The Impact Of Inflation On Farmers And Agriculture

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Iowa State University

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The Impact Of Inflation On Farmers And Agriculture

Abstract
As part of the restructured regional research program of the U.S. I Department of Agriculture and the Land-Grant Universities, a research strategy committee (NCR-113) was formed in 1978 to identify new research thrusts in the area of farm firm management and finance. At the first meeting in April, 1979, a number of possible areas for additional research activity or new thrusts were identified. One area identified was that of the impact of inflation on farmers and agriculture...

Disciplines
Agribusiness | Econometrics | Growth and Development | Regional Economics

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THE IMPACT OF INFLATION ON FARMERS AND AGRICULTURE

Papers presented at the NCR-113 (Farm and Financial Management) Meeting in Kansas City, Missouri March 1980

No. 16
Preface

As part of the restructured regional research program of the U.S. Department of Agriculture and the Land-Grant Universities, a research strategy committee (NCR-113) was formed in 1978 to identify new research thrusts in the area of farm firm management and finance. At the first meeting in April, 1979, a number of possible areas for additional research activity or new thrusts were identified. One area identified was that of the impact of inflation on farmers and agriculture.

To focus the discussion more specifically on the issues in this area, two papers were commissioned and are published herein. The first paper by Dennis Starleaf discusses key concepts on defining and measuring inflation and adjustments that individuals might make to "live with" inflation. The second paper by Luther Tweeten discusses the impact of inflation on farmers with specific emphasis on farm incomes and cash flow.

These papers are published with the intent of stimulating discussion and dialogue on the desirability of implementing research in this area.

Michael Boehlje, Chairman
NCR-113, Farm and Financial Management
Price Inflation and Relative Price Movements

by

Dennis R. Starleaf
Iowa State University

I. Introduction

In discussing any controversial economic subject, I think that it is always wise to begin the discussion with a definition of the subject. This is particularly important when the subject under discussion is price inflation, for it is my experience that the term price inflation is used by different people to refer to a large number of different phenomena. Of course, anyone is free to define any term as he or she sees fit, but useful and meaningful communication among people is hardly possible if the participants employ different definitions of the subject in question.

The definition of price inflation which I employ in this paper is the classic definition of economic science: price inflation is the rise in the money price level of goods and services in general or in the aggregate. Stated differently but consistently, price inflation is the decline in the real value or the real purchasing power in general of a unit of money.

If the rate of inflation was always zero percent per year, we would not expect to see the money price of every commodity remain exactly constant through time. We would not be surprised to observe increases in the money prices of some commodities and decreases in the money prices of other commodities. In an economy in which resources are allocated among alternative uses mainly by relative prices, relative price movements over time are to be expected — the result of such real forces as technological innovations, changes in consumer tastes, random natural events, progressive depletion of nonrenewal natural resources, etc.
Similarly, during a period in which the rate of inflation is greater than zero percent per year, we should not expect the money prices of all commodities to rise at the same rate. We should not be surprised to observe the money prices of some commodities rising more rapidly than the money prices of other commodities. Indeed, we should not be surprised to observe the money prices of some commodities actually falling during mild inflations. Relative price movements are to be expected when the rate of inflation is greater (or smaller) than zero percent per year just as they are to be expected when the rate of inflation is precisely zero percent per year. This is not to deny that a positive (or negative) rate of inflation can itself cause relative price movements. It clearly can and undoubtedly does cause such price movements. However, it does not necessarily follow that a particular relative price movement, observed during a period in which the rate of inflation was nonzero, was itself caused by the nonzero rate of inflation. It might have occurred anyway to a greater, lesser, or even the same degree had the rate of inflation been zero percent per year.

The fact that relative price movements are an essential part of the operation of a market economy greatly complicates the task of measuring inflation. (If there were never any relative price movements, measuring the change in the real purchasing power of a unit of money over time would be extremely simple.) It also greatly complicates the task of trying to measure the extent to which price inflation itself causes relative price movements. Most of this paper is devoted to these two topics. Section II contains a discussion of the commonly encountered measures of the rate of inflation in the U.S. economy, while section III is concerned with the effects of inflation upon relative prices and the allocation of resources.
Section IV is the last substantive section of the paper. It is concerned with the question of whether or not it is possible to derive a set of rules of behavior which would protect one from potential harm from changes in the purchasing power of money or, better yet, insure that one profits from changes in the purchasing power of money.
II. Measures of Price Inflation

Price inflation is measured with price indices, and there are a large number of price indices available for the U.S. economy. These various price indices differ from one another according to the commodities which they cover and also according to the weights (or importance) which is attached to the covered commodities. The three price indices which are most commonly used to measure the rate of inflation in the United States are (1) the Consumer Price Index (CPI), (2) the Producer Price Index (PPI), which until early 1978 was called the Wholesale Price Index, and (3) the Implicit Price Deflator (IPD) for Gross National Product.

The Consumer Price Index. The CPI measures the relative dollar cost at different points in time of a certain market basket of goods and services, which is thought to be representative of the expenditure patterns of urban consumers as of some particular period. Actually, two Consumer Price Indices have existed since January 1978 -- one for urban wage and clerical workers and the other for all urban consumers -- and the market baskets of goods and services employed in the construction of these two indices are based upon an intensive study of expenditure patterns conducted by the Bureau of Labor Statistics of the U.S. Department of Labor in 1972-73. Before 1978 there was only one CPI - for urban wage and clerical workers. During 1964-77, the market basket employed was based upon an expenditure study conducted in 1960-61. Previous to 1964, there were other CPIs (for urban wage and clerical workers only) based upon expenditure surveys of earlier years. All these CPIs, covering different time periods, have been spliced together by the Bureau of Labor Statistics to form a long composite CPI time series running from 1913 to date. The plot of this time series is shown in Figure 1.
Figure 1

Consumer Price Index

QUARTERLY AVERAGES, 1913-

RATIO SCALE, 1967=100

ALL ITEMS

The relative weights attached to major groups of commodities covered by the two CPI market baskets currently in use are presented in Figure 2. For the market baskets used in earlier years, the commodity-group weights are quite different. Indeed, the precise commodities included in the CPI market baskets have changed considerably over time.²

In addition to the overall or All Items CPI, there are sub-CPIs for groups of commodities within the consumer market basket. For example, there are sub-CPIs for food, housing, apparel, transportation, medical care, entertainment, etc. However, these sub-indices are not nearly as useful as the All Items index for measuring the rate of inflation, because their coverage of commodities is so much more limited than is that of the All Items CPI.

The Producer Price Index. The PPI used to be known as the Wholesale Price Index. The name was officially changed in 1978, because the old name was misleading. It suggested that this was an index of the prices paid by retailers for goods which would ultimately be resold to consumers. In reality, the PPI (or, by its old name, the Wholesale Price Index) is an index of the relative dollar cost of a certain market basket of goods (no services are covered by this index), which includes crude materials and semifinished goods as well as finished goods. The prices employed in the construction of this index are the prices received by the producers of the goods or, in the case of imported goods, by the importers of the goods. Prices subsequently received for the same physical goods by jobbers and other distributors are not used in the construction of the index. The goods covered by this index are items produced in the manufacturing, agricultural, forestry, fishing, mining, gas and electricity, and public utility sectors.

Since January 1976, the PPI market basket has consisted of approximately 2,800 goods. The weights attached to the prices of these various goods in the
Figure 2

Weights for Major Commodity Groups Employed in the Construction of the Consumer Price Indices for Urban Wage and Clerical Workers and All Urban Consumers

<table>
<thead>
<tr>
<th>Major Commodity Groups</th>
<th>Wage and Clerical Workers</th>
<th>All Urban Consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food and alcoholic beverages</td>
<td>0.204</td>
<td>0.188</td>
</tr>
<tr>
<td>Housing</td>
<td>0.398</td>
<td>0.429</td>
</tr>
<tr>
<td>Apparel</td>
<td>0.070</td>
<td>0.070</td>
</tr>
<tr>
<td>Transportation</td>
<td>0.198</td>
<td>0.177</td>
</tr>
<tr>
<td>Medical care</td>
<td>0.042</td>
<td>0.046</td>
</tr>
<tr>
<td>Entertainment</td>
<td>0.043</td>
<td>0.045</td>
</tr>
<tr>
<td>Personal care</td>
<td>0.018</td>
<td>0.017</td>
</tr>
<tr>
<td>Other commodities</td>
<td>0.027</td>
<td>0.028</td>
</tr>
</tbody>
</table>

Sum of weights                      | 1.000                     | 1.000               |
construction of the index reflect their relative importance in primary markets
(i.e., the first significant markets in the United States through which the
goods pass) as of 1972. Before 1976, the PPI market basket was smaller and
the weights attached to the prices of specific goods were generally different
(reflecting the relative importance of the goods in primary markets as of some
earlier date). As in the case of the CPI, it is possible to splice together
PPIs of different eras to produce a long composite PPI time series. Figure 3
shows a plot of such a composite PPI time series for the period from 1800
through 1977.

One serious problem with the overall or All Commodities PPI is that it
implicitly counts some price changes more than once. Consider the following
simple example. Suppose that the price of raw cotton was to fall sharply.
Suppose further that this price decrease is passed through by the producers of
cotton yarn, of gray cotton fabric, of finished cotton fabric, and then finally
of cotton shirts. Since cotton, cotton yarn, gray cotton fabric, finished
cotton fabric, and cotton shirts are all separate goods included in the PPI
market basket, the fall in the price of raw cotton would be counted five times.
This problem of multiple counting of price changes plagues not only the All
Commodities PPI but also the various sub-PPIs -- such as the sub-PPI for
Industrial Commodities and that for Farm Products and Processed Foods and
Feeds -- which include items in various stages of processing or finishing.
As a consequence, the All Commodities PPI and its multi-stage sub-indices are
very sensitive to changes in the prices of crude materials and, to a lesser
extent, of some semifinished goods.

Because of this problem of multiple counting of price changes, in recent
years the Bureau of Labor Statistics (the agency responsible for the PPI) has
arranged the data of the PPI in a stage-of-processing framework. Within this
framework, there are three sub-PPIs (and sub-sub-PPIs for commodity groupings
Figure 3
Producer Price Index
ANNUALLY, 1800-
RATIO SCALE, 1967=100
ALL COMMODITIES
within the stage-of-processing sub-PPIs): one for crude materials, another for semifinished or intermediate goods, and a third for finished goods — goods which are in a form suitable for sale to final users, be they consumers or other producers. The sub-PPI for semi-finished goods is still plagued by multiple counting of specific price changes, so the Bureau has been emphasizing the Crude Materials Price Index and, even more so, the Finished Goods Price Index in its press releases and its data presentations in recent years. Figure 4 shows a plot of the Finished Goods Producer Price Index together with its major components for the period from early 1971 through 1979.

Furthermore, the Bureau is currently working on a rather sweeping revision of the PPI. It is scheduled for completion in the mid-1980s. Among other things, the revision will significantly expand the coverage of the PPI, will eliminate the multiple-counting-of-price-changes problem and will bring the basic data of the PPI more into line with the Standard Industrial Classification system employed by other government agencies in data collection.

The Implicit Price Deflator for Gross National Product. The Gross National Product (GNP) is a measure of the dollar value of all the final goods and services produced in the economy, plus the change in business inventories, during a stipulated time period (a year or a quarter of a year). One serious problem associated with the use of GNP data to measure the change in the real output of the economy is that the purchasing power of the dollar usually changes with the passage of time. Because of this problem, GNP has for many years been measured in terms of the money prices of a particular year as well as in terms of the money prices of the period in question. At the present time, GNP is measured in terms of 1972 dollars (1972 money prices) as well as in terms of current dollars (or current money prices). GNP data reported in terms of 1972 dollars are commonly termed "constant dollar GNP data" or "real GNP data."
Figure 4

Producer Price Index — Finished Goods

### Table: Producer Price Index — Finished Goods

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<thead>
<tr>
<th></th>
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<td>Foods, Feeds</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Foodstuffs</td>
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<tr>
<td>1972</td>
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<td>121.7</td>
<td>115.4</td>
<td>113.4</td>
<td>113.2</td>
<td>113.8</td>
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<tr>
<td>1973</td>
<td>127.9</td>
<td>130.1</td>
<td>120.1</td>
<td>118.5</td>
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<td>133.9</td>
<td>132.6</td>
<td>129.6</td>
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<td>184.8</td>
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<td>170.2</td>
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<td>183.4</td>
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<td>1978</td>
<td>194.6</td>
<td>200.5</td>
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<td>186.7</td>
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<td>1979</td>
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<td>226.2</td>
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<td>213.6</td>
<td>211.8</td>
<td>223.5</td>
<td>235.7</td>
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<td>1978: Dec</td>
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<td>217.3</td>
<td>196.1</td>
<td>190.0</td>
<td>187.3</td>
<td>201.9</td>
<td>215.5</td>
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<td>1979: Jan</td>
<td>205.3</td>
<td>221.3</td>
<td>192.5</td>
<td>185.2</td>
<td>180.6</td>
<td>201.8</td>
<td>212.5</td>
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<td>223.5</td>
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<td>185.8</td>
<td>181.7</td>
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<td>214.0</td>
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<td>227.9</td>
<td>197.1</td>
<td>189.3</td>
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<td>205.1</td>
<td>218.3</td>
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<td>192.3</td>
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<td>232.8</td>
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<td>192.7</td>
<td>190.1</td>
<td>215.7</td>
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<td>215.5</td>
<td>231.6</td>
<td>201.8</td>
<td>192.5</td>
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<td>217.9</td>
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<td>192.6</td>
<td>191.7</td>
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<td>227.9</td>
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<tr>
<td>Sept</td>
<td>220.6</td>
<td>237.3</td>
<td>202.5</td>
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<td>190.0</td>
<td>188.9</td>
<td>222.1</td>
<td>234.3</td>
</tr>
</tbody>
</table>

Note: Data revised for April 1979.

Source: Department of Labor, Bureau of Labor Statistics.

**Intermediate materials for food manufacturing and manufactured animal feeds.**
Price data employed in the construction of the CPI and the PPI as well as price data from other sources are used in calculating constant dollar GNP data.

When the current dollar GNP time series is divided by the constant dollar series (and the quotient is multiplied by 100), the result is a price index which is known as the Implicit Price Deflator (IPD) for GNP. In my opinion, the IPD is superior to both the CPI and the PPI as a device for measuring the rate of inflation. This opinion is mainly based on the fact that the IPD is much more comprehensive than is either the CPI or the PPI. Unlike the CPI, it covers more than just a few hundred consumer goods and services. Unlike the PPI, its coverage includes the output of the construction, services, and trade sectors (as well as many manufacturing sectors currently not covered by the PPI). Moreover, the IPD is free of the multiple-counting-of-price-changes problem which is associated with the All Commodities PPI, as well as some of its sub-indices.

The IPD is available quarterly back to 1948 and annually back to 1929. Figure 5 shows a plot of the quarterly IPD time series for the period from early 1972 through 1979.

The IPD is essentially constructed according to the Paasche formula, with the weights for the prices of the various goods and services covered by the index changing from year to year (or from quarter to quarter) as the output mix of the economy changes. In contrast, the CPI and PPI are both fixed-weight price indices (at least between revisions), constructed according to the Laspeyres formula.\(^5\) Some economists believe that the Laspeyres formula is superior for constructing a price index designed to measure changes in the purchasing power of money (as opposed to constructing a cost-of-living index). Because of this view, the U.S. Department of Commerce began constructing a Fixed-Weighted GNP Price Index a few years ago. The fixed-weights for the
Figure 5

Implicit Price Deflator for Gross National Product

RATIO SCALE

1972=100


PERCENTAGES ARE ANNUAL RATES OF CHANGE FOR PERIODS INDICATED.

LATEST DATA PLOTTED. 4TH QUARTER PRELIMINARY

PREPARED BY FEDERAL RESERVE BANK OF ST. LOUIS
prices of the goods and services covered by this index reflect the relative importance of these goods and services in 1972. In addition, the Department began constructing a GNP Chain Price Index. In the construction of this price index, the price weights employed in any particular year (or quarter) reflect the relative importance of the goods and services in the previous year (or quarter). Chain Price Index data are usually presented in a percent-change-from-previous-period form.

Figure 6 shows values of the IPD and Fixed-Weighted Price Indices for GNP and for Gross Domestic Product for most of the years from 1929 through 1979. The figure also shows annual (quarterly, in recent years) percentage changes in these two indices as well as the Chain Price Index. Note that the IPD, Fixed-Weight Price Index, and Chain Price Index all behave very similarly over the time period covered by this figure.
Figure 6

- Implicit price deflators and alternative price measures for gross national product and gross domestic product, 1929-79

<table>
<thead>
<tr>
<th>Year or quarter</th>
<th>Gross national product</th>
<th>Gross domestic product</th>
<th>Gross national product</th>
<th>Gross domestic product</th>
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<tr>
<td></td>
<td>Implicit price deflator</td>
<td>Fixed-weighted price index (1972 weights)</td>
<td>Implicit price deflator</td>
<td>Fixed-weighted price index (1972 weights)</td>
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<td>1929</td>
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<td>1934</td>
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<td>1935</td>
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<td>1939</td>
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<td>78.0</td>
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</tr>
</tbody>
</table>

*Changes are based on unrounded data and therefore may differ slightly from those obtained from published indexes shown here. Quarterly data are at annual rates.

Source: Department of Commerce, Bureau of Economic Analysis.
III. The Allocative Effects of Inflation

Calculating the impact of inflation upon relative prices and the allocation of resources would be an easy task if we had a mathematical model of the economy which was rich in allocative detail, which embodied legal and institutional constraints (as well as the mechanisms by which these constraints evolve in response to events), and which accurately reflected how people behave and how they form their expectations. Armed with such a model, it would be a simple matter to carry out several simulation runs. For example, with one run, we might hold down the rate of money stock growth sufficiently to maintain a stable general price level. In other runs, we could increase the rate of money stock growth, thereby generating inflation. By contrasting the behavior of relative prices and the allocation of resources in the inflation simulation runs with their behavior in the stable-price-level run, we could easily discover the precise impact of inflation upon relative prices and resource allocation. (With such a model, we could even resolve the long-standing debate between the monetarists and the non-monetarists as to whether inflation is mainly a monetary phenomena.)

There is no point in carrying this fairy tale further. We don't have such a mathematical model and, at this stage in the development of economic science, it seems unlikely that we will ever have such a model.

On the other hand, we are not completely ignorant of the effects of inflation. What follows is a brief and by no means exhaustive review of some of the more important things we know about the allocative effects of inflation.

Real Income Reallocation. Inflation reduces the real incomes of those whose money incomes are fixed. It also tends to increase the real before-tax incomes of those whose money incomes are variable. Assuming that the aggregate real percapita output of the economy is not falling (it is usually rising, and
it usually rises unusually rapidly when the rate of inflation is increasing, if inflation reduces the real incomes of those whose money incomes are fixed, it must also increase the real before-tax incomes of the aggregate of those whose money incomes are variable.

If the government's income tax rates are progressive, and if they are based upon money income, inflation tends to increase the real tax receipts of the government over what they would otherwise be, given the same real output of the economy. The inflation-induced rise in real government tax revenues must result in more real government spending, smaller real fiscal deficits, cuts in tax rates, or some combination of the three. To the extent that it results in more real government spending, some people receive more government services and/or larger real government transfer payments. To the extent that it results in smaller real government deficits (or larger real government surpluses), the total real saving rate (government plus private) in the economy is increased. If it results in tax cuts, the government at least partially offsets the revenue effects of inflation operating through the nominal progressive income-tax system. Of course, the tax cuts may work to the benefit of either those with fixed money incomes or those with variable money incomes or both, in a systematic or haphazard manner.

Wealth Reallocation. An unanticipated increase in the rate of inflation benefits net monetary debtors at the expense of net monetary creditors. (A net monetary debtor is an institution or person with liabilities defined in terms of money which are larger than its/his/her assets defined in terms of money. A good example of a net monetary debtor is a farmer whose only assets are land, buildings, and machinery and who owes money on the land, buildings, and machinery. A net monetary creditor is just the opposite of a net monetary debtor: an institution or person with assets defined in terms of money which exceed its/his/her monetary liabilities.) The unanticipated increase in
the rate of inflation reduces the real value of the net monetary debtor's liabilities and also reduces the real value of the net monetary creditor's assets.

The qualification used above that the increase in the rate of inflation be unanticipated is very important. Presumably, if the increase in the rate of inflation was perfectly anticipated, the interest rates on the debts (assets) would have been sufficiently large to compensate for the decline in the purchasing power of the dollar. If this were the case (and if interest was paid on all monetary assets), no wealth reallocation would take place as a result of inflation.

An unanticipated decrease in the rate of inflation has just the opposite effects of an unanticipated increase in the rate of inflation. It benefits net monetary creditors at the expense of net monetary debtors.

One of the major net monetary debtors in most economies is the government, and an unanticipated increase in the rate of inflation reduces the real value of the government's debt. To the extent that the government's debt is interest-bearing (as opposed to non-interest-bearing high-powered money — currency in circulation plus commercial bank deposits at the central bank), this reduces the burden on current and future tax payers to service the debt. The losers are the current holders of the debt.

**Asset Price Effects and Anticipated Inflation.** Inflation imposes a tax burden on those who hold monetary assets. The recipients of the tax are those who issued the assets (for whom they are monetary liabilities). However, interest is paid on many monetary assets and, as explained above, it is possible for the interest rate to rise sufficiently to compensate for the decline in the purchasing power of money, in which case there is no tax burden resulting from inflation.
Interest is not paid on narrow money (currency plus demand deposits), however, and the rate of interest which can be paid on some close substitutes for narrow money, such as savings and small time deposits, is legally constrained. Hence, inflation, whether it is anticipated or not, imposes a tax on those who hold narrow money and some money substitutes.

No one likes to pay taxes, and people generally take actions to avoid paying taxes. The obvious action to take to avoid paying the inflation tax on money is to attempt to hold less of one's wealth in the form of money and more in the form of other assets. Thus, when inflation (and, therefore, the tax) becomes anticipated, people take steps to reduce the portion of their asset portfolios held in the form of money. The result is an increase in the velocity of money and additional upward pressure on the price level. (People in the aggregate cannot reduce their money holdings. They can only reduce their holdings of real money balances by bidding up the general price level.)

The prices of durable assets may be bid up more than the general price level as people attempt to acquire them as a means for storing wealth over time. This may be part of the reason that land prices rose so much more than the general price level over the last fifteen years.

In this connection, one might ask why the price of common stock was not bid up like the price of land. At least part of the answer, I think, has to do with the tax treatment of depreciation. Most of the assets owned by corporations are capital goods which wear out over time. The depreciation of capital goods is, of course, an expense item which can be legitimately deducted from gross income in the computation of taxable income. However, the tax laws require that depreciation must be figured on the basis of the historical cost of the capital good, not on the basis of its replacement cost. During a period of inflation, the replacement cost of a capital good will generally be
greater than its historical cost, and the greater the rate of inflation, the
greater the difference between replacement and historical cost. Thus, given
the current state of the tax laws, inflation effectively forces firms to pay
income taxes on part of the replacement value of the depreciation of their
capital stock. If a corporation was to pay out all of its after-tax accounting
profits to its stockholders in the form of dividends, it would be steadily
paying out part of the firm's real net worth in the form of dividends. During
inflation, corporations must retain some portion of their after-tax accounting
profits just to keep their real net worth from declining. All this amounts to
saying that the reported after-tax earnings of corporations in the recent past
have been exaggerated. However, the stock market was not fooled, and common
stock prices remained low.

In the case of land, the tax rules concerning depreciation are irrelevant,
since land does not depreciate. By this analysis, it is not surprising that
land prices rose strongly in the recent past, while common stock prices hardly
changed.
IV. Inflation Strategies

Assume that a person has an accurate forecast that the rate of inflation will rise significantly in the near future and that, from then on, it will remain at its new high or even increase. Assume also that few, if any, other persons possess this information. It should be very easy for the person with the inside information to devise a plan of action to take advantage of the upcoming events. Such a plan would be to buy as much land as possible with as much credit as possible.

Suppose, however, that the forecast is not inside information, that everybody knows it. Then buying land on credit will not yield extraordinary gains. The reason is straightforward. If everybody knows that the rate of inflation will rise, everybody will want to acquire land on credit. Their actions will bid up both the price of land and the cost of credit sufficiently to wipe out the potential for extraordinary gains.

This example illustrates two important facts about inflation. First, everyone cannot profit from a rise in the rate of inflation. Inflation is pretty nearly a zero-sum game. If some people profit from inflation, others must lose. Second, a person who can accurately forecast future increases in the rate of inflation can profit from the use of that information only if other people do not possess the same information. (This is not to deny that people may gain from an increase in the rate of inflation through no fault or virtue of their own, due simply to an accident of happening to have the right portfolio at the right time. For example, I suspect that the extraordinary gains which large numbers of farmers realize over the past ten or fifteen years as a result of rising inflation was due more to their accidentally having the right portfolio at the right time than to the farmers possessing superior inflation-forecasting abilities.)
Assume now that a person buys land on credit at a time when there is near universal belief that the rate of inflation will not decline in the future. Suppose, however, that the rate of inflation does decline—that it falls significantly and permanently. Then our land purchaser will suffer losses. For one thing, the person will end up paying a higher real rate of interest on the mortgage loan than was anticipated at the time the land was acquired. These losses may not be great, however, if the person can prepay the mortgage without a large penalty and then refinance the land at the lower nominal interest rates which the decline in the rate of inflation will bring about. Then too, the decline in the rate of inflation may cause the nominal market value of the land to fall as land ownership ceases to be as attractive a means for holding wealth over time. If the price of the land does fall, our land purchaser will suffer a loss of net worth. But there is a limit to the loss of net worth: the person's equity in the land.

This example points out that a person in a good position to profit from an increase in the rate of inflation will suffer losses if the rate of inflation falls. It also points out that the losses which can result from a decrease in the rate of inflation are strictly limited. In contrast, the gains to be realized as a result of an increase in the rate of inflation are unlimited.

Because of the asymmetry of losses and gains, it would appear to be wise to buy land on credit even if the probability of the rate of inflation falling significantly in the near future was greater than fifty percent. The problem is that, given what has happened in the United States during the last ten to fifteen years, there must be large numbers of actual and potential land investors who are quite aware of this asymmetry. This suggests that the price of land has already been bid up sufficiently to compensate for the asymmetry of gains and losses.
V. Summary and Conclusions

Price inflation is the decline in the general real purchasing power of money. It is measured with price indices and either the Implicit Price Deflator for Gross National Product or the Fix-Weighted Price Index for Gross National Product appear to be the best indices readily available at the present time for measuring changes in the general or overall purchasing power of the dollar.

Relative price movements are to be expected when the rate of inflation is positive just as they are to be expected when the rate of inflation is zero percent per year. Changes in the rate of inflation affect relative prices and the allocation of resources, however, because they are usually not generally anticipated. Even when it is generally anticipated or appreciated, inflation affects relative prices and the allocation of resources, because legal institutions (such as the tax laws concerning depreciation) are slow to change.

It is questionable whether economists can advise large numbers of people on how they can profit or avoid losses from changes in the rate of inflation. To consistently profit or avoid losses, one must be either lucky or possess inside information.
Footnotes

1. Thus far, there has been very little difference in the behavior of these two CPIs.


4. For a review of the various aspects of the PPI revision, see John F. Early, loc. cit.


6. Gross Domestic Product is GNP less net factor earnings abroad by domestic nationals.
National opinion polls reveal "the economy" to be viewed as the number one national problem and "inflation" to be the most prominent economic problem. With the parity ratio 60 percent of the 1910-14 average as of April 15, 1980, a poll of farmers undoubtedly would show the same concern as the public at large over the economy and inflation.

Farmers for decades championed inflationary economy policies such as no central banks, no gold standard and no redeeming of "greenbacks" for specie (hard money) payments. Now many farmers call for sound monetary-fiscal policy to control inflation. But are not farmers supporting such policy in vain hope that prices received would continue their upward spiral of recent years even as the rise in prices paid by farmers is throttled? Rigid views of inflation are not restricted to farmers--many economists define inflation as a proportional increase in all prices.

Research is beginning to pull back the veil that shrouds what has long been a mystery: the impact of inflation on farmers. This paper reports some of my research findings, but it will be obvious that
much remains to be learned.

Inflation is defined here as an increase in the general price level as measured by the implicit deflator of the Gross National Product. My research explores two principal pressures on the farming industry from inflation: (1) cost-price and (2) cash flow. Emphasis is on the latter because of its greater interest to farm and financial management.

Cost-Price Impact

Figure 1 illustrates results of a recent study of the impact of inflation on farm prices (Tweeten, 1980a). If retail and marketing demand curves are homogenous of degree zero in prices and income and if demand price and income shifters are of unitary elasticity with respect to the general price level, then demand at the farm level exhibits unitary elasticity with respect to inflation. Similarly if the farm supply curve is homogenous of degree zero in prices and the elasticities of supply price shifters are unitary with respect to the general price level, then supply at the farm level exhibits unitary elasticity with respect to inflation. Increasing the general price level by 1 percent raises farm demand 1 percent (from $D_0$ to $D_1$), farm supply 1 percent (from $S_0$ to $S_1$) and prices received by farmers 1 percent (from $p_0$ to $p_1$) while quantity $q_0$ remains unchanged. This textbook result is precisely what I found empirically for demand based on 1963-77 annual data.

Supply was not so well behaved in the period. Data revealed that each 1 percent increase in the general price level was associated with nearly a 1.4 percent rise in prices paid by farmers. In theory, this would shift supply at the farm level upward by 1.4
Figure 1. Illustration of impact of inflation on farm level supply and demand.
percent to $S_2$ in Figure 1. If prices received by farmers would increase to $p_2$, the parity ratio (ratio of prices received to paid by farmers) would remain unchanged by inflation. But with quantity fixed at $q_0$ in the short run the supply curve is a vertical line and the product price is only $p_1$, implying the index of prices received by farmers increases by an expected .72 percent with a 1 percent increase in the index of prices paid by farmers arising from inflation. Because the inflation passsthrough, .72 percent, is less than unitary, the parity ratio is reduced.

In time, output adjusts to a new equilibrium quantity $q_1$ and price $p_3$. In a 1976 study, Tweeten and Griffin estimated in some detail the mathematical model depicting that adjustment. Farmers restrain inputs and output in response to lower real prices. This raises price from $p_1$ to $p_3$ and, because demand is price inelastic, raises revenue. Because of the time required to complete the process, farmers experience economic hardship and a cost-price squeeze. The time required for adjustment is shortened as farmers learn to anticipate inflation.

Cash Flow Impact

The conceptual model used below except that for the tax component has been presented in detail elsewhere (Tweeten, 1980b) and only some highpoints and an example of application of the model are presented herein. The results help resolve puzzles including why farm operators, especially entry level indebted ones, have complained so vigorously about low rates of return on investment and excessively high land prices over a period when rates of return on farming resources have averaged well above those on investments outside of farming.
The conceptual equation relating the inflation rate \( i \) to current land price \( P_0 \) is:

\[
(1) \quad P_0 = \int_{t=0}^{\infty} \frac{R_0 e^{(1 + i^* + \varepsilon(i))t}}{e^{(\alpha + i)t}} \, dt = \frac{R_0}{\alpha - i^* - \varepsilon(i)}
\]

where \( R_0 \) is after-tax net rent per acre in the initial period 0, \( i^* \) is the before-tax real rate of increase in rents (rate of gain in excess of \( i \)), \( \alpha \) is the desired real rate of return on land, \( \varepsilon(i) \) is the rate of increase in net rent due to the tax advantage on farmland versus that on alternative investments, \( e \) is the base of natural logarithms and time \( t \) goes from the initial period 0 to infinity. If markets function perfectly, the capitalized present market value of an acre of farmland is \( R_0 / \alpha - i^* - \varepsilon(i) \), the initial rate of return on investment in farmland \( R_0 / P_0 = R_t / P_t \) is \( \alpha - i^* - \varepsilon(i) \) and land rents and values increase at the rate \( 1 + i^* + \varepsilon(i) \). Because in theory the seller acquires the present value of future earnings when land is sold if transaction costs were zero, conceptual results remain unchanged by setting a finite time horizon in (1).

The conceptual model provides additional insights.

(a) If rents are expected to increase exactly at the inflation rate \( (i^* = 0) \) and taxes on land returns respond to \( i \) in the same manner as taxes on alternative investments \( (\varepsilon(i) = 0) \), then land is capitalized at the desired real rate of return \( \alpha \) and the initial return on land is \( \alpha \). This principle constitutes the foundation for the cash flow problem engendered by inflation, i.e. the initial rate of return on farmland is invariant to the inflation rate! If \( \alpha = .04 \) or 4 percent, the land price is 25 times net rent and the initial return on land is 4 percent whatever the inflation rate. In theory, the mort-
gage interest rate is the real rate of interest plus the inflation rate, hence inflation defers returns and inflates immediate costs. If inflation is 9 percent per year, nominal capital gain is 9 percent which, together with the current return of 4 percent, brings total return to 13 percent per year. However, the real return is only 4 percent per year because the inflation in land values and rents does not add to buying power.

(b) Real increases in land rents \( (i' > 0) \) change the capitalization rate and initial and subsequent current return on land to \( \alpha - i' \) with farmland taxed at the same rate as alternative investments in response to inflation. If the desired real rate of return on land is \( \alpha = 0.04 \) or 4 percent, if land rents are expected to increase at a real rate of \( i' = 0.02 \) or 2 percent per year and if land returns are taxed at the same rate as returns from other investments, the land price is 50 times rents and the initial rate of return on land is 0.02 or 2 percent. Using Melichar's terminology (p. 109) farmland becomes a "growth stock" when \( i' > 0 \) and real capital gain accrues at the rate \( i' \). If inflation is 9 percent annually, with the above parameters the nominal capital gain is 9 percent, real capital gain 2 percent and current return 2 percent for a total annual return of 13 percent. Again real return is only 4 percent (2 percentage points each of current earnings and real capital gain) because the 9 percent capital gain induced by inflation represents no increase in buying power of land.

(c) The third source of increase in land and rent values, \( \varepsilon(i) \), introduces differential tax rates on farmland versus alternative investments. Mainly because of property taxes and capital gain taxes, inflation changes tax rates and real net returns on farmland compared
to other investments. Because inflation tends to increase property
tax levels but not rates, the impact of property taxes is omitted here.
Inflation increases capital gain taxes. Because capital gain is
taxed at lower rates than ordinary income, the impact is to increase
the attractiveness of land investment over alternatives such as bonds.

For simplicity assume the same real rate of return $\alpha$ on farmland
and bonds, an alternative investment. Let the marginal tax rate on
current earnings be $T$ and capital gain be taxed at $.4T$ as provided in
the federal income tax tables for 1979. Also, for convenience, let
$i^- = 0$, a simplification that does little to change the value of
$\epsilon(i)$ given most likely values for $i$ and $i^-' in the 1980's. First
consider the tax on land; then on bonds.

**Tax on Land**

The tax on income from land $T_{Lt}$ is comprised of a component $TR_t$
on current land earnings $R_t$ and a component $.4TR_t(i/\alpha)$ on capital gains
for a total of:

\[ (2) \quad T_{Lt} = TR_t \left[ 1 + .4 \left( \frac{i}{\alpha} \right) \right]. \]

The tax rate $r_{Lt} = T_{Lt}/P_{Lt}$ assuming $(R_t/P_{Lt}) = \alpha is$

\[ (3) \quad r_{Lt} = T \left( \alpha + .4i \right). \]

The issue of concern for measuring $\epsilon(i)$ is how $r_{Lt}$ changes over
time. Before-tax rents will increase at the rate $i + i^-' and move
landowners into higher income tax brackets. Because $\alpha$ and $i$ are con-
stant in (4),

\[ (4) \quad \frac{\partial r_{Lt}}{\partial t} = \frac{\partial T}{\partial t} \left[ \alpha + .4i \right]. \]
Property taxes are assumed to be proportional to rent, hence the focus is only on the income tax rate which is a function of time in an inflationary economy. If total taxable income is \( Y \), then

\[
\frac{\partial T}{\partial t} = \frac{\partial T}{\partial Y} \frac{\partial Y}{\partial R} \frac{\partial R}{\partial t}.
\]

Let \( \partial Y/\partial R \) and \( \partial R/\partial t \) be unitary. For a family of 3 persons in 1979, the federal income tax marginal rate \( T \) ranged from 16 percent with $10,000 of taxable earnings to 20 percent with $20,000 of earnings. Thus, the value of \( \partial Y/\partial R \) is .000004 based on the average change over the above range of taxable income. Substituting this value into (4), \( \partial r_{L_t}/\partial t = .0000003 \). It is apparent that tax rates have only nominal annual impact on the rate of increase in net land rents and prices.

Then why the conventional wisdom that inflation is shifting investment to land? The reasons is that whereas \( \epsilon(i) \) is based on a constant inflation rate, the incentive to switch investment to land can be explained in part from inflation going from (say) 0 to 9 percent and the favorable tax treatment for capital gain. Feldstein shows that under such circumstances changes in the inflation rate can have large impacts on the price of land relative to the price of alternative investment instruments. In this study, the capital gain is presumed to be paid in the current year; deferred payment of the tax would enhance the attractiveness of land investment but not change the basic findings of this study.

**Tax on Bonds**

It is not sufficient to show the impact of inflation on land rent; of importance is what happens to land rent as compared to returns on alternative investments, say bonds. Let the value of bonds \( P_B \) be con-
The annual interest on bonds $R_{Bt}$ is

(6) $R_{Bt} = P_{Bt} (\alpha + i)$

and the tax is

(7) $T_{Bt} = TP_{Bt} (\alpha + i)$

The tax rate is $T_{Bt}/P_{Bt}$ or

(8) $r_{Bt} = T(\alpha + i)$

Tax rates on bonds in excess of those on farmland constitute a source of increasing returns to farmland if inflation increases. The excess $\mu(i) = r_{Bt} - r_{Lt}$ is

(9) $\mu(i) = .6Ti$

Because .6 is 1.0 minus the tax preference rate on capital gains, it follows that $\mu(i)$ will be zero if land returns are taxed at the same rate as other earnings, if the inflation rate is zero or if the individual or family has low earnings so $T = 0$. The implication is that high inflation rates and favorable capital gains tax treatment will tend to attract the wealthy to invest in land. Based on an inflation rate of $i = .10$ or 10 percent and a tax bracket of .2, $\mu(i) = .01$. Thus 1 percentage point is added to net land rent relative to alternative investment because inflation increased from 0 to 10 percent—a one shot impact not applicable to equation (1). Introduction of $i^* = .02$ or 2 percent changes $\mu(i)$ very little—it still rounds off to .01 or 1 percent.

We now estimate $\epsilon(i)$ which is defined as the rate of increase in net returns to land compared to that on alternative investments as influenced by taxes. The change in tax rate on bonds with respect to time $t$ is

(10) $\frac{\partial r_{Bt}}{\partial t} = \frac{\partial T}{\partial t} [\alpha + i]$ or .000004[\alpha + i]$
given the value of $\frac{\partial T}{\partial t}$ specified earlier. The rate of increase in the tax rate on alternative investments in excess of the tax rate on land rent constitutes an addition to the rate of gain in land rent, or

$$\varepsilon(i) = \frac{\partial r_{bt}}{\partial t} - \frac{\partial r_{lt}}{\partial t} = \frac{\partial T}{\partial t} \cdot i = 0.000024. \tag{11}$$

The conclusion is that inflation at a given rate $i$ causes net land rents to increase relative to returns on other investment but the impact as measured by the value of $\varepsilon(i)$ is small and can be ignored in equation (1). Of the three sources of land net rent and price gains in the 1980's, the impact of inflation $i$ is expected to be several times that of real gains $i''$ which in turn is several times that of tax preference $\varepsilon(i)$.

**Summary Example**

Table 1 illustrates results using a benchmark of no inflation as well as projected values for the 1980's. Net cash flow shifts from a surplus of 1 percent of land price with no inflation and no real growth in land earnings (left column, Table 1) to a net deficit of 10 percent with 9 percent inflation and 2 percent real growth in earnings (right column, Table 1). Considering the same range of alternatives, land values go from 25 times rent with current returns of 4 percent to 50 times rent with current returns of 2 percent. Tax impact from inflation is ignored in Table 1 in accordance with earlier findings. Also it is well to recognize that some of the cash flow deficit can be overcome by borrowing on capital gain, a strategy that is theoretically if not practically feasible the initial and later years.
Table 1. Illustration of Cash Flow to Owner-Operator in the Initial Year with Full Debt Financing of Farmland

<table>
<thead>
<tr>
<th>Item</th>
<th>Inflation and Real Land Earnings Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No national inflation and annual real growth in land earnings of:</td>
</tr>
<tr>
<td></td>
<td>0 Percent</td>
</tr>
<tr>
<td>Cost</td>
<td></td>
</tr>
<tr>
<td>Mortgage Interest Rate</td>
<td>3</td>
</tr>
<tr>
<td>Returns</td>
<td></td>
</tr>
<tr>
<td>Current Earnings</td>
<td>4</td>
</tr>
<tr>
<td>Deferred Earnings</td>
<td>0</td>
</tr>
<tr>
<td>Real Capital Gains</td>
<td>0</td>
</tr>
<tr>
<td>Nominal Capital Gains</td>
<td>0</td>
</tr>
<tr>
<td>Total Returns</td>
<td>4</td>
</tr>
<tr>
<td>Cash Flow Surplus (Deficit)</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Tweeten (November 1979).

*aCurrent land earnings rate less mortgage interest rate.*
In each instance in Table 1 the real rate of return is 4 percent, hence land is not overpriced by conventional economic measures. But for the beginning owner-operator with limited potential to generate cash flow, land is clearly "overpriced." Operator-family labor-management returns are not expected to exceed 2 percent of land values in the 1980's, hence applying the entire amount (if that were possible) to pay the interest would still leave a large cash flow deficit with 9 percent inflation. Principal payments (not considered in Table 1) add to while equity ownership reduces the cash flow problem. Tenancy, off-farm employment and special assistance from parents and other concessional sources are various means used by operators to cope with the problem. Unless new financial strategies, sound monetary-fiscal policies and other measures are found to deal with the cash flow problem apparent in Table 1 in an inflation-prone economy, the trend is likely to accelerate toward farmland ownership and operation by part-time farmers, corporate conglomerates and established, wealthy commercial farmers.

Research Suggestions

This report points to several research opportunities in farm finance. One is to improve on the conceptual and empirical foundation for estimates presented herein. An example is the value of \( \alpha \). In my judgment, realization of land returns less than rate \( \alpha = 0.04 \) will cause investors to seek alternatives to farmland, and land prices will fall. Values of \( \alpha \) greater than 0.04 will invite investment by farmers and nonfarmers until land values rise to the point where \( \alpha = 0.04 \) over a period of years. Melichar (p. 1089) found current earnings plus real capital gains resulted in a real rate of
return of farm production assets averaging 7 percent over the 1954-78 period, and with no diminution in recent years. This result suggests the value of a used herein is too low. On the other hand, his result is a real rate of return on farmland far higher than real rates have averaged on alternative investment since 1960. The real rate of interest is approximately 3 percent; a real rate of return on land greater than this might be warranted by risk but that element is partly offset by the attractiveness of holding land as an indes- tructible asset. Part of the real rate of return found by Melichar probably is the result of unanticipated high real capital gains due to land prices catching up from prior underpricing of land. It seems unlikely that a real rate of return of 7 percent will be sustained in the 1980's (with 9 percent inflation, 7 percent real rates imply 16 percent nominal rates of return on farmland). The 7 percent real rate likely implies only the land was underpriced in the past. Collection of additional data over time is necessary to identify a.

A change in the expected inflation and mortgage rate creates real wealth redistribution because of commitment to long-term mortgages at fixed mortgage rates (Tweeten, 1980b). If inflation is greater than anticipated, debtors realize real wealth gains at the expense of lenders; if inflation is less than anticipated and interest rates fall, creditors realize real wealth gains at the expense of debtors. Research is needed to determine appropriate mortgage indexing methods to remove this source of financial risk.

Inflation is eroding the family farm ideal defined as an owner-operator and his family responsible for providing most of the labor, management and capital for an economic farming unit. A chief ob-
stacle to the family farm ideal is obtaining sufficient capital in the face of cash flow problems created by inflation. Devising imaginative credit systems to deal with the problem constitutes one of the greatest challenges facing those in agricultural finance. Devising appropriate management strategies for farmers in the face of cash flow and other financial problems constitutes one of the greatest challenges facing farm management research and extension.
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