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Productive Economy

Abstract

In order to figure out the relationship between economic input and output in the United States in 2008, 2008 Summary Use Annual I-O Table was used to judge whether the economy was productive or not by establishing a consumption matrix.

Input and output information

2008 Summary Use Annual I-O Table, namely, the Input and output information were obtained from network database（http://www.bea.gov/industry/io_annual.htm）. The obtained table was in CSV format, so I sorted the US Economy Use Data 2008 into a matrix A of 65*65 and the Total Output Vector into a diagonal matrix P of 65*65 in EXCEL.

Matrixes as follows:

U=[[49079,202,0,0,0,1,1445,0,0,0,0,0,0,0,0,0,0,0,39,194737,2072,0,0,0,0,1407,0,318,988,0,0,0,0,0,0,7,0,1,0,0,0,0,0,0,0,129,0,0,0,549,28,100,0,167,1,33,0,7,67,163,2899,21,-21,8,2351,0]

[17893,6913,0,0,0,0,0,15212,5,0,0,0,0,10,9,0,60,247,6853,0,41,3096,86,3,583,2181,0,781,0,0,2,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,157,8,1,0,63,0,113,21,3,105,454,4533,54,0,19,1369,0]

[0,0,32679,5,7,122936,0,23,7,38,10,14,0,2,9,4,4,3,26,6,0,23,5,506245,8230,20,425,293,0,0,0,1,0,3305,0,21,21,8,372,9,0,20,12,0,35,168,24,8,641,175,130,34,23,101,179,60,29,57,270,403,168,0,460,0,9394]

…

…

…

[51,6,0,24,2,148,45,0,0,24,55,382,17,137,0,0,0,25,0,5,0,0,175,51,45,0,10445,7463,0,1,373,69

49,32,137,2196,429,2374,314,704,831,4963,1721,163,0,66,1030,537,303,4014,245,1349,286,

820,2784,3228,221,185,123,2782,5019,2358,230,52,4059,46]

[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]

[0,2,0,0,0,9,0,36,54,252,113,61,43,18,69,43,51,39,342,25,11,109,36,16,254,109,280,475,0,0,

0,36,0,0,13,49,80,16,588,37,221,58,17,0,803,558,260,95,740,87,460,228,51,994,290,1148,41,

84,511,542,548,619,274,3217,2439]]

P=[[,329199,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]

[0,55085,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]

[0,0,299490,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,

0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]

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[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

,0,0,0,0,0,0,0,0,0,0,0,0,77757,0,0]

[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1452431,0]
[0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,75620]]

Solution

Consumption matrix A tells how much of each input goes into a unit of output. It is calculated by the ratio of Use Matrix U and Total Industry Output Vector, namely, A=U/P:

A=[[0.149,0.00367,0.,0.,0.,1.86*10^(-6),0.00107,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.000262,0.261,0.0394,0.,0.,0.,0.,0.00209,0.,0.000255,0.000854,0.,0.,0.,0.,0.,0.,0.0000474,0.,4.32*10^(-6),0.,0.,0.,0.,0.,0.,0.,0.0000541,0.,0.,0.,0.000439,0.0000719,0.000167,0.,0.000570,1.26*10^(-6),0.0000384,0.,0.0000627,0.000431,0.00108,0.00459,0.0000288,-0.0000225,0.000103,0.00162,0.],
[0.0544,0.125,0.,0.,0.,0.,0.,0.160,0.0000479,0.,0.,0.,0.,0.0000867,0.0000229,0.,0.000812,0.00166,0.00918,0.,0.00129,0.0190,0.00114,4.10*10^(-6),0.000868,0.0108,0.,0.000675,0.,0.,0.0000510,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.000126,0.0000205,1.67*10^(-6),0.,0.000215,0.,0.000132,0.000155,0.0000269,0.000676,0.00300,0.00717,0.0000740,0.,0.000244,0.000943,0.],
[0.,0.,0.109,0.0000535,0.0000400,0.228,0.,0.000242,0.0000671,0.000151,0.0000305,0.0000400,0.,0.0000173,0.0000229,0.0000151,0.0000541,0.0000201,0.0000348,0.000114,0.,0.00014

1,0.0000661,0.692,0.0123,0.0000988,0.000340,0.000253,0.,0.,0.,3.36*10^(-6),0.,0.118,0.,0.000353,0.0000908,0.0000788,0.000701,0.0000628,0.,0.0000472,0.0000175,0.,0.0000147,0.000427,0.0000836,0.0000211,0.000513,0.000449,0.000217,0.000385,0.0000785,0.000127,0.000209,0.000442,0.000260,0.000367,0.00179,0.000638,0.000230,0.,0.00592,0.,0.124],

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…

[0.000155,0.000109,0.,0.000257,0.0000114,0.000275,0.0000333,0.,0.,0.0000954,0.000168,0.00109,0.0000454,0.00119,0.,0.,0.,0.000168,0.,0.0000950,0.,0.,0.00231,0.0000697,0.0000670,0.,0.00836,0.00645,0.,0.0000135,0.00952,0.0234,0.000696,0.00490,0.0149,0.00721,0.0103,0.00309,0.00133,0.00580,0.00578,0.00406,0.000237,0.,0.0000277,0.00262,0.00187,0.000798,0.00321,0.000629,0.00225,0.00324,0.00280,0.00351,0.00376,0.00163,0.00166,0.000792,0.0184,0.00794,0.00323,0.000246,0.000669,0.00279,0.000608],

[0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.,0.],

[0.,0.0000363,0.,0.,0.,0.0000167,0.,0.000379,0.000518,0.00100,0.000345,0.000174,0.000115,0.000156,0.000176,0.000163,0.000690,0.000262,0.000458,0.000475,0.000346,0.000668,0.000476,0.0000219,0.000378,0.000539,0.000224,0.000411,0.,0.,0.,0.000121,0.,0.,0.0000880,0.000823,0.000346,0.000158,0.00111,0.000258,0.000257,0.000137,0.0000247,0.,0.000337,0.00142,0.000906,0.000250,0.000592,0.000223,0.000767,0.00258,0.000174,0.00125,0.000338,0.00845,0.000367,0.000541,0.00338,0.000858,0.000751,0.000662,0.00352,0.00221,0.0323]]

In the individual economy, some of the output production was consumed in the production process, while others were transported to meet external demand. We defined the external demand as the matrix Y, and its relationship with the output vector P and the consumption matrix A was: p – A*p = y or p = $(I-A)^{-1}$y. I65 (I cannot be used as the matrix name in the software) is 65* 65.So the determinant of (I –A) was not 0, which meant that I-A was invertible. So I evaluated $(I – A)^{-1}$, the results were follows:

$(I – A)^{-1}$= [[1.20, 0.728*10(-2), 0.506*10(-3), 0.456*10(-3), 0.105*10(-2), 0.380*10(-3), 0.234*10(-2), 0.282*10(-2), 0.159*10(-2), 0.772*10(-3), 0.881*10(-3), 0.975*10(-3), 0.714*10(-3), 0.855*10(-3), 0.188*10(-2), 0.995*10(-3), 0.324*10(-2), 0.190*10(-2), .375), 0.612*10(-1), 0.210*10(-1), 0.377*10(-2), 0.378*10(-2), 0.476*10(-3), 0.536*10(-2), 0.311*10(-2), 0.182*10(-2), 0.741*10(-2), 0.875*10(-3), 0.772*10(-3), 0.762*10(-3), 0.687*10(-3), 0.268*10(-3), 0.614*10(-3), 0.570*10(-3), 0.376*10(-3), 0.197*10(-2), 0.842*10(-3), 0.934*10(-3), 0.111*10(-2), 0.163*10(-2), 0.515*10(-3), 0.237*10(-3), 0.384*10(-3), 0.544*10(-3), 0.509*10(-3), 0.647*10(-3), 0.585*10(-3), 0.195*10(-2), 0.835*10(-3), 0.117*10(-2), 0.894*10(-3), 0.742*10(-2), 0.957*10(-3), 0.933*10(-2), 0.820*10(-2), 0.707*10(-2), 0.628*10(-2), 0.108*10(-1), 0.380*10(-1), 0.112*10(-2), 0.122*10(-2), 0.637*10(-2), 0.116*10(-1), 0.255*10(-2)]

,

[0.768*10(-1), 1.15, 0.792*10(-3), 0.842*10(-3), 0.198*10(-2), 0.522*10(-3), 0.740*10(-2), .232), 0.305*10(-2), 0.158*10(-2), 0.131*10(-2), 0.221*10(-2), 0.107*10(-2), 0.221*10(-2), 0.394*10(-2), 0.151*10(-2), 0.243*10(-1), 0.650*10(-2), 0.388*10(-1), 0.635*10(-2), 0.453*10(-2), 0.347*10(-1), 0.106*10(-1), 0.657*10(-3), 0.295*10(-2), 0.167*10(-1), 0.107*10(-2), 0.234*10(-2), 0.531*10(-3), 0.437*10(-2), 0.538*10(-3), 0.799*10(-3),

0.312*10(-3), 0.970*10(-3), 0.494*10(-3), 0.611*10(-3), 0.295*10(-2), 0.145*10(-2),

0.116*10(-2), 0.238*10(-2), 0.101*10(-2), 0.431*10(-3), 0.243*10(-3), 0.295*10(-3),

0.128*10(-2), 0.125*10(-2), 0.483*10(-3), 0.357*10(-3), 0.906*10(-3), 0.568*10(-3),

0.811*10(-3), 0.844*10(-3), 0.142*10(-2), 0.867*10(-3), 0.185*10(-2), 0.253*10(-2),

0.133*10(-2), 0.184*10(-2), 0.661*10(-2), 0.136*10(-1), 0.866*10(-3), 0.764*10(-3),

0.182*10(-2), 0.411*10(-2), 0.527*10(-2)] ,

[0.113, 0.324*10(-1), 1.15, 0.610*10(-1), 0.626*10(-1), 0.278, 0.661*10(-1), 0.486*10(-1),

0.660*10(-1), 0.668*10(-1), 0.384*10(-1), 0.362*10(-1), 0.186*10(-1), 0.368*10(-1),

0.377*10(-1), 0.272*10(-1), 0.356*10(-1), 0.277*10(-1), 0.663*10(-1), 0.763*10(-1),

0.401*10(-1), 0.713*10(-1), 0.675*10(-1), 0.838, 0.123, 0.711*10(-1), 0.281*10(-1),

0.211*10(-1), 0.211,0 .144, 0.228,0 .182, 0.933*10(-1), 0.197,0 .135, 0.282*10(-1),

0.350*10(-1), 0.114*10(-1), 0.239*10(-1), 0.185*10(-1), 0.181*10(-1), 0.907*10(-2),

0.413*10(-2), 0.533*10(-2), 0.108*10(-1), 0.133*10(-1), 0.944*10(-2), 0.705*10(-2),

0.158*10(-1), 0.138*10(-1), 0.504*10(-1), 0.416*10(-1), 0.206*10(-1), 0.167*10(-1),

0.191*10(-1), 0.216*10(-1), 0.156*10(-1), 0.155*10(-1), 0.525*10(-1), 0.274*10(-1),

0.138*10(-1), 0.197*10(-1), 0.739*10(-1), 0.422*10(-1), .400]),

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…

[0.260*10(-2), 0.976*10(-3), 0.110*10(-2), 0.252*10(-2), 0.294*10(-2), 0.110*10(-2),

0.227*10(-2), 0.340*10(-2), 0.368*10(-2), 0.300*10(-2), 0.274*10(-2), 0.394*10(-2), 0.267*10(-2), 0.365*10(-2), 0.319*10(-2), 0.259*10(-2), 0.299*10(-2), 0.233*10(-2),

0.313*10(-2), 0.319*10(-2), 0.280*10(-2), 0.263*10(-2), 0.618*10(-2), 0.132*10(-2),

0.205*10(-2), 0.236*10(-2), 0.102*10(-1), 0.820*10(-2), 0.244*10(-2), 0.270*10(-2),

0.122*10(-1), 0.268*10(-1), 0.144*10(-2), 0.650*10(-2), 0.168*10(-1), 0.863*10(-2),

0.147*10(-1), 0.492*10(-2), 0.359*10(-2), 0.803*10(-2), 0.894*10(-2), 0.575*10(-2),

0.981*10(-3), 0.264*10(-2), 0.160*10(-2), 0.394*10(-2), 0.297*10(-2), 0.167*10(-2),

0.460*10(-2), 0.235*10(-2), 0.380*10(-2), 0.531*10(-2), 0.381*10(-2), 0.494*10(-2),

0.501*10(-2), 0.317*10(-2), 0.336*10(-2), 0.170*10(-2), 0.209*10(-1), 0.955*10(-2),

0.468*10(-2), 0.202*10(-2), 1.00), 0.487*10(-2), 0.746*10(-2]),

[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0],

[0.320*10(-3), 0.169*10(-3), 0.269*10(-3), 0.305*10(-3), 0.623*10(-3), 0.147*10(-3),

0.399*10(-3), 0.874*10(-3), 0.994*10(-3), 0.195*10(-2), 0.114*10(-2), 0.847*10(-3),

0.535*10(-3), 0.815*10(-3), 0.934*10(-3), 0.758*10(-3), 0.132*10(-2), 0.755*10(-3),

0.972*10(-3), 0.114*10(-2), 0.935*10(-3), 0.125*10(-2), 0.131*10(-2), 0.249*10(-3),

0.831*10(-3), 0.113*10(-2), 0.534*10(-3), 0.732*10(-3), 0.237*10(-3), 0.463*10(-3),

0.312*10(-3), 0.495*10(-3), 0.147*10(-3), 0.320*10(-3), 0.360*10(-3), 0.111*10(-2),

0.118*10(-2), 0.476*10(-3), 0.174*10(-2), 0.760*10(-3), 0.736*10(-3), 0.441*10(-3),

0.165*10(-3), 0.240*10(-3), 0.576*10(-3), 0.169*10(-2), 0.118*10(-2), 0.442*10(-3),

0.885*10(-3), 0.555*10(-3), 0.111*10(-2), 0.330*10(-2), 0.384*10(-3), 0.162*10(-2),

0.654*10(-3), 0.903*10(-2), 0.748*10(-3), 0.729*10(-3), 0.409*10(-2), 0.123*10(-2),

0.103*10(-2), 0.103*10(-2), 0.394*10(-2), 0.272*10(-2), 1.03]]

Conclusion

Most of entries of matrix $(I-A)^{-1}$ are positive and the rest of entries are close to 0), so the economic is productive.