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*****BIS*****
Source: Bank for International Settlements
Base year = 2010
Real effective exchange rate index
Broad indices = 61 economies
Narrow indices = 27 economies
*****;

rsubmit;
%let rolling_period=60; *cumulative return period;
%let estimation_period=60; *time-series period used to determine whether a
firm is exposed;

*****CRSP variables*****;
*Keep necessary CRSP variables;
proc sql;
create table a01
as select a.permno, a.date, a.ret, b.exchcd, b.shrcd, c.vwretd, c.ewretd
from crsp.msrf as a
left join crsp.mseall as b
on a.permno=b.permno and a.date=b.date
left join crsp.msi as c
on a.date=c.date;
quit;
proc sort data=a01; by permno date; run;

*Clean data;
data a02;
set a01;
by permno date;
retain lexchcd lshrcd;
if first.permno then do; lexchcd = exchcd; lshrcd = shrcd; end;
else do;
if missing(exchcd) then exchcd = lexchcd; else lexchcd = exchcd;
if missing(shrcd) then shrcd = lshrcd; else lshrcd = shrcd;
end;
if date>='01Jan1984'd;
run;
proc sort data=a02 nodupkey; by permno date ret; run;

*****FXI return calculations*****;
*Upload BIS data to WRDS;
PROC upload data=exp.fxi;
run;

*create cumulative FXI returns;
proc sql;
create table fxi_cum
as select distinct a.*, exp(sum(log(1+b.ret_nFXI))) - 1 as cum_nFXI,
exp(sum(log(1+b.ret_bFXI))) - 1 as cum_bFXI
from fxi as a, fxi as b
where 0<=intck('month', b.date, a.date)<&rolling_period
group by a.date having count(b.ret_nFXI)=&rolling_period;
quit;

data fxi_cum;
set fxi_cum;

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format date YYMMDDN8.;
informat date 8.;
run;

*****CRSP return calculations*****;
proc sql; *buy-hold cumulative ret;
create table a03
as select a.permno, a.date as cluster "Cluster", b.date, b.ret, b.vwretd,
b.ewretd
from a02 as a left join a02 as b
on a.permno=b.permno and 0<=intck('month', b.date, a.date)<&rolling_period
group by a.permno, a.date having count(b.ret)=&rolling_period and
count(b.vwretd)=&rolling_period and count(b.ewretd)=&rolling_period
order by a.permno, a.date, b.date;
quit;

proc sql;
create table a04
as select distinct permno, cluster, exp(sum(log(1+ret))) - 1 as cum_ret,
exp(sum(log(1+vwretd))) - 1 as cum_vwretd, exp(sum(log(1+ewretd))) - 1 as
cum_ewretd
from a03
group by permno, cluster
order by permno, cluster;
quit;

proc sql; *estimation period;
create table a05
as select distinct a.permno, a.cluster, b.cluster as datadate 'datadate',
b.cum_ret, b.cum_vwretd, b.cum_ewretd
from a04 as a, a04 as b
where a.permno=b.permno and 0<=intck('month', b.cluster,
a.cluster)<&estimation_period
group by a.permno, a.cluster having count(b.cum_ret)=&estimation_period
order by a.permno, a.cluster, b.cluster;
quit;

*keep clustered data only for fiscal year ends (full Compustat sample);
PROC upload data=fx.Comp03_all;
run;
PROC SQL;
CREATE TABLE a06 AS
SELECT a.gvkey, a.permno, a.datadate, b.cluster, b.datadate as ret_date,
b.cum_ret, b.cum_vwretd, b.cum_ewretd, c.date as FXret_date, c.cum_nFXI,
c.cum_bFXI
FROM Comp03_all as a left join a05 as b
on a.permno = b.permno and -10<=intck('day', b.cluster, a.datadate)<=10
left join fxi_cum as c
on -10<=intck('day', c.date, b.datadate)<=10
order by a.permno, a.datadate, b.datadate;
QUIT;

data a06;
set a06;
if not missing (cluster);
if not missing (permno);
run;

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*Estimate stock return volatility to FX risk (narrow);
%let lags=3;
ods output parameterestimates=est_narrow;
ods listing close;
proc model data=A06;
by permno datadate;
instruments cum_vwretd cum_nFXI;
parms b0 b1 b2;
cum_ret=b0+b1*cum_vwretd+b2*cum_nFXI;
fit cum_ret / gmm kernel=(bart,%eval(&lags+1),0) vardef=n; run;
quit;
ods listing;

*Keep coefficients;
data est_narrow1;
set est_narrow;
if parameter='b2';
drop EstType StdErr tValue DF;
run;

*Change output file name;
proc download data = est_narrow1 out=exp.est_narrow1;
run;

*Estimate stock return volatility to FX risk (broad);
ods output parameterestimates=est_broad;
ods listing close;
proc model data=A06;
by permno datadate;
instruments cum_vwretd cum_bFXI;
parms b0 b1 b2;
cum_ret=b0+b1*cum_vwretd+b2*cum_bFXI;
fit cum_ret / gmm kernel=(bart,%eval(&lags+1),0) vardef=n; run;
quit;
ods listing;

*Keep coefficients;
data est_broad1;
set est_broad;
if parameter='b2';
exposed=net_negative+net_positive;
drop EstType StdErr tValue DF;
run;
proc download data = est_broad1 out=exp.est_broad1;
run;

*Create clusters to estimate beta_FTR;
proc sql;
create table firm1
as select a.gvkey, a.datadate as cluster "Cluster", b.fyear, b.avgfros,
b.avgro, b.avgftr
from Comp03_all as a left join Comp03_all as b
on a.gvkey=b.gvkey and 0<=intck('year', b.datadate, a.datadate)<5
group by a.gvkey, a.datadate having count(b.avgftr)=5
order by a.gvkey, a.datadate, b.fyear;
quit;

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*Estimate income shifting intensity;
ods output parameterestimates=est_ftr;
ods listing close;
proc model data=firm1;
  by gvkey cluster;
  instruments avgros avgftr;
  parms b0 b1 b2;
  avgfros=b0+b1*avgros+b2*avgftr;
  fit avgfros;
run;
quit;
ods listing;
data est_ftr2;
set est_ftr;
if parameter='b2';
if tValue ne .;
run;
proc download data = est_ftr2 out=exp.est_ftr2;
run;
endrsubmit;

*Local merge;
proc sql;
create table exp.B1
as select a.*, b.estimate as b_ftr, abs(c.estimate) as abs_est_narrow,
abs(d.estimate) as abs_est_broad,
       e.hedge
from fx.Comp03_all as a left join exp.est_ftr2 as b
on a.gvkey = b.gvkey and a.datadate=b.cluster
left join exp.est_narrow1 as c
on a.permno = c.permno and a.datadate=c.datadate
left join exp.est_broad1 as d
on a.permno = d.permno and a.datadate=d.datadate
left join exp.hedge as e
on a.ciknumber = e.ciknumber and a.fyear=e.fyear;
quit;

*Create controls and clean data;
data exp.b2;
set exp.b1;
if not missing (b_ftr);
if unique_link=1;
size=log(1+at);
fsale_sale=fsale/sale;
if avgftr<0;
if fyear<=2017;
if not missing(abs_est_narrow+abs_est_broad+hedge);
keep gvkey ciknumber datadate fyear sic2 abs_est_narrow abs_est_broad b_ftr
size fsale_sale hedge;
run;

*Winsorize continuous variables here and then export;

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