CUFE·CAFD

TITLE：Investment Assignment VI

GROUP NAME：GGM Never Die

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DATE：11/7/2019

Part I: Replicating Banz (1981)

The paper extended the Fama and MacBeth's (1973) experiment by adding size as an explanatory variable in the regression

$$R_{it} = \delta_{0t} + \delta_{1t}\beta_i + \delta_{2t}Size_i + \eta_{it}$$

And the results are shown below:

Table 1. Testing CAPM (beta and size) using 25 portfolios sorted on size and beta

Obs	sample	# months	Start	End	delta0	t(delta0)	delta1	t(delta1)	delta2	t(delta2)
1	1967-6/84	210	196701	198406	0.006913	2.8839	0.007016	1.7095	-.000000	-2.522
2	1967-77	132	196701	197712	0.005991	2.0084	0.004988	0.9523	-.000000	-1.985
3	1967-91	300	196701	199112	0.009611	4.9579	0.004062	1.2276	-.000000	-1.478

From the results above, we can find during the first period, delta1 is positive and significant. This means the higher beta, and the higher expected return. This result can prove part of CAPM model is right, that is, Beta explains the cross-sectional differences in expected returns and higher risk should be associated with higher expected return, and hence the market premium should be positive.

The table shows a significantly negative estimate for delta2 for the overall time period. Thus, shares of firms with large market values have had smaller returns, on average, than similar small firms. And therefore, it also implies CAPM model appears to be misspecified, that is, Beta is not the only measure of risk that matters. Here we should also notice that delta0 and dela1 are different from the risk-free rate and the risk premium, respectively.

Part II: Computing Abnormal Returns Using CAPM

Event: Announced Inclusion into sp500 -Abnormal Returns

Day	Average MAR(%)	t-statistic	Average CMAR(%)	t-statistic	N
-10	0.02645	0.2431	0.03319	0.29384	570
-9	0.08516	0.8167	0.11835	0.83434	570
-8	-0.18314	-1.9316	-0.06479	-0.39634	570
-7	-0.14872	-1.4676	-0.21352	-1.08038	570
-6	-0.01853	-0.1708	-0.23204	-1.00309	570
-5	-0.11069	-1.1006	-0.34273	-1.41640	570
-4	0.07385	0.7527	-0.26888	-1.03089	570
-3	0.17777	1.6381	-0.09111	-0.32408	570
-2	0.09284	0.9846	0.00173	0.00596	570
-1	0.06176	0.5708	0.06349	0.21077	570
0	0.39318	3.5563	0.45343	1.39880	571
1	1.96820	11.2374	2.42328	6.40292	571
2	-0.11197	-1.0336	2.30905	5.96764	571
3	0.24544	2.2522	2.55980	6.28666	571
4	-0.06276	-0.5082	2.49676	5.91076	571
5	0.07905	0.7163	2.57783	5.91829	571
6	0.02189	0.2212	2.59863	5.76349	571
7	0.03624	0.3711	2.63828	5.75200	571
8	-0.07211	-0.7106	2.56626	5.58608	571
9	-0.07521	-0.6237	2.48925	5.24686	571
10	-0.16152	-1.7390	2.32649	4.79982	571

Event: Announcement of inclusion in the SP500 -Abnormal Returns

Day	Average MAR(%)	t-statistic	Average CMAR(%)	t-statistic	N
-10	0.06620	0.5624	0.06981	0.57948	570
-9	0.14539	1.3259	0.21520	1.45131	570
-8	-0.13849	-1.3797	0.07670	0.44393	570
-7	-0.11531	-1.0777	-0.03861	-0.18587	570
-6	0.04355	0.3875	0.00494	0.02030	570
-5	-0.08252	-0.7981	-0.07758	-0.30832	570
-4	0.15577	1.5589	0.07819	0.29106	570
-3	0.20716	1.8639	0.28535	0.98330	570
-2	0.10798	1.1240	0.39333	1.32245	570
-1	0.07338	0.6809	0.46671	1.52516	570
0	0.41251	3.5507	0.87607	2.70759	571
1	1.97535	11.2192	2.85302	7.53592	571
2	-0.11071	-1.0381	2.73992	7.05994	571
3	0.31599	2.7780	3.06135	7.44514	571
4	-0.00147	-0.0118	3.05971	7.14882	571
5	0.11002	0.9644	3.17167	7.12237	571
6	0.04959	0.4972	3.22004	6.97584	571
7	0.03364	0.3345	3.25682	6.90805	571
8	-0.01266	-0.1239	3.24405	6.82224	571
9	0.03300	0.2652	3.27523	6.67809	571
10	-0.10317	-1.0879	3.17083	6.33950	571

Figure 1 right:ar=ret-vwretd, left:ar=ret-alpha-vwretd*beta

According to the graphs above we can see that the abnormal return of regression result is much less than the minus method. The probable reason is that some permno's beta is greater than 1 and alpha positive. The minus method"ar=ret-vwretd" just takes beta is equal to 1. Correspondingly, the average CMAR on right is generally larger than average CMAR on left. And the in day0 and day1 the abnormal return is significant and abnormal return increases by 550% in day0 and by 402% in day1, which means the market is relatively significant.

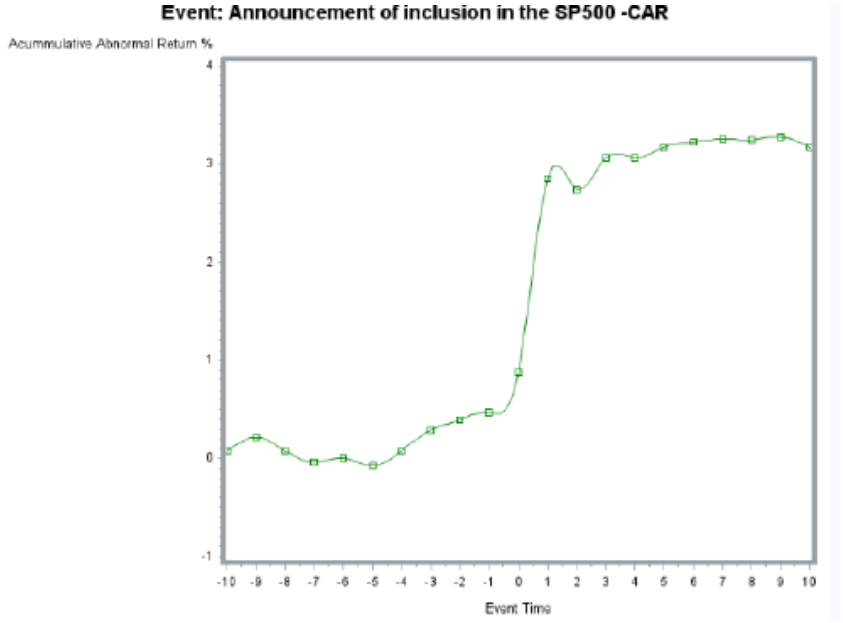

Figure 2 ar=ret-vwretd

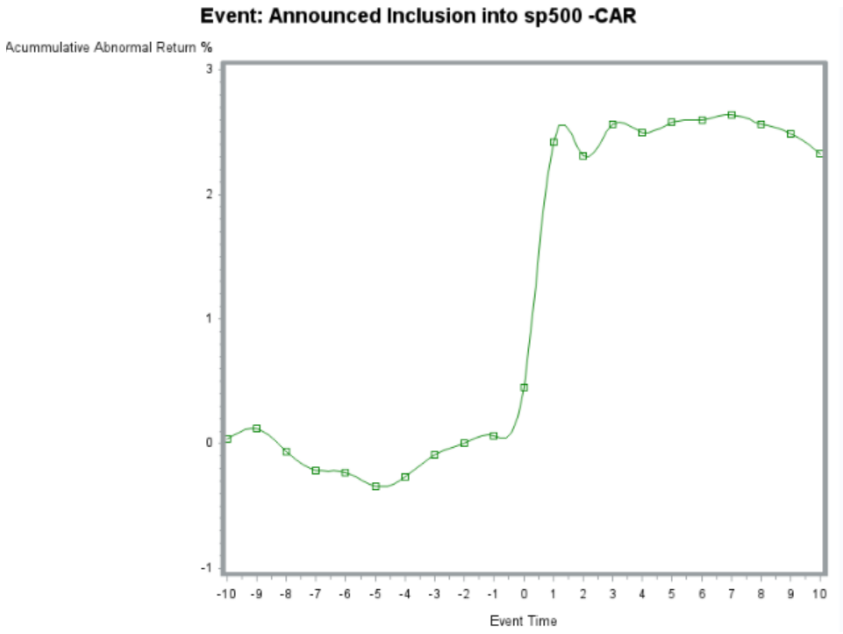

Figure 3 ret-alpha-vwretd*beta

We can see that the curves above showing the difference between the two methods. And in both graphs the value increases rapidly at day0, which mean there is no information leakage.

Event: Announced merger and the effect on the target -Abnormal Returns

Day	Average MAR(%)	t-statistic	Average CMAR(%)	t-statistic	N
-10	-0.25034	-1.8706	-0.25034	-1.8706	1280
-9	-0.15234	-0.9275	-0.40268	-2.0122	1280
-8	-0.08482	-0.6144	-0.48750	-2.1215	1280
-7	-0.17699	-1.2319	-0.66449	-2.4655	1280
-6	0.05058	0.3330	-0.61390	-2.0602	1280
-5	-0.36917	-2.1485	-0.98307	-2.8558	1280
-4	0.18801	0.8277	-0.79506	-2.1220	1280
-3	0.03860	0.2544	-0.75185	-1.8867	1279
-2	0.20605	1.0991	-0.54580	-1.2316	1279
-1	0.15696	0.9613	-0.38884	-0.8146	1279
0	6.60329	13.3476	6.26329	9.1560	1279
1	1.97531	6.9400	8.33097	11.5973	1276
2	0.11419	0.9077	8.48895	11.7502	1274
3	0.03056	0.2629	8.51419	11.7825	1274
4	0.09409	0.8860	8.61293	11.8221	1274
5	-0.04694	-0.4203	8.57962	11.5603	1273
6	-0.00185	-0.0173	8.59007	11.4278	1272
7	-0.01587	-0.1497	8.57510	11.1932	1272
8	-0.14483	-1.1974	8.42992	10.8626	1272
9	-0.10672	-1.0963	8.32369	10.6757	1272
10	0.00965	0.0913	8.43642	10.7889	1270

Event: Merger Targets -Abnormal Returns

Day	Average MAR(%)	t-statistic	Average CMAR(%)	t-statistic	N
-10	-0.20083	-1.5030	-0.20083	-1.5030	1280
-9	-0.09433	-0.5669	-0.29516	-1.4687	1280
-8	-0.08841	-0.6356	-0.38356	-1.6621	1280
-7	-0.13028	-0.8984	-0.51384	-1.8827	1280
-6	0.11342	0.7421	-0.40042	-1.3351	1280
-5	-0.32915	-1.9009	-0.72957	-2.0929	1280
-4	0.26825	1.1797	-0.46132	-1.2121	1280
-3	0.11930	0.7813	-0.33559	-0.8322	1279
-2	0.27243	1.4427	-0.06316	-0.1409	1279
-1	0.18516	1.1265	0.12200	0.2518	1279
0	6.65716	13.4047	6.82833	9.8421	1279
1	2.05040	7.1576	8.97666	12.3127	1276
2	0.14162	1.1197	9.16188	12.4640	1274
3	0.10148	0.8574	9.25928	12.5516	1274
4	0.14853	1.3727	9.41241	12.6594	1274
5	0.02409	0.2146	9.45012	12.4720	1273
6	0.06259	0.5845	9.52629	12.4159	1272
7	0.01769	0.1658	9.54510	12.1851	1272
8	-0.05179	-0.4218	9.49280	11.9577	1272
9	-0.06555	-0.6612	9.42757	11.8184	1272
10	0.05433	0.5084	9.58586	12.0026	1270

Figure 4 right:ar=ret-vwretd, left:ar=ret-alpha-vwretd*beta

According to the graphs above we can see that the abnormal return of regression result is much less than the minus method. The probable reason is that some permno's beta is greater than 1 and alpha positive. The minus method"ar=ret-vwretd" just takes beta is equal to 1. Correspondingly, the average CMAR on right is generally larger than average CMAR on left. And the in day0 and day1 the abnormal return is significant and abnormal return increases by 4300% in day0, which means the market is relatively significant.

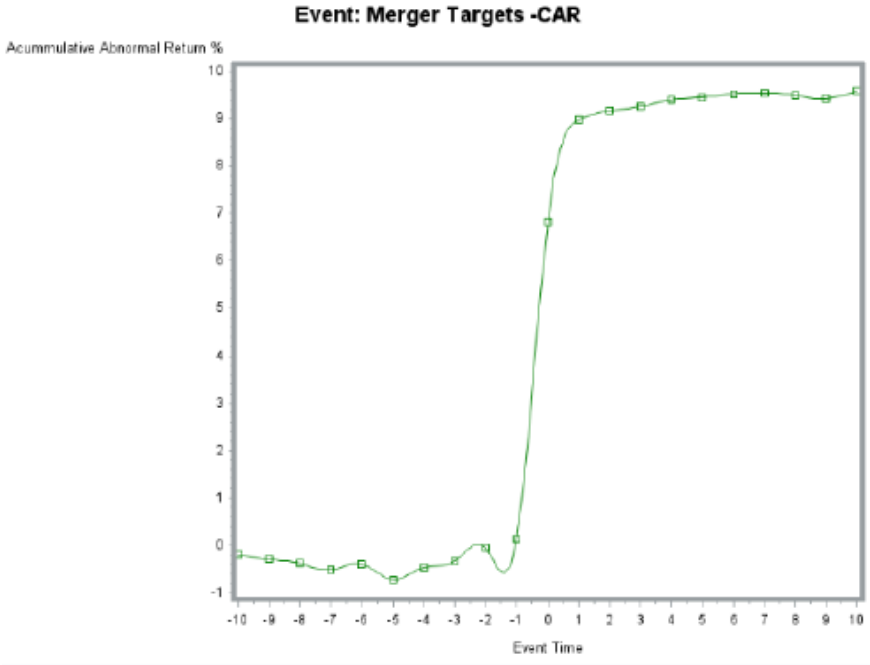

Figure 5 ar=ret-vwretd

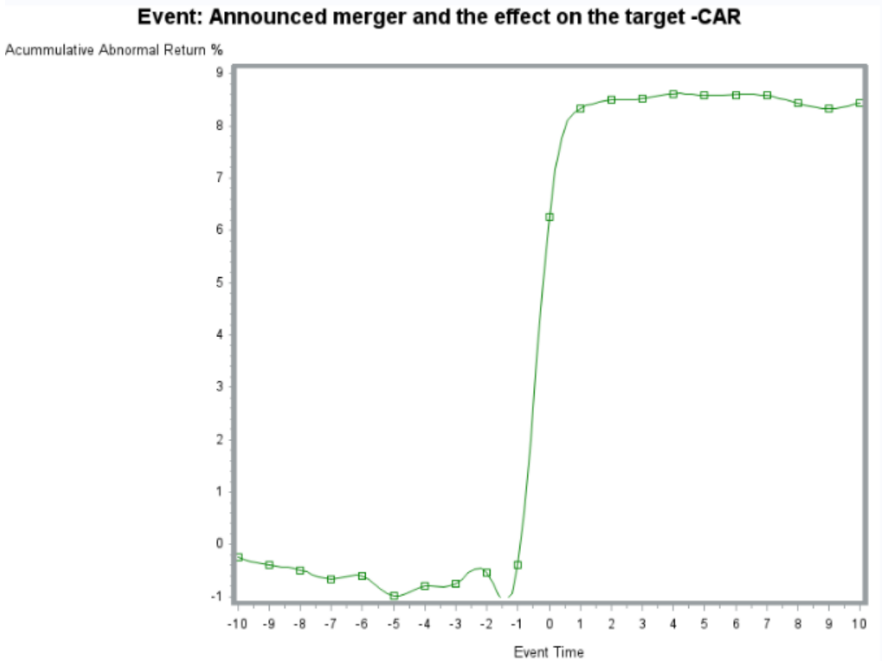

Figure 6ar=ret-alpha-vwretd*beta

We can see that the curves above showing the difference between the two methods. And in both graphs the value increases rapidly at day0, which mean there is no information leakage.

Part III: Assignment Code

Question 1:

```
options ls=80 mprint;
libname worklib "F:\Investment";


%macro fm(num_cycles=);
*Collect monthly data for NYSE stocks, 1958-1991;
data msf;
    set worklib.msf0;
    if hexcd=1 and 1958<=year(date)<=1991;
data d_fm;
    set msf;
    sizeall=prc*shrout;
run;
%do i=1 %to &num_cycles;
  %let year_cycle=%eval(1961+(&i-1)*4);
  proc sql;
  create table d as
  select
      d_fm.*,
      (year(d_fm.date)*100+month(d_fm.date)) as month
  from
      d_fm
  where
      &year_cycle-6<=year(date)<=&year_cycle+9;
 * Number months;
  proc sort data=d out=d_months(keep=month) nodupkeys;
    by month;
  data d_months;
    set d_months;
    i+1;
  run;
  * Get market return;
  proc sort data=d;
    by month;
  proc means data=d noprint;
    by month;
    output out=d_mkt_return
        mean(ret)=market_ret;
  proc sort data=d;
    by month;
  data d;
    merge
```

```
     d
     d_mkt_return(keep=month market_ret)
     d_months(keep=month i);
   by month;
   year_cycle=&year_cycle;
   if ret^=.;
 * Keep only securities with returns in all 60 months of the
estimation period   and at least 48 months of the formation
period;
 proc sort data=d;
   by permno;
 proc means data=d noprint;
   var ret;
   output out=d_stats_form n=n_ret_form;
   by permno;
   where (&year_cycle=1961 and 1<=i<=48) or (&year_cycle^=1961
and 1<=i<=84);
 proc means data=d noprint;
   var ret;
   output out=d_stats_test n=n_ret_test;
   by permno;
   where (&year_cycle=1961 and 49<=i<=48+60) or
(&year_cycle^=1961 and 85<=i<=84+60);
 data d;
   merge d d_stats_form d_stats_test;
   by permno;
   if n_ret_form>=48 and n_ret_test=60;
  * Compute betas on the portfolio formation period,i.e., i=1
thru 84 or i=1 thru 48 if first cycle;
 proc reg data=d
outest=data_reg(rename=(market_ret=beta_formation)) noprint;
   model ret=market_ret;
   by permno;
   where (&year_cycle=1961 and 1<=i<=48) or (&year_cycle^=1961
and 1<=i<=84);
 *Define portfolios;
proc rank data=d out=d1 group=5;
   var sizeall;
   ranks sizerank;
   where month=&year_cycle*100+12;
 run;
data d1;
 set d1;
 size=sizeall;
```

```
run;
proc sql;
  create table d as
  select
    d.*,
    d1.sizerank,
    d1.size
  from
    d left join d1
  on d.permno=d1.permno;
 quit;
 proc sql;
 create table d as select
  d.*, data_reg.beta_formation
  from d left join data_reg
  on d.permno=data_reg.permno;
quit;
proc sort data=d;
by sizerank;
run;
proc rank data=d out=d group=5;
var beta_formation;
ranks portfolio;
by sizerank;
run;
   %do year_testing=1 %to 4;
    *Recompute beta thru estimation period;
   proc sort data=d;
   by permno;
    proc reg data=d outest=data_reg(rename=(market_ret=beta))
noprint;
     model ret=market_ret;
     by permno;
     where (&year_cycle=1961 and 49<=i<=48+(5+&year_testing-
1)*12) or
          (&year_cycle^=1961 and 85<=i<=84+(5+&year_testing-
1)*12);
     proc sql;
    create table d_year as
    select
      d.*,
      data_reg.beta
    from
      d, data_reg
```

```
    where
      d.permno=data_reg.permno and
      year(date)=&year_cycle+5+&year_testing
    order by
      permno,date;
    %if &i=1 and &year_testing=1 %then
    %do;
      data d_testing;
        set d_year;
    %end;
    %else
    %do;
      proc append base=d_testing data=d_year;
      run;
    %end;
  %end;
%end;
*Compute portfolio returns and betas;
proc sort data=d_testing;
    by sizerank portfolio month;
proc means data=d_testing noprint;
    var beta ret size;
    by sizerank portfolio month;
    output out=d_reg
        mean(beta)=beta
        mean(ret)=ret
        mean(size)=size;
*Compute monthly CS regressions;
proc sort data=d_reg;
    by month;
proc reg data=d_reg outest=d_reg_output(keep=month intercept beta
size) noprint;
    model ret=beta size;
    by month;
*Summarize the CS coefficients;
proc means data=d_reg_output noprint;
    var intercept beta size month;
    output out=d_fm_output_1
        mean(intercept beta size)=mean_intercept mean_beta
mean_size
        stddev(intercept beta size)=std_intercept std_beta std_size
        n(intercept beta size)=n_intercept n_beta n_size
        min(month)=starting_month
        max(month)=ending_month;
```

```
    where month<=198406;
data d_fm_output_1;
    set d_fm_output_1;
    t_intercept=mean_intercept/(std_intercept/sqrt(n_intercept));
    t_beta=mean_beta/(std_beta/sqrt(n_beta));
    t_size=mean_size/(std_size/sqrt(n_size));
    sample="1967-6/84";
proc means data=d_reg_output noprint;
    var intercept beta size month;
    output out=d_fm_output_2
        mean(intercept beta size)=mean_intercept mean_beta
mean_size
        stddev(intercept beta size)=std_intercept std_beta std_size
        n(intercept beta size)=n_intercept n_beta n_size
        min(month)=starting_month
        max(month)=ending_month;
    where 196701<=month<=197712;
data d_fm_output_2;
    set d_fm_output_2;
    t_intercept=mean_intercept/(std_intercept/sqrt(n_intercept));
    t_beta=mean_beta/(std_beta/sqrt(n_beta));
    t_size=mean_size/(std_size/sqrt(n_size));
    sample="1967-77";
proc means data=d_reg_output noprint;
    var intercept beta size month;
    output out=d_fm_output_3
        mean(intercept beta size)=mean_intercept mean_beta
mean_size
        stddev(intercept beta size)=std_intercept std_beta std_size
        n(intercept beta size)=n_intercept n_beta n_size
        min(month)=starting_month
        max(month)=ending_month;
    where 196701<=month<=199112;
data d_fm_output_3;
    set d_fm_output_3;
    t_intercept=mean_intercept/(std_intercept/sqrt(n_intercept));
    t_beta=mean_beta/(std_beta/sqrt(n_beta));
    t_size=mean_size/(std_size/sqrt(n_size));
    sample="1967-91";
data d_fm_output;
    set d_fm_output_1
        d_fm_output_2
        d_fm_output_3;
proc print data=d_fm_output label;
```

```
    var sample n_intercept starting_month ending_month
mean_intercept t_intercept
        mean_beta t_beta mean_size t_size;
    label
        starting_month="Start"
        ending_month="End"
        n_intercept="# months"
        mean_intercept="delta0"
        t_intercept="t(delta0)"
        mean_beta="delta1"
        t_beta="t(delta1)"
        mean_size="delta2"
        t_size="t(delta2)";
    format
        mean_intercept mean_beta mean_size 8.6
        t_intercept t_beta t_size 6.4;
run;
%mend fm(num_cycles=);
%fm(num_cycles=7);
```

Question 2:

```
%macro
event_study_beta(d_p,permno_p,date_p,lwindow,rwindow,graph_p,title_p)
;
libname worklib'D:\investment\data\lecture4';
*merge all data together;
data dp;
set worklib.&d_p;
run;
data ret;
set worklib.dsf_all;
run;
data mret;
set worklib.Mktret_daily;
run;
proc sql;
create table d as select distinct
dp.*,
ret.date,
ret.ret
from dp left join ret
on dp.&permno_p=ret.permno
order by &permno_p, date;
quit;
proc sql;
```

```
create table d1 as select distinct
d.*,
mret.vwretd
from d left join mret
on d.date = mret.date
order by &permno_p, date;
quit;
proc sort data=d1;
by &permno_p &date_p;
run;
*get the num_before;
proc means data=d1 noprint;
var &permno_p;
by &permno_p &date_p;
output out=d_stats
n=num_before;
where DATE<&date_p;
run;
*get rel_day;
data d2;
merge d1 d_stats(keep=&permno_p &date_p num_before);
by &permno_p &date_p;
if first.&date_p then
rel_day=-num_before;
else
rel_day= rel_day +1;
retain rel_day;
label num_before= 'num_before';
run;
* Compute abnormal return according to market model;
data d_reg;
 set d2;
 run;
proc sort data=d_reg;
 by &permno_p date;
 run;
   proc reg data=d_reg outest=out_reg
 (rename=(vwretd=beta intercept=alpha)) noprint;
 model ret=vwretd;
 by &permno_p;
 run;
* Compute abnormal return according to market model;
 proc sql;
create table reg as select distinct
```

```
d_reg.*,
out_reg.alpha,
out_reg.beta
from d_reg left join out_reg
on d_reg.&permno_p=out_reg.&permno_p
order by &permno_p, date;
quit;
*keep (-5,5) data and calculate car;
data d3;
set reg;
by &permno_p;
if &lwindow<=rel_day<=&rwindow;
ar=(ret-alpha-vwretd*beta)*100;
data d3;
set d3;
by &permno_p;
if first.&permno_p then
car=ar;
else
car=car+ar;
retain car;
run;
proc sort data=d3;
by rel_day;
proc means data=d3 noprint;
var ar car;
output out=d_stats1
mean(ar)=mean_ar
t(ar)=t_ar
mean(car)=acar
t(car)=t_car
n(ar)=n_ar;
by rel_day;
run;
proc print data=d_stats1 label noobs;
title 'Event:' &title_p '-Abnormal Returns';
var rel_day mean_ar t_ar acar t_car n_ar;
label
rel_day="Day"
mean_ar="Average MAR(%)"
t_ar="t-statistic"
acar="Average CMAR(%)"
t_car="t-statistic"
n_ar="N";
```

```
run;
%if &graph_p=1 %then
%do;
symbol1
color=green interpol=spline width=1 value=square;
axis1
label=("Event Time")
order=&lwindow to &rwindow by 1
width=3;
axis2
label=("Acummulative Abnormal Return %")
width=3;
run;
proc gplot data=d_stats1;
title 'Event:' &title_p '-CAR';
plot acar*rel_day/haxis=axis1 vaxis=axis2;
run;
quit;
%end;
%mend event_study_beta;
options ls=72 mautosource
SASAUTOs='C:\Users\m1371\Desktop\event_study_beta' mprint;
%event_study_beta(added_sp500_ev,permno,anndate_sas,-
10,10,1,Announced Inclusion into sp500);
%event_study_beta(merger_ev,target_permno,ann_date,-10,10,1,Announced
merger and the effect on the target);
```