the difference between actual and desired inventories.[5] The segments marked "residual" represent the error in the production equation in the two years.

What do the results suggest? First, they show that most of the decline in labour productivity relative to the steady growth case is explained by the MACE production equations: 96% in 1981 and 82% in 1982. Second, there is more to explain in 1982 than 1981, and the demand variables play a large part in the explanation. The large residual in 1982 requires some discussion. Since this residual was 0.4% in 1981, the 2.4% error in 1982 is almost surely linked to the failure of the production equation to capture the large negative change in inventories in 1982. To the extent that this sharp drop in

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[5] In the pie charts, the inventory stock effects, which would have been small negative slices in the pie, and hence hard to represent, have been used to reduce the sales and profitability effects. The size of the inventory stock effect was 0.6% in 1982, and much smaller in 1981. In both years actual inventories were below their normal relation to the capital stock, and hence should have led to a higher utilization rate.

inventories was due to a liquidity squeeze or to temporarily pessimistic expectations of future sales, then it is likely to be reversed as the recession ends. To the extent that it is linked to a longer term pessimism, it is likely to affect fixed capital spending also, and hence to keep the rebound of the economy below the fairly rapid rates suggested by the model for 1983 and 1984.

In either event, the inventory rundown of 1982, and the associated low levels of production do not provide evidence of long-run productivity problems. Even if they did, by far the largest proportion of the decline in output per worker is explained by changing factor proportions and abnormally low sales and profitability. Thus there does not appear to be strong evidence of a "productivity puzzle" requiring explanation in terms of increasing regulatory burdens, declining R & D, changes in the labour force mix, the growth of the underground economy, or any of the other structural factors that have been invoked to explain the post-1973 productivity declines.

Having argued that the drop in output per worker has been largely due to factor prices, sales, and profitability, it is now necessary to explain how and why these factors, which are endogenous variables rather than exogenous shocks, moved so adversely in the 1974-81 period.

But first, how do our results relate to other research on the post-1973 declines in productivity growth? I am not familiar with any studies that have attempted, as we have done, to explain aggregate productivity change in a framework that treats capacity utilization and factor substitution in an integrated and consistent way. The Economic Council of Canada (1980) identified a post-1973 "productivity puzzle" in its Seventeenth Annual Review, and thereafter launched a series of further empirical studies, many of which focussed on particular industries.

One of these studies, by Rao and Preston (1982), attempts to unravel the puzzle by estimating translog cost share equations as a means of discovering how much of the post-1973 slowdown in productivity growth could be attributed to factor substitution. Unfortunately, the model and the estimation method require the assumption that production and factor use are in continual equilibrium. This has the effect of leaving capacity utilization effects as part of an unexplained catch-all residual or, worse yet, getting capacity utilization effects mixed up with estimated economies of scale or factor substitution possibilities. A number of other Canadian studies, mostly of the same sort, are usefully surveyed by Denny and Fuss (1982).

At the aggregate level, Jarrett and Selody (1982) have attempted reduced-form estimation of a link between inflation and productivity, and have used their results to infer that "... the increased inflation rates of the 1970s are sufficient to explain the entire recent slowdown in productivity growth." The correlation that they have found is not inconsistent with our results, since the inflation induced by the external stagflationary shocks is surely correlated with, and may even lead, the induced changes in productivity. To experiment with causality tests between jointly endogenous variables invites false inferences, such as the conclusion that the consequence arriving first (e.g. inflation) in some sense "explains" the consequence arriving second. This would in turn invite the equally false inference that any policy that stopped Canadian inflation in the 1970s would also have removed the productivity slowdowns. To the extent that both were caused by exogenous stagflationary shocks, the policy inference is probably backwards, in that stronger anti-inflationary policies would have changed the mix of output and price responses, and could have easily, by acting on capacity utilization, have made the productivity declines even larger.

Bruno (1982) has attempted to avoid these problems to some extent by using cross sectional data in a reduced-form analysis of inter-country differences in productivity decline in manufacturing. He attributed roughly 60% of the productivity decline to changes in materials price changes and 40% to the slowdown of demand. Since the relative size of the absorption changes is probably correlated with the relative size of export reductions, the absorption variable is probably picking up some of the external demand effect, while his estimated effect of raw materials price changes must include both the input substitution effects as well as some induced utilization effects, to the extent that the latter were not otherwise captured by the absorption variable. While Bruno's results appear to be consistent with ours, it is not possible to make them fully comparable with the results from our more structural approach.

Finally, if it is true, as the research with MACE suggests, that a large part of the post-1973 decline in output per employee is due to low utilization, the same pattern ought to show up even more markedly in the evidence from the 1930s. It does. Real GNP per employee rose, on average, by 3.3% annually from 1926 to 1929, fell by 10.2% annually from 1929 to 1933, and rose by 6.5% per annum from 1933 to 1936.

4. Sources of Stagflation and Output Decline

Curves 1 and 2 of Figure 4.1 show the steady growth and actual historical values of real GNP over the 1974 to 1981 period. Curve 3 shows what would have happened to the steady growth path if world oil prices had followed their actual path but if foreign real income and prices had remained on steady growth paths. For all of the results shown in Figure 4.1, Canadian crude oil prices are set at world levels, with natural gas priced at btu parity with crude oil. Under the world oil price shock, Canadian GNP falls well below the steady growth path after the 1974 oil price increases, converges towards the steady growth path as the oil price growth slows down, and then diverges again after the 1979-80 oil price shock. The effects on the Canadian economy depend crucially on the type of monetary policy assumed. In all of the results reported in this section, the monetary policy is based on the estimated interest-rate reaction function. Since the interest rates determined by the reaction function depend largely on interest rates in the United States, on the level of foreign exchange reserves, and on the rate of growth of government debt, with some influence from the rate of growth of the money supply (no separate role could be found for the inflation rate), there is little increase in interest rates but a very substantial temporary increase in the rate of growth of the money supply after each of the OPEC price shocks. The annual rate of growth of high-powered money is over 21% in 1974, drops to less than 10% in 1977 and 1978, is 11% in 1979, 17% in 1980, and then falls to less than 8% by 1982. The domestic inflation rate, as shown in Figure 4.2, also takes large jumps (it is over 15% in 1974 and almost 13% in 1980) at the time of each oil price increase, falling to less-than-average rates between the two shocks.

The overall effect of the OPEC price shocks, in the absence of world recession, and with an accommodating money supply, is to give two large jumps in the inflation rate, and two corresponding drops in the GNP growth rate. The oil price increases therefore have important, but fairly transitory, stagflationary effects. By 1982, the level of real GNP is back to within 2% of the steady growth path, while the price level remains 30% above that in the steady growth case. The cumulative loss of real GNP over the nine years is about 30 billion 1971$.

Curve 4 in Figure 4.1 (as well as the corresponding curve in Figure 4.2) shows what happens if international oil prices and world activity and price levels are all set to follow their actual paths. After the first OPEC shock, the world recession was sharp but relatively short-lived, and the additional negative effects on GNP are not very large. In part this is due to the additional U.S. inflation, which is reflected in large part in higher Canadian inflation as well. As can be seen from Figure 4.2, the 1974 Canadian inflation rate would have been 8% higher, from the additional impact of world stagflation, and the inflation rate in curve 4 continues thereafter generally 2% to 4% higher than in curve 3. These higher general price levels serve to reduce the real increase in the oil price, which is set exogenously in terms of U.S. dollars. The extra inflation cumulates to give a 1982 GNP price level that is 80% higher than in the steady growth case.

The effects of the world stagflation on Canadian real GNP are especially large after the second oil shock; by 1982 annual GNP in this case is 19 billion 1971$ less than in the price shock curve 3. Relative to the steady growth case, the cumulative loss of GNP to the end of 1982 is over 80 billion 1971$. As can be seen from Figures 4.1 and 4.2, the OPEC oil price shocks and the associated world stagflation explain most of the loss of output growth, and the higher inflation, that Canada has experienced since 1973.

The cumulative average annual productivity increase from 1972 to 1982 in the OPEC case without world stagflation is only one-half what it is in the steady growth case, as it drops from 1.8% to 0.9% per year. Since real GNP in 1982 under the OPEC price shocks is only 2% below its steady growth level, these results show how misleading it can be to use labour productivity as a measure of welfare when relative factor prices are changing. In the case of energy price increases without world stagflation, the drop in labour productivity is almost entirely due to the resulting substitution of labour for energy in order to achieve least cost production.

When the effects of world stagflation are added, as they are in curve 4, there are offsetting consequences for productivity growth. On the one hand, the slump in export demand lowers the rate of capacity utilization, and hence the amount of output per employee. On the other hand, the rise in the general world inflation rate serves to dampen the size of the real increase in the world oil prices, and thus to limit the substitution of labour for energy. The utilization rate effect is larger, and hence labour productivity growth is lower with the world stagflation than without it.

5. The Effects of Domestic Policies

Figures 5.1 and 5.2 show the real GNP and inflation effects of changes in Canadian macroeconomic policy since 1973, while Figures 5.3 and 5.4 show the effects of alternative energy pricing policies. The first two curves on all the figures show history and steady growth. In the first set of figures (5.1 and 5.2) the third curve shows the effects of OPEC prices and world stagflation combined (curve 4 in Figures 4.1 and 4.2). This section thus starts off where the last section finished. The first set of figures shows first (in curve 4) the effects of the 1976-78 Anti-Inflation Board (AIB) and then (in curve 5) the effects of moving all tax rates and government expenditures to their actual values, and reintroducing the estimated effects on wages of changes in unemployment insurance premiums and benefits. The effects of actual interest rate and exchange rate policy, compared to the reaction functions used, are shown by comparing curve 5 in Figures 5.1 and 5.2 with curve 3 in Figures 5.3 and 5.4, since the latter curve has interest rates, as well as all tax rates and government spending and transfers, held at their actual values, and uses the actual rather than lagged exchange rate as the starting point for exchange market intervention.

Turning to the results themselves, the key effect of the AIB was to reduce nominal (and real) wage rates, leading indirectly to a lower price level. Assuming the use of world oil prices in Canada the cumulative wage level effects of the AIB amount to 20%, and the cumulative price level effects (using the GNP deflator) to 13%, thus giving a 7% drop in the real wage. The effects on real GNP depend entirely on the type of monetary and and exchange rate policy assumed. In an earlier paper (Helliwell, 1982), the effects of the AIB were analyzed using a monetary policy focussed on the money supply and real interest rates, and the exchange rate was allowed to appreciate substantially. The lower prices, given the relatively fixed money supply, gave sharply lower nominal interest rates and increased real GNP substantially. In the current analysis, in which the AIB is being added back in a different policy environment, nominal interest rates fall only slightly, real interest rates rise, and the combination of higher real interest rates and the transfer of incomes from employees to employers combine to reduce slightly both consumption and investment spending, and hence GNP.

The effects of the AIB on labour productivity are fairly substantial, as the lower real wage causes more labour to be used relative to capital and energy. Output per employee in 1982 is 4% lower with the AIB, and the 1982 use of energy per unit of labour is lower by 6%, reflecting the relative increase in the demand for labour in response to the lower real wage.

Government spending and taxation policies combined give slightly higher level of GNP and slightly higher inflation than the steady growth alternatives. In the steady growth case, real government spending grows at 2% every year; in actual history it grew at an average rate of 1.7% from 1973 to 1982, but at a faster rate (4.6%) from 1973 to 1975, and at a slower rate (0.9%) on average since then. The overall effect of moving from the steady growth fiscal policies to the actual ones, combining all policies (including the AIB) and all levels of government, was to add 10 billion 1971$ to cumulative GNP between 1974 and 1982, and to reduce the 1982 price level by 10%, using the steady growth monetary and exchange rate policies, and using world oil prices in Canada.

Adding actual monetary and exchange rate policies, instead of the equations used in the earlier cases, makes only a slight additional effect on GNP, although the resulting price of foreign exchange is substantially higher. In part this reflects the fact that a devaluation in MACE does not have much net expansionary impact on GNP after induced inflation is taken into account.

Putting all of the domestic aggregate fiscal and monetary policies together, their combined impact on real GNP is fairly small relative to the size of the external shocks analyzed in the last section. All of the analysis in this section has assumed that Canadians paid world prices for crude oil throughout the 1974 to 1982 period. In fact, however, the domestic oil price increases have been much more gradual, and the domestic city-gate crude oil price has been well below the world price imediately after each of the world oil price shocks.

To illustrate, the Canadian price was less than 60% of the landed price of imported oil in 1974, rose to about 80% by 1978, fell to 52% in 1980, and thereafter rose to 80% in 1982 and over 90% from 1983 on. After each of the OPEC price increases, wellhead oil prices were held down by federal government regulation until agreed pricing and taxation arrangements could be developed between the federal government and the governments of the producing provinces. After 1973-74, the agreed resolution involved fixed nominal price increases ($1 per barrel each six months) towards the world price, with the federal government financing the subsidy on imported oil. The 1979-80 world oil price increases hiked the net annual economic rents from Canadian crude oil and natural gas (measured relative to world prices, and after allowing for losses of potential rents by having domestic prices below world levels) from less than $10 billion in 1978 to $21.6 billion in 1980, or 7% of GNP. Because of the import subsidy (more than $3 billion annually), a small federal tax share, and low user prices, the federal share of the $21.6 billion was -3%, the provincial share 26%, the producer share 17%, and the energy users' share 56%, with the rest accruing to natural gas export customers.

The federal National Energy Program of late October, 1980, established higher federal taxes, unilaterally set producer prices, and raised user prices to finance the subsidies for synthetic and imported oil. The policy was rejected by Alberta, and a year of stalemate followed. The federal-provincial energy agreements of late 1981 established the world oil price for all new and synthetic oil production, set a schedule of price increases to move the price of old conventional oil to 75% of the world price, and established a number of new federal taxes and charges, including a levy to finance new acquisitions by PetroCan, the federally-owned oil company. In 1982, this raised the federal share of the total rents to 27%, equal to the provincial share, with the producer share at 8% and the energy users' share at 38%.

We have assessed the macroeconomic effects of these actual policies against the 1980 Alberta pricing proposals (the detailed assumptions of the two cases are spelled out in Helliwell and McRae (1982)) and against the world price alterative used earlier in this paper. The Alberta proposals involved user prices similar to those in the actual policies. These prices mainly affected the split between between levels of government, and between government and industry. Since there were no significant macroeconomic differences between the two cases, only the actual policies and the world price alternatives are shown in Figures 5.3 and 5.4.

The effect of the phased and lagged increases in domestic energy prices was to reduce the initial stagflationary impacts of the increases in world oil prices. For example, under the actual policies the inflation rate was lower by 8 percentage points in 1974 and by 4 percentage points in 1980. Growth of real GNP under the actual policies, relative to the world price policies, was 1.5% higher in 1974 and 0.4% higher in 1980. However, these gains in the impact years were dissipated later on as the pricing adjustments were made. By the end of 1982, cumulative GNP was almost indentical, and the price of GNP only slightly lower with the actual policies.

Measured labour productivity is higher under actual prices than under world prices. This effect is entirely due to the fact that there has been less substitution of labour for energy under the actual energy pricing policies.

It is interesting to ask by how much the 1982 recession is due to Canadian energy prices rising later than elsewhere in the world. The results suggest that 1982 GNP growth would have been 1.3% higher, and the rate of inflation 2% lower, had domestic energy prices followed the world prices rather than their actual path.

The U.S. inflation rate has been added to Figure 5.4 to show how the Canadian energy pricing policies in the post-1979 period shifted the Canadian inflation rate out of alignment with the U.S. rate. The U.S. inflation rate peaked in 1980, as the Canadian rate would have done under the world pricing case. Under the actual policies, the peak inflation rate was shifted forward to 1981.

Combining the effects of domestic macroeconomic and energy policies, we have the comparison between curve 4 in Figures 4.1 and 4.2 and curve 4 in Figures 5.3 and 5.4. Cumulative GNP is almost identical in the two cases. The wage level in 1982 is 8% lower, and the GNP price 2% higher in the "policy" case than in the "no policy" case, with resulting impacts on labour productivity. This impact on the nominal and real wage is a consequence of the AIB.

By comparing curve 1 and curve 4 on Figures 5.3 and 5.4 we can see the overall ability of the model as a whole to explain real GNP and inflation from 1974 through 1982. The model tracks the pattern and turning points of GNP and inflation rates and, as reported in detail in Table 2.1, explains most (and sometimes more than all) of the 1982 divergences between the actual and steady growth paths.

6. Conclusion

What inferences can be drawn from the foregoing econometric decomposition and reconstruction of history? On the productivity question, the results provide fairly strong evidence that one-quarter or two-fifths of the post-1973 drop in aggregate productivity (depending on whether 1982 or 1981 is used as the terminal year) is due to changes in factor proportions, induced by higher energy prices, with almost all of the rest caused by decreases in capacity utilization due to low sales and profitability. In terms of underlying causes, almost all of the changes in factor proportions, sales, and profitability were due to the OPEC oil price shocks and the related changes in inflation and real GNP elsewhere in the world.

Given the relative importance of capacity utilization as a determinant of post-1973 productivity changes, it seems inappropriate to study measured productivity change, as many researchers continue to do, by means of production models and factor share equations that assume that there have been no systematic changes in capacity utilization. To do so not only fails to estimate the important role of changes in capacity utilization, but almost guarantees the misestimation of other key parameters, such as the factor substitution possibilities and economies of scale.

On the role of policy, the results suggest that the aggregate role of changes in government spending, taxation, and energy policies was to smooth slightly the path of adjustment of GNP and prices to the OPEC shocks, but with little or no effect on cumulative GNP, and at the cost of a slight worsening of the 1982 recession.

What are the key puzzles that remain? On the basis of the preliminary data for 1982, the model is unable to account for the substantial reductions in consumption, and the very large inventory reductions that were so important in making the 1982 recession as sharp as it was. If output in 1983 and 1984 remains below potential output to the same extent as in

1982, and if these low levels of output are not adequately explained by cyclical variables, then there will be a substantial productivity puzzle remaining. While this evidence is still accumulating, it is intended to apply a similar framework to the aggregate evidence from other industrial countries, and to assess the reasons for international differences in stagflation and productivity growth.

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APPENDIX

Output, Potential Output, and Factor Demands in MACE

List of Variables

Conventions

* denotes desired value, e.g., k^{*}_{inv}

~ denotes quantity given by a CES bundle, e.g., $\tilde{k}_{ev}$

— denotes a two period average, e.g., $\bar{k}_{ne} = \frac{1}{2}\left(k_{ne} + k_{ne-1}\right)$

-t denotes a lag of t years, e.g., q_{-1}

^ denotes equilibrium value at normal capacity utilization after lags are worked out, e.g., $\hat{m}_{ne}$

• denotes one-period proportionate change, e.g.,

$\dot{p}_a = \left(p_a - p_{a-1}\right)/p_{a-1}$

Variable	Equation No.	Description
a	2.3	Real absorption, billion 1971 $
c_q	1.10	Production costs relative to output price for q
D_{aib}		Dummy variable in labour force equation, equal to 1 in 1976 and -1 in 1978, to account for effects of anti-inflation board policies
e	1.8	Energy expenditure, billion 1971 $
e_v	1.4	Vintage-based energy requirement, billion 1971 $

Variable	Equation No.	Description
i_{inv}	1.13	Value of physical change in inventories, billion 1971 $
i_{ne}	1.1	Business fixed investment (excluding energy investment), billion 1971 $
i_{new}	1.3	Re-investment with energy use malleable in the current year, billion 1971 $
$\tilde{k}_{ev}$	1.3	Vintage measure of capital and energy, billion 1971 $
k_{inv}	1.14	Stock of inventories, billion 1971 $
k_{ne}	1.2	Business fixed capital stock (excluding energy), billion 1971 $
M_{id}	4.5	Interest and dividend payments to foreigners, billion $
m_{ne}	1.12	Imports of goods and services (excluding energy, interest, and dividends), billion 1971 $
N_e	1.6	Total employed (excluding armed forces), millions of persons
N_ℓ	1.5	Total civilian labour force, millions of persons
$N_{p\ell}$	Exogenous	Population of labor force age, millions of persons
p_a	3.4	Implicit price of absorption, 1971 = 1.0
P_e	Link	Price of energy to final users, 1971 = 1.0
p_{mne}	3.5	Price of imports of goods and services (excluding energy), 1971 = 1.0
p_q	3.2	Implicit price for output of the energy-using sector.
q	1.11	Gross output (at factor cost) of the non-energy sector, billion 1971 $. (Equals real GDP plus net energy imports)

Variable	Equation No.	Description
q_a	1.15	Aggregate demand (output less unintended inventory accumulation), billion 1971 $
q_s	1.9	Synthetic supply variable, billion 1971 $
q^*	1.16	Desired level of profitable future output for investment demand, billion 1971 $
q_ℓ^*	1.19	Desired level of profitable future output for labour demand, billion 1971 $
q_{sv}	1.17	Vintage-based synthetic supply, billion 1971 $
r_ℓ	5.7	Average yield on Government of Canada bonds, 10 years and over, percent
T_i	5.1	Indirect taxes less subsidies, billion $
W	3.1	Wage rate, thousands of dollars per year per employed person
X_{id}	2.10	Interest and dividend receipts from non-residents, billion $
y_{res}	Exogenous	Residual error of estimate, billion 1971 $
δ_1	Estimated parameter	Annual rate at which energy/capital proportions become malleable in $\tilde{k}_{ev}$. δ_1 = .72
δ_2	Exogenous	Depreciation rate for non-energy capital stock (including housing). δ_2 = .05
Π	Estimated	Labour productivity index for Harrod-neutral technical progress in Cobb-Douglas function for q. The annual growth rate is 1.99 per cent
ρ_r	Exogenous	Real supply price of capital, percent. ρ_r = 7.0
α, β, γ, σ	Estimated parameters	Parameters for nested production functions. α = .356; β = .70584; γ = .10831; σ = .6

MACE Equations for Supply and Factor Demands

(1.1) Business fixed investment:

$$i_{ne}/\bar{k}_{ne} = \underset{(3.70)}{.38258}\ i_{ne-1}/\bar{k}_{ne-1} + \underset{(6.96)}{.052500}\ (k^{*}-\bar{k}_{ne})/\bar{k}_{ne}$$

$$- \underset{(5.87)}{.079159}\ c_q + \underset{(7.42)}{.12167}$$

2SLS 1954-1980: s.e.e = .00296; $\bar{R}^2$ = .823; Durbin-h = 1.11

(1.2) Business fixed capital stock:

$$k_{ne} = (1-\delta_2)k_{ne-1} + i_{ne}$$

(1.3) Vintage bundle of capital and energy:

$$\tilde{k}_{ev} = (1-\delta_1-\delta_2)\tilde{k}_{ev-1} + i_{new}\left[\beta + \gamma \left(\frac{\gamma p_k}{\beta p_e}\right)^{\sigma-1}\right]^{\frac{\sigma}{\sigma-1}}$$

where $i_{new} = i_{ne} + \delta_1 k_{ne-1}$ is re-investment with energy use malleable in the current year.

(1.4) Vintage-based energy requirement:

$$e_v = (1-\delta_1-\delta_2)e_{v-1} + \left(\frac{\gamma p_k}{\beta p_e}\right)^{\sigma} i_{new}$$

(1.5) Labour force:

$$(N_\ell/\dot{N}_{p\ell}) = \underset{(3.48)}{.19526}(\overline{q/q_{sv}}) + \underset{(2.34}{.011779}(r_{nat}/r_{nu})$$

$$+ \underset{(6.86)}{.015185}\ \mathrm{sech}^2\left[(t-29)/15\right]$$

$$- \underset{(2.86)}{.051421}\ W/(6.0209\Pi P_a)$$

$$+ \underset{(3.12)}{.0083121}\ D_{aib} - \underset{(3.10)}{.15562}$$

2SLS 1956-1980: s.e.e. = .00377 R^2 = .650 DW = 1.66

F-test on constraint that constant plus coefficients on the 1^{st}, 2^{nd} and 4^{th} terms sum to zero = 1.03

(1.6) Employment:

$$N_e = \underset{(95.76)}{.83757}\ N_{e-1} + \underset{(18.57)}{.16243}\ \frac{1}{\Pi}\left(\frac{q_\ell^* \tilde{k}_{ev}^{-\alpha}}{3.5196}\right)^{\frac{1}{1-\alpha}}$$

2SLS 1954 - 1980: s.e.e. = .0595; $\bar{R}^2$ = .9987

Durbin-h = 2.23; F-test on constraint = 1.06

(1.7) Unemployment rate:

$$r = 100\ \frac{N_\ell - N_e}{N_\ell}$$

(1.8) Energy demand:

$$\ln e = \ln e_v + .010024t - .69028$$
$$\qquad\qquad (23.22) \quad (23.54)$$

2SLS 1954 - 1980; s.e.e = .0165; $\bar{R}^2$ = .9987; D-W = 1.29;

F-test on constraint = .007

(1.9) Optimal capital stock:

$$k^* = \frac{q^*}{3.5196}\left[\beta+\gamma^{\sigma}\left(\beta\frac{p_e}{p_k}\right)^{1-\sigma}\right]^{\frac{\sigma}{1-\sigma}}\left[\frac{\alpha W/\Pi}{(1-\alpha)\left(\beta^{\sigma}p_k^{\,1-\sigma}+\gamma^{\sigma}p_e^{\,1-\sigma}\right)^{\frac{1}{1-\sigma}}}\right]^{1-\alpha}$$

where $p_k = (\delta_2 + .01\rho_r)p_a$ is the price of capital services.

(1.10) Average unit cost, relative to output, price for producing gross output of the non-energy sector:

$$c_q = \frac{ep_e + \bar{k}_{ne}(\delta_2 + .023354 + .0071\ r_\ell)p_a + N_eW}{qp_q}$$

(1.11) Output equation:

$$\ln q = -.19840 + \ln q_{sv} - \underset{(7.40)}{.21787} \ln c_q$$
(9.69)

$$+ \underset{(9.52)}{.59121} \ln \frac{a + x_{ne}}{q_{sv}} + \underset{(1.02)}{.048907} \ln \frac{k^{*}_{inv}}{\bar{k}_{inv}}$$

where $k^{*}_{inv} = .12423\ \bar{k}_{ne}$

2SLS 1954 - 1980; s.e.e. = .00727; $\bar{R}^2$ = .9996; D-W = 1.29

F-test for constraint on q_{sv} = 7.1

(1.12) Non-energy imports:

$$\ln \left(m_{ne} - m_{car2}\right) = -\underset{(96.5)}{1.5850} + \ln q_{sv}$$

$$- \underset{(4.18)}{1.0302} \ln \left(\frac{1}{3} \sum_{i=0}^{2} \frac{p_{mne-i}}{p_{q-i}} \right) + \underset{(1.43)}{1.2170} \ln \left(\frac{q}{q_{sv}}\right)$$

2SLS 1955 - 1980: s.e.e = .0549; $\bar{R}^2$ = .9826; D-W = .83

F-test on constraint on q_{sv} = .853

where imports of cars from the U.S. is given by

$$\ln m_{car2} = \underset{(10.76)}{-7.3935} - \underset{(1.81)}{1.0388} \ln\left(p_{mne}/p_q\right)$$

$$+ \underset{(12.96)}{1.2659} \ln\left[\left(.9656\ a_2 + a\right) \tanh \frac{t-12}{5}\right]$$

(1.13) Change in business inventories:

$$i_{inv} = q + T_i/p_q - a - x_{ne} + m_{ne} - M_{id}/p_q + M_{id}/p_{mne} - y_{res}$$

(1.14) Stock of non-farm business inventories:

$$k_{inv} = k_{inv-1} + i_{inv}$$

(1.15) Aggregate demand:

$$q_a = q - \left[i_{inv} - .08\left(k^*_{inv} - \bar{k}_{inv}\right)\right]$$

(1.16) Desired level of future output for investment demand:

$$q^* = q_a\left[1 + 2.5(m_{ne} - \hat{m}_{ne})/q\right]q/q_{-2}$$

where $\hat{m}_{ne}$ is the equilibrium level of imports at full capacity with lags worked out

$$\ln\left(\hat{m}_{ne} - m_{car2}\right) = -1.5850 + \ln q_{sv} - 1.0302 \ln \frac{p_{mne}}{p_q}$$

(1.17) Vintage based synthetic supply:

$$q_{sv} = 3.5196\ \left(\overline{\tilde{k}_{ev}}\right)^{\alpha}\left(\Pi\ N_e\right)^{1-\alpha}$$

(1.19) Desired level of future output for labour demand:

$$q^*_{\ell} = .65\ q_a\left[1 + 1.3(m_{ne} - \hat{m}_{ne})/q\right]q/q_{-2}$$

$$+ (1.-.65)9.5153(\Pi N_{\ell})^2/(\Pi_{-2}N_{\ell-2})$$

OLS 1966 - 1980: s.e.e. = .104; $\bar{R}^2$ = .936; D-W = 1.15

Desired level of future output for investment demand:

(1.16) $$q^{*} = q_a\left[1 + 2.5(m_{ne} - \hat{m}_{ne})/q\right]q/q_{-2}$$

where m_{ne} is the equilibrium level of imports at full capacity with lags worked out

$$\ln\left(\hat{m}_{ne} - m_{car2}\right) = -1.5850 + \ln q_{sv} - 1.0302 \ln \frac{p_{mne}}{p_q}$$

Vintage based synthetic supply:

(1.17) $$q_{sv} = 3.5196 \left(\overline{\tilde{k}_{ev}}\right)^{\alpha} \left(\Pi N_e\right)^{1-\alpha}$$

Desired level of future output for labour demand:

(1.19) $$q_{\ell}^{*} = .65\, q_a\left[1 + 1.3(m_{ne} - \hat{m}_{ne})/q\right]q/q_{-2} + (1.-.65)9.5153(\Pi N_{\ell})^2/(\Pi_{-2} N_{\ell-2})$$

Table 2.1

Summary of Alternative Histories

	Steady Growth	Actual History	Model with Shocks	Portion of Change Traceable to Identified Sources
1. Real GNP (billion 1971$)				
1981	151.8	134.5	136.6	88%
1982	157.9	128.4	135.8	75%
Cumulative 1974-81	1206	1115	1127	86%
2. Real Domestic Absorption (C+I+G) (billion 1971$)				
1981	154.7	138.3	136.4	112%
1982	160.8	132.7	136.0	88%
3. Implicit Price of GNE (1971=1.0)				
1981	1.50	2.46	2.68	123%
1982	1.57	2.70	2.99	126%
4. Unemployment Rate (%)				
1981	5.1	7.6	8.5	136%
1982	5.1	10.8	10.4	93%

Table 3.1

Productivity, Potential Output and Factor Inputs 1981-82

	Steady Growth	Actual History	Model with Shocks	Portion of Change Traceable to Identified Sources
1. Output per Employee (q/ne) ('000 1971$ per person)				
1981	12.48	11.22	(i) 11.37	88%
			(ii) 11.49	79%
1982	12.76	11.05	(i) 11.00	103%
			(ii) 11.39	80%
2. Output Level (q) (billion 1971$)				
1981	136.7	122.8	(i) 123.3	96%
			(ii) 123.9	92%
1982	142.3	117.3	(i) 120.2	89%
			(ii) 123.1	77%
3. Potential Output (qsv) (billion 1971$)				
1981	136.7	130.1	129.5	109%
1982	142.4	129.9	132.2	82%
3. Components of Potential Output				
a. Capital stock (billion 1971$)				
1981	261.6	244.3	241.3	117%
1982	273.0	248.5	243.6	120%
b. Energy (billion 1971$)				
1981	14.77	10.31	10.67	92%
1982	15.41	10.35	10.28	101%
c. Employment (million persons)				
1981	10.95	10.93	10.78	no difference
1982	11.15	10.61	10.81	63%
4. Ratio of Employment to Energy (ne/e)				
1981	0.741	1.060	1.010	84%
1982	0.723	1.025	1.052	109%
5. Utilization Rate (q/qsv) (% of normal)				
1981	100.0%	94.0%	(i) 95.0%	83%
			(ii) 95.7%	72%
1982	99.9%	90.0%	(i) 91.0%	90%
			(ii) 94.0%	60%

Note that (i) uses actual values and (ii) uses simulated values for the variables determining production.

FIGURE 3.1: SOURCES OF LOW LABOUR PRODUCTIVITY
ACTUAL OUTPUT PER EMPLOYEE COMPARED TO STEADY GROWTH

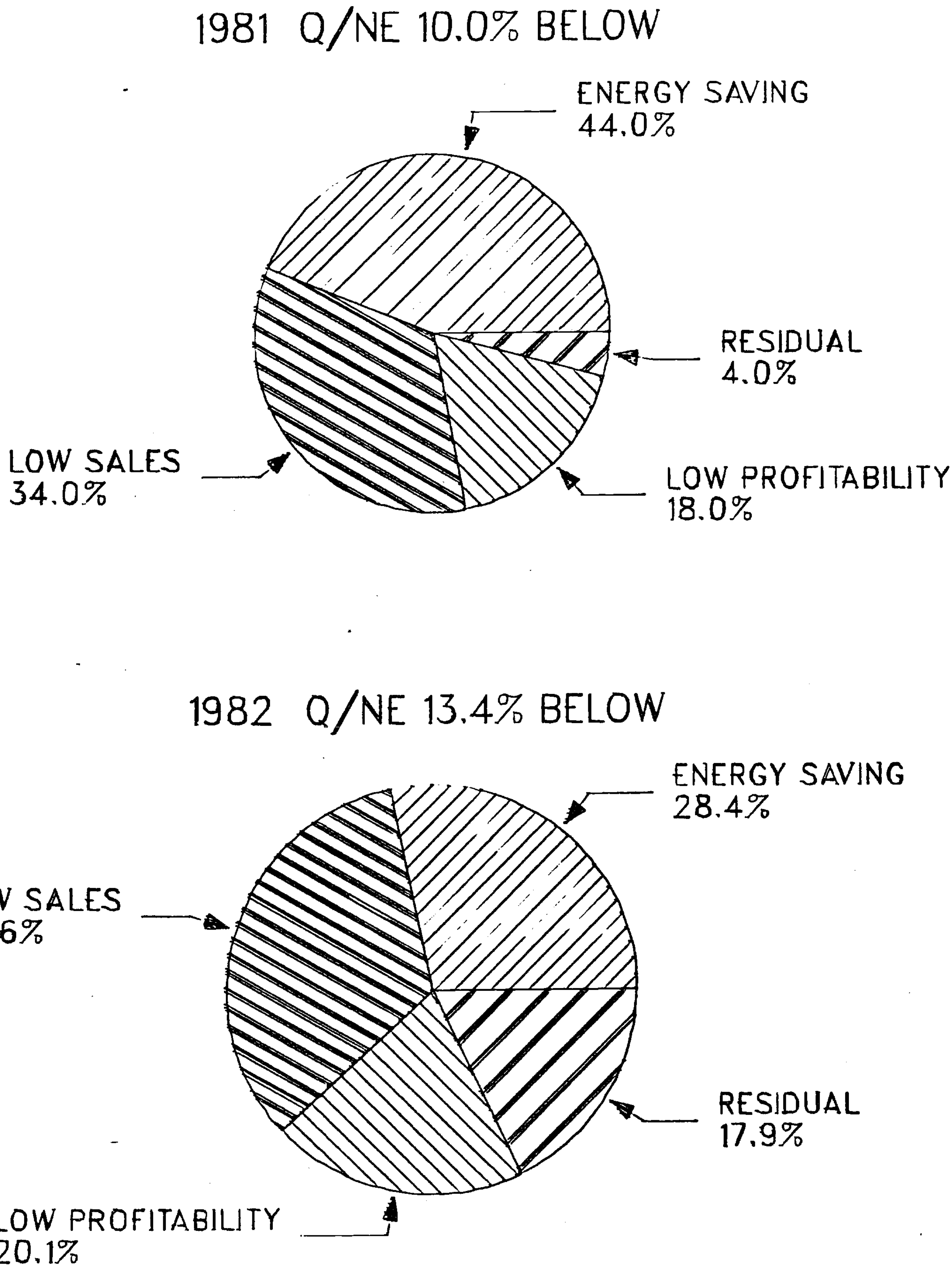

FIGURE 4.1

THE EFFECTS OF OPEC ON GROSS NATIONAL PRODUCT.

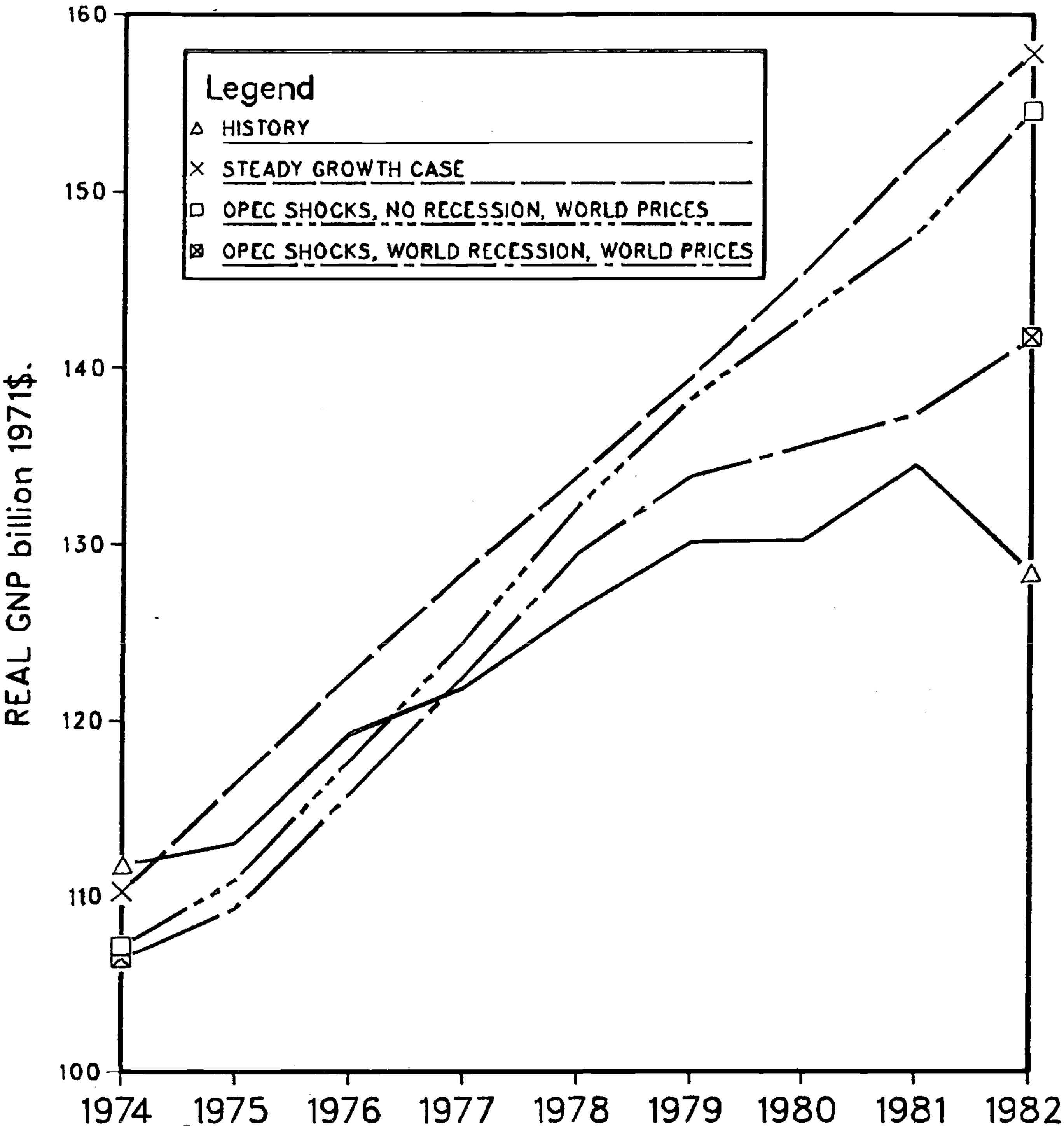

FIGURE 4.2

THE EFFECTS OF OPEC ON INFLATION.

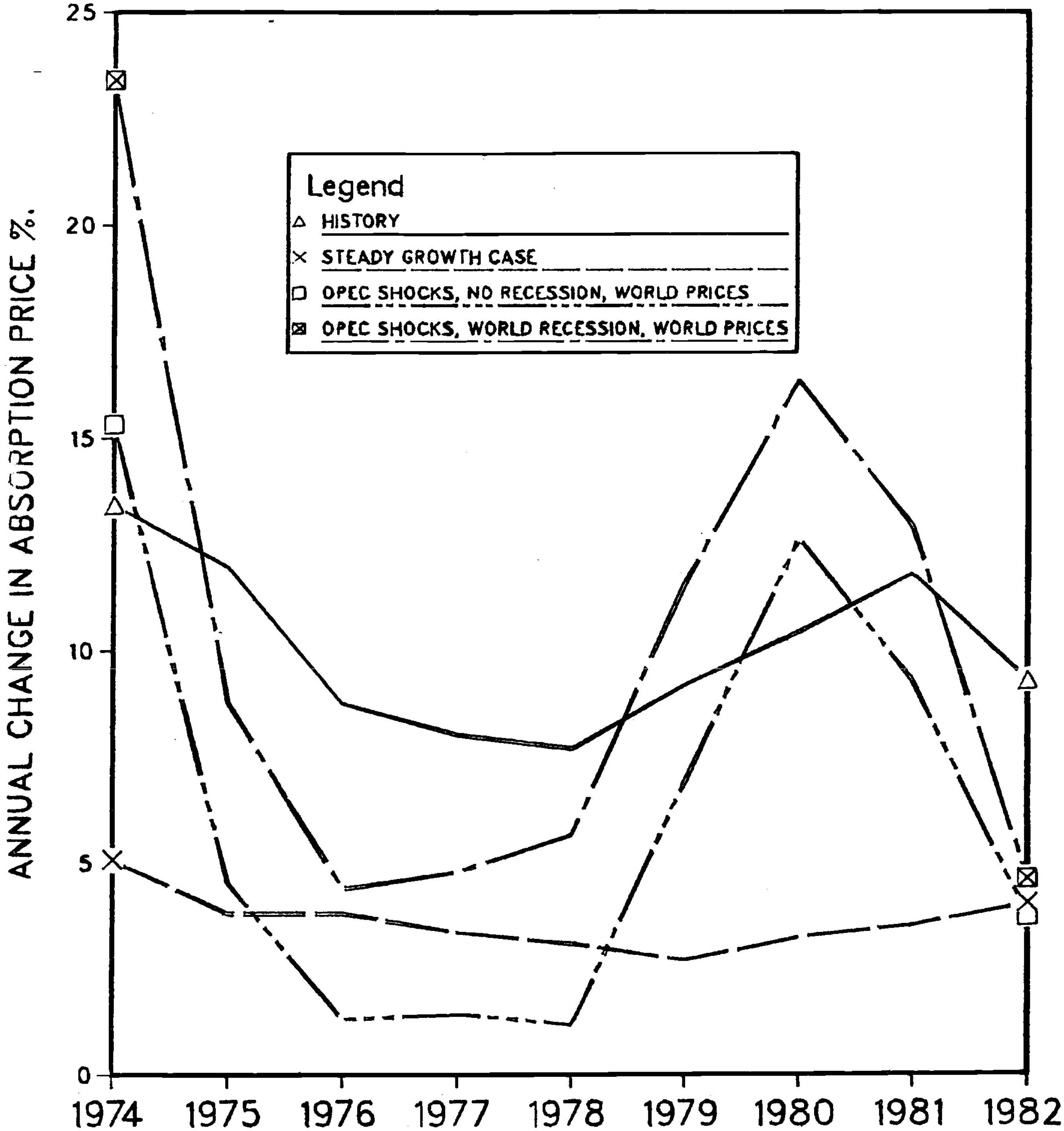

FIGURE 5.1

THE EFFECTS OF MACRO POLICY ON GROSS NATIONAL PRODUCT.

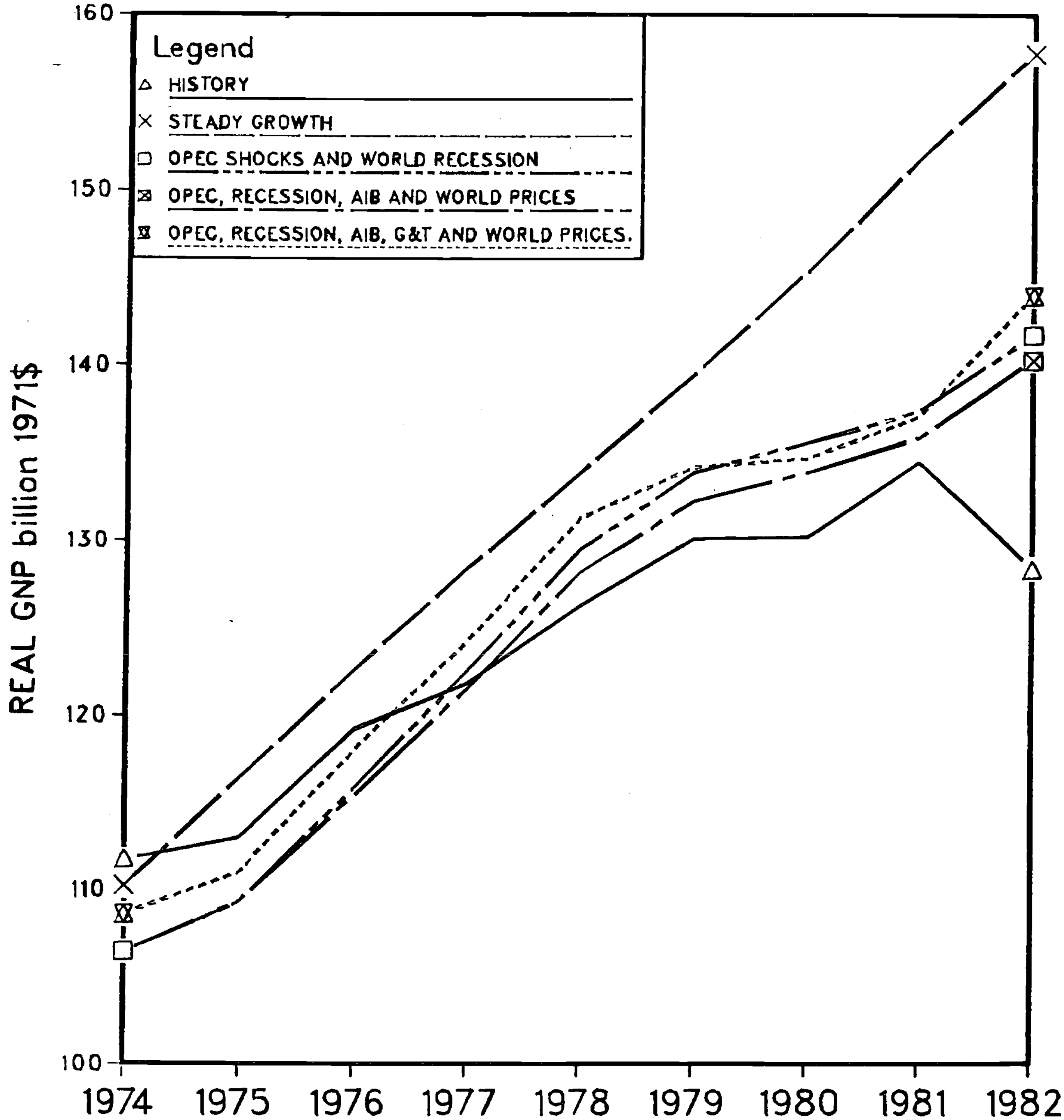

FIGURE 5.2

THE EFFECTS OF MACRO POLICY ON INFLATION.

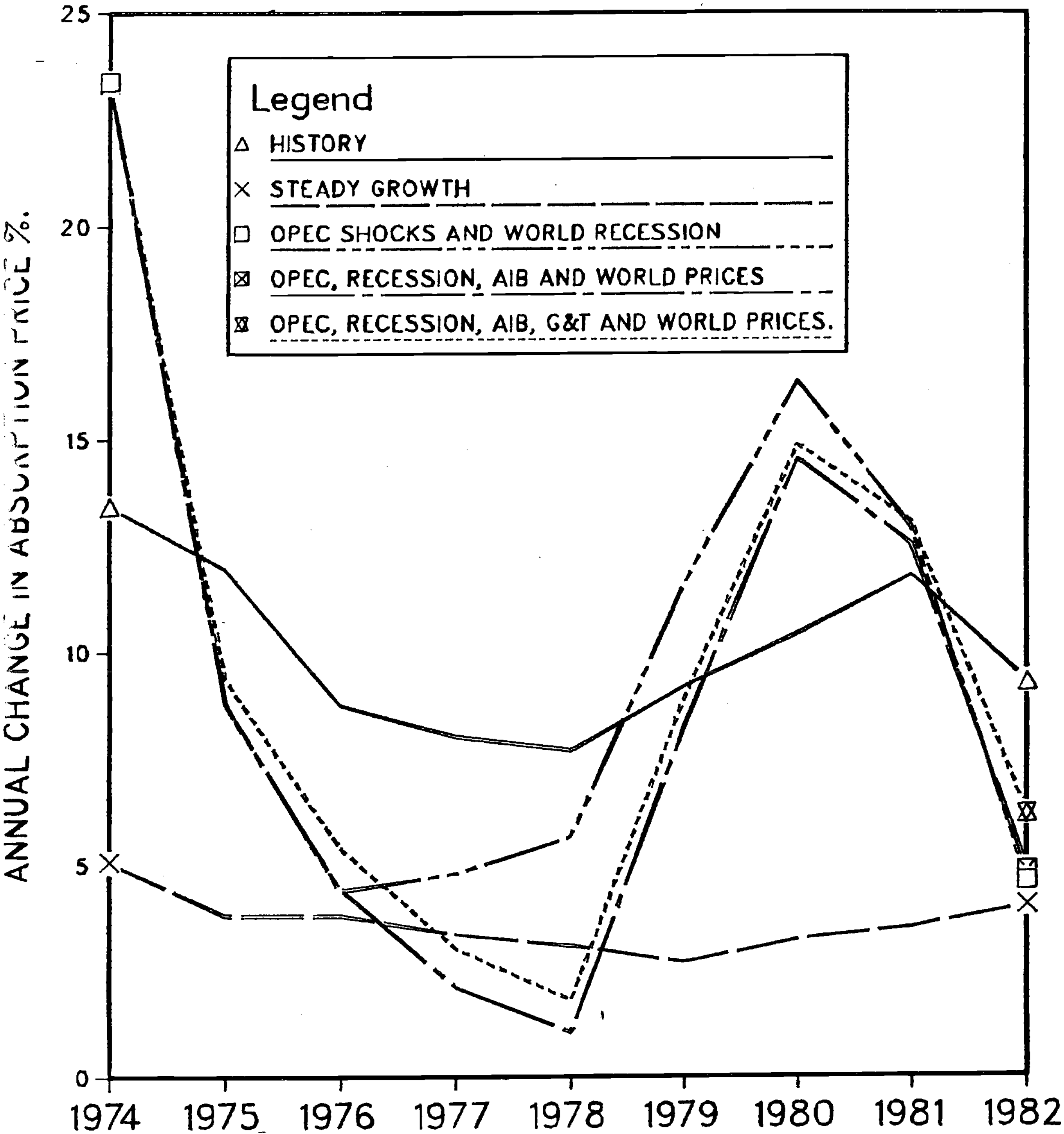

FIGURE 5.3

THE EFFECTS OF ENERGY POLICY ON GROSS NATIONAL PRODUCT

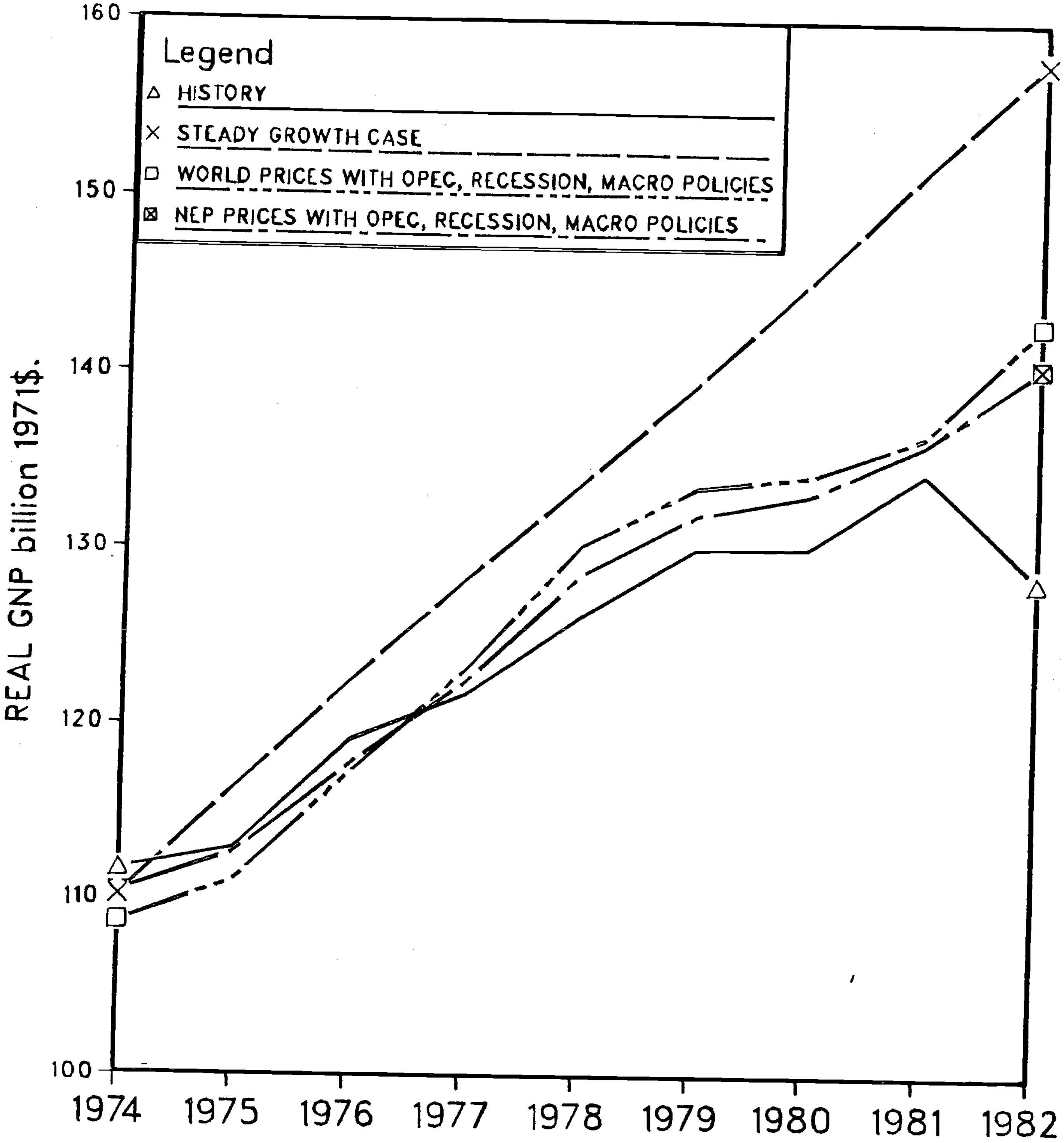

FIGURE 5.4

THE EFFECTS OF ENERGY POLICY ON INFLATION.