

Exhibits

The Impact of Interest Rates and Earnings Expectations  
on Bond, Stock, and Farmland Prices

Emanuel Melichar

Seminar

Department of Agricultural Economics and Rural Sociology  
The Pennsylvania State University  
University Park, Pennsylvania

April 19, 1991

Table 1

Value of zero-coupon bond at specified maturities and interest rates

Maturity (years)	Market rate of interest								
	.04	.05	.06	.07	.08	.09	.10	.11	.12
1	96.15	95.24	94.34	93.46	92.59	91.74	90.91	90.09	89.29
2	92.46	90.70	89.00	87.34	85.73	84.17	82.64	81.16	79.72
3	88.90	86.38	83.96	81.63	79.38	77.22	75.13	73.12	71.18
4	85.48	82.27	79.21	76.29	73.50	70.84	68.30	65.87	63.55
5	82.19	78.35	74.73	71.30	68.06	64.99	62.09	59.35	56.74
6	79.03	74.62	70.50	66.63	63.02	59.63	56.45	53.46	50.66
7	75.99	71.07	66.51	62.27	58.35	54.70	51.32	48.17	45.23
8	73.07	67.68	62.74	58.20	54.03	50.19	46.65	43.39	40.39
9	70.26	64.46	59.19	54.39	50.02	46.04	42.41	39.09	36.06
10	67.56	61.39	55.84	50.83	46.32	42.24	38.55	35.22	32.20
11	64.96	58.47	52.68	47.51	42.89	38.75	35.05	31.73	28.75
12	62.46	55.68	49.70	44.40	39.71	35.55	31.86	28.58	25.67
13	60.06	53.03	46.88	41.50	36.77	32.62	28.97	25.75	22.92
14	57.75	50.51	44.23	38.78	34.05	29.92	26.33	23.20	20.46
15	55.53	48.10	41.73	36.24	31.52	27.45	23.94	20.90	18.27
16	53.39	45.81	39.36	33.87	29.19	25.19	21.76	18.83	16.31
17	51.34	43.63	37.14	31.66	27.03	23.11	19.78	16.96	14.56
18	49.36	41.55	35.03	29.59	25.02	21.20	17.99	15.28	13.00
19	47.46	39.57	33.05	27.65	23.17	19.45	16.35	13.77	11.61
20	45.64	37.69	31.18	25.84	21.45	17.84	14.86	12.40	10.37
21	43.88	35.89	29.42	24.15	19.87	16.37	13.51	11.17	9.26
22	42.20	34.19	27.75	22.57	18.39	15.02	12.28	10.07	8.26
23	40.57	32.56	26.18	21.09	17.03	13.78	11.17	9.07	7.38
24	39.01	31.01	24.70	19.71	15.77	12.64	10.15	8.17	6.59
25	37.51	29.53	23.30	18.42	14.60	11.60	9.23	7.36	5.88
26	36.07	28.12	21.98	17.22	13.52	10.64	8.39	6.63	5.25
27	34.68	26.78	20.74	16.09	12.52	9.76	7.63	5.97	4.69
28	33.35	25.51	19.56	15.04	11.59	8.95	6.93	5.38	4.19
29	32.07	24.29	18.46	14.06	10.73	8.22	6.30	4.85	3.74
30	30.83	23.14	17.41	13.14	9.94	7.54	5.73	4.37	3.34

Table 2

Percentage change in value of zero-coupon bond when market rates change

Market rate when bond purchased = .080

Maturity	Market rate of interest									
	.04	.05	.06	.07	.08	.09	.10	.11	.12	
1	4	3	2	1	0	-1	-2	-3	-4	
2	8	6	4	2	0	-2	-4	-5	-7	
3	12	9	6	3	0	-3	-5	-8	-10	
4	16	12	8	4	0	-4	-7	-10	-14	
5	21	15	10	5	0	-5	-9	-13	-17	
6	25	18	12	6	0	-5	-10	-15	-20	
7	30	22	14	7	0	-6	-12	-17	-22	
8	35	25	16	8	0	-7	-14	-20	-25	
9	40	29	18	9	0	-8	-15	-22	-28	
10	46	33	21	10	0	-9	-17	-24	-30	
11	51	36	23	11	0	-10	-18	-26	-33	
12	57	40	25	12	0	-10	-20	-28	-35	
13	63	44	28	13	0	-11	-21	-30	-38	
14	70	48	30	14	0	-12	-23	-32	-40	
15	76	53	32	15	0	-13	-24	-34	-42	
16	83	57	35	16	0	-14	-25	-35	-44	
17	90	61	37	17	0	-15	-27	-37	-46	
18	97	66	40	18	0	-15	-28	-39	-48	
19	105	71	43	19	0	-16	-29	-41	-50	
20	113	76	45	20	0	-17	-31	-42	-52	
21	121	81	48	22	0	-18	-32	-44	-53	
22	129	86	51	23	0	-18	-33	-45	-55	
23	138	91	54	24	0	-19	-34	-47	-57	
24	147	97	57	25	0	-20	-36	-48	-58	
25	157	102	60	26	0	-21	-37	-50	-60	
26	167	108	63	27	0	-21	-38	-51	-61	
27	177	114	66	29	0	-22	-39	-52	-63	
28	188	120	69	30	0	-23	-40	-54	-64	
29	199	126	72	31	0	-23	-41	-55	-65	
30	210	133	75	32	0	-24	-42	-56	-66	



Table 4

Percentage of the total present value of a stream of income payments equal to the market rate of interest specified that is due within the specified number of years

Years	Market rate of interest								
	.04	.05	.06	.07	.08	.09	.10	.11	.12
1	3.8	4.8	5.7	6.5	7.4	8.3	9.1	9.9	10.7
2	7.5	9.3	11.0	12.7	14.3	15.8	17.4	18.8	20.3
3	11.1	13.6	16.0	18.4	20.6	22.8	24.9	26.9	28.8
4	14.5	17.7	20.8	23.7	26.5	29.2	31.7	34.1	36.4
5	17.8	21.6	25.3	28.7	31.9	35.0	37.9	40.7	43.3
6	21.0	25.4	29.5	33.4	37.0	40.4	43.6	46.5	49.3
7	24.0	28.9	33.5	37.7	41.7	45.3	48.7	51.8	54.8
8	26.9	32.3	37.3	41.8	46.0	49.8	53.3	56.6	59.6
9	29.7	35.5	40.8	45.6	50.0	54.0	57.6	60.9	63.9
10	32.4	38.6	44.2	49.2	53.7	57.8	61.4	64.8	67.8
11	35.0	41.5	47.3	52.5	57.1	61.2	65.0	68.3	71.3
12	37.5	44.3	50.3	55.6	60.3	64.4	68.1	71.4	74.3
13	39.9	47.0	53.1	58.5	63.2	67.4	71.0	74.2	77.1
14	42.3	49.5	55.8	61.2	66.0	70.1	73.7	76.8	79.5
15	44.5	51.9	58.3	63.8	68.5	72.5	76.1	79.1	81.7
16	46.6	54.2	60.6	66.1	70.8	74.8	78.2	81.2	83.7
17	48.7	56.4	62.9	68.3	73.0	76.9	80.2	83.0	85.4
18	50.6	58.4	65.0	70.4	75.0	78.8	82.0	84.7	87.0
19	52.5	60.4	66.9	72.3	76.8	80.6	83.6	86.2	88.4
20	54.4	62.3	68.8	74.2	78.5	82.2	85.1	87.6	89.6
21	56.1	64.1	70.6	75.8	80.1	83.6	86.5	88.8	90.7
22	57.8	65.8	72.2	77.4	81.6	85.0	87.7	89.9	91.7
23	59.4	67.4	73.8	78.9	83.0	86.2	88.8	90.9	92.6
24	61.0	69.0	75.3	80.3	84.2	87.4	89.8	91.8	93.4
25	62.5	70.5	76.7	81.6	85.4	88.4	90.8	92.6	94.1
26	63.9	71.9	78.0	82.8	86.5	89.4	91.6	93.4	94.7
27	65.3	73.2	79.3	83.9	87.5	90.2	92.4	94.0	95.3
28	66.7	74.5	80.4	85.0	88.4	91.0	93.1	94.6	95.8
29	67.9	75.7	81.5	85.9	89.3	91.8	93.7	95.2	96.3
30	69.2	76.9	82.6	86.9	90.1	92.5	94.3	95.6	96.7

Table 5

Present value of specified income payment (interest, dividend, or rent)  
due in specified number of years, at different market rates of interest

Annual income payment = \$ 8

Years	Market rate of interest								
	.04	.05	.06	.07	.08	.09	.10	.11	.12
1	7.69	7.62	7.55	7.48	7.41	7.34	7.27	7.21	7.14
2	7.40	7.26	7.12	6.99	6.86	6.73	6.61	6.49	6.38
3	7.11	6.91	6.72	6.53	6.35	6.18	6.01	5.85	5.69
4	6.84	6.58	6.34	6.10	5.88	5.67	5.46	5.27	5.08
5	6.58	6.27	5.98	5.70	5.44	5.20	4.97	4.75	4.54
6	6.32	5.97	5.64	5.33	5.04	4.77	4.52	4.28	4.05
7	6.08	5.69	5.32	4.98	4.67	4.38	4.11	3.85	3.62
8	5.85	5.41	5.02	4.66	4.32	4.01	3.73	3.47	3.23
9	5.62	5.16	4.74	4.35	4.00	3.68	3.39	3.13	2.88
10	5.40	4.91	4.47	4.07	3.71	3.38	3.08	2.82	2.58
11	5.20	4.68	4.21	3.80	3.43	3.10	2.80	2.54	2.30
12	5.00	4.45	3.98	3.55	3.18	2.84	2.55	2.29	2.05
13	4.80	4.24	3.75	3.32	2.94	2.61	2.32	2.06	1.83
14	4.62	4.04	3.54	3.10	2.72	2.39	2.11	1.86	1.64
15	4.44	3.85	3.34	2.90	2.52	2.20	1.92	1.67	1.46
16	4.27	3.66	3.15	2.71	2.34	2.01	1.74	1.51	1.30
17	4.11	3.49	2.97	2.53	2.16	1.85	1.58	1.36	1.17
18	3.95	3.32	2.80	2.37	2.00	1.70	1.44	1.22	1.04
19	3.80	3.17	2.64	2.21	1.85	1.56	1.31	1.10	0.93
20	3.65	3.02	2.49	2.07	1.72	1.43	1.19	0.99	0.83
21	3.51	2.87	2.35	1.93	1.59	1.31	1.08	0.89	0.74
22	3.38	2.73	2.22	1.81	1.47	1.20	0.98	0.81	0.66
23	3.25	2.60	2.09	1.69	1.36	1.10	0.89	0.73	0.59
24	3.12	2.48	1.98	1.58	1.26	1.01	0.81	0.65	0.53
25	3.00	2.36	1.86	1.47	1.17	0.93	0.74	0.59	0.47
26	2.89	2.25	1.76	1.38	1.08	0.85	0.67	0.53	0.42
27	2.77	2.14	1.66	1.29	1.00	0.78	0.61	0.48	0.38
28	2.67	2.04	1.57	1.20	0.93	0.72	0.55	0.43	0.33
29	2.57	1.94	1.48	1.12	0.86	0.66	0.50	0.39	0.30
30	2.47	1.85	1.39	1.05	0.80	0.60	0.46	0.35	0.27
R	61.66	37.02	23.21	15.01	9.94	6.70	4.58	3.18	2.23
Total	200.00	160.00	133.33	114.29	100.00	88.89	80.00	72.73	66.67

Table 6

Present value of an income payment (interest, dividend, or rent) initially equal to the market rate of interest specified and growing at the specified annual rate, and due in the specified number of years

Annual growth rate of income payment = 2 percent

Years	Market rate of interest									
	.04	.05	.06	.07	.08	.09	.10	.11	.12	
1	3.92	4.85	5.77	6.67	7.55	8.41	9.26	10.09	10.91	
2	3.84	4.71	5.55	6.35	7.12	7.86	8.57	9.26	9.92	
3	3.77	4.58	5.33	6.05	6.72	7.35	7.94	8.49	9.02	
4	3.70	4.44	5.13	5.76	6.34	6.87	7.35	7.79	8.20	
5	3.62	4.31	4.93	5.48	5.98	6.42	6.81	7.15	7.45	
6	3.55	4.19	4.74	5.22	5.64	6.00	6.30	6.56	6.77	
7	3.48	4.07	4.56	4.97	5.32	5.60	5.83	6.02	6.16	
8	3.41	3.95	4.38	4.74	5.02	5.24	5.40	5.52	5.60	
9	3.35	3.83	4.22	4.51	4.74	4.90	5.00	5.06	5.09	
10	3.28	3.72	4.05	4.30	4.47	4.58	4.63	4.65	4.63	
11	3.22	3.61	3.90	4.09	4.21	4.28	4.29	4.26	4.21	
12	3.15	3.51	3.75	3.90	3.98	4.00	3.97	3.91	3.82	
13	3.09	3.40	3.60	3.71	3.75	3.73	3.68	3.59	3.48	
14	3.03	3.31	3.46	3.54	3.54	3.49	3.40	3.29	3.16	
15	2.97	3.21	3.33	3.37	3.34	3.26	3.15	3.02	2.87	
16	2.91	3.12	3.20	3.21	3.15	3.05	2.92	2.77	2.61	
17	2.86	3.03	3.08	3.05	2.97	2.85	2.70	2.54	2.37	
18	2.80	2.94	2.96	2.91	2.80	2.66	2.50	2.33	2.16	
19	2.75	2.85	2.85	2.77	2.64	2.49	2.32	2.14	1.96	
20	2.69	2.77	2.74	2.64	2.49	2.33	2.15	1.96	1.78	
21	2.64	2.69	2.63	2.51	2.35	2.17	1.99	1.80	1.62	
22	2.59	2.61	2.53	2.39	2.22	2.03	1.84	1.65	1.47	
23	2.54	2.53	2.43	2.28	2.09	1.90	1.70	1.52	1.34	
24	2.49	2.46	2.34	2.17	1.98	1.77	1.58	1.39	1.22	
25	2.44	2.39	2.25	2.07	1.86	1.66	1.46	1.28	1.11	
26	2.39	2.32	2.16	1.97	1.76	1.55	1.35	1.17	1.01	
27	2.34	2.25	2.08	1.87	1.66	1.45	1.25	1.07	0.92	
28	2.30	2.19	2.00	1.79	1.57	1.35	1.16	0.99	0.83	
29	2.25	2.12	1.92	1.70	1.48	1.27	1.07	0.90	0.76	
30	2.21	2.06	1.85	1.62	1.39	1.18	0.99	0.83	0.69	
R	110.41	68.66	46.25	32.39	23.21	16.89	12.42	9.21	6.88	
Total	200.00	166.67	150.00	140.00	133.33	128.57	125.00	122.22	120.00	

Table 7

## Phases of the common stock investment cycle

- Phase: 1 Interest rates rise, stocks rise, bonds fall  
 2 Interest rates rise, stocks fall, bonds fall  
 3 Interest rates fall, stocks fall, bonds rise  
 4 Interest rates fall, stocks rise, bonds rise

Start of phase	Months in period				Percent change in stocks				Percent change in rates			
	1	2	3	4	1	2	3	4	1	2	3	4
T Apr 42				48				138				-13
Apr 46	1				0				2			
P May 46		19				-18				14		
Dec 47			18				-9				-5	
T Jun 49				7				21				-5
Jan 50	36				55				18			
P Jan 53		5				-9				13		
Jun 53			3				-3				-3	
T Sep 53				7				19				-13
Apr 54	27				77				15			
P Jul 56		14				-10				26		
Sep 57			3				-8				-8	
T Dec 57				6				11				-6
Jun 58	13				33				25			
P Jul 59		6				-3				3		
Jan 60			9				-7				-7	
T Oct 60				5				19				-2
Mar 61	9				12				5			
P Dec 61			6				-22				-3	
T Jun 62				8				18				-2
Feb 63	35				42				13			
P Jan 66		8				-17				16		
Sep 66			1				-1				-1	
T Oct 66				4				13				-7
Feb 67	22				22				28			
P Dec 68		18				-29				31		
T Jun 70				8				28				-17
Feb 71	23				22				1			
P Jan 73		21				-41				30		
Oct 74			2				-3				-4	
T Dec 74				21				57				-6
P Sep 76			12					-9			-5	
Sep 77		6				-8				7		
T Mar 78	23				30				46			
P Feb 80		1				-9				5		
Mar 80			1				-2				-7	
T Apr 80				2				11				-12
Jun 80	5				18				23			
P Nov 80		10				-13				19		
Sep 81			10				-8				-6	
T Jul 82				10				50				-22
May 83	5				2				7			
P Oct 83		8				-9				11		
Jun 84			1				-1				-1	
T Jul 84				30				75				-38
Jan 87	7				25				16			
P Aug 87		2				-15				9		
Oct 87			2				-14				-4	
T Dec 87				24				45				-12
Dec 89	6				3				5			
P Jun 90		3				-12				3		
Sep 90			1				-3				0	
T Oct 90 (to Apr 91)				6				27				-5
Totals since Jan 50	211	102	51	131	341	-175	-90	373	202	173	-49	-142

Computed from monthly averages of the S&P 500 composite index and Moody's yield on seasoned AAA corporate bonds.



Table 8

Indicator of earnings growth expectations implied in price of S&amp;P 500

S&P trough or peak	Price/ earnings ratio	AAA bond rate	Earnings/ price (percent)	<del>Earnings rate minus bond rate</del> Bond rate minus earnings rate	
				Trough	Peak
T Dec 57	11.8	3.81	8.47	-4.66	
P Jul 59	19.7	4.47	5.08		-.61
T Oct 60	16.1	4.30	6.21	-1.91	
P Dec 61	21.3	4.42	4.69		-.27
T Jun 62	14.7	4.28	6.80	-2.52	
P Jan 66	17.8	4.74	5.62		-.88
T Oct 66	13.4	5.41	7.46	-2.05	
P Dec 68	18.1	6.45	5.52		.93
T Jun 70	14.2	8.48	7.04	1.44	
P Jan 73	19.2	7.15	5.21		1.94
T Dec 74	7.3	8.89	13.70	-4.81	
P Sep 76	11.5	8.38	8.70		-.32
T Mar 78	8.2	8.47	12.22	-3.75	
P Feb 80	7.9	12.38	12.64		-.26
T Apr 80	7.0	12.04	14.37	-2.33	
P Nov 80	9.1	12.97	10.96		2.01
T Jul 82	7.4	14.61	13.53	1.08	
P Oct 83	13.3	12.25	7.54		4.71
T Jul 84	9.9	13.44	10.08	3.36	
P Aug 87	22.3	9.67	4.48		5.19
T Dec 87	15.4	10.11	6.49	3.62	
P Jun 90	16.7	9.26	6.00		3.26
T Oct 90	14.4	9.53	6.96	2.57	
Mar 91	17.5	9.10e	5.72		3.38

"Bond rate minus earnings rate" is the implied expected growth rate for the S&P 500 stock index.