SAS CODE

This code allows you to import your data, to smooth your data, and to create rolling window to calculate AR1, the variance and the skewness.

Here, this is an example for the Asian crisis of 1997. We calculate the rolling window with size 4 and sigma=10 on our series with the logarithm of the index. It's possible to do the same thing with the log-returns, the cumulative log returns and with different value for both indicators. You just have to change the value, and uncomment the desired comment.
We also decide to analyze the robustness of our results. This is the second part of our code. We analyse the results for the serie with cumulative log returns, by changing the value of the bandwidth and rolling window.
We plotted all the graphs with ODS Designer.

```
libname asie "\\Mac\Home\Documents\Master\SAS\PROJET\DATA\Asie";

/*Data import*/
proc import
datafile="\\Mac\Home\Documents\Master\SAS\PROJET\DATA\Asie\HSI.csv"
dbms=CSV
out=asie.HSI
replace;
run;

/*creation of a SAS data set*/
data asie.HSI;
set asie.HSI (obs=618);
keep Date Adj_Close;
format Date DATE9.;
run;

proc iml;
use asie.HSI;
read all into M;
/*logarithm of the index */
M[,2]=log(M[,2]);

/*log return*/
M[,2]=log(M[,2]/lag(M[,2]));
M=M[2:nrow(M),1:2];
/*cumulative log return*/
M[,2]=cusum(M[,2]);

/*function of density*/
start G(x,sigma);
g=1/(sqrt(2*constant('PI'))*sigma)*exp(-x##2/(2*sigma##2));
return(G);
```

```
finish G;


/*MA processus for detrending series*/
MA=j(nrow(M),1,0);
do j=1 to nrow(M);
i=(j-nrow(M):j-1)`;
W=g(i,10);
XX=M[j-i,2];
MA[j]=sum(W#XX)/w[+];
end;

resu=M[,2]||M[,2]-MA||MA||M[,1];

create asie.resultat_log from
resu[colname={'Series','Denoise','Trend','Date'}];
append from resu;
close asie.resultat_log;

/*T=4 et sigma=10*/
window=nrow(resu)/4;
do i=1 to nrow(resu)-window;
serieX=resu[i:i+window-1,2];
serieY=resu[i+1:i+window,2];
b=inv(serieX`*serieX)*serieX`*serieY;
v=var(serieX);
k=skewness(serieX);
fenetre=fenetre//(b||v||k||M[i+window,1]);
end;

create asie.deux_dix_log from
fenetre[colname={'AR1','variance','skewness','date'}];
append from fenetre;
close asie.quatre_dix_log;
QUIT;

data asie.quatre_dix_log;
set asie.quatre_dix_log;
format date date9.;
run;
data asie.resultat_log;
set asie.resultat_log;
format date date9.;
run;

/*ROBUSTNESS ANALYSIS*/
proc iml;
use asie.HSI;
read all into M;
/*logarithm of the index */
/*M[,2]=log(M[,2]);*/

/*Log return*/
M[,2]=log(M[,2]/lag(M[,2]));
M=M[2:nrow(M),1:2];

/*Cumulative log return*/
```

```
M[,2]=cusum(M[,2]);

start G(x,sigma);
g=1/(sqrt(2*constant('PI'))*sigma)*exp(-x##2/(2*sigma##2));
return(G);
finish G;

do sigma=10 to 20 by 0.1;
MA=j(nrow(M),1,0);
do j=1 to nrow(M);
i=(j-nrow(M):j-1)`;
W=g(i,sigma);
XX=M[j-i,2];
MA[j]=sum(W#XX)/w[+];
end;
residu=M[,2]-MA;
do t=2 to 6 by 0.1;
window=nrow(residu)/t;
do i=1 to nrow(residu)-window;
serieX=residu[i:i+window-1];
serieY=residu[i+1:i+window];
b=inv(serieX`*serieX)*serieX`*serieY;
v=var(serieX);
k=skewness(serieX);
tk=corr(serieX||serieY,"kendall"); /*Kendall's tau */

end;
rolling_window=rolling_window//(sigma||t||b||v||k);
end;
end;

create asie.rolling_window_cum from
rolling_window[colname={'sigma','window','AR','var','skewness'}];
append from rolling_window;
close asie.rolling_window_cum;
```