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Location Quotient, Coefficient of Specialization and Shift-Share

Applications on Matlab

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Location Quotient, Coefficient of Specialization and Shift-Share

Juan Tomas Sayago-Gomez and Caleb Stair

Abstract

This technical document describes the foundations for three different regional economic functions implemented in MATLAB and R. These functions are Location Quotients, Coefficients of Localization, and Shift-Share Analysis.

1 Location Quotient

Economic Base Theory assumes that all growth in a region is due to exports. Exports bring income into a region. One way to determine which sectors comprise the base of the local economy (sectors that export) is through location quotients (McCann, 2001). Location quotients (LQs) are ratios that allow an area's distribution of employment by industry to be compared to a reference area's distribution. The reference or base industry is usually the industry total (Richardson, 1973). According to the Bureau of Labor Statistics, if a LQ is equal to 1, then the industry has the same proportion of its area employment as it does in the reference area. A LQ greater than 1 indicates an industry with a greater proportion of the local area employment than is the case in the reference area. For example, assuming the U.S. as the reference area, Las Vegas will have an LQ greater than 1 in the Accommodation and Entertainment industry because this industry makes up a larger share of the Las Vegas employment total than it does for the country as a whole. A sector with a LQ greater than 1 is assumed to be an exporting sector (Hoover and Giarratani, 1971).

An Industry Location Quotient is a way of quantifying how “concentrated” an industry is in a region compared to a larger geographic area, such

as the state or nation (Richardson, 1973). The basic uses of industry LQs (and, by extension, for clusters and occupations as well) include these:

- To determine the industries that make the regional economy unique
- To identify the most export-oriented industries in the region
- To identify developing export industries, which are beginning to bring money into the region
- To identify troubled export industries, which could wear away the regions economic base

The formula for an Industry Location Quotient is shown below in (1).

$$LQ_i = \frac{\left(\frac{E_{iS}}{E_S}\right)}{\left(\frac{E_{iR}}{E_R}\right)} \tag{1}$$

Where:

- LQ_i is the location quotient for sector i in the subregion
- E_{iS} is the number of employees in sector i in the subregion
- E_S is the total number of employees in the subregion
- E_{iR} is the number of employees in sector i in the region
- E_R is the total number of employees in the region

$$LQ_{manufactures} = \frac{\left(\frac{500,000}{3,500,000}\right)}{\left(\frac{10,000,000}{200,000,000}\right)} = 2.857 \tag{2}$$

A location quotient can yield more useful information than job numbers or job growth. Industries with high LQ are typically (but not always) export-oriented industries, which are important because they bring money into the

Table 1: Example of location quotient for Maryland

Maryland's manufacturing employment	500,000
Maryland's total employment	3,500,000
Nation's manufacturing employment	10,000,000
Nation's total employment	200,000,000

region rather than simply circulating money that is already in the region (many retail stores and restaurants do) (McCann, 2001). Industries that have both high LQ and relatively high total job numbers typically form a region's economic base (Hoover and Giarratani, 1971).

2 Coefficient of localization

A coefficient of specialization (COS) is a way of measuring the diversity in a region. The theory for COS stems from portfolio theory in finance (North, 1955). More specialized means more volatile future returns and more diversified means more stable future returns. The lowest possible COS value is 0, which means employment is distributed in the region in the same proportion as the nation (the U.S. is viewed as completely diversified in this paper). Therefore, if the COS values are decreasing over time, the region is becoming more diversified (Hoover and Giarratani, 1971). The highest possible COS is approximately 100. This means that all employment in the region is in one sector and that there is no employment elsewhere in the nation in that sector (Hoover and Giarratani, 1971).

$$CS = \frac{1}{2} \sum \left| \frac{A_{ir}}{A_r} - \frac{A_{in}}{A_n} \right| \quad (3)$$

Steps: Using the data from Table 2

Step 1: Calculate the percent of total employment in each sector in the sub-region and the region (Shown in Table 3).

Step 2: Subtract the percent employed in each sector in the region from the percent employed in each corresponding sector in the subregion (Shown in Table 4).

Step 3: The coefficient of specialization is then the sum of all positives or the absolute value of the sum of all negatives from step 2 in Table 4 (COS=34.72).

Table 2: Data to use in example for coefficient of specialization.

	Employment: Jackson County	Employment: USA (millions)
Total	10,200	140
Farm	5,000	20
Manufacturing	2,000	40
Services	3,200	80

Table 3: Example for coefficient of specialization after step 1.

	Employment%: Jackson County	Employment%: USA
Total	100	100
Farm	49.01	14.29
Manufacturing	19.61	28.57
Services	31.37	57.14

3 Shift-Share Methodology

The Shift-Share method is used to decompose regional changes; this model separates the economic change into the national growth effect, the industry mix effect and the competitive effect (Loveridge and Selting, 1998; McCann, 2001). The classic Shift-Share model is presented in equation (4).

Table 4: Example for coefficient of specialization after step 2.

	%Jackson - %USA
Total	0
Farm	34.72
Manufacturing	-8.97
Services	-25.77

$$\Delta e_{i,t} = (G + (G_i - G) + (g_i - G_i))e_{i,t-1} \tag{4}$$

where

- Δe_i is the change in the i th sector
- $G_i e_{i,t-1}$ is the National Effect or National Share
- $(G_i - G)e_{i,t-1}$ is the Industry Mix Effect (MIX)
- $(g_i - G_i)e_{i,t-1}$ is the Competitive Effect or Regional Share (DIF)

which becomes for simplicity:

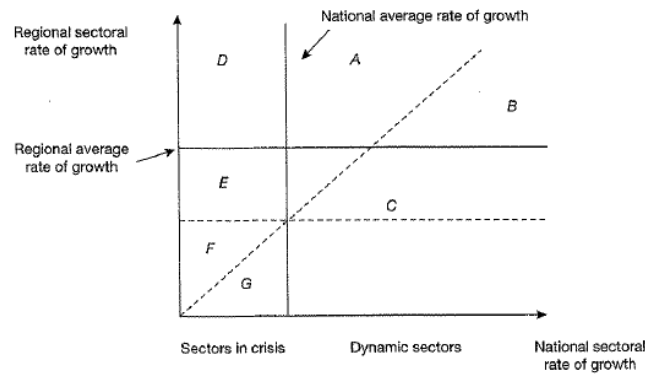
$$g_i = (G + (G_i - G) + (g_i - G_i)) \tag{5}$$

The National effect is the amount the region would have changed at the same rate as the national economy¹. The industry mix accounts for the differences in changes through sector in region i with respect to the nation. Then the competitive effect captures the differences between local sectoral change and the region (DIF). These variables can be measured as the percentage change, if the estimated change is positive, then the sector has positive MIX or DIF effect with respect to other sectors or regions.

¹Loveridge and Selting (1998) explained that this identity explains that the industries in the region should grow at the same rate as the national industry

Capello (2007) defines a graphical diagram to classify the sectors in a economy as having a MIX or DIF positive conditions (see Figure 1). According to the location of the sector in the diagram it can be observed that it has favorable MIX or DIF effects.

Figure 1: Shift-Share analysis clasification and composition effects. Source Capello (2007).



Supporting Algorithm(s)/Code

3.1 Location Quotient

```
function [ LQs ] = LocQ( region, subregion )
```

```
%Usage: This function is designed to produce location quotients using GDP or
%employment data for a region and a subregion from the BEA. The output is a
%matrix of location quotients.
```

```
%Inputs:
```

```
  %region – the primary geographic area with totals in the first row (nation)
```

```
  %subregion – a subset of data of the primary region with totals in the first row
```

```
%Outputs:
```


`%LQ` – a matrix of location quotients

```
% Location quotients (LQs) are ratios that allow an area's distribution
% of employment by industry to be compared to a reference area's
% distribution (Schaeffer, 2015). The reference or base industry is
% usually the industry total. According to the Bureau of Labor
% Statistics, if a LQ is equal to 1, then the industry has the same
% proportion of its area employment as it does in the reference area.
% A LQ greater than 1 indicates an industry with a greater proportion of
% the local area employment than is the case in the reference area.
% For example, (assuming the U.S. as the reference area) Las Vegas will
% have a LQ greater than 1 in the Accommodation and Entertainment
% industry because this industry makes up a larger share of the Las Vegas
% employment total than it does for the country as a whole. A sector with
% a LQ greater than 1 is assumed to be an exporting sector.
```

```
%Function created by Caleb Stair (summer 2015)
```

```
[ind,year]=size(region);
SubSum=subregion(1,:);
RegSum=region(1,:);
LQ=zeros(ind,year);

for j=1:year;
    for i=1:ind;
        LQ(i,j)=(subregion(i,j)./SubSum(j))./(region(i,j)./RegSum(j));
    end
end

end
```

3.2 Coefficient of Specialization

```
function [ COS ] = COS( region,subregion,lines )
%USAGE: This function calculates coefficients of specialization using
%input data from the BEA.

%Inputs:
    %region – the primary geographic area (nation)
    %subregion – a subset of data of the primary region (state)
    %lines – the rows of data which sum to the total
```



`%Outputs:`

`%COS – a matrix of COS values`

`%A coefficient of specialization (COS) is a way of measuring the diversity
%in a region. The theory for COS stems from portfolio theory in finance.
%More specialized means more volatile future returns and more diversified
%means more stable future returns. The lowest possible COS value is 0, which
%means employment is distributed in the subregion in the same proportion as
%the region. Therefore, if COS are decreasing overtime the subregion is
%becoming more diversified. The highest possible COS is approximately 100.
%This means that all employment in the subregion is in one sector and there is
%no employment elsewhere in the region in that sector.`

`% Function created by Caleb Stair (summer 2015)`

```
[ind,year]=size(region);  
[lin,etc]=size(lines);  
newdataR=zeros(lin,year);  
newdataS=zeros(lin,year);
```

```
for i =1:lin  
sel=lines(i);  
A=region(sel,:);  
B=subregion(sel,:);  
newdataR(i,:)=A;  
newdataS(i,:)=B;  
end
```

```
TotalR=newdataR(1,:);  
TotalS=newdataS(1,:);
```

```
percentageR=zeros(lin,year);  
percentageS=zeros(lin,year);
```

```
for i=1:lin;  
for j=1:year;  
A=newdataR(i,j)./TotalR(j);  
B=newdataS(i,j)./TotalS(j);  
percentageR(i,j)=A;  
percentageS(i,j)=B;  
end  
end
```

```
percentageR=percentageR.*100;
```

```
percentageS=percentageS.*100;

diff=zeros(1in,year);
diff=percentageS-percentageR;

COS=zeros(1,year);

for i =1:year
    tmp=diff(:,i)
    COS(i)=sum(tmp(tmp>0));
end

COS
end
```

3.3 Shift-Share

Instructions

The zip file Shiftshare_example.zip includes two sets of files: SSbaset1.mat and SSbaset10.mat. The number in each file name indicates a posterior period for the same regional unit. The two non-numbered files include the price deflator (Deflator.mat) and the industries by number in groups (PPindustries.mat) where the number in each line identifies the last sector included in the model. The zip file also includes the codes ShiftShare.m and democode-ss_file.m. To run the example below, perform the following steps:

1. Unzip the file Shiftshare_example.zip and save the files in a folder on the computer.
2. Open matlab and change the folder to where saved the files in the computer.
3. Open the matlab democode-SS_file.m and run it.
4. The results will be on the matlab data.

```
function [ NS, IM,RS,Dif, Mix ] = ShiftShare( Baset, Basetpl, i,graph )
% PURPOSE: Compute the Shift-share Analysis
%
% This program has been developed to perform the shift share analysis and provide
% results such as the Industry Mix, and Regional or competitive share and which sect
% to have DIF and MIX effects.
```

```

%
%
% -----
% USAGE: results = ShiftShare( Basetp1, Baset, i,graph)
% where: Baset = Matrix of output by geographical unit and sector for
% origin year or base year (t)
%         Basetp1 = Matrix of output by geographical unit and sector for
% future year or change year (t+1)
%         i = Geographical unit of analysis selected for calculation.
%         graph = 0,1 indexes for to create a the shift share plot. If 1 it will cre
%
%
% -----
% RETURNS: a structure
%         NS = National Share
%         IM = Industry Mix
%         RS = Regional Share
%         Dif = Sectors that have a favourable DIF effect
%         Mix = Sectors that have a favourable MIX effect
%
% -----
%
% Function created by J. T. Sayago-Gomez (summer 2015) to implement the
% structural decomposition analysis
%
% REFERENCES:
% Capello, R. (2007). Regional Economics. Routledge advanced texts in economics and
% McCann, P. (2001). Urban and Regional Economics. Oxford University Press.
%
%The control processes check if the matrixes have the same size:

[fil col]=size(Baset);

if size(Baset)==size(Basetp1)
    disp('Matrixes of income by sector and regions have the same size');
else
    errordlg('Matrixes of income by sector and regions do not have the same size') ;
end

if fil<i
    errordlg('The selected sector is not part of the matrix') ;
else

%Calculates the outputs for the country and the the rates of growth for all
%sectors for the country and the unit of analysis.
A=Baset;B=Basetp1;A=A;B=B;
AS=sum(A');AS2=sum(A);BS=sum(B');BS2=sum(B);
Gi=(log(BS2)-log(AS2))/10;

```

```

G=(log(sum(BS'))-log(sum(AS')))/10;
gi=(log(B)-log(A))/10;
g=(log(BS)-log(AS))/10;

%This process creates the Shift-Share plot
if graph==1
plot(Gi,gi(i,:),'.')
line([G,G],[min(gi(i,isfinite(gi(i,:))))],max(gi(i,isfinite(gi(i,:))))], 'LineStyle',
line([min(Gi(isfinite(Gi))),max(Gi(isfinite(Gi)))],[Gi(i),Gi(i)], 'LineStyle', '—',
line([0,0],[min(gi(i,isfinite(gi(i,:))))],max(gi(i,isfinite(gi(i,:))))])
line([min(Gi(isfinite(Gi))),max(Gi(isfinite(Gi)))],[0,0])
minx=max([min(Gi(isfinite(Gi))) min(gi(i,isfinite(gi(i,:))))]);
maxy=min([max(Gi(isfinite(Gi))) max(gi(i,isfinite(gi(i,:))))]);
line([minx,maxy],[minx,maxy], 'LineStyle', '—')
[b x]=size(gi(i,:));
a = [1:x]'; b = num2str(a); c = cellstr(b);
dx = 0.1; dy = 0.1; % displacement so the text does not overlay the data points
text(Gi,gi(i,:), c);
gi(i,isfinite(gi(i,:)));
end

%This process estimates the results for NS, IM, and RS
[b x]=size(gi(i,:));
a = [1:x]'; b = num2str(a); c = cellstr(b);
c2=b(isfinite(gi(i,:)));
NS=A(i,isfinite(gi(i,:))).*G;
IM=A(i,isfinite(gi(i,:))).*Gi(:,isfinite(gi(i,:))) -NS;
RS=A(i,isfinite(gi(i,:))).*(gi(i,isfinite(gi(i,:)))-Gi(:,isfinite(gi(i,:))));

%This process classifies the sectors that have mix and dif effects.
gi2=gi(i,isfinite(gi(i,:)));
sc2=size(c2);Dif=(zeros(sc2));Mix=zeros(sc2)';
for b2 = 1:sc2(2)
    if gi2(b2)>G
        Dif(b2) = c2(b2);
    end
    if gi2(b2)>g(i)
        Mix(b2) = c2(b2);
    end
end
end
end

```

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