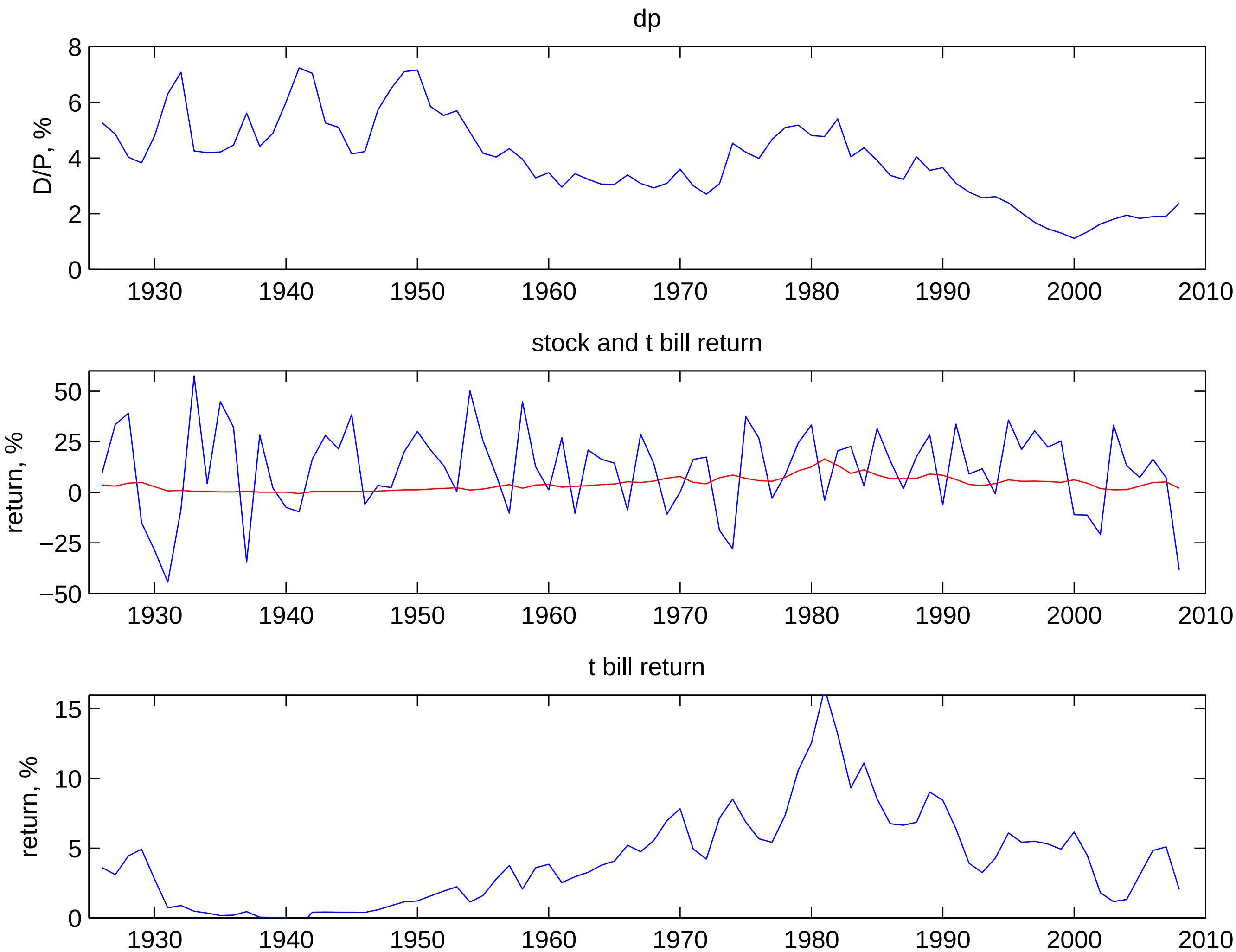
Problem Set 1 answers

1. It's always a good idea to make sure numbers are reasonable. Notice how slow-moving DP is. In some sense we only realy have 3-4 data points, which should worry us a lot. As we'll see this is an AR(1) with a coefficient of about 0.94. Until 2007, DP seemed to be trending down. Lots of people wrote unfortunately-timed papers about the structural shift to a lower DP and "great moderation." If you're not accustomed to this data, stock returns look astoundingly volatile. Yes, the graph extends from -50 to +50 %. They also look a lot like an iid series. I plotted stocks and t bills together so you could see how much more volatile stock returns are. T bills, visible in the bottom graph, rise and fall with inflation and clearly-visible business cycles. Tbills are also extremely autocorrelated. iid return tests only apply to excess returns, not to the level of returns.



2. a,b,c)

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Returns on D/P, overlapping, many horizons, 1926-today
Horizon (years)
           1      2      3      4      5      6      7      8      9     10
b       3.67   6.70   9.90  13.77  15.84  19.94  26.14  32.50  38.34  45.91
t,HH    2.49   2.88   3.19   3.16   3.09   2.62   2.98   3.11   2.86   2.77
t,OLS   2.59   3.50   3.59   3.74   4.27   4.84   5.58   6.37   6.00   5.56
t,NO    2.59   2.27   2.31   1.77   2.19   2.04   1.86   3.02   2.34   1.41
R2      0.07   0.10   0.14   0.16   0.16   0.19   0.23   0.24   0.24   0.24

Excess Returns on D/P, overlapping, many horizons, 1926-today
Horizon (years)
        1      2      3      4      5      6      7      8      9     10
b    4.20   7.76  11.49  15.97  18.76  23.77  31.13  39.21  47.41  57.75
t    2.83   3.14   3.22   3.09   3.12   2.82   3.13   3.20   3.05   2.94
R2   0.09   0.13   0.18   0.21   0.21   0.27   0.33   0.35   0.37   0.37
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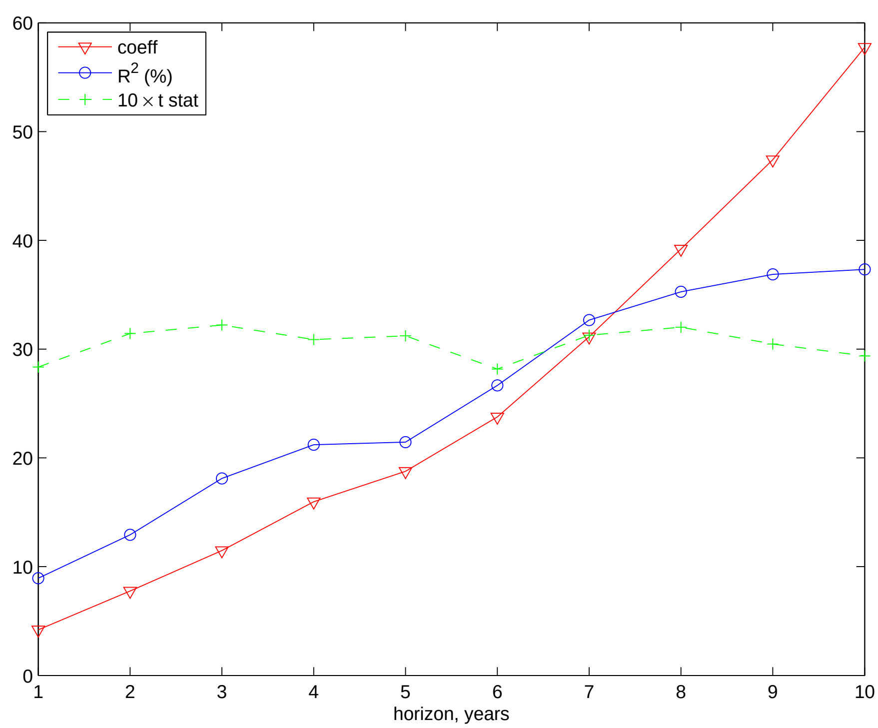
You see the coefficients and R2 rise with horizon. This happens because DP is so serially correlated.

The corrected t statistics do not rise with horizon– what you gain in coefficient, you lose in loss of data points. I thought long horizons were no better statistical evidence for many years based on this, but the barking dog taught me otherwise, there is more statistical evidence in long-run regressions. I plotted coefficients, corrected t and R2 as a function of horizon:



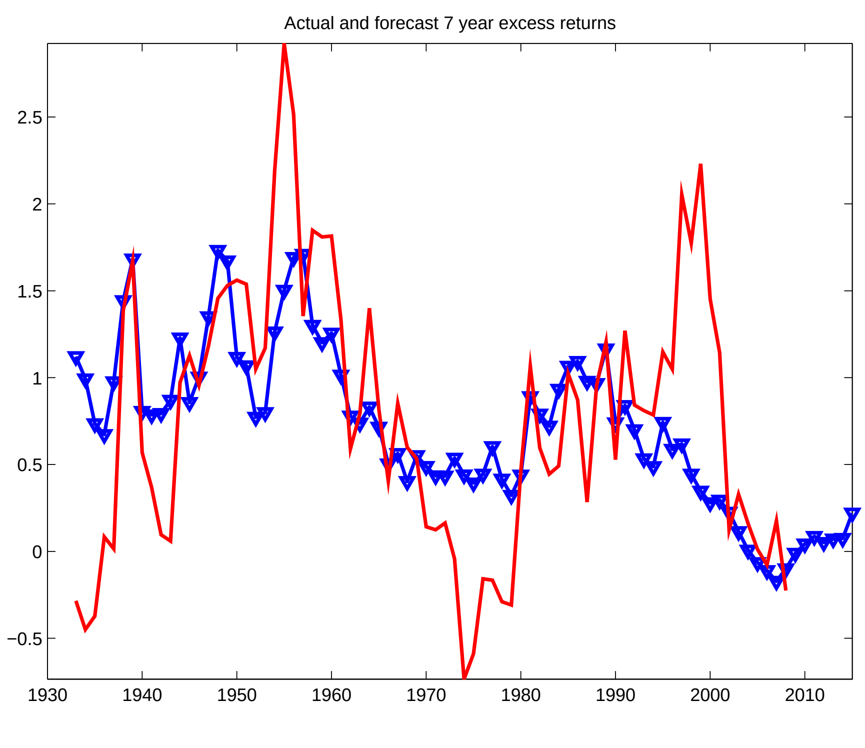
The return and excess return regressions are about the same. Actually excess returns are somewhat stronger. This means that dp ratios forecast interest rates in somewhat the "wrong" way – higher prices correspond to higher, not lower, future interest rates. Interestingly, it turns out that dp is quite well correlated with long-term interest rates. Neither DP nor long-term interest rates forecast short term rates well, which is the Fama-Bliss and Cochrane-Piazzesi puzzle we'll get to next.

No, neither coeffcients nor R^2 are affected by overlapping data.

The OLS t statistics look great – but these are wrong. BIG LESSON: when errors are correlated over time or across firms, OLS coefficients are unbiased but OLS standard errors are way, way off and MUST be corrected. The non-overlapping regressions give unbiased coefficients and t statistics, but they are slightly less efficient. This fact is correctly reflected in the smaller t stats using the larger nonoverlapping OLS standard errors. They are a good first cut if you're lazy or distrust the HH correction procedure.

Note the HH correction also has problems; calculating 12 autocorrelations and adding them up doesn't work too well in sample. There are lots of better things to do. Nonoverlapping data standard errors are obviously a good back-of-the envelope check. The HH correction is often too general; it allows for arbitrary autocorrleation up to 12 lags and heteroskedasticity. If you impose that the underlying errors are iid, so the only problem is induced serial correlation due to overlap, you can get much simpler and more robust formulas, that work so long as in fact the underlying errors are iid. I was going to put this on the problem set, but it's a finance course not an econometrics course so I'll leave it as an exercise for the interested reader.

d) Here's the plot. This is similar to the graph in lecture, but the "forecast" is a+b*DP where in lecture I just showed DP. The rise in D/P at the end of the sample is not nearly as large. It turned out D was crashing too, so P/D didn't rise all that much. Alas.



3.

Excess Returns on D/P, overlapping, many horizons, 1926-today
Horizon (years)

	1	2	3	4	5	6	7	8	9	10
b	4.20	7.76	11.49	15.97	18.76	23.77	31.13	39.21	47.41	57.75
t	2.83	3.14	3.22	3.09	3.12	2.82	3.13	3.20	3.05	2.94
R2	0.09	0.13	0.18	0.21	0.21	0.27	0.33	0.35	0.37	0.37

vw data from 19521231.00 to 20081231.00
cay data from 195204.00 to 200804.00
Excess Returns on D/P, overlapping, many horizons, 19521231 - 20081231
Horizon (years)

	1	2	3	4	5	6	7	8	9	10
b	4.47	7.31	8.49	9.66	14.25	21.84	30.26	39.30	50.84	61.74
t	1.99	1.70	1.75	2.12	2.63	2.56	3.30	3.85	3.90	3.28
R2	0.08	0.10	0.09	0.08	0.10	0.17	0.24	0.27	0.30	0.31

Excess Returns on cay, overlapping, many horizons, 19521231 - 20081231
Horizon (years)

	1	2	3	4	5	6	7	8	9	10
b	5.02	9.64	12.79	16.99	20.82	23.73	25.08	28.97	35.86	36.79
t	3.42	3.54	3.21	4.94	5.96	4.54	4.04	4.36	6.29	6.73
R2	0.15	0.26	0.30	0.35	0.31	0.29	0.25	0.24	0.27	0.22

Excess Returns on D/P and cay, overlapping, many horizons, 19521231 - 20081231
Horizon (years)

	1	2	3	4	5	6	7	8	9	10
b, dp	3.89	6.37	7.88	9.64	15.34	24.63	33.38	42.56	55.94	71.99
t	1.80	1.62	1.69	2.06	3.13	3.29	4.16	5.06	6.75	8.93
b,cay	4.70	9.21	12.53	16.99	21.37	25.62	27.60	31.68	39.80	45.07
t	2.97	3.17	2.83	4.26	7.83	12.26	8.34	6.48	8.26	12.15
R2	0.21	0.33	0.38	0.43	0.43	0.51	0.54	0.55	0.64	0.64

a) First, compare DP only with what we have above. I reprinted earlier results for comparison. The coefficients are about the same. The t stats are worse, but the sample is smaller. In particular, when a coefficient changes from 3.74 to 3.69, even if the t stat changes from 2.61 to 1.69, that just means you lost sample not that the phenomenon went away. *Don't pay slavish attention to t stats!*

b) The cay regression is impressive, but note the coefficient and R2 don't rise with horizon quite as much. Rather than a factor $61.74/4.47 = 13.8$, the coefficient rises by a factor of $36.79/5.01 = 7.3433$. Why? cay is much less persistent – see the picture below.

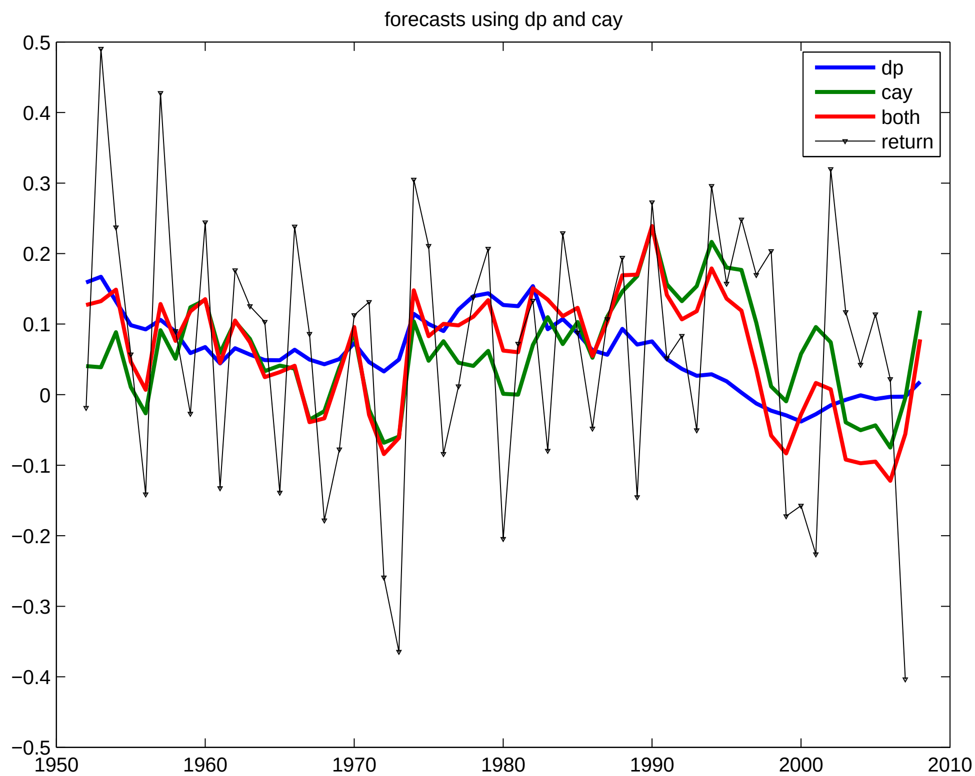
c) In the multiple regression, I think cay and dp seem to both survive in the presence of the other. How can I say that with t stats below 2? Well, we decided the 4.47 D/P coefficient was real, based on the full sample 2.83 t stat, even though the 52 - on t stat is only 1.99, since the coefficient is unchanged from the full-sample value. The multiple regression coefficients are almost the same. The real question is whether the presence of one variable removes the other's coefficient. The 10 year return coefficient on dp rises slightly from 62 to 72 and becomes a lot more significant. The reason is that the R^2 is so much higher. cay soaked up a lot of residual standard error.

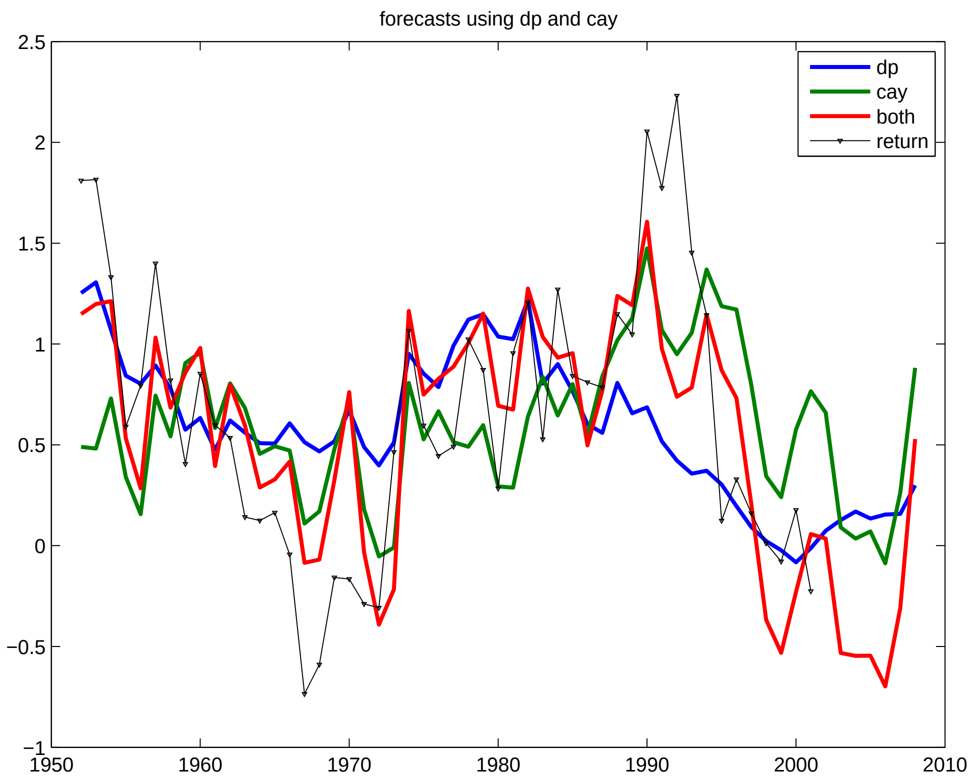
The R^2 rises to truly impressive values. One thing that attracts me to keeping dp in the regression is that the R^2 using both is about double that using cay only. (cay is a little suspect because Lettau and Ludvigson fit the cointegrating vector in sample, but c/y i/k and other macro ratios do add forecast ability in much the same way.)

I'm a bit suspicious of the huge ts and R^2 here. If you find a mistake, let me know.

d) Here are the plots. You see here clearly that cay is a "short run" variable, where dp captures "long-term trends." cay does well because it is able to foresee many one-year wiggles in stock returns. In particular, it foresees stock returns associated with recessions and booms. Its big successes are in capturing the poor markets of the 1970s and especially of capturing the boom of the 1990s. Don't disparage the improvement of the "both" line however. It slowly drags down cay's forecast, especially in the later part of the sample, and improving a little bit in every data point does a lot to R^2. These are good plots to understand that *variance comes at all frequencies.* Your eye is drawn to matching wiggles, but sums of squares want to match trends as well.

The cay return forecast is very optimistic!





forecasts using dp and cay
dp
cay
both
return
2.5
2
1.5
1
0.5
0
−0.5
−1
1950
1960
1970
1980
1990
2000
2010