Measuring Agricultural Labor Hours and the
Rate of Return to Equity in Farm Assets

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Abstract

Three statistically different labor hour series are compared to determine how they would affect historical measures of various labor related indicators, including the rate of return to equity in farm assets. General trends in labor use and productivity were not significantly altered. However, two statistically different series for the rate of return (an indicator often used to gauge the profitability of farming) were developed.

Acknowledgments

MEASURING AGRICULTURAL LABOR HOURS AND THE
RATE OF RETURN TO EQUITY IN FARM ASSETS

Labor hours data currently reported by the Economic Research Service (ERS) of USDA in Production and Efficiency Statistics are based primarily on labor "requirements" per acre or per unit output, not on survey data. Consequently, labor hours are not independent of an assumed level of efficiency and therefore do not reflect efficiency changes.

Recognizing the inherent weaknesses of such an approach, the 1978 AAEA Task Force on Measuring Agricultural Productivity recommended that the national labor hours be based on estimates of labor use derived from sample surveys. Currently, three separate and independent labor surveys are conducted to measure aggregate labor hours used in agriculture. The sample surveys of both USDA's National Agricultural Statistics Service (NASS) Farm Labor Survey (FLS) and the Census Bureau's Current Population Survey (CPS) give independent estimates of labor use. The ERS Farm Costs and Returns Survey (FCRS) also provides an estimate of labor use, but was not conducted until 1984. The Task Force preferred the NASS labor use estimate if it were based on a monthly survey instead of the current quarterly sampling.[1]

This paper summarizes current efforts to implement the recommendations of the AAEA Task Force as they pertain to the agricultural labor series published by ERS. In addition, data from the FLS and CPS were used to determine how different estimates of the national labor input affect historical measures of labor productivity, the indices of total farm input and total factor productivity, and the rate of return to equity in farm assets.

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[1] Quarterly surveys were started in 1974. For 1981 through 1984, only one or two surveys were taken per year. The quarterly surveys were reinstated in 1985.

ERS Labor Series Revisited

Published estimates of total labor hours for each of 12 enterprise groups[2] and 10 regions[3] are for the most part obtained by multiplying labor coefficients by the Agricultural Statistics Board's (ASB) estimates of planted acreage (for pre-harvest labor), harvested acreage (for harvest labor), or weight units of production or animal numbers for livestock. A constant proportion of 13-15 percent (depending on the region in question) is added to the total labor hours for overhead labor (e.g., miscellaneous, management, bookeeping, etc.). The national labor input is calculated by aggregating over the enterprise groups and regions.

Requirement coefficients for many of the commodity accounts were obtained on an individual commodity basis by means of consultations with state agricultural experts. This was last done on a comprehensive basis in 1964, and before that in agricultural census years. After 1964, modifications in base labor coefficients occurred sporadically and were based on subjective judgements of changes in yields and developments in mechanization. Unfortunately, documentation to justify these modifications was not prepared and uniform procedures were not used in the modification process.

According to the AAEA productivity report, base labor coefficients for the major crops were revised in 1974 based on the Cost of Production (COP) surveys[4] conducted by ERS. However, in many accounts, ERS staff decided

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2 Feed grains, hay and forage, food grains, vegetables, fruits and nuts, sugar crops, cotton, tobacco, oil crops, meat animals, milk cows, and poultry.
3 Northeast, Lake States, Corn Belt, Northern Plains, Appalachian, Southeast, Delta States, Southern Plains, Mountain, and Pacific.
4 Currently replaced by the FCRS.

not to use the revised COP coefficients, but to continue using modified coefficients based on the 1964 benchmarks.

In response to these problems, revised coefficients from COP surveys were incorporated into the productivity accounts. This procedure did not fully align the ERS series (1974-1984) with either of the series developed from the two other survey sources (Table 1). The gap among these series can be related to engineering formulas (developed over 25 years ago) used to derive labor requirements, and underestimates of overhead labor.

A Comparision of Different Estimates of Total Labor Hours

The current ERS series, the series developed using NASS data, and the current BLS series are presented in table 1. The NASS series was derived as the sum of two products: (1) multiplying the average number of all family workers (which includes self-employed and unpaid) on farms by the average number of hours worked per week by this group, times 52, and (2) multiplying the average number of hired workers on farms by their respective average number of hours worked per week, times 52. This series commences in 1965, the first year in which average number of hours worked per week became available.

The BLS series is derived from a survey conducted on a monthly basis (i.e., the CPS). Although the CPS sample is taken from the entire U.S. population, numerous key personnel at the Bureau of the Census and at BLS have confirmed that the sample is proportional to size and representative of the farm sector (i.e., if the farm labor force accounts for 3 percent of the national labor force, then it will be so represented in the sample). Nevertheless, there are some disadvantages. The most serious one is that if an interviewee is a multiple job holder, all hours worked in all jobs are credited to the major job. Therefore, if the interviewee's primary occupation is classified as farm work, any hours spent working in nonfarm jobs are included under the primary occupation classification. However, it is very difficult to determine

Table 1—Total agricultural labor hours, United States, 1947-84

Year	:	Current ERS series	:	Series developed using NASS data	: Current BLS series 1/
		Billion hours			
1947	:	17.2		—	21.7
1948	:	16.8		—	21.0
1949	:	16.2		—	20.9
1950	:	15.1		—	19.3
1951	:	15.2		—	18.3
1952	:	14.5		—	17.4
1953	:	14.0		—	16.1
1954	:	13.3		—	15.6
1955	:	12.8		—	15.9
1956	:	12.0		—	15.1
1957	:	11.1		—	13.9
1958	:	10.5		—	12.9
1959	:	10.3		—	12.9
1960	:	9.8		—	12.5
1961	:	9.4		—	11.8
1962	:	9.0		—	11.4
1963	:	8.7		—	11.0
1964	:	8.2		—	10.4
1965	:	7.3		11.2	10.1
1966	:	6.9		10.4	9.1
1967	:	6.7		9.8	8.8
1968	:	6.4		9.4	8.6
1969	:	6.2		9.0	8.2
1970	:	5.9		8.9	7.7
1971	:	5.7		8.6	7.5
1972	:	5.4		8.5	7.6
1973	:	5.3		8.5	7.4
1974	:	5.2 (4.2)		8.2	7.4
1975	:	5.0 (4.2)		8.1	7.2
1976	:	4.8 (4.1)		8.1	6.9
1977	:	4.7 (4.0)		7.8	6.8
1978	:	4.4 (3.8)		7.4	6.9
1979	:	4.3 (4.3)		7.3	6.8
1980	:	4.3 (4.4)		7.2	6.6
1981	:	4.2 (4.3)		6.9	6.6
1982	:	4.0 (4.3)		6.2	6.4
1983	:	3.7 (4.2)		5.9	6.7
1984	:	3.7 (4.2)		5.8	6.7

— = Not available.
Numbers in parenthesis indicate series developed using COP survey data.

1/ This series is published by the Bureau of Labor Statistics (BLS) and is derived from the CPS.

whether the net effect is that the BLS series is overestimating or underestimating agricultural labor hours.

The gap between the ERS series and the other two is significant.[5] Between 1947 and 1964, the BLS series is about 24 percent larger than ERS's. However, after 1964 (the last benchmark year for ERS) the spread between these two series widens considerably. By 1984, the BLS series indicates a labor use 75 percent greater. The difference between the ERS series and the one developed using NASS data is also somewhat dramatic, reaching a high of 70 percent in 1979. The BLS series and the one developed using NASS data are also statistically different at the 99.5% level. However, the gap between these two series is considerably less, never reaching 20 percent. Nevertheless, all three series indicate a trend of declining labor input use.

The rate of decline in labor use in the three series varies. For example, between 1965 and 1977, labor use according to the ERS series decreased by almost 60 percent, compared to 49 percent in the BLS series and 44 percent in the series developed using NASS data.[6]

Labor Productivity

The disparity in the rate of decline in the labor input is reflected somewhat in the growth of labor productivity over the years (Table 2). In general, labor productivity grew the fastest according to the ERS series. For example, between 1965 and 1977, labor productivity according to the ERS series increased 48 percent, compared to 45 percent in the BLS series and 43 percent

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[5] Based on a paired difference t-test, the series developed using NASS data and the BLS series are statistically different from the ERS series at the 99.5% level.
[6] Based on a paired difference t-test, the annual rates of change reflected in each of the three series are not statistically different at the 99.5% level.

Table 2—Index of farm production per hour, United
States, 1947-84 (1977=100)

Year	Current ERS series	Series developed using NASS data	Series developed using BLS data
1947	16	—	18
1948	18	—	20
1949	19	—	20
1950	19	—	21
1951	20	—	23
1952	22	—	26
1953	23	—	28
1954	24	—	29
1955	26	—	29
1956	28	—	31
1957	29	—	33
1958	33	—	38
1959	35	—	39
1960	37	—	41
1961	39	—	44
1962	41	—	46
1963	45	—	49
1964	47	—	52
1965	52	57	55
1966	53	59	59
1967	58	66	64
1968	62	70	67
1969	63	74	70
1970	66	74	74
1971	74	84	84
1972	78	83	81
1973	81	85	85
1974	79	84	81
1975	89	91	90
1976	94	93	96
1977	100	100	100
1978	108	109	103
1979	119	118	111
1980	112	112	106
1981	131	134	122
1982	133	147	123
1983	120	125	96
1984	139	150	112

— = Not available.

in the series developed using NASS data.7 However, in general, all three
series indicate a steady increase in labor productivity.

Index of Total Farm Input

As shown in table 3, the index of total farm input is not all that sensitive
to large changes in the labor input component.7 Even though the gap among
the three different labor series widened considerably after 1965, the diffe-
rence in the index of total farm input is not, in general, dramatic. How-
ever, this result is not surprising since all three labor series reflect the
declining importance of labor relative to other inputs.

Index of Total Factor Productivity

As with labor productivity and the index of total farm input, the index of
total factor productivity was recalculated using ERS's current methodology.
The three series presented in table 4 are quite similar, given the diffe-
rences in the absolute value of the labor component. All three series in-
dicate that, in general, total factor productivity has increased over time
although the rate of increase is slightly (although not statistically)
different for each series.

Rate of Return to Equity in Farm Assets

Currently, ERS estimates the income attributed to equity in farm assets as
a residual claimant of farm income. Returns to operators8 plus net rent to

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7 Based on a paired difference t-test, the annual rates of change reflected
in each of the three series are not statistically different at the 99.5%
level.
8 Gross receipts of farms (farm marketings plus net inventory change plus
other farm income plus government payments plus other farm income plus non-
money income); minus nonfactor payments (intermediate product expenses,
capital consumption, and business taxes); minus interest on real and nonreal
estate debt; minus wages paid to hired labor; minus net rent to all land-
lords.

Table 3 —Index of total farm input, United States,
1947–84 (1977=100)

Year	Current ERS series	Series developed using NASS data	Series developed using BLS data
1947	99	—	105
1948	100	—	106
1949	102	—	109
1950	101	—	107
1951	104	—	107
1952	104	—	107
1953	103	—	104
1954	102	—	104
1955	102	—	105
1956	101	—	104
1957	98	—	100
1958	98	—	99
1959	99	—	101
1960	98	—	100
1961	97	—	99
1962	97	—	99
1963	97	—	99
1964	97	—	98
1965	96	99	98
1966	96	98	97
1967	98	98	98
1968	97	97	98
1969	97	97	97
1970	97	97	97
1971	98	97	97
1972	97	98	98
1973	98	99	98
1974	98	98	98
1975	96	97	97
1976	99	99	99
1977	100	100	100
1978	102	101	103
1979	105	104	106
1980	103	102	103
1981	102	100	102
1982	99	96	100
1983	95	92	98
1984	96	93	98

— = Not available.

Table 4 —Index of total factor productivity, United
States, 1947-84 (1977=100)

Year	:	Current ERS series	:Series developed using NASS data	:Series developed using ELS data
1947	:	58	—	55
1948	:	63	—	59
1949	:	61	—	57
1950	:	61	—	57
1951	:	61	—	59
1952	:	63	—	62
1953	:	64	—	63
1954	:	65	—	64
1955	:	67	—	65
1956	:	68	—	67
1957	:	69	—	67
1958	:	74	—	74
1959	:	74	—	73
1960	:	77	—	76
1961	:	78	—	77
1962	:	79	—	78
1963	:	82	—	81
1964	:	81	—	80
1965	:	86	83	84
1966	:	83	81	82
1967	:	86	85	85
1968	:	87	87	87
1969	:	88	88	88
1970	:	87	86	87
1971	:	94	94	95
1972	:	94	93	93
1973	:	95	94	95
1974	:	90	90	89
1975	:	99	98	98
1976	:	98	98	98
1977	:	100	100	100
1978	:	102	103	101
1979	:	105	107	105
1980	:	100	101	100
1981	:	116	118	115
1982	:	117	121	116
1983	:	100	103	97
1984	:	116	120	113

— = Not available.

all landlords plus interest on real estate and nonreal estate debt less returns imputed to operators' labor and management equals residual income to farm assets. Residual income to equity is derived by subtracting the interest on real estate and nonreal estate debt from the residual income to farm assets. The residual income to equity is then divided by the estimated equity in farm assets (market basis) to obtain a rate of return.

At the present time, the return imputed to operators' labor is estimated by multiplying ERS's estimate of total hours of labor times the average hourly cash wage rate, and subtracting from this product an estimate of total wages paid to hired farm labor. Consequently, in order to determine how sensitive the rate of return to equity in farm assets is to changes in the labor hours component, this rate of return was recalculated using the two labor hours series developed from NASS and BLS data (Table 5). Both the NASS and BLS data provide for the breakdown of labor hours by all family (which includes self-employed and unpaid) and hired workers. The number of hours worked by all family workers was valued at the average wage rate for all hired workers.

The differences between the three rates of return are significant,[9] especially in 1980 and 1983 where the NASS and BLS based series indicate negative rates of return as opposed to positive ones in the ERS series. The residual incomes to equity were negative in these two cases. This was the direct result of changing only the labor component in the rate of return accounts.

Conclusion

Although the ERS, BLS, and NASS based labor hour series are three statistically different series, the results of this investigation indicate that

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[9] Based on a paired difference t-test, the NASS based series and the BLS series are statistically different from the ERS series at the 99.5% level.

Table 5—Rate of return to equity in farm assets, United States, 1947-84

Year	Current ERS series	Using NASS data		Using ELS labor data	
		Reestimated series	Decrease in rate of return	Reestimated series	Decrease in rate of return
			Percent		
1947	7.4	—	—	6.2	16.2
1948	8.7	—	—	8.1	6.9
1949	4.3	—	—	3.2	25.6
1950	5.9	—	—	5.0	15.3
1951	6.0	—	—	5.7	5.0
1952	4.5	—	—	4.1	8.9
1953	3.0	—	—	3.0	0.0
1954	3.1	—	—	3.0	3.2
1955	2.3	—	—	1.9	17.4
1956	2.4	—	—	1.8	25.0
1957	2.6	—	—	1.9	26.9
1958	4.0	—	—	3.5	12.5
1959	1.9	—	—	1.2	36.8
1960	2.7	—	—	2.1	22.2
1961	3.3	—	—	2.6	21.2
1962	3.5	—	—	2.5	28.6
1963	3.3	—	—	2.5	24.2
1964	2.7	—	—	1.9	29.6
1965	4.4	2.4	45.5	3.1	29.6
1966	4.6	2.8	39.1	3.4	26.1
1967	3.2	1.5	53.1	2.1	34.4
1968	3.0	1.4	53.3	1.9	36.7
1969	3.7	1.9	48.7	2.4	35.1
1970	3.5	1.6	54.3	2.2	37.1
1971	3.5	1.7	51.4	2.4	31.4
1972	5.3	3.4	35.9	4.0	24.5
1973	10.1	7.8	22.8	8.5	15.8
1974	5.7	3.7	35.1	4.0	29.8
1975	4.9	2.7	44.9	3.1	36.7
1976	2.8	0.6	78.6	1.1	60.7
1977	2.1	0.2	90.5	0.6	71.4
1978	3.3	1.4	57.6	1.7	48.5
1979	3.2	1.6	50.0	1.8	43.8
1980	1.1	-0.3	127.3	-0.2	118.2
1981	1.8	0.6	66.7	0.6	66.7
1982	1.3	0.1	92.3	0.1	92.3
1983	0.2	-1.1	650.0	-1.1	650.0
1984	2.8	1.5	46.4	1.4	50.0

— = Not available.

annual rates of change in labor use, labor productivity, total farm input use, and total factor productivity derived from these series are not statistically different. Thus, if a labor hour series were to be used for the sole purpose of capturing general trends in labor use, labor productivity, total farm input use, and total factor productivity, the consequences of using any one of these series would be somewhat trivial. However, because estimates of labor hours are used to develop financial indicators of the farm sector, the absolute value of these estimates takes on a role of major importance. By changing only the labor component in the rate of return to equity in farm assets accounts, two statistically different series were developed for an indicator which is often used to gauge the profitability of farming.

Given the results of this analysis and the recommendations of the AAEA Task Force, the BLS series and the FCRS are recommended as the two sources upon which the national labor input should be based.[10] The series developed using the NASS data was not chosen primarily for two reasons: monthly surveys have not been reinstated and the likelihood of such a reinstatement is at best dubious. NASS's labor survey has in the past been adversely affected by budgetary constraints. Given current budget restrictions, the reliability of obtaining even quarterly labor estimates remains clouded.

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[10] According to the 1984 FCRS, labor use is estimated at 6.8 billion hours, a level comparable to the BLS estimate of 6.7 billion.

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