Financing Agriculture: Demand for and Supply of Farm Capital and Credit

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In this paper, I discuss aggregate farm financial relationships and trends, and then project a large further increase in farm debt. Along the way, I note some interesting findings bearing on the underlying causes of the debt-increase process--findings that raise questions about the completeness of the popular current assessment of that process. Where my story differs from the standard analysis, I take the liberty of stating the differences boldly--perhaps more boldly than they deserve to be advanced, given deficiencies of the data base and the fact that current econometric work on aggregate postwar farm financial behavior is still in the exploratory stage. But since my projections do not differ significantly from those emanating from the standard analysis, I thought it best to emphasize the analytical differences lest they be overlooked when, as usually happens, the numerical projections attract the limelight.

To whet your appetite for the analysis, therefore, let me momentarily depart from orderly presentation of the subject, to look at the main components of the standard analysis of most farm economists and lenders. A statement by Evans on the agricultural finance outlook for 1972, presented at the USDA's National Outlook Conference last February, is representative of this genre:

> More credit will be used this year than any year so far--about 7 per cent more than last year which was also a record. ...it is reasonable to ask, why the increase and for what purpose?

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> Perhaps of most importance is that farmers are basically optimistic. And this year they may be more willing than usual to borrow to become more efficient or to meet higher costs. ...Capital improvements and farm enlargement...will create additional debt. Building and equipping livestock feedlots...will require increased financing. ...Farm operating costs are continually increasing. ...Money going into livestock, ranch, and feedlot operations in 1972 will likely increase over 1971. ...Machinery and equipment bought to replace worn-out or obsolete items will cost more than last year. ...Other expense items will also increase. All of these expense items will call for additional sums of borrowed money. [3, pp. 1-3].

On January 1, 1972, outstanding farm debt (excluding CCC loans) was estimated at $64.6 billion, having risen steadily from a low of $ 7.6 billion in 1946 and more recently from $27 billion in 1962. The increase of 7 per cent in 1972 expected by Evans therefore amounts to $4.5 billion.

Using the model of the farm financial sector on which most of this paper is based, and specifically the particular long-term simulation that is presented here, I find that the increase in debt projected for 1972 is $4.69 billion. This is virtually identical to Evans' projection. So what is my problem?

The standard analysis, as we have seen, attributes the increase in debt mainly to (1) additions to capital assets and (2) increases in land, machinery, and other input prices. To test this hypothesis, I therefore performed a second simulation in which I specified that all real capital stocks remain unchanged at their January 1, 1972 level. The projected increase in debt during 1972 was $4.63 billion.

In a third simulation, I specified that neither the general price level nor any asset price could change during 1972. The projected increase in debt was $4.20 billion.

Finally, in a fourth simulation I specified that neither prices nor real stocks could change. The projected increase in debt was then $4.16 billion.

Thus, while Evans and I agreed on the increase in debt projected for 1972, I can attribute only $530 million of that increase directly to the causal factors he emphasized. An explanation for the other $4.16 billion must await the orderly presentation of the flow-of-funds model to which I now turn.

A model of farm capital and credit

The formulation of the model has its roots in previous work by Tostlebe, Johnson, and Brake [2, 5, 8, 13]. When employed as a framework for analysis of past financial behavior, the capital flows that had to be financed are first identified, quantified, and summed. This sum was financed either externally, through increase in debt, or internally from farm cash

flow (net income and depreciation allowances). The increase in debt is known, and so the amount of internal financing is computed residually. Insight into the causes of any past changes in outstanding debt can be obtained by noting the course of the total capital flow over time, and by observing the behavior of such ratios as the percentage of cash flow devoted to internal financing.

For simulation and projection, some additional steps are necessary. First, equations are developed for the various components of capital flow, and are solved to obtain estimated total capital flow under specified conditions. The same is done for the components of cash flow. Another equation specifies the "savings rate," the proportion of cash flow that farmers will allocate toward meeting their capital flow. The amount of internal financing is then computed. Finally, the difference between that amount and the total capital flow is the increase in debt that will occur.

For the farm finance insights that we seek, we must go through this formulation step-by-step, at each point examining the historical data, the equation developed for the model, and the projected data employed in or obtained from the specific simulation, covering 1972-79, on which this paper focuses. Eight charts that illustrate the historical and projected data form an integral part of this presentation. A unique feature of these charts is that all series on all the charts are plotted on the same ratio scale; thus equal slopes anywhere represent the same annual percentage rate of change, and equal vertical distances indicate the same total percentage change.

Capital flow.
The capital flow to be financed consists of expenditures for new machinery, buildings, and land improvements; changes in holdings of livestock, stored crops, and financial assets; and an annual capital requirement associated with the largest farm input, land. Except the last item, these are straight-forward concepts for which USDA estimates are published. But the annual land capital requirement presents conceptual as well as data problems.

Real estate transfers. To start with, I think that other workers who have recently added up farm capital flows, also with the goal of estimating credit demands, have erred conceptually, given that particular goal, in their choice of the measure of the annual land capital requirement. One sets it equal to the change in book value of the land that is transferred [1,2]. Several others use the change in the total value of all land [6,10].

But I reason as follows. First, the capital flow to be financed is associated with transfers; if perchance no land is transferred in a given year, there is no capital requirement to be financed that year. On the other hand, if some land is transferred, there may be a positive capital requirement even if the total value of all land remained unchanged or even decreased. Thus the financing requirement does not correspond to the capital appreciation, if any, that may have occurred.

Second, there is no capital requirement to be financed when land is inherited rather than purchased. And for the farming sector as a whole, there is no new financing requirement to the extent of existing outstanding debt on the property transferred, or to the extent that land is sold by persons who continue to be farm operators. Thus the financing requirement does not correspond to the change, if any, in book value. (The book value

and capital gain concepts are simply variants of the same theme; one defers recognition of appreciation until the year of transfer, while the other records it as it occurs.)

With these negative observations in mind, I can derive a positive statement of the annual financing requirement associated with farm transfers: it is the amount of funds withdrawn from the farming sector by sellers who leave the farming sector or who are nonfarm heirs.

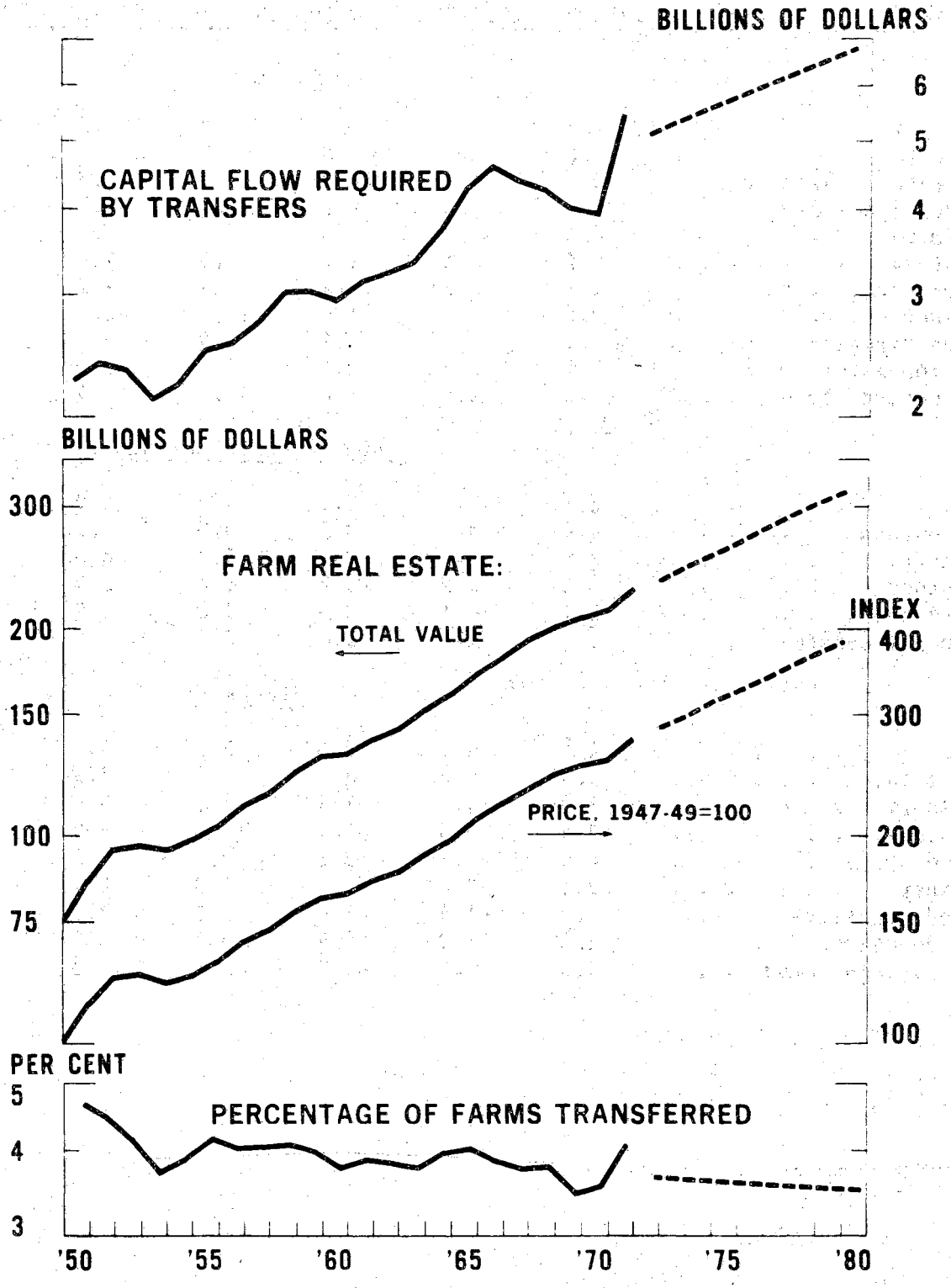
My rough estimate of this series is shown in Chart 1. For 1965-71, it corresponds to the value of voluntary and estate transfers less adjustments for existing debt and for sales by persons who continue to farm. For 1950-64, the value of transfers in this calculation is approximated by the product of the total value of farm real estate, the percentage of farms transferred, and an adjustment factor to reflect that the average parcel transferred differs from the average farm in size and per-acre value.

As Chart 1 illustrates, an upward trend in the annual capital flow required by transfers reflects a similar trend in the total value of farm real estate, while short-term fluctuations in the annual flow reflect variations in the percentage of farms transferred (land market activity.) Furthermore, the rising trend in total value of real estate reflects mainly the trend in land prices, as the real stock has risen by only 10 per cent since 1950, very little of this in the last few years (Table 1).

The process of projecting the annual capital flow required by transfers employs the above sequence in reverse. The key element is the land price projection, which I will discuss in a moment. The real stock is projected as unchanged from the January 1972 level, and this value times

CHART 1

FACTORS AFFECTING CAPITAL FLOW IN REAL ESTATE TRANSFERS



BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

Table 1. Average annual percentage changes in farm capital stocks and prices

Stock	1950-54	1955-59	1960-64	1965-69	1970-71	Projection 1975-79
			Real stocks			
Total	1.4	.1	.2	.9	.5	.4
Real estate	.8	.4	.4	.2	.2	.0
Operators' dwellings	-2.3	-1.1	-2.3	-2.9	-3.5	-2.8
Service buildings	-2.3	-1.0	-2.3	-2.8	-2.6	-2.7
Machinery	6.6	- .3	- .5	1.4	.1	.8
Livestock	2.2	- .1	1.4	.8	2.6	.9
Stored crops	2.1	.7	- .4	5.8	2.2	2.0
Currency	-3.6	-3.9	-1.9	- .9	-3.2	-2.4
Demand deposits	-1.1	-2.7	-2.6	- .9	-3.1	-2.0
Time deposits	1.7	1.4	3.4	5.2	2.9	3.3
U.S. savings bonds	-1.0	-2.5	-3.0	-4.1	-5.7	-3.9
			Implicit price deflators			
Total	3.1	4.5	3.1	4.4	4.9	3.5
Real estate	4.6	5.4	3.9	5.0	4.9	4.1
Machinery	2.0	4.5	2.2	3.7	6.8	3.8
Livestock	-4.1	6.3	-2.2	9.4	5.3	2.4
Stored crops	2.7	-4.1	3.9	-1.0	1.9	.1
Financial assets	2.1	1.5	1.4	2.7	5.5	2.2
			Stocks			
Total	4.5	4.5	3.3	5.3	5.4	4.0
Real estate	5.5	5.8	4.3	5.1	5.1	4.1
Machinery	8.9	4.1	1.7	5.2	6.9	4.6
Livestock	2.5	6.3	-1.1	10.3	8.0	3.4
Stored crops	4.9	3.7	3.5	3.5	4.2	2.1
Currency	2.1	-2.8	- .6	1.8	2.1	- .5
Demand deposits	.9	-1.4	-1.4	1.7	2.1	- .1
Time deposits	3.8	3.0	4.9	8.1	3.3	5.6
U.S. savings bonds	1.0	-1.2	-1.9	-2.1	- .9	-2.2

Table 2. Percentage composition of farm capital stock

Stock	1950	1955	1960	1965	1970	1972	Projection 1975	Projection 1980
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Real estate	61.8	64.6	68.6	72.2	71.7	71.2	73.0	73.5
Machinery	10.0	12.2	12.0	11.1	11.0	11.3	12.1	12.5
Livestock	10.6	7.4	8.0	6.4	8.1	8.5	6.8	6.6
Stored crops	6.2	6.3	4.1	4.1	3.8	3.7	3.2	2.9
Currency	2.1	1.5	1.0	.8	.7	.7	.6	.5
Demand deposits	3.7	3.1	2.3	1.8	1.5	1.4	1.3	1.1
Time deposits	1.7	1.7	1.5	1.7	1.9	2.0	2.1	2.3
U.S. savings bonds	3.9	3.3	2.5	1.9	1.3	1.1	1.0	.7

the projected price yields the projected total value series. The projected percentage of farms transferred is an extrapolation of the 1950-72 trend. The projected annual capital flow is the product of this ratio, the total value, and the three adjustment factors listed above.

Note that in this model no attempt has been made to develop equations that would incorporate factors causing the significant short-term variations in variables such as land market activity. Consequently, the model can project only the longer-term trend.

Price of land. Real estate constitutes over two-thirds of total capital stock (Table 2), and the annual capital flow associated with real estate transfers usually represents about two-fifths of total capital flow (Table 3). Thus the projected land price greatly influences the projected total capital stock and flow. In these circumstances, considerable importance attaches to development of a structural equation for the price of land. (All asset prices in the model are measured as the implicit price deflators calculated from data in the USDA's Balance Sheet of the Farming Sector.) Unfortunately, a large number of possible explanatory variables with strong postwar trends are highly correlated with the national average land price. For instance, Reinsel obtains an R^2 of .99 using population and the money supply (M_2) [11]. As he notes, what usually passes for great success is readily achieved with little assurance that any real knowledge has been gained.

Table 3. Percentage composition of farm capital flow

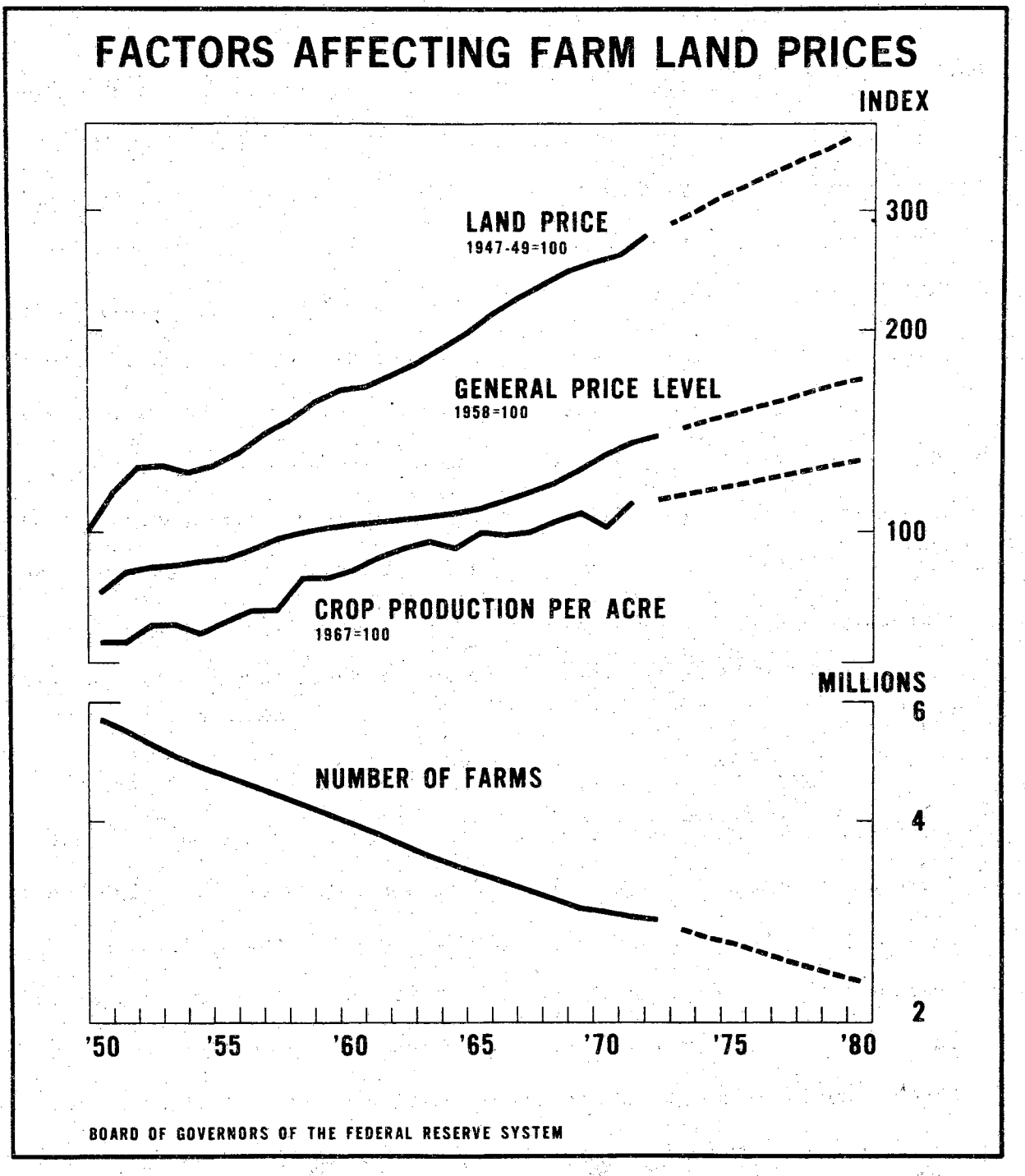
Capital flow	1950-54	1955-59	1960-64	1965-69	1970-71	Projection 1975-79
Total	100.0	100.0	100.0	100.0	100.0	100.0
Real estate transfers	30.1	39.1	41.3	39.2	37.6	39.4
Capital expenditures:						
Machinery	40.7	39.4	40.2	42.5	41.5	45.8
Operators' dwellings	8.4	7.4	6.0	4.5	3.9	3.5
Service buildings	12.0	12.1	10.0	7.2	7.0	5.8
Additions to inventory:						
Livestock	6.3	1.3	3.2	1.0	4.8	1.5
Stored crops	1.1	2.4	- .5	2.2	.5	1.5
Additions to financial assets:						
Currency	- .7	- .9	- .2	.3	.3	- .1
Demand deposits	.5	- 1.0	- .8	.7	.8	.0
Time deposits	1.1	1.1	2.0	3.2	3.9	3.0
U.S. savings bonds	.7	- .9	- 1.1	- .8	- .3	- .5

In my land price equation, I use the three variables shown in Chart 2. Of these, the general price level and the number of farms--the latter intended to reflect the pace of land market and farm enlargement activity--contribute most of the R^2 of .98. The index of crop production per acre, intended to represent the intrinsic value of farmland, is relatively uninfluential in this equation.

To solve this equation for the price of land during 1972-80, values of the explanatory variables must first be projected. For crop production per acre, I extrapolate the 1950-72 linear trend, which has this index rising by about 1.7 per cent annually over the projection period. For farm numbers, I extrapolate the 1950-72 double-log trend, which results in numbers falling by about 2.5 per cent yearly.

General price index. Choosing an appropriate projection of the general price level--represented by the implicit price deflator for private GNP--is not only more difficult, but also more important in that the choice affects all incomes, wages, and asset prices in the model. On average, this GNP deflator rose by 2.1 per cent yearly during 1950-72. If the periods of war-related inflation and subsequent price controls at each extreme of this span are omitted, the average rate of increase during the remaining years (1953-68) was 1.7 per cent. But much of this period was characterized by a degree of underutilization of labor and other resources which, it appears, is not likely to be tolerated in this decade. So a higher rate of inflation might be projected as a consequence of running a more fully-employed economy--not, however, approaching the rates over 4 per cent experienced during 1969-71, which proved equally unacceptable. After weighing these factors, I chose to use 2.5 per cent in the projection being described. Later I will also report briefly on results from use of other rates of general price inflation.

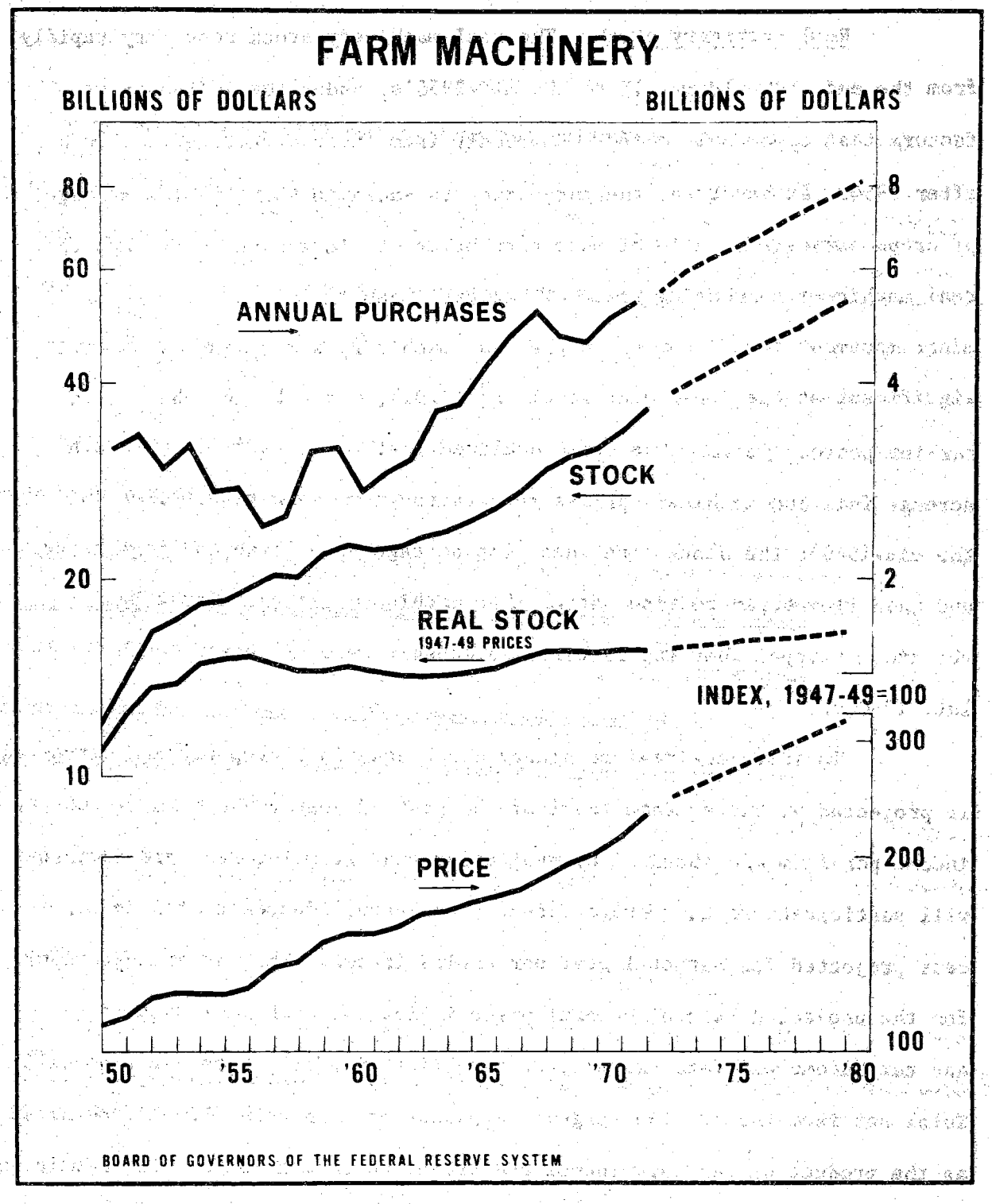
CHART 2


FACTORS AFFECTING FARM LAND PRICES
INDEX
LAND PRICE
1947-49=100
GENERAL PRICE LEVEL
1958=100
CROP PRODUCTION PER ACRE
1967=100
300
200
100
MILLIONS
NUMBER OF FARMS
6
4
2
'50
'55
'60
'65
'70
'75
'80
BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

Machinery purchases. Purchases of new machinery are the other major capital flow, accounting for another two-fifths of the total flow. The record of purchases since 1950, shown in Chart 3, hints at cyclicality, and indeed purchases exhibit several long cycles in this century. The upward trend in the value of the machinery stock on farms--fairly sharp in recent years--is well known, but few persons seem aware that virtually all of the rise in value since 1955 has occurred through price increases. (Real stock data for the last decade were revised downward this year, eliminating much of the already small gains that had previously been shown for the mid-1960's.) What this means is that the large annual purchases have largely just served to replace worn-out or obsolete machinery. Comparison of USDA expenditure and depreciation-allowance data confirms this view.

Projected machinery purchases are the sum of the spending necessary to cover depreciation allowances and to achieve any projected increase in real stock. Annual depreciation allowances since 1950 have varied only between 13.3 and 15.6 per cent of the January 1 stock. The average ratio (14.4 per cent) is used to project this item. The second component is based on a structural equation for the real stock, discussed below. Both components are valued at machinery prices that are projected to advance from the 1972 level at the 1953-68 average annual rate of 3.1 per cent, adjusted upward to 3.8 per cent to reflect that, as already noted, more general price inflation is projected than was experienced in 1953-68.

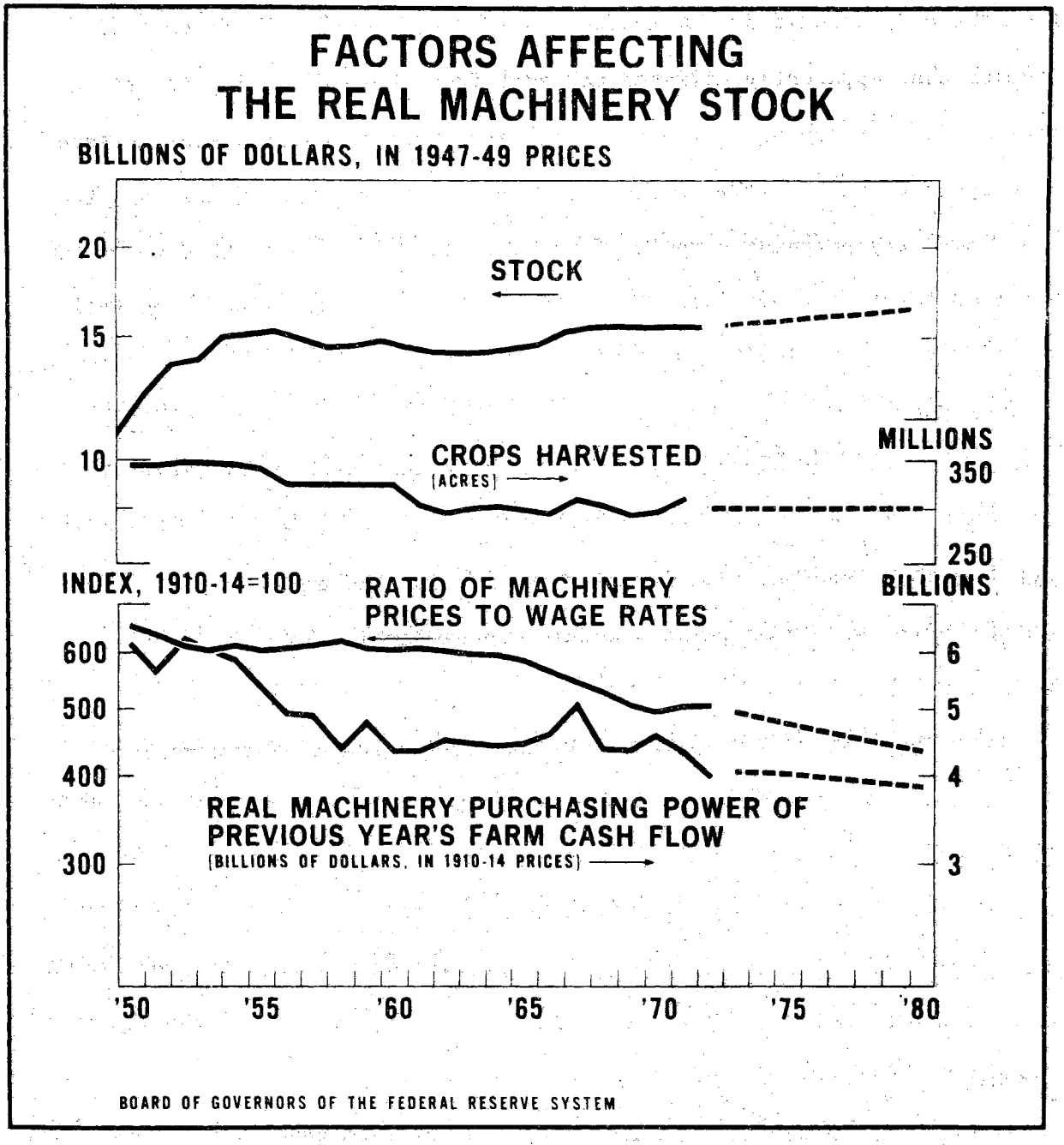
CHART 3


FARM MACHINERY
BILLIONS OF DOLLARS
BILLIONS OF DOLLARS
80
60
40
20
10
8
6
4
2
ANNUAL PURCHASES
STOCK
REAL STOCK
1947-49 PRICES
INDEX, 1947-49=100
300
200
100
PRICE
50
'55
'60
'65
'70
'75
'80
BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

Real machinery stock. The real machinery stock rose very rapidly from the end of World War II to the mid-1950's, under the influence of factors that apparently differed markedly from those affecting the stock after 1954. At any rate, the three factors shown in Chart 4--the acreage of crops harvested, ratio of machinery prices to farm wage rates, and the real machinery purchasing power of farmers' cash flow--explain much of the minor movement that occurred in the real machinery stock since 1954 (all significant at the 1 per cent level, $R^2 = .91$), but not the behavior in earlier postwar years. The stock declined in the late 1950's when crop acreage fell and machinery prices rose faster than cash flow. Then in the mid-1960's the stock rose when crop acreage stabilized and wage rates and cash flow began to rise faster than machinery prices. Additions to the stock stopped when the latter relationships were reversed in the late 1960's.

To solve the real machinery stock equation, crop acreage harvested is projected at the average level of the past 10 years. Wage rates and net income per farm are obtained by projecting that farm laborers and operators will participate to an average extent in an annual increase of 3.25 per cent projected for national real per capita income. Thus after adjustment for the projected rate of general price inflation, both farm wage rates and net income per farm are projected to rise by nearly 6 per cent annually. Total net farm income, the largest component of farm cash flow, is obtained as the product of per farm income and projected farm numbers. The remaining components are the projected depreciation allowances for machinery, buildings, and land improvements. Given the resulting values for the two ratios used in the equation, the real machinery stock rises by about 0.8 per cent annually during the projection period.

CHART 4


FACTORS AFFECTING
THE REAL MACHINERY STOCK
BILLIONS OF DOLLARS, IN 1947-49 PRICES
20
15
10
STOCK
CROPS HARVESTED
(ACRES)
MILLIONS
350
250
INDEX, 1910-14=100
RATIO OF MACHINERY
PRICES TO WAGE RATES
BILLIONS
600
500
400
300
6
5
4
3
REAL MACHINERY PURCHASING POWER OF
PREVIOUS YEAR'S FARM CASH FLOW
(BILLIONS OF DOLLARS, IN 1910-14 PRICES)
'50
'55
'60
'65
'70
'75
'80
BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

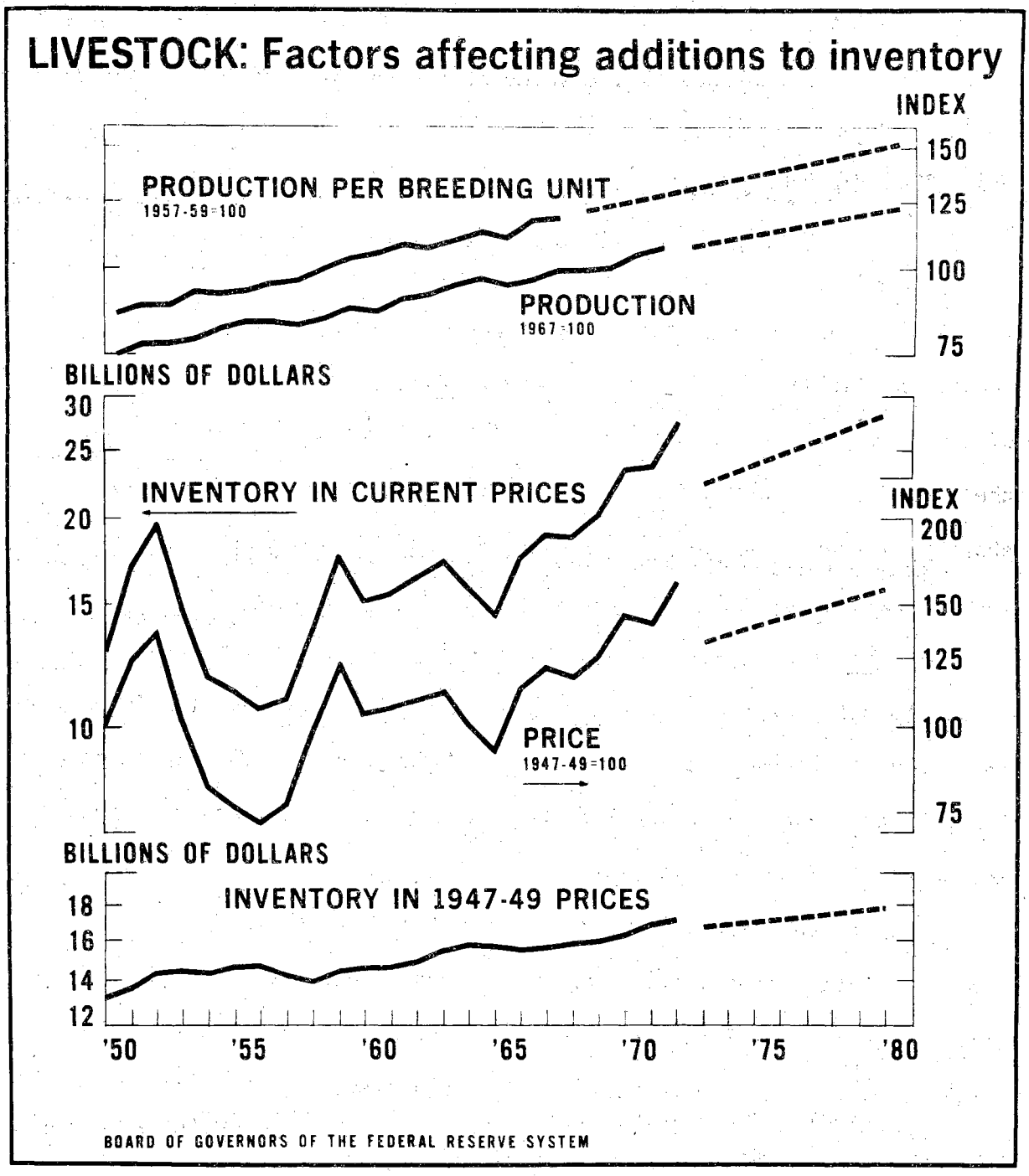
Additions to livestock inventory. The annual capital expenditure for livestock consists of the value of the physical change in the livestock inventory during the year. The average relative amount of this capital flow (Table 3) may appear surprisingly small to those familiar with the trend in physical livestock production. Part of the explanation appears in the top portion of Chart 5. A significant portion of the livestock inventory consists of breeding units, and output per breeding unit (a USDA series discontinued in 1968) has been rising somewhat faster than total output.

Furthermore, as the center portion of Chart 5 indicates, the sharp rise in the value of the livestock inventory since 1964 has been largely a revaluation that does not entail a capital flow. Two livestock cycles are evident in both the price and real stock series charted, and 1972 finds us in the third rising phase since 1950. Both series are now substantially above their 1950-72 trend lines.

Projected changes in livestock inventories are obtained as follows. First, the real stock and the price deflator are projected by extrapolating their 1950-72 trends, which were, respectively, 0.9 per cent and 1.7 per cent a year. The rate of price increase is adjusted upward to 2.4 per cent. Each year's change in real stock is then valued at the price projected for that year.

The resulting annual flow is in the $200 to $250 million range. Given the cyclical nature of this series, actual annual flows will fluctuate considerably around such a trend projection. During 1950-71, the annual flow ranged between $1,107 million and $ -345 million.

CHART 5


LIVESTOCK: Factors affecting additions to inventory
INDEX
150
125
100
75
PRODUCTION PER BREEDING UNIT
1957-59=100
PRODUCTION
1967=100
BILLIONS OF DOLLARS
30
25
20
15
10
INVENTORY IN CURRENT PRICES
INDEX
200
150
125
100
75
PRICE
1947-49=100
BILLIONS OF DOLLARS
INVENTORY IN 1947-49 PRICES
18
16
14
12
'50
'55
'60
'65
'70
'75
'80
BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

Additions to the stored crop inventory. A similar procedure is used to project changes in the inventory of stored crops, and as it happens the projected annual flow lies in the same range. In contrast to the rising livestock price trend, however, such trend as could be discerned in stored crop prices during 1950-72 was slightly downward. But the real stock averaged a 2.0 per cent annual gain. Annual flows during 1950-72 ranged between $1,169 million and $ -782 million.

Additions to financial assets. The financial assets properly included in this model are those that constitute the working capital or readily-available secondary reserves for farm operations. Farmers' holdings of currency, demand deposits, and time deposits at commercial banks meet these criteria. Having included time deposits, which have been rising sharply, it seems advisable to include also a close substitute, U.S. savings bonds, holdings of which have been declining.

The price deflator used by the USDA to compute the real stock series for financial assets (as well as to obtain real net farm income) is the index of prices paid for farm family living items. This index rose by 1.5 per cent annually during 1953-68; consequently, the projected rate of increase is 2.3 per cent a year.

In real terms, the average annual rate of change in farmers' financial assets over 1950-71 was as follows: currency, -2.7 per cent; demand deposits, -2.2 per cent; and time deposits, 3.3 per cent. The real stock of U.S. savings bonds developed a consistent downtrend after 1960, at an annual average rate of -4.6 per cent. These rates are used in the real stock projections.

Upon combining the real and price trends, financial assets are projected to change at these annual rates: currency, -0.5 per cent; demand deposits, no change; time deposits, 5.6 per cent; and U.S. savings bonds, -2.4 per cent. The projected combined annual capital flow to achieve these changes is $247 million in 1972 and rises to $456 million by 1980.

The combined projected flow for financial assets and inventory additions is shown in Chart 6. Though it is rising relatively fast, this sum still averages only 6 to 7 per cent of the total capital flow to be financed. One may be concerned that these stocks of working capital have been measured on January 1, whereas the peak in farm production activity in most areas occurs during the summer. However, I have shown elsewhere that farm operating expenses with large seasonal components increased by only 3.3 per cent annually during 1956-68, and that the seasonality in bank and PCA operating loans has fallen drastically [9 , pp. 146-148].

Expenditures for buildings and land improvements. The real stocks of farm operator dwellings and of service buildings and land improvements have been decreasing, partly as farmsteads have moved out of the farming sector, and otherwise because expenditures since the mid-1950's have been lower than capital consumption. The rates of decline were greater in the last decade than in the 1950's. The average annual rates of the last 10 years are used for the projections: -3.2 per cent for operators' dwellings and -3.0 per cent for service buildings and land improvements.

Having projected the two real stock series, depreciation allowances are projected by applying the annual depreciation rates that the USDA presently plans to employ, which are 4.67 per cent for dwellings and 7.22 per cent for service buildings. To complete the projection of capital consumption, accidental damage is projected at the average annual rate (0.69 per cent) experienced since 1950.

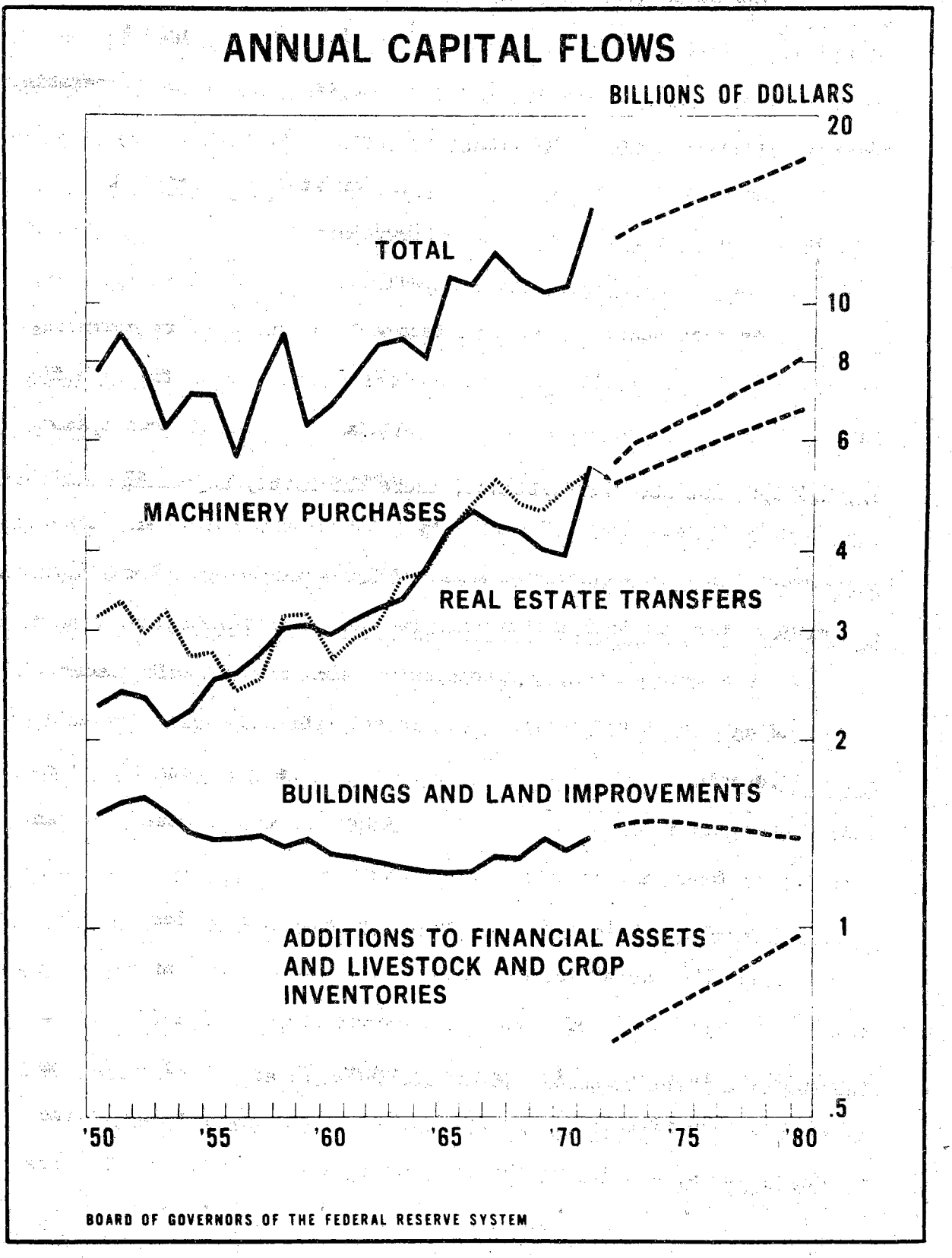
Annual expenditures are then projected as the amounts required to make up for the capital consumption as necessary to hit the annual stock figure projected for the end of each year, plus an adjustment for the buildings on land removed from the farming sector. The total annual expenditure is shown in Chart 6.

The expenditure and capital consumption series are all valued according to indexes of construction costs, which during 1953-68 rose at average annual rates of 1.8 per cent for dwellings and 1.7 per cent for service buildings. After adjustment to reflect the higher rate of general price inflation projected, these price series are projected to advance at average annual rates of 2.5 per cent and 2.4 per cent, respectively.

Total capital flow. The sum of all these capital flows--the total annual amounts that had to be financed--is shown in Chart 6. Those who judge the amount of financing needed by looking at the trend in total assets or in outstanding debt say that financing needs have been going up, up, and up. Not so. For instance, there was hardly any change for six straight years recently, 1965-70. And in the early 1950's the trend was down. But in some years, such as 1965 and 1971, a boom in machinery buying or a spurt in land market activity can cause the capital flow to be financed to rise much faster, percentagewise, than the value of the stock. The point is that the two are only loosely related--as the preceding item-by-item tour should have made clear--and to continue our analysis of farm financial behavior it is the flow series that we need.

After hitting $12.0 billion in 1967, the capital flow to be financed fell off the next three years, then broke out to a new high of $14.4 billion in 1971 as real estate transfers and additions to livestock and stored crop inventories were all unusually high. The projected values--the sum of all the component projections--begin at $12.8 billion in 1972 and climb to $17.3 billion by 1980, which is an average annual increase on the order of 3.7 per cent.

CHART 6


ANNUAL CAPITAL FLOWS
BILLIONS OF DOLLARS
20
10
8
6
4
3
2
1
.5
TOTAL
MACHINERY PURCHASES
REAL ESTATE TRANSFERS
BUILDINGS AND LAND IMPROVEMENTS
ADDITIONS TO FINANCIAL ASSETS
AND LIVESTOCK AND CROP
INVENTORIES
'50
'55
'60
'65
'70
'75
'80
BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

Knowing the past capital flow opens up a whole new world of analysis. To begin with, we can ask how burdensome the capital flow has been in relation to the stream of funds received after current operating expenses have been paid--the farm cash flow.

Cash flow. Farm cash flow, and how it is projected, has already been discussed in the section on machinery purchases, but an additional word about the concept may be in order.

As just noted, gross farm income less current farm operating expenses equals the farm cash flow. USDA accounts divide the cash flow into two further components: net farm income and capital consumption allowances. The latter sum represents that amount that, if spent on new machinery and buildings, would exactly compensate for the wear, obsolesence, and damage during the year, as estimated from schedules reflecting average experience with such matters.

But in any given year, the capital consumption allowances and the spending on buildings and machinery are different--related, certainly, but not identical. The allowances and net income are a commingled and indistinguishable income stream. The recipients of the cash flow can spend these funds as they wish.

This point is important because the part labelled "capital consumption allowances" is now a substantial 28 per cent of the farm cash flow--$7.2 billion out of $24.6 billion cash flow in 1971 (Table 4). Furthermore, in contrast to the meandering course of net farm income, the allowances have risen steadily mainly due to the rising value of the machinery stock, but during the last decade also because the USDA was

Table 4. Percentage composition of farm cash flow

Farm cash flow	1950-54	1955-59	1960-64	1965-69	1970-71	Projection 1975-79
Total	100.0	100.0	100.0	100.0	100.0	100.0
Net farm income	82.0	76.4	75.7	74.2	71.9	71.1
Capital consumption allowances	18.0	23.6	24.3	25.8	28.1	28.9
Machinery	12.9	17.1	17.3	18.1	20.1	22.4
Operators' dwellings	1.9	2.5	2.6	2.8	3.1	2.6
Service buildings	2.2	3.0	3.4	3.9	4.0	3.3
Accidental damage	.9	1.0	1.0	1.0	.9	.7

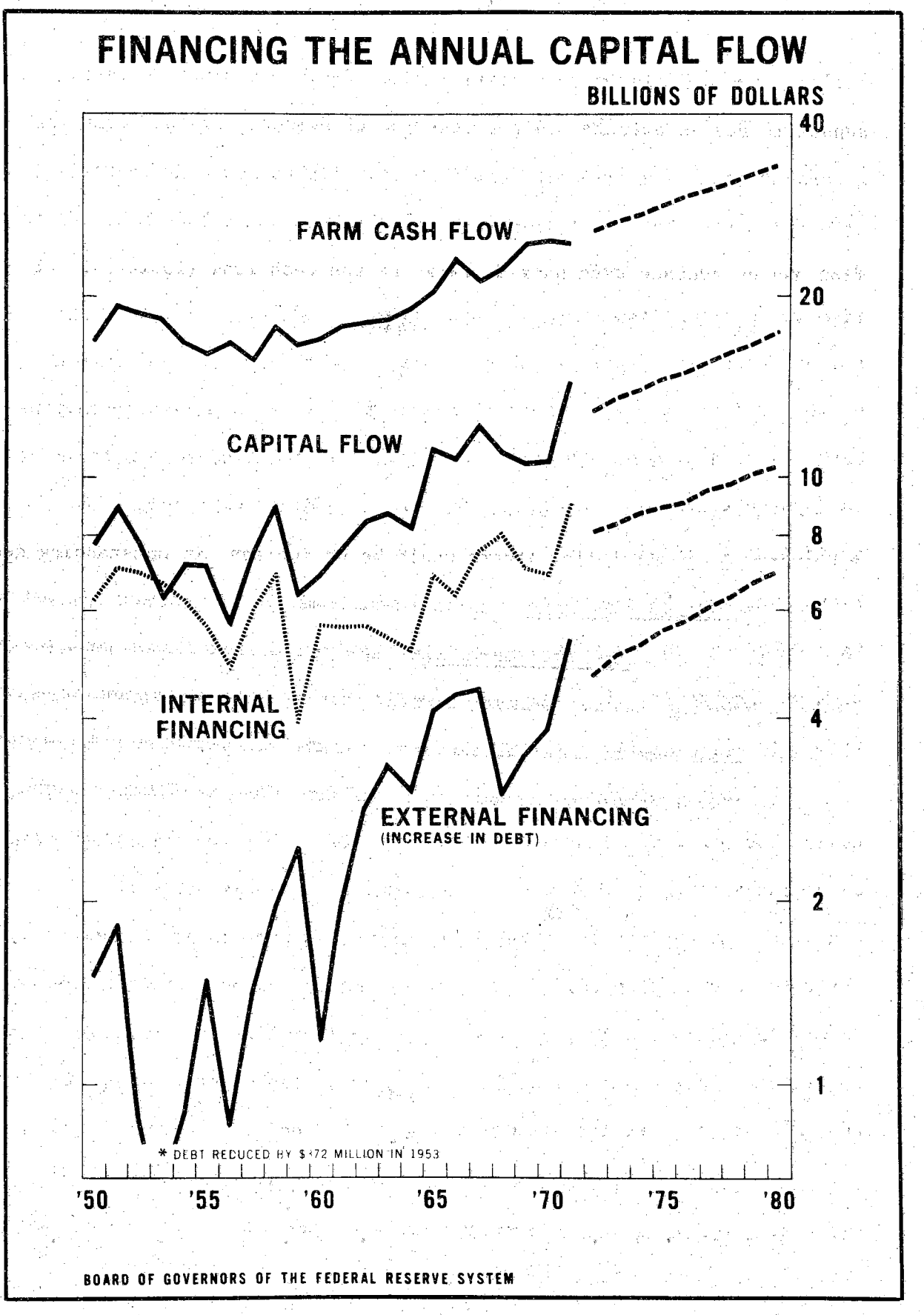
shifting to much higher depreciation rates for buildings. Projected annual increases average 3.4 per cent for allowances, 2.9 per cent for net farm income, and 3.0 per cent for total farm cash flow (Chart 7).

The relative capital financing burden. Since 1965 the capital flow has on average been half as large as the cash flow (Table 5). At this ratio, the relative burden has shifted upward significantly from the 1950-64 average of 0.43. The first year over 0.50 during the period studied was 1965, and 1971 was the highest year at 0.59. The projected relative burden rises slowly from 0.50 in 1972 to 0.52 in 1979. If the farming sector were to allocate this proportion of cash flow toward financing the capital flow, there would be no increase in outstanding debt.

Internal financing. The second significant analytical gain from knowing the past annual capital flow is that the amount of past internal financing can then be computed, merely by subtracting the known increases in debt from the annual capital flows. The resulting internal financing series is shown in Chart 7. The chart illustrates well how the proportion of capital flow financed internally has dropped from around 88 per cent in the early 1950's to less than 65 per cent in recent years (Table 5).

Savings rate. Greater analytical significance, however, attaches to the ratio between internal financing and cash flow, for this represents the percentage of its flow of spendable funds that the farming sector has in fact allocated toward meeting the capital flow. This ratio, which for convenience I will call the "savings rate," stood at a steady 37 per cent in the early 1950's, but over the next ten years it moved down into the low thirties, where it has on average remained (Table 5). The average for the last ten years was 31.4 per cent.

CHART 7


FINANCING THE ANNUAL CAPITAL FLOW
BILLIONS OF DOLLARS
40
20
10
8
6
4
2
1
FARM CASH FLOW
CAPITAL FLOW
INTERNAL FINANCING
EXTERNAL FINANCING
(INCREASE IN DEBT)
* DEBT REDUCED BY $172 MILLION IN 1953
'50
'55
'60
'65
'70
'75
'80
BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

The record of these analytical ratios is worth reiterating for the insight it gives into the debt expansion of the past two decades. In the early 1950's, when capital flow averaged 42 per cent of cash flow, the savings rate was 37 per cent and thus 88 per cent (.37/.42) of the capital flow was financed internally. But in the late 1960's, by which time the capital flow had increased to 50 per cent of cash flow, the savings rate had dropped to 32 per cent so that only 65 per cent (.32/.50) of the capital flow was financed internally. Thus the move toward greater external financing had two aspects rather than one, and the shift in the savings rate deserves as much recognition and study as the shift in the capital flow burden. Similarly, the prognosis for the amount of internal financing needs be a part of any speculation about the future course of farm debt just as badly as the prognosis for capital spending and other capital flows. And the reasons for and possible consequences of a long-term shortfall in internal financing beg for the attention of analysts.

Incidentially, this clarifies why, in the little paradox I initially posed, the projected increase in debt for 1972 was only marginally dependent on an increase in capital flow. The present annual gap between internal financing and the capital flow is so large that any conceivable one-year shift in internal financing is not going to come anywhere near closing it. So one does not need to project a higher capital flow next year in order to project a sizable increase in debt. One can do so even while expecting the same or lower capital flow!

Table 5. Analysis of farm financial behavior

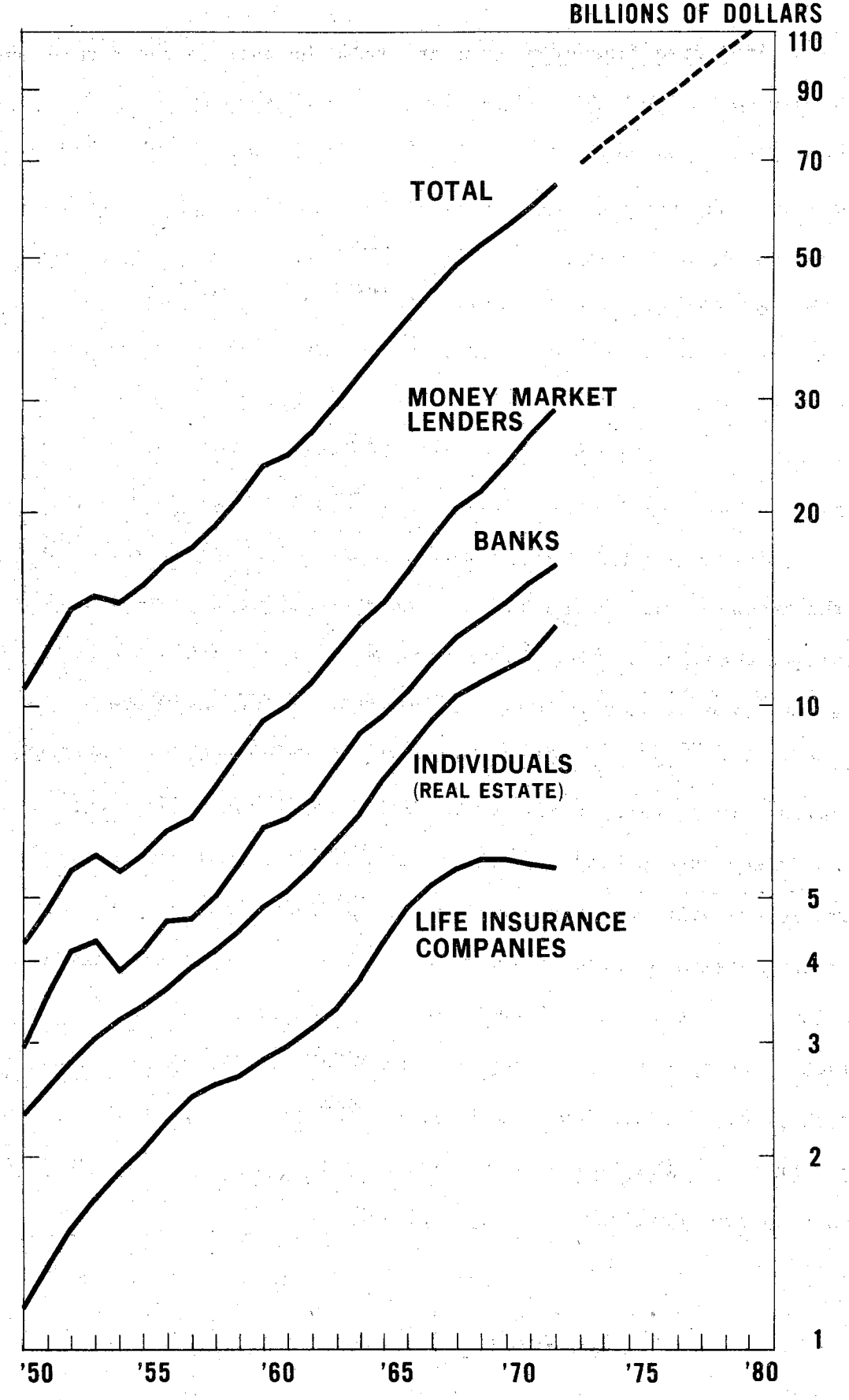
Analytical ratio	1950-54	1955-59	1960-64	1965-69	1970-71	Projection 1975-79
Ratio of capital flow to cash flow . .	.42	.43	.44	.50	.51	.52
Proportion of cash flow allocated to financing capital flow (savings rate)	.37	.33	.30	.32	.32	.31
Percentage of capital flow financed--						
Internally (from cash flow). . . .	88	77	69	65	63	61
Externally (by increase in debt) .	12	23	31	35	37	39
Average annual growth rate of--						
Capital stock	4.5	4.5	3.3	5.3	5.4	4.0
Outstanding debt	7.5	8.9	8.8	9.0	8.0	6.7
Ratio of:						
Debt to capital stock (end of period).	.10	.12	.16	.19	.20	.25
Increase in debt to increase in stock	.16	.21	.37	.29	.29	.40

Projected financing. Turning from the past to the future, and having already projected farm cash flow, we are ready to calculate projected internal financing. For this, a long-term projection of the savings rate is needed. Many possible influences on this variable come to mind: the state of confidence in long-term farm income prospects, appreciation (or lack thereof) of their farm and nonfarm investments, earnings available on nonfarm credit or equity instruments, relative desire to upgrade consumption levels, number of farmers' progeny in college, cost and availability of credit. The list could go on. As with the projected inflation rate, it seems best to assume one specific savings rate and then vary it for alternative projections. As the savings rate averaged about 31 per cent in each of the last two five-year periods, it is projected to continue at this level. The product of this rate and the projected cash flow yields the projected internal financing (Chart 7). When this internal financing is subtracted from the projected capital flow, the projected annual increases in debt are obtained, as also shown on the chart. They approach the $7 billion mark by 1980. During the latter 1970's, this projection indicates that 61 per cent of the capital flow is financed internally, and 39 per cent by increasing debt (Table 5).

Outstanding debt. The annual increases in debt, past and projected, accumulate into the outstanding debt shown in Chart 8. Debt reaches $110 billion in January 1980, almost exactly doubling during the present decade. But outstanding debt grows at an annual rate of only 6.7 per cent during the latter part of the projection span, which is significantly less than postwar experience so far (Table 5). The debt/asset ratio advances further to .25

CHART 8

OUTSTANDING FARM DEBT by Lender Group



BOARD OF GOVERNORS OF THE FEDERAL RESERVE SYSTEM

by 1980, and the ratio of projected increases in debt to projected increases in the value of assets is .40 and rising, indicating that the debt/asset ratio in this projection is considerably far from achieving stability.

Supply of credit. In this model considerations relating to the cost and availability of credit are subsumed in the determination of the savings rate. I find this an attractive formulation because it keeps one keenly aware that factors affecting the quantity or proportion of internal financing are necessarily also the factors affecting its mirror image, the quantity or proportion of external financing.

I consider this de-emphasis of the credit supply function justified on the grounds that a major lender--the cooperative farm credit system--serving the entire farming sector provides a very elastic supply of funds at a cost tied closely to national money market interest rates. The Farmers Home Administration and the larger farm supply and equipment corporations are also able to raise funds for farm lending in the money market. Together, these "money market lenders," whose outstanding farm loans are shown in Chart 8, are able to respond with almost perfect elasticity to shifts in farm loan demand because agriculture's borrowings represent only a small portion of funds flowing through the money centers. They can offset the effect of changes in the supply of farm loans offered by other lender groups. And the cost of their funds is determined by the interplay of fund demand and supply in the entire economy, and thus is only marginally affected by demand changes originating in agriculture.

The other major farm lenders--sellers of farms, life insurance companies, and commercial banks--do have unique loan offer functions that reflect differences in their own sources of funds and other considerations as I have discussed elsewhere [7 ,pp. 5-6]. Briefly, loans offered by sellers of farms undoubtedly reflect land prices, land market activity, and provisions of tax laws. Farm lending by the life insurance companies appears to be related to their own cash flow (affected in turn by cyclical swings in policy loans and the repayment rate of outstanding loans) and the degree to which they may be temporarily over- or under-committed in commercial lending. For commercial banks, the rate of deposit growth and the relative strength of loan demand from other sectors are probable factors. Each of these lender groups is also influenced by the relative rate of return on its farm lending as compared with other possible loans and investments. Specification of such functions represents a logical future extension of the model. Lins recently completed a model incorporating such detail [6].

Alternative projections

I began this paper by noting that debt projections for 1972 would be only marginally affected by rather different assumptions about changes in prices and real stocks during that year. Such alternatives can now be examined in more detail.

Deviations from the projected 1980 debt of $110 billion appear most likely to result from price trends that differ from those projected. This could take the form of a sharp change in the price trend for a particular asset such as land or livestock, or the form of an annual rate of general price inflation other than 2.5 per cent. The former exercise presents possibilities and combinations without limit and is not attempted here. Results from some of the latter possibilities are reported in Table 6. They indicate that even rather wide changes in the projected rate of inflation do not materially alter the debt projection. However, this exercise indicates that the rising trend in the debt/asset ratio is significantly reduced as the rate of inflation is increased. Even though debt rises faster at higher inflation rates, the value of capital stocks is affected to a greater extent, and therefore the rate at which the farming sector is mortgaging its capital plant is reduced.

The second type of exercise reported in Table 6 indicates that a large increase in outstanding debt is very probable over the next few years. Even with no change in stocks or prices, the debt in 1980 is projected at $96 billion, as compared to 1972 debt of $65 billion. Before concluding that a large increase is inevitable, however, we should examine the possibility of a change in the savings rate. In all these projections, internal financing was specified at 31.4 per cent of farm cash flow. How would a shift in the savings rate affect the debt projection of $110 billion?

Table 6. Projections using alternative assumptions regarding prices and real stocks

Projected item	Annual rise in general price level set at--				No change allowed in--			Addendum
	2.5%	Zero	1953-68 average (1.7%)	1968-72 average (4.1%)	Real stocks	Prices	Stocks or prices	
								Value on 1/1/72
Value on January 1, 1980:								
Outstanding debt (billions of dollars)	110	105	108	114	108	100	96	65
Ratio of debt to capital stock	.257	.284	.265	.243	.256	.313	.307	.201
Average per farm (thousands of dollars):								
Capital stock	185	160	177	203	183	139	136	113
Outstanding debt	48	45	47	49	47	44	42	23
								Flow in 1971
Flow in 1980 (billions of dollars):								
Farm cash flow	33.0	27.1	31.1	37.1	32.8	27.0	26.6	24.6
Capital flow	17.3	14.2	16.3	19.5	16.7	12.9	11.9	14.4
Increase in debt	6.9	5.7	6.5	7.9	6.4	4.4	3.5	5.4

During the projection period, 1972-79, farm cash flow is projected to average $28.8 billion annually. Given the savings rate of 31.4 per cent, yearly internal financing averages $9.0 billion (.314 x 28.8 = 9.0). As the average annual projected capital flow is $14.7 billion, an average annual debt increase of $5.7 billion is indicated (14.7 - 9.0 = 5.7). Over the eight-year period the total increase in debt is $45.4 billion; thus outstanding debt reaches $110 billion in January 1980.

Going back to the beginning of this sequence, one can see that each increase of one percentage point in the average savings rate for this projection period increases average annual internal financing by $288 million and therefore reduces the average annual increase in debt by the same amount. Thus, for example, a savings rate five percentage points higher represents an additional $1.4 billion in average yearly internal financing. This would reduce the average annual projected increase in debt to $4.3 billion, and outstanding debt in 1980 reaches only $98.5 billion.

What savings rate would stabilize outstanding debt at its January 1972 level? Average annual internal financing would have to rise $5.7 billion. The savings rate would have to be about 20 percentage points higher (5.700 ÷ .288 = 20), putting it at 51 per cent. Such a savings rate appears very unlikely. The top savings rates for individual years since 1950 have been 39 per cent in 1957-58 and 37 per cent in 1950-53, 1955, and 1971. A decrease of about 7 percentage points occurred between the early 1950's and early 1960's (Table 5). If a reverse shift of this magnitude is assumed to occur immediately, projected 1980 debt is reduced by $16 billion. This is a significant effect, particularly when compared to the impact of alternative inflation assumptions and the like, but the move to substantially higher debt over the next few years still seems assured.

Concluding thoughts on farm debt expansion

What events might bring about an eventual reduction in debt expansion? Since this requires that internal financing get more closely aligned with capital flow, the answer requires a search for possible adjustments in either of these two variables.

First, the amount of real net capital formation supported by the present capital flow is already rather small. Since we do not anticipate that real stocks of machinery and livestock will begin downward trends, there seems little likelihood of a significant negative effect on capital flow from this area.

That leaves, on the capital flow side, the funds being withdrawn from the farming sector in the course of intergenerational transfers of property. For one thing, an increase in the average level of existing debt on property that is transferred will tend to decrease these withdrawals. We might also wonder whether the rate of farmer retirements and/or the proportion of nonfarm heirs may be lower in the future than it has been over the last two decades.

On the internal financing side, the question boils down to speculation about what the farming sector is doing with the funds that it has not had to save because of the ability to borrow. One possibility is that the sector is enjoying a higher level of consumption by mortgaging its assets. If this is the case, the sector's ability to pursue this course will diminish as the debt/asset ratio rises and as debt service absorbs a higher percentage of gross receipts.

More likely, however, the use of debt rather than internal financing does not stem from that kind of choice, but is instead a necessary consequence of the reorganization of agriculture into larger units. Technological advances keep making larger farms more efficient and profitable than smaller units. The optimum size of farm in most areas has gone beyond the size that represents the wealth than an average American--not to mention an average American farmer--can presently expect to accumulate over his lifetime. As other types of business enterprises in the United States have reached this stage, ownership and management have generally been separated through the sale of equity shares to the public or through takeover by publicly-held firms. Agriculture has largely not yet followed this route. The need to do so has been obviated, at least temporarily, by the ability to raise funds for expansion by increasing debt.

Incidentally, this has allowed farming to remain a single-family enterprise. If family farmers were unable to increase debt to enlarge farms, so that a sizable gap opened up between unit costs of the typical and of the optimum farm, others with the necessary equity capital or borrowing capability would eventually enter the industry.

Some worry about servicing the higher debt. But if the debt expansion is largely financing the reorganization of farming into larger, more efficient units, presumably the net return from the reorganization is positive--the debt service having been covered from the lower unit costs thereby achieved.

If this view of the major underlying cause of the debt expansion is correct, then it follows that the trend rate of expansion should reflect farm enlargement possibilities and pressures.[1/] There remains the ever-present possibility, however, that institutional arrangements will be created or revised to allow or to encourage the nonfarm sector to shift to providing funds to the farming sector relatively more through the purchase of equity instruments and relatively less through direct lending or the purchase of credit instruments. For example, fairly recent arrangements already permit a substantial amount of nonfarmer equity investment in cattle operations. Or, Hieronymus points out that some recently created futures contracts in effect permit speculators to furnish equity capital for farm commodities still in the farm production process [4 , pp. 130-133]. Further developments like these may eventually alter the financing of agriculture.

1/ Much of the past analytical comment on increases in capital and debt of individual farms may not have been well founded, however, because it has been based on comparison of per farm averages over time. We have known that the change in such averages is distorted because the farm units disappearing over time are mostly small farms, but we may not have appreciated how big this distortion may really be. In an article that deserves more attention than it appears to have received, Reinsel shows that two-thirds of the 1959-64 increase in the average number of acres per farm is a statistical illusion [12]. The published average rose from 302 to 351 acres, or by a sizable 16 per cent in five years. But an analysis reveals that the farms still existing in 1964 averaged 335 acres in 1959. On average these farms each purchased or rented an additional 16 acres, raising the 1964 average to 351 acres. Thus the true rise in average size was from 335 to 351 acres, or only 5 per cent in 5 years. What a difference from 16 per cent! This could well be an indication of the degree to which comparisons of average assets and debt are also distorted.

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A separate report, "Econometric Model of the Farm Financial Sector, and Projection Run #3A, December 1972," which gives the model and projections on which this paper is based, is available from the author on request.