PROJECTIONS OF AGRICULTURAL CAPITAL AND CREDIT REQUIREMENTS: AN OKLAHOMA APPLICATION

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INTRODUCTION

The growth in the capital investment in agriculture that occurred during the 1950's and 1960's and the resulting credit demands led to a number of inquiries into the future capital and credit requirements of American agriculture [2, 3, 4]. The results of these studies suggest that the aggregate capital and credit needs of the agricultural sector will increase significantly in the future. However, estimates of future capital and credit requirements of firms that are representative of different sizes and enterprise types of farms are not available. These estimates would be useful to farmers and lending institutions in determining the future amount of capital and credit needed to generate a given level of gross sales or income. Those entering farming could compare the present and future capital needed for different types of operations. Estimates by type of enterprise would indicate the potential for lending institutions to specialize in type-of-farming, package financing. These data may also indicate to policy-makers and financial intermediaries what adjustments or changes in lending limits and restrictions are needed to properly serve the larger, more capital intensive farms of the future. In addition, representative farm estimates of future capital and credit needs can be aggregated to provide estimates of state and national capital requirements.

The following discussion will outline a model to determine capital and credit requirements of representative farms by analyzing the capital flows necessary to move from past to future stocks of assets. The usefulness of this model is then tested by estimating the future capital (total, equity, and non-equity) requirements of Oklahoma farm firms.

THE CONCEPTUAL MODEL

Equity Flow

Much of the past measurement, analysis, and projection of the use of capital in agriculture has dealt mainly with stocks of assets and with the past and expected future changes in the stocks. However, several researchers have suggested that investigations of the flows of capital into and out of agriculture would provide better indications of future capital and credit requirements of the farm sector [2, 3, 4]. Brake and Melichar have argued that the financing of agricultural assets, whether from equity or debt capital, is done by cash flows, not stocks [1, pp. 2-3]. Thus the main problem becomes one of estimating the implied cash flows to go from the capital stock to a given year to the projected capital stock of a future year.

The Model

The model used to predict and analyze the future capital and credit needs of Oklahoma farms employs a linear regression procedure to project the past and future stocks of assets on representative farms. Then the sources of cash or inflows and the uses of cash or outflows are projected with regression procedures to determine what proportion of the stock of capital could be provided by the farmer's equity. The remaining proportion of the stock of capital, the residual, is assumed to be provided by non-equity (debt or renting and leasing).

The analysis procedure employs census data from an economic class-enterprise type cross-classification of farms. The economic classes used are Classes I through V as delineated in the agricultural census

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[6]. The enterprise types of farms include cash grain, cotton, other field crops, poultry, dairy, livestock other than poultry and dairy, livestock ranches, and general farms as classified in the census. Utilizing 1969 census data, this classification scheme accounts for 50,977 Oklahoma farms, or only 62 percent of the total number of Oklahoma farms reported. However, the market value of all agricultural products sold from these five classes and eight enterprise types of farms accounts for 96 percent of the total value of agricultural products sold from all Oklahoma farms.

A basic assumption underlying the analysis and the projections reported here is that historical trends and relationships will be prevalent in the future. The use of linear regression with non-deflated data to project future income and asset values implies that historical rates of inflation and changes in input prices and quantities will continue into the future. Another implicit assumption is that the forms of land ownership and asset control that existed in agriculture during the data period (1959-1969) will not change within the projection interval. In addition, it is assumed that the past rates of change in the size structure of agriculture and the past trends in government farm programs and policies will continue into the future. To determine the sensitivity of the results to these assumptions, projections were also made of the capital and credit requirements using non-historical trends in the rate of inflation, the growth of government program payments and the growth in non-farm (supplementary) income. These projections are reported elsewhere [5, pp. 110-125].

As suggested by Brake, the capital needs of farm firms are supplied first from equity sources and second from debt sources. Thus, the demand (or need) for credit represents a residual demand for funds [1, p. 2]. Based on this assumption the model consists of the following equations:

$$(1) \quad C_{ijt} = LB_{ijt} + ME_{ijt} + L_{ijt},$$

$$(2) \quad I_{ijt} = GFI_{ijt} + NFI_{ijt},$$

$$(3) \quad NFI_{ijt} = SI_{ijt} + GP_{ijt},$$

$$(4) \quad O_{ijt} = FOE_{ijt} + PW_{ijt} + OFI_{ijt},$$

$$(5) \quad E_{ijt} = I_{ijt} - O_{ijt} + \lambda LB_{ijt},$$

$$(6) \quad C_{ijt} = \overline{IE}_{ijl} + \sum_{t=1}^{k} E_{ijt} + NE_{ijt} \quad (\text{for } t = k),$$

$$(7) \quad NE_{ijt} = C_{ijt} - (\overline{IE}_{ijl} + \sum_{t=1}^{k} E_{ijt}) \quad (\text{for } t = k),$$

where

C_{ijt} = capital per firm in class i of type j in year t,
LB_{ijt} = value of land and buildings per firm in class i of type j in year t,
ME_{ijt} = value of machinery and equipment per firm in class i of type j in year t,
L_{ijt} = value of livestock per firm in class i of type j in year t,
I_{ijt} = cash inflows into each firm in class i of type j in year t,
GFI_{ijt} = gross farm income per firm in class i of type j in year t,
NFI_{ijt} = non-farm income per firm in class i of type j in year t,
SI_{ijt} = supplementary income per firm in class i of type j in year t,
GP_{ijt} = government program payments per firm in class i of type j in year t,
O_{ijt} = cash outflows from each firm in class i of type j in year t,
FOE_{ijt} = farm operating expense per firm in class i of type j in year t,
PW_{ijt} = proprietor's withdrawals per firm in class i of type j in year t (taxes and consumption),
OFI_{ijt} = non-farm or off-farm investments per firm in class i of type j in year t,
E_{ijt} = the change in equity per firm in class i of type j in year t,
$\overline{IE}_{ijl}$ = initial equity capital per firm in class i of type j in year one,
NE_{ijt} = total non-equity capital per firm in class i of type j in year t,
i = economic class of firm,
j = enterprise type of firm,
t = time in years,
λ = the price component or price appreciation factor for land and buildings, and
k = the specific year of interest.

Equation (1) indicates that the total capital requirement (C_{ijt}) for the i^{th} economic class, j^{th} enterprise type of farm in year t is the sum of the value of land and buildings (LB_{ijt}) plus the value of machinery and equipment (ME_{ijt}) plus the value of livestock (L_{ijt}) for this class-type farm in year t. Equation (2) denotes that the total cash inflows (I_{ijt})for each representative firm are calculated as the sum of gross farm income (GFI_{ijt}) and non-farm income (NFI_{ijt}). As indicated in equation (3), non-farm income (NFI_{ijt}) is composed of government farm program payments (GP_{ijt}) and supplementary

income (SI_{ijt}) derived from sources not related to farming.[1] Equation (4) of the conceptual model denotes that the total cash outflows (O_{ijt}) in any year for each representative firm consist of the sum of farm operating expenses (FOE_{ijt}), proprietor's withdrawals (PW_{ijt}) for income tax, social security, and consumption and non-farm investments (OFI_{ijt}).

The future change in equity capital per representative firm (E_{ijt}) is derived in equation (5) by taking the difference between the projected cash inflows per firm (I_{ijt}) and the projected cash outflows per firm (O_{ijt}) and adding to this difference the estimated change in equity due to any change in the value of owned land and buildings (LB_{ijt})[2]. While an increase in the value of an owned asset does not represent liquid funds that are available for investment in the farm business or the non-farm sector, it does represent equity that could be obtained if the farm assets are liquidated. If appreciation of owned assets is included in equity, then that portion of the current total value of capital requirements does not have to be supplied by non-equity or debt funds. However, a number of farm operators in Oklahoma are part- or full-renters and do not receive the equity benefit from price appreciation in land and buildings. In addition, many farmers do not revalue their assets each year to take advantage of price appreciation. Consequently, two equity projections were made, one assuming that the farmer is a full-owner and all price appreciation in land and buildings accumulates as equity, and the second assuming that the farmer receives no equity from price appreciation.

As indicated by equation (6), the capital requirement (C_{ijt}) in any future year for a representative farm is provided by the initial equity ($\overline{IE}_{ijl}$) of the firm in the base year plus the summation of the changes in equity (E_{ijt}) during the years analyzed plus non-equity capital (NE_{ijt}). Equation (7) is simply a reformulation of equation (6) and denotes that the difference between the total capital per representative farm (C_{ijt}) and the sum of the initial equity per farm (IE_{ijl}) and the changes in equity per farm ($\sum_{t=1}^{k} E_{ijt}$) must be provided by some form of non-equity capital.

Most of the data used for the projections are taken directly from the Census of Agriculture for Oklahoma for the years 1959, 1964, and 1969. However, to be consistent with the conceptual model, it was necessary to employ some non-census data to complement and modify the basic census data. Non-census information consists of published USDA data or estimates derived therefrom [5, pp. 33-49]. The rate of price appreciation in land and buildings used in the projections presented here is 5.4 percent. This rate is consistent with the rates reported in the *Farm Real Estate Market Developments* and *Balance Sheet of the Farming Sector* publications for the 1959-1969 period, but is about twice the census rate of price appreciation for this period.

REPRESENTATIVE FARM PROJECTIONS

Total Capital

Estimates of total capital required by representative Oklahoma farms for selected years are presented in Table 1. The figures in Table 1 are current dollar estimates of the average total capital (C_{ijt}) that is controlled by each representative farm. Thus, the data for Class I cash grain farms indicate that those Oklahoma farmers who derive 50 percent or more of their farm revenues from cash grain operations and have at least $40,000 of gross farm sales control through ownership and renting and leasing an estimated $602,266 of total farm capital or assets per farm in 1972. By 1980, this total is expected to increase to $887,807. Note that the total capital requirements of all class-type representative farms are projected to increase from 1972 to 1980, but the rate of growth is much lower for poultry and dairy farms compared to the other enterprise type farms. The annual growth rates appear to be the highest for Class I and Class V other field crop farms. Class I livestock ranches will control $1,134,844 of capital per farm by 1980, whereas Class V poultry farms will control only $38,436 of total capital per farm in that year.

Equity Capital

Estimates of total equity capital for selected years are presented in Tables 2 and 3. Table 2 presents the equity capital projections if equity accumulation occurs only from net cash inflows (unadjusted equity). Table 3 summarizes the equity capital estimates for farmers who accumulate equity from the price appreciation in land and buildings as well as from net cash inflows (adjusted equity).

Data in Table 2 indicate that the annual rate of

[1] All items of non-farm income such as wages and salaries, non-farm business or professional income, rent, interest, dividends, etc., are grouped under the heading supplementary income.

[2] It would have been desirable to reflect the equity inflow and outflow that occurs from gifts and inheritances in this equation. However, data on transfers to farm and non-farm heirs for economic class-enterprise type representative farms are unavailable.

Table 1. TOTAL CAPITAL FOR REPRESENTATIVE FARMS

Enterprise Type		Economic Class I	II	III	IV	V
Cash Grain	1972	$602,266	$335,387	$210,455	$129,401	$ 78,025
	1974	673,636	375,795	236,481	145,434	87,045
	1980	887,807	497,018	314,558	192,334	114,117
	Per. Change/Yr.	5.93	6.02	6.18	6.08	5.78
Cotton	1972	548,481	268,690	150,777	83,875	52,103
	1974	620,926	303,832	171,253	93,715	58,100
	1980	838,309	409,260	232,681	123,249	75,822
	Per. Change/Yr.	6.61	6.54	6.79	5.87	5.69
Other Field Crop	1972	393,567	164,368	101,782	60,716	76,203
	1974	452,777	185,550	112,255	67,402	90,541
	1980	630,453	249,096	143,671	87,459	133,554
	Per. Change/Yr.	7.52	6.44	5.15	5.51	9.41
Poultry	1972	83,377	59,279	42,941	33,182	27,459
	1974	85,599	66,906	45,220	35,608	30,202
	1980	92,265	89,810	52,063	42,885	38,436
	Per. Change/Yr.	1.33	6.44	2.66	3.66	5.00
Dairy	1972	236,292	132,665	85,059	52,444	47,857
	1974	245,878	139,167	91,351	56,031	53,167
	1980	274,637	158,671	110,229	66,792	69,097
	Per. Change/Yr.	2.03	2.45	3.70	3.42	5.55
Livestock	1972	548,016	269,448	155,000	95,281	60,302
	1974	611,687	300,239	170,573	104,791	65,937
	1980	802,703	392,609	217,319	133,054	82,843
	Per. Change/Yr.	5.81	5.71	5.03	4.94	4.67
Livestock Ranches	1972	829,731	320,226	192,002	125,213	83,315
	1974	906,009	349,892	209,413	139,369	94,235
	1980	1,134,844	438,888	261,646	181,839	127,005
	Per. Change/Yr.	4.60	4.63	4.53	5.65	6.56
General	1972	510,412	277,758	171,367	107,376	74,638
	1974	555,793	308,685	191,994	120,723	85,197
	1980	691,985	401,466	253,932	160,773	116,895
	Per. Change/Yr.	4.45	5.57	6.02	6.22	7.08

increase in unadjusted equity capital is the highest for Class I poultry and dairy farms. However, Class I livestock ranches, and cotton and general farms have a larger absolute increase in equity capital from 1972 to 1980 than poultry and dairy farms. The annual rates of growth (unadjusted equity) for all sizes of livestock ranches and cash grain and livestock farms appear to be consistently low compared to the other enterprise types of farms.

A comparison of the data in Tables 1 and 2 indicates that the rate of increase in unadjusted equity capital does not keep pace with the growth in total capital for most representative farms, and the result is a decline from 1972 to 1980 in the equity-to-total capital ratio. For example, the equity-to-total capital ratio for Class I general farms decreases from 86.9 in 1972 to 82.8 in 1980. For Class I livestock farms, the ratio declines from 70.5 to 53.2 during this period, while the ratio for Class III livestock ranches decreases from 78.6 to 70.1. However, for Class I poultry farms, equity accumulates at a more rapid rate than total capital requirements, and by 1980 equity exceeds total capital. More will be said about this generation of excess equity later.

The data in Table 3 indicate that adding the price appreciation in land and buildings to equity capital results in significant increases in the equity accumulation from most representative farms. In many cases the annual rate of growth in equity

Table 2. UNADJUSTED EQUITY CAPITAL FOR REPRESENTATIVE FARMS

Enterprise Type		Economic Class I	II	III	IV	V
Cash Grain	1972	$476,463	$248,848	$153,012	$ 90,932	$ 59,804
	1974	504,616	257,941	157,382	93,656	62,205
	1980	595,237	286,127	170,418	102,400	70,931
	Per. Change/Yr.	3.12	1.87	1.42	1.58	2.33
Cotton	1972	450,747	207,168	109,195	58,987	38,021
	1974	491,266	222,484	113,310	60,540	38,320
	1980	622,849	276,202	125,815	65,509	39,309
	Per. Change/Yr.	4.77	4.17	1.90	1.38	.42
Other Field Crop	1972	305,806	130,445	78,834	43,721	47,123
	1974	327,823	140,331	82,036	45,114	47,034
	1980	391,335	170,368	91,745	49,661	46,640
	Per. Change/Yr.	3.50	3.83	2.05	1.70	-.13
Poultry	1972	83,058	40,477	36,969	23,608	22,127
	1974	92,758	40,303	39,279	23,804	24,381
	1980	131,395	34,801	48,120	26,023	36,517
	Per. Change/Yr.	7.28	-1.75	3.77	1.28	8.13
Dairy	1972	237,429	116,738	71,216	41,993	35,408
	1974	266,277	123,995	75,628	44,431	36,123
	1980	371,986	146,783	91,463	53,897	39,355
	Per. Change/Yr.	7.08	3.22	3.55	3.54	1.39
Livestock	1972	386,329	199,813	119,661	72,892	49,138
	1974	398,281	206,591	124,475	77,055	51,831
	1980	426,796	227,336	140,455	92,225	62,061
	Per. Change/Yr.	1.31	1.72	2.17	3.32	3.29
Livestock Ranches	1972	630,108	241,284	150,982	91,605	61,461
	1974	663,042	247,200	157,860	96,183	63,829
	1980	767,536	266,958	183,382	113,726	73,240
	Per. Change/Yr.	2.73	1.33	2.68	3.02	2.40
General	1972	443,446	212,375	128,346	78,268	52,555
	1974	465,953	222,482	133,894	82,650	53,544
	1980	572,767	255,225	152,489	98,407	57,041
	Per. Change/Yr.	3.65	2.52	2.35	3.22	1.07

capital is tripled or quadrupled when price appreciation is included in equity. The effect of land and building price appreciation on equity accumulation is particularly noticeable for the Class IV and V farms where adjusted equity capital increases at an annual rate of 7 to 11 percent for six of the eight enterprise types of farms. This compares to growth rates of 1 to 3 percent for most of the Class IV and V farms when equity only includes accumulated net cash inflows. Class I livestock ranches and cotton farms exhibit the largest absolute growth in adjusted equity capital.

By comparing the adjusted equity capital estimates to total capital requirements (Table 1), one can see that equity-to-total capital ratios will increase from 1972 to 1980 if price appreciation in land and buildings is included in equity accumulation. In fact, many Class I and Class II farms accumulate more equity capital than needed in the farm operation. The interpretation of this excess equity accumulation will be discussed shortly. Note however, that the Class I and II livestock farms and livestock ranches do not accumulate excess equity capital even when all price appreciation in land and buildings is assigned to equity.

Non-Equity Capital

The non-equity capital estimates for each economic class and enterprise type can be obtained by subtracting the appropriate projection of equity

Table 3. ADJUSTED EQUITY CAPITAL FOR REPRESENTATIVE FARMS

Enterprise Type		Economic Class I	II	III	IV	V
Cash Grain	1972	$559,561	$295,675	$184,110	$110,276	$ 71,295
	1974	643,112	336,593	209,212	125,895	81,357
	1980	899,928	459,161	284,444	173,326	113,065
	Per. Change/Yr.	7.60	6.91	6.81	7.15	7.32
Cotton	1972	533,821	248,382	133,845	71,423	46,012
	1974	629,722	291,172	154,394	81,266	51,639
	1980	927,452	427,317	216,199	111,105	68,611
	Per. Change/Yr.	9.22	9.01	7.69	6.95	6.14
Other Field Crop	1972	372,863	154,209	90,593	51,770	65,507
	1974	439,585	179,937	101,635	58,529	77,675
	1980	637,231	257,600	134,863	79,174	114,050
	Per. Change/Yr.	8.86	8.38	6.11	6.62	9.26
Poultry	1972	78,024	49,465	39,031	26,580	25,387
	1974	84,368	55,284	42,714	28,758	29,814
	1980	112,939	67,759	55,678	36,921	48,470
	Per. Change/Yr.	5.59	4.62	5.33	4.86	11.37
Dairy	1972	246,696	124,624	78,982	46,748	42,100
	1974	281,721	137,139	88,571	52,357	47,276
	1980	405,964	175,698	119,939	71,334	63,893
	Per. Change/Yr.	8.07	5.12	6.48	6.57	6.47
Livestock	1972	455,242	235,916	138,137	84,569	56,243
	1974	513,135	266,763	155,268	96,518	63,672
	1980	679,475	359,713	208,199	135,044	88,111
	Per. Change/Yr.	6.16	6.56	6.34	7.46	7.08
Livestock Ranches	1972	720,660	278,015	172,650	109,156	75,004
	1974	813,962	308,418	193,974	125,434	86,400
	1980	1,099,579	401,638	262,833	178,077	122,897
	Per. Change/Yr.	6.57	5.56	6.53	7.89	7.98
General	1972	486,606	248,909	152,900	94,917	66,097
	1974	552,858	283,373	174,818	110,399	76,115
	1980	763,959	389,184	242,522	159,454	106,698
	Per. Change/Yr.	7.13	7.05	7.33	8.50	7.68

capital from the estimate of total capital. If the price appreciation in land and buildings is not included in equity, the non-equity estimates indicate that higher debt-equity ratios will exist on most Oklahoma farms in 1980 compared to 1972. However, it should be noted that this calculation results in negative non-equity capital figures for several of the class-types of farms when equity capital includes land and buildings price appreciation. This suggests that some representative farmers (primarily those who own all of their land) are able to "pay off" their non-equity capital or debt and accumulate total equity which exceeds the total capital required by the farm operation. The fact that some representative farms accumulate equity in excess of their projected capital needs indicates that these farm operators are capable of expanding, either in the farm or the non-farm sector, at a rate significantly greater than the historical trend from 1959 to 1969.

CONCLUSION

Projections of the future capital and credit requirements of the agricultural sector suggest that substantial increases will occur. However, the anticipated changes in the capital and credit needs of representative farm firms that comprise that sector have not been well documented. The cash flow model presented here can easily be used to project the changes in capital needs of economic class-enterprise type representative farms. These representative farm

estimates will provide useful detail and explanatory information concerning the changes in aggregate capital and credit needs.

The projections for Oklahoma indicate that the total capital requirements will increase substantially from 1972 to 1980 for all class-type representative farms. These estimates suggest that many farmers will face even more serious problems of acquiring, managing, and transferring these large sums of capital than have been encountered in the past.

The equity capital projections that include only net cash inflows in equity accumulation suggest that smaller equity-to-total capital ratios will be prevalent in Oklahoma agriculture in 1980. Thus, more non-equity capital will be required in the form of debt or leased or rented facilities. Acquiring the increased quantities of non-equity capital (particularly for Class I farms) will provide challenges for both farmers and the financial intermediaries that serve agriculture. However, when price appreciation in land and buildings is included in equity accumulation, many farms accumulate equity in excess of total farm capital requirements. These results suggest that a number of farmers (particularly full owners) will generate sufficient capital to expand faster than the historical rate of growth for that particular class-type of farm. Alternatively, some farmers may have the funds that are necessary to initiate forward or backward integration into farm-related activities such as custom cattle feeding.

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