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THE NATURE OF THE SUPPLY FUNCTION FOR AGRICULTURAL PRODUCTS

By D. GALE JOHNSON*

It is generally believed that the total output of farm products responds little if at all to changes in the average price of farm products. For example, most farmers believe this to be true for downward movements in real prices; the willingness of farmers and their representatives to accept direct control of output and marketing clearly reflects their belief that downward movements in real prices will not substantially reduce farm output. Though this belief is apparently based on the depression experiences of 1919-22 and 1929-33, it is applied without hesitation to a period when resources are generally fully employed.¹

The best published discussion of the responsiveness of agricultural output to price changes is by Professors Galbraith and Black.² Their analysis is restricted to depression conditions and lacks preciseness largely because it fails to distinguish between those conditions relevant to the decision process within firms and those relevant to the nature of the factor markets, *i.e.*, the supply conditions of factors. No systematic attempt has been made, to my knowledge, to make a similar analysis for non-depression conditions.

This paper attempts to fill these gaps by analyzing the reaction of aggregate output (1) to falling relative prices under depression conditions and (2) to changing relative prices when resources are fully employed in the economy. These two sets of conditions are chosen to simplify the discussion and because they represent the important empirical conditions.

I. *Agricultural Output During a Depression*

Aggregate farm output has repeatedly failed to decline during depressions. Numerous explanations have been offered for this phenome-

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¹ See Secretary of Agriculture Brannan's *Statement before a Subcommittee of the Committee on Agriculture and Forestry, U. S. Senate, Eighty-First Congress, First Session, on S. 1882 and S. 1971 (July 7, 11, 12, 13, 14, 15, 18, and 19, 1949)*, pp. 50-52.

² See J. K. Galbraith and J. D. Black, "The Maintenance of Agricultural Production during Depression: The Explanations Reviewed," *Jour. Pol. Econ.*, Vol. XLVI (June, 1938), pp. 305-23.

non; such as high fixed costs in agriculture, the length of the production process, and the competitive structure of agriculture. Several such explanations are reviewed and analyzed in this section and an attempt is then made to outline a more general explanation.

A. *The Facts*

Much of the evidence usually presented on the behavior of agricultural output has been interpreted as indicating that agriculture's output response during major cyclical declines is peculiar to it. Table I presents data of the type usually considered rather conclusive. In 1933, agricultural output was only 6 per cent below its 1929 level, and that decline was in substantial part due to poor weather in the Great Plains area. In 1932, farm output was actually higher than in 1929. Manufacturing output as a whole declined by more than a third, while iron and steel output declined by 70 per cent and machinery, by 60 per cent.

But any theory explaining agriculture's behavior must also be consistent with another set of facts, namely that there were other impor-

TABLE I.—INDEXES OF PRODUCTION FOR AGRICULTURE, MANUFACTURING, AND MINING, 1927 TO 1947
(1935-39=100)

Year	Agricultural Output	Manufacturing	Durable Manufacturing	Non-Durable Manufacturing	Iron and Steel	Machinery	Mining
1927	95	94	107	83	108	99	97
28	99	99	117	85	121	106	95
29	97	110	132	93	133	130	103
30	95	90	98	84	97	100	91
31	104	75	67	79	61	66	82
32	101	57	41	70	32	43	72
33	93	68	54	79	54	50	80
34	79	74	65	81	61	69	83
35	96	87	83	90	81	83	89
36	85	104	108	100	114	105	99
37	108	113	122	106	123	126	109
38	105	87	78	95	68	82	99
39	106	109	109	109	114	104	105
40	109	126	139	115	147	136	114
41	114	168	201	142	186	221	122
42	128	212	279	158	199	340	125
43	125	258	360	176	208	443	132
44	130	252	353	171	206	439	145
45	129	214	274	166	183	343	143
46	133	177	192	165	150	240	142

Source: *Statistical Abstract*, 1947, p. 816 and *Agricultural Statistics*, 1947, p. 533.

tant segments in the economy which produced almost as much in 1932 and 1933 as in 1929. The following tabulation shows 1933 annual output as a percentage of 1929 output:³

Meat packing	95
Shortening	98
Canned milk	98
Cheese	95
Butter	110
Cotton goods	87
Woolen and worsted goods	87
Knit goods	100
Shoes, leather	94
Beet sugar	151
Canned fruits and vegetables	88
Clothing, women's	91
Soap	98
Petroleum refining	86

Employment in agriculture in 1929 was 8,323,000 family workers and 2,984,000 hired workers; in 1933, 8,590,000 and 2,433,000, respectively. Total employment declined roughly two per cent, from 11,289,000 to 11,023,000. Employment in manufacturing as a whole declined by 30-35 per cent and employment in certain types of manufacturing (automobiles, for example) by more than 40 per cent and hours worked, by even more. On the other hand, employment in food manufacturing declined only 15 per cent from 1929 to 1932 and rose from 1932 to 1933.

B. A Review of the Explanations

Roughly a half-dozen explanations of the cyclical behavior of agricultural output have been put forward. This section examines each of them; the next presents a general theory constructed to explain those characteristics of agricultural output under discussion.

³ Source: Solomon Fabricant, *The Output of Manufacturing Industries, 1899-1937* (New York, National Bureau of Economic Research, 1940). The reader may object that output behavior of the manufacturing groups included in the tabulation do not support the statement that output in some segments of the economy behaved much the same as agricultural output. Each of the industries, excepting the last, process an agricultural product and since agricultural output did not decline, it seems evident at once that the output of the specified processing groups would not decline. The output behavior of the processing groups can be explained by the same theory developed below, namely by the shifting of the supply functions of factors or by the price inelasticity of the supply functions for one or more of the factors. Inspection of the list will disclose several industries for which the cost of the agricultural raw material represents only a small fraction (less than a fifth) of the total manufacturing cost. In these instances, the supply prices of other factors declined sufficiently to permit the firms to maintain output.

1. *High fixed costs.* The belief that high fixed costs are responsible for the failure of farmers to reduce output during a depression has achieved more general acceptance than any other explanation.

It is generally argued that farm firms have high fixed costs because the labor supply is so closely related to the firm. Labor is viewed as a resource that is fixed to the firm because the operator and family members constitute roughly three-fourths of total farm workers. The same considerations are frequently alleged to apply to land.

This argument seems invalid. The employment of hired labor in agriculture is almost as constant as family employment.⁴ Yet hired labor is certainly not considered a fixed resource by the firm. Hired workers are apparently willing to offer their services at prices which the firms believe are no higher than the value of the marginal product and so continue to be employed.

In many cases, the land operated is one of the assets of a firm in the sense that the firm owns the land. Most farm firms have the alternative of renting the land to another firm to operate, even during a depression. Only in the exceptional case would such an alternative not be available. Even if farmers who own land are unwilling to consider this alternative, the behavior of firms renting land cannot be explained by treating land as a fixed cost. There was roughly as much land rented during the 'thirties as was owned by the farm firms. Presumably operators continued to use the land because the price of land fell enough to equalize demand and supply at a level of "full" employment.

Table II is pertinent to the present argument. It indicates changes in gross income, net operator income, and production expenses from 1929 to 1932. Most of the changes in expenditures are due to changes in prices rather than quantities.⁵ Net operator income represents the returns to all resources owned or controlled by the operator, including labor, land, and capital. Of the total production expenses, only taxes and farm mortgage interest would have continued to be claims on current income even if no output had been planned. These two items represented, in 1929, only 15 per cent of total production expenses and only 9 per cent of the value of gross output.

Even if one were willing to assume that labor is a fixed cost to the farm firm, nothing is gained by so doing. High fixed costs are not an adequate explanation of the relative stability of hired labor employment nor of the constancy of the amount of land rented. Nor can one, on this basis, explain the constancy of the output of livestock products,

⁴ Between 1929 and 1933, hired labor employment declined by 15 per cent, but an unknown fraction of this decline was due to the shift from the hired to the unpaid family labor category.

⁵ See below, pages 550-51.

TABLE II.—EXPENSES OF FARM PRODUCTION AND FARM INCOME
(millions of dollars)

	1929	1932	1947
Gross income	13,824	6,406	34,705
Net operator income	5,654	1,715	17,087
Total production expenses	8,170	4,691	17,618
Feed purchased	919	348	3,783
Livestock purchased	461	164	1,302
Fertilizer and lime	293	125	685
Operating motor vehicles	509	384	1,505
Hired labor	1,284	584	2,791
Miscellaneous current expenses ^a	1,146	814	1,768
Taxes	641	504	705
Farm mortgage interest	582	534	222
Rent (net) ^b	1,062	343	2,300
Depreciation ^c	1,273	890	2,579

^a Includes such items as electricity, twine, ginning fees, dairy supplies, seeds, containers, etc.

^b Gross rents were as follows: 1929—\$1,621,474,000; 1932—\$668,935,000; and 1947—\$3,100,000,000. About the same amount of land was rented in 1932 as in 1929, while perhaps ten per cent less was rented in 1947.

^c Gross investment: 1929—\$1,414,000,000; 1932—\$290,000,000; 1947—\$3,682,000,000.

Source: Department of Agriculture, Bureau of Agricultural Economics, *Net Farm Income and Parity Summary 1919-41* (mimeo.) and *Farm Income Situation, August-September, 1948*.

particularly hogs. Farm management studies indicate that 75 per cent of the average cost of producing hogs is feed cost. Hog output is maintained only because feed prices fall, and fall as much or more than hog prices during the downswing of a major depression.

The constant employment of factors apparently reflects not high fixed costs but either (a) inelastic supply curves together with highly flexible factor prices or (b) changes in the marginal opportunity costs of the factors with the business cycle. The first explanation is pertinent to physical capital assets and land; the second to labor, feed, and livestock. Since most feeds are durable, why do feed prices fall low enough during a depression to clear the market of all of the current output? Given existing cost conditions during a depression, farmers are maximizing their position by producing crops, but they have the alternatives of feeding or storing the feed crops in anticipation of higher prices later. In this way, livestock output could be contracted during depression. Constancy of output of livestock implies that the supply curve of feed grains for current use has shifted far to the right. I shall consider this point later.

2. *Farmers try to offset lower prices by increased output.* The explanation that agricultural output is maintained (or even increased) by farmers as a means of offsetting lower prices may have a certain

validity. Over certain ranges, the supply curve of operator and unpaid family labor may be backward sloping; *i.e.*, individuals work more at a lower than a higher wage. This statement implies that as income falls, the marginal utility of income increases relative to the marginal utility of leisure. Since the employment of some inputs do decline during a depression because their prices are not as flexible as product prices, farm output is probably maintained by a small increase in the quantity of labor supplied by a given number of workers.

3. *Subsistence production is important in agriculture.* If production is largely for the consumption of the operator family and few of the inputs are purchased, relative prices have little effect upon the firm under any circumstances. Production decisions will be based largely on resources owned or controlled (mostly land and labor), and consumption preferences.

In 1939, about one-quarter of all farms had household use as the major source of income, and in 1944, roughly 22 per cent.⁶ These farms produced less than four per cent of the total farm output in 1944.⁷ Roughly three-quarters of what was produced on these self-sufficient farms was consumed in the household. In 1944, the rest of the farm operators consumed only about eight per cent of what they produced.⁸ Consequently, the production of the bulk of the agricultural output is so commercialized that constancy of subsistence production cannot explain constancy of aggregate production.

4. *Technological factors inhibit response to price changes.* The production process in agriculture is relatively long. Consequently, a decline in prices may not be followed at once by a reduction in output. Farmers will find it advantageous to complete the production process as long as price equals or exceeds the marginal cost of completing the production process as of any moment of time. This explanation can apply only to cycles of short duration when prices fall for a year or eighteen months and then start to increase. It cannot apply to the 1929 to 1933 downswing. Here farmers did have time to change their production plans and yet failed to do so.

5. *Agriculture has a more competitive structure than the rest of the economy.* The belief that agricultural output is maintained during depressions because agriculture is competitive is strongly held in many quarters. The belief that output in many sectors of the nonfarm economy is highly variable during a business cycle because of enterprise monopoly is also strongly held.

⁶ *United States Census of Agriculture, 1945*. Volume II, *General Report*, Chap. X, Table 4. Data based on 1945 classification by type of farm.

⁷ *Ibid.*, Chap. X, Table 26.

⁸ *Ibid.*

The data on page 541 suggest that monopoly by no means always leads to large output variations during a business cycle. By measures ordinarily used to measure degree of concentration (percentage of output controlled by a few firms), canned milk, meat packing, soap, and beet sugar are rather non-competitive; the rest of the industries, relatively competitive. Yet all had highly stable output.

In addition, it should be noted that several competitive industries produced much smaller outputs in 1933 than in 1929. Among these were all branches of mining and lumber and most products of lumber.⁹

An enterprise monopolist would restrict output and maintain prices during a depression in two sets of circumstances. First, if the supply functions for all factors were perfectly elastic *and* if the supply functions did not shift from the peak to the trough of the business cycle. In these circumstances the monopolist would find it in its interest to maintain prices in the face of declining demand.¹⁰ Without knowing the exact nature of the shift in demand, it cannot be said with certainty that no price change would occur but it is reasonable to assume that the change in price would be relatively small and most of the adjustment would be in output.

A competitive industry in the same circumstances would react in the same fashion. Since marginal cost did not decline, price could not fall for any period of time.

Second, an enterprise monopolist producing a durable product would be more likely to maintain prices during a depression if it believed that an extra unit sold during a depression at a lower price would otherwise

⁹ See Solomon Fabricant, *The Output of Manufacturing Industries, 1899-1937*, Appendix B and Harold Barger and Sam H. Schurr, *The Mining Industries, 1899-1939*, Appendix A. (New York, National Bureau of Economic Research, 1944). Walter F. Crowder summarized an analysis of the output behavior of 407 products from 1929 to 1933 and 1933 to 1937. He concluded as follows: "If eight or ten products which decreased more than 90 per cent are not given undue weight, the logical inference would seem to be that the changes in quantity output of the great mass of manufactured products between 1929 and 1933 were not related to the concentration ratios of the products." For the 1933-37 period, he stated, ". . . it cannot be said that manufactured products in the 'low' concentration group exhibit any outstandingly different behavior pattern from that of products in the 'high' concentration group." (T.N.E.C. Monograph No. 27, *The Structure of Industry*, pp. 350-51 and 354.)

¹⁰ This seems to be the assumption made by several writers who have discussed the relation between enterprise monopoly and cyclical price rigidity. Boulding, for example, assumed a relatively flat marginal cost curve and then argued that a decline in demand during a downturn of the business cycle would lead to price maintenance and output restriction. This explanation fails to indicate why the marginal cost curve does not shift during the cycle. If the cost curve shifted downward, regardless of how flat it is, price would be permitted to fall unless the demand curve shifted in a very peculiar manner. (See Kenneth Boulding, *Economic Analysis* [New York, Harper and Bros., 1948, 2nd ed.] p. 557.) For an analysis similar to that contained in this paper, see T. De Scitovszky, "Prices under Monopoly and Competition," *Jour. Pol. Econ.*, Vol. XLIX (Oct., 1941), pp. 663-86.

be sold later at a higher price during the subsequent prosperity. A policy such as this is not without costs and it is by no means certain that if such a monopolist realized lower marginal costs during the depression that it would maintain prices at the pre-depression level. A competitive industry producing a similar product with the same demand relationship in time would not react as the monopolist does for obvious reasons.

The degree of competition in the factor markets is probably more important than the degree of competition in the product market in explaining output response during a depression. It would be difficult to distinguish between the price and output behavior during a depression of an enterprise monopolist that buys factors in a competitive market and a competitive firm. Food processors did not contract output because the supply functions for at least one important factor, farm products, shifted and the factor price fell sharply. The output behavior of the firms did not seem to have been affected by the extent of monopoly and one should not have expected that it would be.

But if the factor markets are not competitive and the supply functions for the factors do not shift during the depression, both an enterprise monopolist and a competitive firm would be unable to maintain output if demand for the product declined.

The important unanswered question about price and output reactions during the 1929-33 depression is found in the urban labor market, why the hourly earnings of production workers in manufacturing declined so little (from \$0.566 in 1929 to \$0.442 in 1933) despite the drastic decline in employment.¹¹ Unions were not then sufficiently important in manufacturing to have had much influence. Given the small decline in wages, manufacturing industries which did not use an important factor or input having a flexible price could not react in the same way as agriculture.

6. *Summary of the explanation.* Most of the preceding explanations of the difference between the behavior of output in agriculture and in non-agriculture must be rejected. High fixed costs, the importance of subsistence production, technological conditions are clearly invalid explanations. The differences in the competitive structure of agriculture and industry in the degree of enterprise monopoly is a superficially more plausible explanation, yet I believe it, too, is invalid. An enterprise monopoly faced with the same factor supply conditions as agriculture would, in my view, react in much the same way as a competitive firm.

The belief that farm workers may work harder during periods of

¹¹ Farm wage rates declined by more than 50 per cent in the same period. See *Statistical Abstract, 1947*, pp. 199 and 210.

low income cannot be rejected on the basis of existing data, and this hypothesis is consistent with actual behavior.

C. A Possible Theory

Any theory purporting to explain the constancy of agricultural output during a depression should explain also similar behavior in the rest of the economy; it should be consistent also with the fact that agricultural output increases when the relative price of agricultural products increases and that farmers shift from one product to another as the relative prices of different products vary.

It is my view that a theory meeting these requirements is provided by the usual economic analysis of farmers as profit-maximizing entrepreneurs and that the special characteristics of the behavior of agricultural output can be explained by the characteristics of the supply functions of factors to agricultural firms.

The supply function for agricultural products is sometimes expressed as a simple relation between the quantity of output and the price of the output. However, the use of this relation obscures the complexity of the supply process determining the supply of agricultural products. The supply of agricultural products depends on: (1) Production conditions—the technological relations between inputs and outputs; (2) Supply conditions of the factors of production; (3) Price or demand conditions for output; and (4) The behavior of firms, including the objective of the entrepreneur.

The explanations provided in this paper of the behavior of agricultural output assume that firms maximize profits and that the demand for factors of production is determined solely on this basis unless a contrary assumption is made. The assumption of profit maximization implies that output behavior will be determined by the relationship between output and factor prices. For example, a greater relative increase in product than factor prices will result in increased output, and vice versa. Further, a rise in the price of one factor relative to another will decrease the employment of the first factor relative to the second. It is not necessary for our purposes that farmers actually maximize profits, but it is important, of course, that reliable predictions can be made by using the assumption of profit maximization.

Attention must be given to the supply conditions for the factors of production. These are spelled out in some detail at the relevant points in this article, but some comment on the labor supply function is required at this point. It is assumed that there is a labor supply function including all farm labor. To do this requires a strict separation of the farm firm and the labor function of the operator and other family members. This separation is required if confusion is to be avoided.

A firm is a business unit under single control within which productive resources are combined in order to produce goods and services for sale and use as a means of achieving some objective. A firm may consist solely of entrepreneurship, a business opportunity, and liquid capital. The farm operator is both an entrepreneur and a laborer. He accepts this dual rôle in the belief that he can thereby achieve a larger return from his energies. Otherwise, he would forego his entrepreneurial activities and hire out as a laborer. Analytically, we can divorce the supply of labor by the operator and his family to the farm firm from the farm firm itself, *i.e.*, we need not assume that this labor is a part of the firm.

During a depression, the supply function of land for use in agriculture has a price elasticity of nearly zero for a period of five to ten years. The response in quantity supplied following a price decline is related to disinvestment in land and failure to provide for maintenance. The supply function for capital equipment—to agriculture as a whole—is very inelastic whenever the demand price is below the price of new equipment. The supply function is then related solely to the existing supply of old equipment. Since such equipment does not have alternative uses outside of agriculture, there is no reservation price above the depreciation cost. Since this cost can be postponed, it may not represent an effective lower limit. The supply function of labor shifts with the level of income and employment in the rest of the economy. The marginal opportunity cost of labor falls rapidly as unemployment increases and rises similarly as unemployment declines. As the marginal opportunity cost approaches zero, the supply curve for agricultural labor becomes very inelastic. Farm workers are willing to accept lower rates of pay rather than be unemployed.

These conditions of supply would mean that during a major prolonged decline in business activity that (1) farm prices, farm wage rates, and land rents would fall in about the same proportion and (2) the employment of land, labor, and machinery would not change appreciably. Condition (2) might prevail without (1) if the resources had to be used in fixed proportions or if one of the resources had a fixed coefficient of production, conditions that seem less plausible than the conditions of supply outlined above.

Tables III and IV are not inconsistent with the above conclusions, except for the behavior of wage rates between 1919 and 1921. In part, this is explained by the fact that the peak in prices received came in May, 1920; the minimum, in June, 1921. Actually, no serious drop in farm prices came until the 1920 harvest, after wage bargains had largely been made.

TABLE III.—CROPS PLANTED, LABOR EMPLOYED AND POWER AND MACHINERY USED ON FARMS AND RELATIVE FARM PRICES, 1919-39

Year	Crops Planted ^a (in millions)	Labor Employment ^b		Power and Machinery ^c	Relative Farm Prices ^d
		Total (in millions)	Hired		
1919	363	11.1	2.78	468	112
20	359	11.4	2.88	477	121
21	358	11.4	2.90	505	88
22	354	11.4	2.92	496	85
23	353	11.4	2.89	454	101
24	353	11.4	2.87	455	101
25	364	11.4	2.97	458	106
26	359	11.5	3.03	460	100
27	358	11.3	2.95	463	99
28	367	11.4	2.96	463	102
29	363	11.3	2.98	466	101
30	368	11.2	2.85	471	106
31	372	11.2	2.69	468	73
32	376	11.1	2.50	452	62
33	372	11.0	2.43	416	67
34	339	10.9	2.33	391	73
35	360	11.1	2.43	389	86
36	360	11.0	2.56	391	91
37	364	10.9	2.63	403	90
38	356	10.8	2.62	419	78
39	344	10.7	2.60	428	78

^a 1924-1939, *Agricultural Statistics*, 1940, p. 542. 1919-23, estimate by the author.

^b Department of Agriculture, Bureau of Agricultural Economics, *Farm Wage Rates, Farm Employment, and Related Data*, 1943, p. 155.

^c Martin R. Cooper, Glen T. Barton, and Albert P. Bradell, *Progress of Farm Mechanization*, Dept. of Agriculture Misc. Pub. No. 630 (1947), p. 81. An index number with volume measured in terms of 1935-39 average dollars, 1870=100.

^d Calculated from *Agricultural Statistics*, 1945, pp. 430-31. Based on ratio of prices received by farmers to wholesale prices of all commodities. Index equals 100 in 1910-14.

The 1920-22 depression did not result in any significant decrease in crop acres planted; labor employment was roughly constant, employment of power and machinery increased slightly. Absolute farm prices fell by 42 per cent between 1919 and 1921, and relative farm-nonfarm prices by 22 per cent. Because of the shortness of the time period, the 1920-22 depression cannot be considered as good a verification of our hypotheses as one might like.

The 1930-33 depression is a much better test. The period was four years; sufficiently long to permit farmers to revise their production plans completely. For employment of resources, the experience and hypotheses match very well. Acres planted may have increased slightly, total labor employment remained almost constant (decreasing only

three per cent), while hired labor employment declined by about 15 per cent. Part of this decline resulted from a shift for workers related to the employer from the hired to the unpaid category.

As shown in Table IV, prices received and rent paid moved down

TABLE IV.—FARM PRICES AND WAGE RATES, FARM WAGES AND RENTS PAID,
AND CASH FARM INCOME, 1919-39.

Year	Prices Received by Farmers ^a	Wage Rates ^b	Wages Paid ^c	Gross Rent ^d	Cash Farm Income ^e
			(millions of dollars)		
1919	215	207	1,515	2,226	14,602
20	211	242	1,780	1,645	12,608
21	124	155	1,159	1,208	8,150
22	132	151	1,122	1,347	8,594
23	143	169	1,219	1,501	9,563
24	143	173	1,224	1,651	10,221
25	156	176	1,243	1,585	10,995
26	146	179	1,326	1,518	10,564
27	142	179	1,280	1,648	10,756
28	151	179	1,268	1,640	11,072
29	149	180	1,284	1,621	11,296
30	128	167	1,134	1,315	9,021
31	90	130	847	906	6,371
32	68	96	584	669	4,743
33	72	85	512	793	5,445
34	90	95	601	953	6,780
35	109	103	740	1,101	7,659
36	114	111	880	1,187	8,654
37	122	126	1,039	1,218	9,217
38	97	125	1,000	1,080	8,168
39	95	123	982	1,170	8,684

^a *Agricultural Statistics, 1945*, p. 430, 1910-14=100.

^b Bureau of Agricultural Economics, Department of Agriculture, *Farm Wages Rates, Farm Employment, and Related Data, 1943*, pp. 3-4, 1910-14=100.

^c Bureau of Agricultural Economics, Department of Agriculture, *Net Farm Income and Parity Report, 1943 (1944)*, pp. 26 and 18.

^d *Agricultural Statistics, 1943*, p. 412.

together from 1929 to 1932 and 1933, with rent falling slightly more than prices.¹² In the absence of an important change in the marginal physical productivity of land, the employment of land would not have been expected to decline, and it did not do so.

¹² The following tabulation indicates the relationship more clearly than Table IV:

Year	Prices Received	Cash Farm Income	Wage Rates	Wages Paid	Gross Rent Paid
1929	100	100	100	100	100
1930	86	80	93	88	81
1931	60	56	72	66	56
1932	46	42	53	45	41
1933	48	48	47	40	49

Wage rates tended to lag behind prices and employment of hired labor might therefore have been expected to decline slightly, as indeed it did.

The net income attributable to land, capital, and labor accounts for roughly 70 per cent of gross agricultural income.¹³ The remainder is attributable to products and services purchased (about 15 per cent),¹⁴ taxes (about 4 per cent), and depreciation and maintenance (about 11 per cent). Of these, only taxes requires a net outlay regardless of the level of output or prices. Current outlay for depreciation and maintenance in agriculture can be postponed almost in its entirety for as long as four years.

Current purchases of products and services from the non-agricultural sector of the economy are not made under supply conditions comparable to the supply conditions for land, labor and capital. During depressions, prices of these products and services do not decline as rapidly as prices received by farmers. Consequently, except for products and services that are limitational in character, purchases of such items should fall considerably. And this was the case. Fertilizer prices decreased by 35 per cent.¹⁵ Fertilizer consumption declined by more than 45 per cent.¹⁶ Farm machinery prices declined by less than 10 per cent. Expenditures on motor vehicles and machinery, including repairs for machinery, declined by more than 70 per cent. Building material prices fell 20 per cent, and expenditures by about 80 per cent.

Other current inputs of a highly varied nature, such as the cost of operating motor vehicles, electricity, twine, ginning fees, and seeds apparently declined only moderately in price and in quantity purchased. Many of these inputs such as seed, twine, ginning fees, and containers are in the category of inputs having fixed coefficients of production. Consequently, farmers would not decrease their use of these items as long as they continued to stay at full production.

Two other categories of expenses to the individual farmer need consideration, namely, feed and livestock purchases. Though data on quantities of feed and livestock purchased are not available, the data on expenditures and prices indicate that quantities of feed and livestock purchased decreased by roughly 10 per cent. The prices of feed and livestock declined slightly less than farm prices in general, perhaps five per cent less. Because of the slightly smaller relative price declines

¹³ D. Gale Johnson, "Allocation of Agricultural Income," *Jour. Farm Econ.*, Vol. XXX (Nov., 1948), p. 742.

¹⁴ Includes only products and services purchased from non-farmers.

¹⁵ *Agricultural Statistics, 1945*, p. 429.

¹⁶ *Ibid.*, p. 467.

in feed and livestock for feeding purposes, one would expect that interfarm sales of these items would decline some but not much.

The theory that we have outlined rests on certain presumptions about the supply functions of labor, capital, and land. This theory is not complete. Certain important aspects of output behavior, such as the constancy of livestock output, are not explained by the assumptions. The theory explains why all crop land is utilized during a depression, but it is insufficient to explain why farmers sell the output of durable products or transform the feed into livestock. Why do the farmers not store such products as wheat, corn, and oats during periods of absolute and relative price declines during a major cycle?

TABLE V.—PRODUCTION OF FEED GRAINS, HAY, AND PASTURE, PRODUCT ADDED BY LIVESTOCK AND HOGS

Year	Production of Feed ^a Grains, Hay, and Pasture	Product Added by	
		Meat Animals and ^a Animal Products	Hog Production ^b
1919	106	83	14.0
20	116	80	13.5
21	108	84	14.1
22	107	89	16.5
1927	107	95	16.3
28	108	96	16.2
29	103	97	15.6
30	94	99	15.2
31	103	101	16.5
32	113	101	16.4
33	96	103	16.6

^a 1935-39=100. Source: Glen T. Barton and Martin R. Cooper, *Farm Production in War and Peace*, USDA, BAE, F.M. 53, p. 74.

^b In billions of pounds. Source: *Agricultural Statistics*, 1940, p. 370.

Tables V and VI present the data indicating the constancy of livestock output. Table V requires no comment; farmers kept on producing livestock. Table VI indicates that falling prices led to only minor increases in the stocks of corn and wheat. Most of the wheat stocks were held by the government. The increase in corn stocks should be seen in their proper perspective; from 1929 through 1932, more than 10 billion bushels of corn were produced. Of this total, hogs consumed at least 4 billion bushels.

It is necessary to specify the nature of the supply function for current use or sale of the durable farm products in order to explain this behavior on the part of the farmer. The supply function for current use or sale of durable farm products shifted to the right roughly as far as

did the output curve for these products. In other words, the demand for inventories by farmers or others did not increase to result in a significant difference between the physical output of the products and the quantities offered for sale or used as inputs for further production; supply prices of factors used in producing livestock fell proportionately as much as the prices of livestock, and as one would expect, livestock output was maintained.

TABLE VI.—PRICES AND TOTAL STOCKS OF CORN AND WHEAT IN U. S.

Year	Total Stocks (millions of bushels)		Corn Price (previous marketing year) (cents per bushel)	Wheat Price (previous marketing year) (cents per bushel)
	Corn	Wheat		
	(Oct. 1)	(July 1)		
1919		85		205
20		170		216
21		124		183
22		96		103
23		132		97
1927	217	109	75	122
28	92	113	85	119
29	148	227	84	100
30	136	291	80	104
31	168	313	60	67
32	270	375	32	39
33	386	378	32	38

Source: *Agricultural Statistics 1940*, pp. 10, 23, 46 and 54.

Two explanations seem relevant for the failure of the demand for inventories to increase during depressions. First, farmers do not believe that they can estimate anticipated prices very accurately. What I feel to be the best model available to them, namely, that next year's price will be the same as this one, is consistent with not holding stocks in any large volume.¹⁷ Second, most farmers have never had enough capital to be able to forego the current income required by a definite storage policy or to permit them to accept the large risks that arise from storage.¹⁸

If private storage has not acted to stabilize somewhat the price of the

¹⁷ See D. Gale Johnson, *Forward Prices for Agriculture* (Chicago, University of Chicago Press, 1947), Chap. VI.

¹⁸ *Ibid.*, Chap. X, esp. pp. 156-61. The path of price movements during and following the 1929-33 depression indicates that farmers were relatively wise in not accumulating stocks. For example, if a farmer had stored wheat in 1930 and if the costs of storage were 10 cents a year, he would have been unable to have made a profit at any time until the present. If he had stored wheat in 1931, he would have realized a substantial gain within two years. The same circumstances were true in corn. But what basis would a farmer have had for knowing that he should have stored in 1931 but not in 1930?

durable products over the cycle through storage operations, we may find that public storage will do so. If this occurs, agricultural output will behave quite differently from the way it has in the past. The output of livestock products will decline during the depression and so will aggregate agricultural output. However, government policy may also involve subsidization of the output of livestock products. If this is done, total output would be maintained.

The theory propounded above is consistent with the behavior of the non-agricultural firms that maintained output during the depression. Most of the firms—in meat packing, butter, evaporated milk, cheese, shortening and beet sugar—had one input that was extremely important from a cost standpoint, and this input had a supply function similar to that ascribed to land or to labor in agriculture. This input was an agricultural product. Since the alternative cost of these products fell sharply, the same volume of product would be available for processing at a much lower price and at a price that would clear the market.

Since other factors used by these industries did not have the same type of supply curves for other inputs, total output in any real sense probably fell. The data seem to indicate that hours worked declined more than output. Output is usually measured for such industries as a linear function of agricultural input.

II. Agricultural Output during Periods of Full Employment

The movement of farm prices relative to non-farm prices appears to have no important influence upon total agricultural output during periods of recession or depression. The reasons for this behavior have been outlined above. It is sometimes assumed that agricultural output would be equally unresponsive to a decline in relative farm prices under full-employment conditions. This statement, however, cannot be empirically verified by the experience of the United States. There is no period in our history for which we have reasonably accurate data—which means since 1900—when high levels of employment coincided with declining relative farm prices.¹⁹ One such period may now be emerging—starting in 1949.

Consequently those individuals who rely solely upon empiricism and eschew the use of theoretical models can find no support for the contention that farm output is not responsive to declining relative farm prices when employment opportunities are readily available in the rest of the economy. It may well be that under dynamic conditions aggregate agricultural output would not actually decrease despite a fall in relative

¹⁹ The late 'twenties does not seem to constitute such a period. As indicated in Table III, except for the single year 1925, relative farm prices were stable from 1923 through 1929.

farm prices, but such a statement is certainly not the same as the statement that relative prices do not affect the level of output. If clarity of thought is considered important, the two statements should not be confused.

Since 1900 there have been three periods of sustained full employment. During two of these periods—1900 to 1919 and from 1940 to 1948—real farm prices were rising. The only other period of sustained full employment—1923 to 1929—was a period of relatively stable real farm prices.

A. Implications of the Theory

The theory by which we have sought to rationalize the behavior of farm output during depressions has important implications for the behavior to be expected under full employment conditions. These implications can be best outlined by considering, first, the effect of changes in relative prices under given production conditions, and second, the modifications introduced by changes in production conditions.

Under given production conditions, output of agricultural products can change only as a result of changes in the quantity factors of production employed—to speak broadly, in the quantities of land, labor, or capital employed. An increase in the real price of output will raise the marginal product of factors to farmers, and therefore lead them to demand a larger quantity at previous prices. Under given conditions of supply of factors, this will lead to an increased employment of factors—unless their supply prices are perfectly inelastic—and hence to an increase in output.

A decline in the price of real output will lower the marginal products of the factors. At previous prices of the factors, farmers will demand smaller quantities of the factors. For downward movements in factor prices, the supply function for land is almost perfectly inelastic in the short run. Land is an asset with no alternative use outside of agriculture and its quantity will be affected only as depreciation and depletion exceed maintenance expenditure. A protracted decline in prices would lead to the former exceeding the latter and thus to a decline in the quantity of land supplied.²⁰ Capital equipment of a durable nature also has an inelastic supply function for downward price movements in the short run. A given quantity of such equipment exists and its quantity can be reduced only by depreciation since it has no alternative use outside of agriculture. The value of the existing assets would decline and new purchases from the nonfarm sector would be reduced. The marginal prod-

²⁰ Unless the government subsidizes maintenance through payments for "soil conservation" or increases the available supply of land through irrigation and reclamation projects.

uct of labor would decline and the demand for labor would decrease. Given flexible wage rates in agriculture, labor employment would decrease as a result of migration though unemployment would not emerge.

In a period of three to five years of declining real output prices, the reduction in farm output will depend largely upon the reduction in farm labor employment. The supply of labor to agriculture is a function of its wage in agriculture, of the wage for comparable labor in non-agriculture, of the level of unemployment, and of the growth of the farm labor force due to the excess of additions (individuals living on farms reaching working age) over withdrawals (from death or retirement). If the elasticities of the quantity of labor supplied with respect to the farm wage rate, the nonfarm wage rate and unemployment are relatively small, the reduction in labor supplied produced by a decline in relative prices may be fairly small. These are likely to be the conditions when the price decline is assumed to be temporary. If the price decline is assumed to be permanent, the elasticities of the quantity of labor supplied with respect to the relevant variables are likely to be relatively large, and the adjustment in labor supply would occur more rapidly.

In the above paragraphs, it has been assumed that the production function remains unchanged. The production function in agriculture does change as new techniques become available. Though the availability of new techniques of production is probably unrelated to the level of farm prices, the rate of adoption of new techniques requiring significant investments might be. Many types of new techniques have not, however, required important investments by farmers adopting them in the past; for example, new seeds, new feeding methods and rations, and disease control methods. Thus it may be assumed that the production function shifts at a slow rate under any circumstances and that this rate may be increased somewhat by high real output prices.²¹

If real farm prices were constant, agricultural output would gradually increase due to the autonomous shifts in the production function. The employment of farm resources in a growing economy could increase, decrease, or remain constant depending upon the annual change in demand for farm products, the technological change in agriculture,

²¹ The evidence on the relation between output prices and technological change is admittedly conjectural. It cannot be assumed that because output per worker rises more rapidly during periods of high or rising prices than during periods of low or falling farm prices, the production function is shifting more rapidly in the former period than in the latter. High or rising prices induce more investment per worker, which is not the same thing as a technological change. It is argued below that the rate of technological change in agriculture has been much less than is generally assumed. The same may be true in the rest of the economy. Increased capital per worker over the years may be as important, if not more important, than technological change in increasing output per worker.

and the technological change in the rest of the economy.²² If the annual change in demand were equal to the technological change in agriculture, which in turn was equal to the technological advance in the rest of the economy, resource employment in agriculture would remain unchanged. However, if technological change occurred more rapidly in the rest of the economy than in agriculture, constant real prices of farm products would result in a decline in relative returns to resources in agriculture and some reduction in resource use, particularly of capital and labor. In this case, constant real prices would not represent a long-run equilibrium situation.

Given technological change, falling real farm prices need not produce a decline in aggregate output in agriculture. The autonomous shift in the production function may increase the marginal physical productivity of each of the resources sufficiently to counteract the decline in resource use. In consequence, the failure of aggregate output to decline would not be inconsistent with long-run equilibrium in the factor markets.²³

We have so far taken no account of either uncertainty or capital rationing. A change in relative farm prices for one or two years may not affect the level of resource employment because entrepreneurs do not expect such change to be permanent. Consequently, actual plans may be made in terms of expected prices either higher or lower than the market prices. Capital employment is not determined solely by profit maximization; in addition, as has been argued elsewhere, capital use in agriculture is subject to capital rationing.²⁴ Consequently, new investment in agriculture is a function of the liquidity position of farmers as well as of current and expected returns. However, this factor will not reverse the general direction of movement of capital employment, though the amount of investment would obviously be affected thereby.

In testing the above propositions in any empirical situation, one specific caution must be noted. The conditions stated and conclusions following therefrom are based on the assumption that the economy has been operating at a high level of employment for some time. In other words, it is assumed that labor unemployment in the nonfarm sector of the economy has not been acting as a deterrent to the migration of labor out of agriculture. At the beginning of the period of rising real farm prices if there is much unemployment of labor in the nonfarm economy, farm labor will be earning less than comparable *employed*

²² The change in the demand for farm products is assumed to be a function of the change in per capita income and of the change in population. Technological change is measured by the increase in output from a fixed quantity of resources.

²³ The share of total national output produced by agriculture would decline.

²⁴ See D. Gale Johnson, *Forward Prices for Agriculture*, Chaps. IV and V.

nonfarm labor. Consequently, if the rise in real farm prices is associated with a decline in unemployment, the supply function of agricultural labor will shift to the right; farm labor employment will decline even though the return to labor in agriculture rises relative to the return to employed labor in non-agriculture.²⁵

B. Tests of the Theory

1. 1900-1920. The period 1900 to 1920 was one of almost continuous high levels of employment. According to Douglas, unemployment in manufacturing and transportation—two cyclically volatile industries—exceeded six per cent in only four years out of the 22.²⁶ And only two of these were consecutive years—1914 and 1915.

Real farm prices apparently rose by 25 to 30 per cent,²⁷ and farm output, by 25 per cent²⁸ or roughly 1 per cent per year.

The increased farm output was associated with increased employment of all resources except labor—labor employment was roughly the same in 1920 as in 1900.²⁹ The employment of other resources, however, increased sharply. Total cropland increased from 319 million acres in 1900 to 402 million in 1920—an increase of 26 per cent. However, the land added was less productive (produced less rent per acre) than existing cropland. The net increase in the production capacity of the land was probably of the order of 15 per cent. The quantity of farm power, machinery and equipment increased from an index of 295 in 1900 to 477 in 1920—an increase of 62 per cent.³⁰ Livestock, exclusive of horses and mules, increased by 12 per cent. Total capital inputs probably increased by 30 per cent. Current operating expenses must have increased by at least 100 per cent, perhaps considerably more.³¹

²⁵ There is, of course, an increase in real farm prices that would increase the demand for farm labor by more than the supply decreased and thus result in an increase in farm employment. The argument in the text implies only that an increase in real farm prices and in farm labor returns (wages of hired labor and labor income of unpaid workers, including the operator) relative to the wages of employed nonfarm workers need not be inconsistent with a decline in farm employment in a specific situation.

²⁶ Paul Douglas, *Real Wages in the United States* (Boston, Houghton Mifflin Company, 1930) p. 445.

²⁷ See Bureau of Agricultural Economics, *1949 Agricultural Outlook Charts*, p. 1.

²⁸ Martin R. Cooper, Glen T. Barton, and Albert P. Brodell, *Progress of Farm Mechanization*, Dept. of Agriculture Misc. Pub. No. 630, p. 81.

²⁹ Barton, Cooper and Brodell estimate farm employment at 11.4 millions in 1900 (*ibid.*, p. 5). The Bureau of Agricultural Economics estimates the 1920 farm employment as 11.4 and 1910 as 12.1 (*Farm Wages, Employment and Related Data*, 1943).

³⁰ See Barton, *et al.*, *op. cit.*, p. 7.

³¹ From 1910 to 1920, total current operating expenses, excluding feed and livestock purchased and short-term interest, deflated by the index of prices paid by farmers for items used in production, except feed, increased by 69 per cent. Similar data are not available for 1900 to 1909.

The increased employment of resources was sufficient to account for most of the increased output,³² and the changing relative prices of output and inputs, to account for the increased employment of land, capital and current inputs.³³ In consequence, no substantial change in technology can be inferred from the increase in output.

Why did farm labor employment fail to increase? The evidence available is inconclusive in indicating what rational conduct would have been for farm workers. Farm labor income per worker rose relative to the income of employed industrial workers between 1910 and 1919. The absolute difference between annual earnings, however, increased from about \$335 in 1910-14 to \$570 in 1919, and to \$820 in 1920. A rise in relative earnings when the absolute differences increase may nor may not indicate that real returns to farm workers increased relatively. When the absolute difference is actually larger than the farm labor return, as it was in 1910-14, possible differential changes in the cost of a fixed level of living and changes in the content of the level of living make it impossible to infer with certainty whether the real returns to farm labor kept pace with the real returns to nonfarm labor.

2. 1923-29. The period from 1923 through 1929 was one of stable relative farm prices (in the aggregate). The parity index—a measure of relative farm prices—had the following values starting with 1923—86, 86, 92, 87, 86, 90, 89.

Our theory would indicate reasonable stability in the employment of all inputs, except perhaps labor. With respect to capital and land, actual experience does not contradict the expectations. Net investment in horses and mules, machinery, motor vehicles, including tractors,

³² We do not have the data that would permit an accurate estimate of the production function for agriculture. However, a crude estimate of changes in the function is possible if we assume (a) that there are constant returns to scale for agriculture as a whole, and (b) that the marginal productivities of resources are equal to the average net productivities. (As defined by Joan Robinson, *Imperfect Competition* [London, Macmillan, 1934], p. 239.)

Using estimates of average productivities for 1910-14 (See Johnson, "Allocation of Agricultural Income," p. 742) and assuming two different functions that meet the requirement of constant returns to scale (one linear and one linear in the logs), the following functions were obtained:

(1) $\log \text{ output} = .44 \log \text{ labor} + .27 \log \text{ land} + .17 \log \text{ capital} + .12 \log \text{ current expenses.}$

(2) $\text{Output} = .44 \text{ labor} + .27 \text{ land} + .17 \text{ capital} + .12 \text{ current expenses.}$

All variables were 100 in 1900, while the 1920 values were 100 for labor, 115 for land, 130 for capital and 200 for current inputs. Substituting these values in the functions gave 1920 estimates of output of 118 for the log function and 121 for the linear function. Actual output was 125. Roughly three-fourths or more of the increase seems to have been explained by increased inputs.

³³ Between 1910 and 1920, the average price of current inputs increased from 100 to 188, while farm prices increased from 102 to 211. Comparable data are not available for 1900 through 1910, but during this period the wholesale price of farm products increased by 47 per cent and the wholesale price of nonagricultural products increased by 17 per cent.

trucks, and the farm share of autos, and service dwellings was zero or perhaps negative.³⁴ The estimate made by Cooper, Barton and Brodell of farm power and machinery also indicated no change.³⁵ The current inputs purchased from non-agriculture increased, in real terms, by about 22 per cent. This increase was associated largely with the shift from farm produced to mechanical power.³⁶

It is not clear how labor employment should have been expected to behave. If it is assumed that the labor market was in long-run full-employment equilibrium in 1923, there should have been no appreciable change in labor employment. And this is what actually happened according to Bureau of Agricultural Economics estimates. Total farm employment declined by less than one per cent.³⁷

Between 1923 and 1929, the labor income of farm workers increased somewhat relative to the income of employed industrial workers—from about 30 per cent as much in 1923 to about 35 per cent in 1929.³⁸ During the seven-year period, there was a net movement of 4,260,000 people off farms—an annual average of 630,000 or roughly two per cent of the population.³⁹ This movement, large as it was, was only sufficient to stabilize the quantity of labor supplied.

The changes in farm production and in resource use are not inconsistent with an essentially unchanged production function. Calculations similar to those in footnote 32 indicate that one-half of the approximate eight per cent increase in farm output can be explained by increased inputs. The rest of the increase could be due to weather and other natural changes, though there seems to be no evidence that weather changes were important.⁴⁰

3. 1940-48. Following 1940, real farm prices rose rapidly—from 80 to a peak of 121 in 1946 and then fell slightly to 115 in 1948. It seems clear that the demand for all inputs would rise in these circumstances. And such increases in demand did occur. More capital was employed

³⁴ Based on values expressed in 1910-14 dollars. Data taken largely from Bureau of Agricultural Economics, *Net Farm Income and Parity Report*, 1943.

³⁵ *Op. cit.*, p. 81. The index was 454 in 1923 and 466 in 1929.

³⁶ *Ibid.*, p. 90. The cost of farm produced power which is payment for inputs produced by farmers, declined by \$300,000,000 measured in dollars of constant purchasing power. Costs of operating mechanical power increased by 390 million dollars.

³⁷ See Bureau of Agricultural Economics, *Farm Wages, Farm Employment, and Related Data*, p. 155.

³⁸ Based on estimates of labor income by writer, "Allocation of Agricultural Income," p. 738 and Bureau of Agricultural Economics, *1949 Agricultural Outlook Charts*, p. 7.

³⁹ Bureau of Agricultural Economics, *Farm Population Estimates, 1910-1942*, pp. 1 and 2.

⁴⁰ See United State Department of Agriculture, *Crops and Markets*, 1949 edition, p. 6 for estimates of yields per acre. Yields for field crops were identical in 1923 and 1929.

and net investment would have been even greater had items been available at quoted prices. Between January, 1940 and January, 1948, the quantity of power and machinery increased by about 40 per cent. Acreage of land harvested increased by about 10,000,000 or 3 per cent. Current operating expenses (except livestock and feed purchased and short-term interest) increased by 60 per cent. Farm output increased by 20 per cent.

The farm population declined from 30.3 millions to 27.8 millions by January 1, 1949, and the level of farm employment by slightly more than 4 per cent.

The change in farm employment is consistent with our theory. It is quite clear that labor in agriculture was not in a position of long-run equilibrium in 1940. The supply of labor was large in agriculture because of the heavy rate of unemployment that had prevailed previously in the rest of the economy. As unemployment declined, the supply of labor to agriculture also decreased. The differential in earnings was such as to induce movement out of agriculture at a given level of unemployment. Agriculture had a net migration during the last half of the 'thirties of 2,770,000 or 555,000 per annum,⁴¹ despite unemployment ranging from 14 to 20 per cent.⁴²

Agriculture would have lost more of its labor force had it not been for the rapid rise in returns to agricultural resources. During the early part of the period, labor income in agriculture rose more rapidly than labor income in the rest of the economy, yet the movement out of agriculture was at a fantastic rate—net civilian migration of 1,920,000 in 1942 and 1,146,000 in 1941. This was due to the large absolute difference in real earnings that still persisted. In 1941, labor returns per worker on commercial farms was \$700 less than the wage income of employed workers—a difference of slightly less than 50 per cent. By 1946 the absolute difference had narrowed to \$450 and the relative difference to 20 per cent,⁴³ and these differences remained roughly the same in 1947 and 1948.

In the three years 1946, 1947, and 1948—there was probably a rough equilibrium in the allocation of labor to commercial farms. Consequently, no significant change in farm population or labor force was to be expected during these years, except from the return of veterans. Apparently about one-half of the farm veterans returned to the farm and stayed there.

⁴¹ Bureau of Agricultural Economics, *Farm Population Estimates, 1910-1942*, p. 2.

⁴² Bureau of Agricultural Economics, *1949 Agricultural Outlook Charts*, p. 4.

⁴³ See Johnson, "Allocation of Agricultural Incomes," pp. 740 and 745, and Bureau of Agricultural Economics, *1949 Agricultural Outlook Charts*, p. 7.

The change in the production function between 1940 and 1948 was probably not as spectacular as is frequently believed. A large fraction of the increased output—perhaps half—can be attributed to increases in resource inputs. The remainder can be attributed to changes in the production function and natural factors, such as weather.

C. Conclusions

On the whole, the simple theory that we have used gives a reasonably accurate indication of the response of resource employment and output to changes in relative farm prices during periods of high-level employment, at least as judged by the three “tests” we have been able to make.

The attempt to judge the shift in the production function in the periods surveyed is significant in understanding the probable response of farm output to falling relative prices during periods of high-level employment. If during a period of rising relative prices, a considerable fraction of the increased output reflects increased inputs, a subsequent period of falling prices may well result in an actual decline in output. As farm prices decline, net investment will fall, the level of current inputs will diminish, and labor migration will increase. The decline in output may not be large, but it does not need to be in order to re-establish equilibrium in the factor markets because of the price inelasticity of demand for agricultural output.

An important policy conclusion can be drawn from this analysis. Maintaining farm price returns at levels above market prices during periods of high-level employment will make farm output higher than it would otherwise be.⁴⁴ Such induced increases in output will increase the difficulty of maintaining farm price returns, necessitating direct controls of output if governmental expenditures are not to exceed the amounts that even a “generous” Congress is willing to appropriate. In fact, it can be argued that increasing farm price returns by governmental action during periods of full employment does a real disservice to farm people, unless agriculture is to be permanently subsidized. If the price props are withdrawn (or a depression occurs), returns to agricultural resources would be lower than otherwise because too many resources have been retained in agriculture.

The attainment of equilibrium in the factor markets in agriculture during a period of generally falling prices or after the establishment of a lower level of agricultural prices may take longer than seems desir-

⁴⁴ The term farm price returns is used in this paragraph instead of farm prices because farm prices can be supplemented by direct subsidies to farmers.

able. If this is so, the appropriate policy action would not seem to be higher support prices *which would prevent the resource adjustments from occurring*. Rather, the slowness of the adjustment process would seem to call for direct measures to increase the outmovement of labor.⁴⁵

Summary

The theory presented in this article to explain the output behavior of agriculture rests on two major assumptions: (1) That farmers are profit-maximizing entrepreneurs and (2) that the supply functions of factors to agriculture have certain characteristics. These characteristics are: (a) The labor supply function shifts with changes in the general level of business activity and unemployment (reflecting the alternatives to farm employment) and for any level of business activity, unemployment and nonfarm wage rates, the price elasticity with respect to labor returns in agriculture is small enough to lead to essentially full employment of labor. (b) The land supply function has a very low price elasticity in the short run in part due to the lack of alternative uses outside of agriculture and due to small changes that can be made in the quantity of land through investment and disinvestment. (c) The supply function of capital assets has a very small price elasticity for downward movements in prices since the quantity of such assets existing at any one time can achieve higher returns in agriculture than elsewhere; in response to upward movements in prices, the price elasticity is higher as new investment becomes profitable to farmers.

This theory, simple as it is, seems to be consistent with the observed phenomena. The theory seems much more useful in understanding the behavior of agricultural output under various sets of circumstances than other explanations that have been offered. The high fixed cost explanation of constancy of output during a depression not only has the defect of being inconsistent with the observed behavior of the employment of hired labor and rented land, but high fixed costs are not an explanation at all of output responses to rising real output prices. Nor

⁴⁵ Walter Wilcox has indicated a contrary view in "High Farm Income and Efficient Resource Use," *Jour. Farm Econ.*, Vol. XXXI (Aug., 1949), pp. 555-57. He argues that farm migration is increased by high farm family incomes due to increased mechanization and the aid high incomes give to migration. He used population changes for Iowa, South Carolina and Tennessee for 1930 to 1940 in support of his position. A more detailed study of farm migration for the same decade made under the direction of the writer indicates that state differences in migration rates were unrelated to the level of farm income. The two factors which were most closely associated with migration were a measure of population pressure (the excess of new entrants to the farm labor force over deaths) and changes in the level of farm income from the late 'twenties to the 'thirties. The changes in farm population in the Pacific Coast States since 1930 clearly contradict Wilcox's position, as well.

does the competitive structure of agriculture seem to have much relevance to output behavior. Other explanations—the length of the production process and the importance of subsistence production—have been found to be unsatisfactory. The effect of the real wage upon the amount of effort a given labor force will exert is an explanation of behavior that seems consistent with observed phenomena. It is a hypothesis that deserves further investigation. The hypothesis is not inconsistent with the theory expounded here. If we knew more of its relevance and significance, it would be possible to specify with greater accuracy the nature of the labor supply function.