About the criteria of output coincidence for forecasts
to determine the orientation of the economy.
Application for France, 1980-1997.

Preliminary version

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AUTHOR. Prof. Louis de MESNARD
AFFILIATION. LATEC (UMR CNRS 5118), Faculty of Economics, University of Burgundy
ADDRESS.
LATEC
2 Bd Gabriel, B.P. 26611,
F-21066 Dijon Cedex,
FRANCE
Tel: (33) 3 80 39 35 22
Fax: (33) 3 80 39 35 22
E-mail : *louis.de-mesnard@u-bourgogne.fr*

ABSTRACT. This note indicates that the method of output coincidence for forecasts used to determine if sectors are demand-driven or supply-driven in an input-output framework mixes two effects, the structural effect (choosing between demand and supply driven models) and the effect of an exogenous factor (final demand or added-value). The note recalls that another method is possible, the comparison of the stability of technical and allocation coefficients, generalized by the biproportional filter: if for a sector, after biproportional filtering, column coefficients are more stable than row coefficients, then this sector is declared as not supply-driven (but one cannot decide that it is demand-driven anyway), and conversely.

I. Introduction

Following Leontief (1953), Carter (1967, 1970) and Vaccara (1970) that have examined the stability of technical coefficients, Bon (1986) [1] tries to evaluate the comparative stability of the coefficients of the demand-driven model (Leontief, 1936) and of the supply-driven model (Ghosh, 1958), in the framework of a national economy. Starting from the idea that the model that has the more stable coefficients over time is the more valid, he uses an indirect but simple method [2]: the output of each sector is forecast under the base of each model and then it is compared to the true value of the output. The model that produces the best forecast is the better for this sector but one model can be the best for one given sector and the alternative model can be the best for another sector [3]. I name this method the criteria of output coincidence for forecasts. In this paper, after recalling this method in details, I will explain its drawbacks then I will expose an alternative method that is not affected by these drawbacks.

II. The weakness of the method of output coincidence for forecasts: mixing the exogenous factor effect and the structural effect

Assume that we have two years or two countries (or regions), the second denoted by a star in superscript. Denote $\mathbf{x}$ and $\mathbf{x}^*$ the two output vectors, either at two different dates, either in two different countries (or regions) of space, $\mathbf{Z}$ and $\mathbf{Z}^*$ the two flow matrices that correspond to them, denote $\mathbf{A} = \mathbf{Z}\,\hat{\mathbf{x}}^{-1}$ and $\mathbf{A}^* = \mathbf{Z}^*\,(\hat{\mathbf{x}}^*)^{-1}$ the two technical coefficient matrices, $\mathbf{B} = \hat{\mathbf{x}}^{-1}\,\mathbf{Z}$ and $\mathbf{B}^* = (\hat{\mathbf{x}}^*)^{-1}\,\mathbf{Z}^*$ the two allocation coefficient matrices deduced from $\mathbf{Z}$ and $\mathbf{Z}^*$; denote $\mathbf{f}^*$ the final demand vector for the second year or the second and $\mathbf{v}^*$ the added-value vector for the second year or the second countries. At equilibrium, the forecast output is given by ${}^{d}\mathbf{x}^* = (\mathbf{I}-\mathbf{A})^{-1}\,\mathbf{f}^*$ and ${}^{s}\mathbf{x}^* = \mathbf{v}^*\,(\mathbf{I}-\mathbf{B})^{-1}$. Both $\mathbf{x}_d^*$ and $\mathbf{x}_s^*$ will be compared to the true value $\mathbf{x}^*$. This comparison is done sector by sector: if ${}^{d}x_i^* - x_i^* < {}^{s}x_i^* - x_i^*$ then the sector i is

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[1] Exactly the same methodology applied to other countries than US (e.g., UK, Japan, Italy, Turkey) can be seen in (Bon, 1993, 1996a, 1996b, 1997, 2000a); all these papers are reprinted in (Bon, 2000b).

[2] It is not the aim of this paper to discuss the respective merits and dismerits of these two polar models. For an introduction see (Miller and Blair, 1985) and for a complete discussion, see Oosterhaven (1988, 1989, 1996), Miller (1989), Gruver (1989), Rose and Allison (1989).

[3] Do not confuse with the discussion conducted by Bon (1984) about the comparative merits and dismerits -- in a multiregional input-output framework -- of a column coefficient model, a row coefficient model, and a Leontief-Strout gravity model when the economy is assumed to be **demand-driven**: only the row coefficient model is consistent, the other violate the conditions of productivity.

declared as more column-stable than row-stable, and conversely [4]. Note that matrices $\mathbf{Z}$ and $\mathbf{Z}^*$ have to be square.

This is a very simple way to perform a comparative evaluation of the alternative models but it has a main drawback. When you compare outputs, you introduce the final demand for the demand-driven model, or the added-value for the supply-driven model, so you mix two different things: 1) the structure (the structure of production for the demand-driven model or the structure of allocation for the supply-driven model), and 2) the effect of the exogenous factor (demand and value-added, respectively). It is a pity because the evolution of the exogenous factor could hide the evolution of the structure. It is even possible to compute what is the final demand vector (respectively the added-value vector) that allow the best matching as possible, that is:

$$\mathbf{x}^* = {}^d\mathbf{x}^*$$

$$\Rightarrow \mathbf{x}^* = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f}^*$$

$$\Rightarrow (\mathbf{I} - \mathbf{A}^*)^{-1}\mathbf{f}^* = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{f}^*$$

$$\Rightarrow \left[(\mathbf{I} - \mathbf{A}^*)^{-1} - (\mathbf{I} - \mathbf{A})^{-1} \right] \mathbf{f}^* = 0$$

This is a simple homogenous system. If $\left| (\mathbf{I} - \mathbf{A}^*)^{-1} - (\mathbf{I} - \mathbf{A})^{-1} \right| = 0$ then there is a non-trivial solution (and if not, the trivial solution is $\mathbf{f}^* = \mathbf{0}$). As the solution is parametric (at least, any f_i^* is a function of one of the final demands, say f_1^*), there is an infinite set of vectors $\mathbf{f}^*$ that are solutions of the problem of output coincidence for forecasts!

Fortunately, the method of output coincidence for forecasts is not the only possible to do the job. At least another is possible, that has not the above weakness.

III. Another method

It is preferable to take a look at the structure itself to see what model is the best: the stability of technical and allocation coefficients over time could be also a good criterion. Assuming that a direct comparison of the stability of technical coefficients and of allocation coefficients is possible, one can decide what are the more stable, the technical coefficients or the allocation coefficients of each sector, and one can decide if the model is demand-driven or supply-driven for this sector. This analysis is not affected by the above critic, namely the mixing of the structural effect and the effect of the exogenous factor.

Unfortunately, the direct comparison of coefficients cannot be done so simply. As it is well known, when technical coefficients are assumed to be stable $(\mathbf{A}^* = \mathbf{A})$, allocation coefficients cannot $(\mathbf{B}^* = \hat{\mathbf{x}}^{*\ -1}\ \mathbf{A}\ \hat{\mathbf{x}}^* \neq \mathbf{B})$, and conversely, except in a very special case, the *absolute joint stability*, that is the homothetical variation of the gross output of all sectors (Chen and Rose, 1986 and 1991): $\mathbf{x}^* = k\,\mathbf{x}$ and $\mathbf{A}^* = \mathbf{A}$ imply that $\mathbf{B}^* = \hat{\mathbf{x}}^{*\ -1}\ \mathbf{A}\ \hat{\mathbf{x}}^* = \mathbf{B}$. So, one has to use a

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4 One could have done reverse forecasts also: ${}^d\mathbf{x} = (\mathbf{I} - \mathbf{A}^*)^{-1}\,\mathbf{f}$ and ${}^s\mathbf{x} = \mathbf{v}\,(\mathbf{I} - \mathbf{B}^*)^{-1}$.

more sophisticated method than the direct comparison of the stability of column or row coefficients, that is the biproportional filter (Mesnard, 1990a and b, 1994, 1997). When you compare technical or column coefficients, you remove the effect of the variation of the margins of columns; when you compare allocation or row coefficients, you remove the effect of the variations of row margins. With the biproportional filter, the idea consists into removing the effect of the variation of both types of margins. To perform this, matrix **Z** can be equipped with the margins of $\mathbf{Z}^*$ by a biproportion: $\hat{\mathbf{Z}} = K(\mathbf{Z},\ \mathbf{Z}^*)$ [5]: $K(\mathbf{Z},\ \mathbf{Z}^*) = \mathbf{P}\,\mathbf{Z}\,\mathbf{Q}$, with $p_i = \dfrac{z^*_{i\bullet}}{\sum_{j=1}^{m} q_j\, z_{ij}}$, for all i, and $q_j = \dfrac{z^*_{\bullet j}}{\sum_{i=1}^{n} p_i\, z_{ij}}$, for all j. This cannot be solved analytically but only iteratively. However, it is demonstrated that biproportion is a very safe operation: the solution of Stone's RAS -- another biproportional algorithm -- has a unique and convergent solution (Bacharach, 1970) and any algorithm, the above, RAS or any other, lead to the same solution (Mesnard, 1994).

Then the result is compared to $\mathbf{Z}^*$ by computing the Frobenius norm of column or row vectors of the difference matrix $\mathbf{Z}^* - K(\mathbf{Z},\ \mathbf{Z}^*)$, divided by the margin of $\mathbf{Z}^*$ to obtain a percentage of variation [6]:

$$\sigma_j = \frac{\sqrt{\sum_i \left[z^*_{ij} - K(\mathbf{Z},\ \mathbf{Z}^*)_{ij} \right]^2}}{\sum_i z^*_{ij}} \text{ for column } j \text{ and, } \sigma_i = \frac{\sqrt{\sum_j \left[z^*_{ij} - K(\mathbf{Z},\ \mathbf{Z}^*)_{ij} \right]^2}}{\sum_j z^*_{ij}} \text{ for row } i.$$

If for any sector i one has $\sigma_i^C > \sigma_i^R$, then the row is more stable than the column: the sector is declared as not demand-driven, nevertheless one cannot say that it is supply-driven (and conversely if $\sigma_i^C < \sigma_i^R$). Following the rules of logic, if technical coefficients (respectively allocation coefficients) are stable, then it is false to say that the model is demand-driven (respectively supply-driven) -- even one can suspect that it is -- but it is true to say that it is not supply-driven (respectively demand-driven). Here, the logic does not lead to accept a model directly -- only to suspect that it works --, but itauthorizes to reject its alternative (Mesnard, 1997).

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5 Note that matrices **Z** and $\mathbf{Z}^*$ have not to be square, what is an advantage to take into account of some sectors (for example, *Trade* in French accounting: it has only a column but not a row). K denotes the biproportional operator, what gives to **Z** the margins of $\mathbf{Z}^*$, the result $K(\mathbf{Z},\ \mathbf{Z}^*)$ being the closer as possible to **Z**.

See in Mesnard (1990a, 1997) why it is more suitable to use a biproportion (that is a generalization of RAS) instead of another criterion of projection, as the orthogonal projection. In addition to be providing the projected matrix that is close to the original matrix **Z**, under the respects of the margins of $\mathbf{Z}^*$, biproportion guarantees that coefficients are positive in the projected matrix $K(\mathbf{Z},\ \mathbf{Z}^*)$ if they are in the original matrix **Z**.

To do the job, some variants can be used, as projecting $\mathbf{Z}^*$ to **Z** in a reverse computation, or as giving to both **Z** and $\mathbf{Z}^*$ the same margins: it is not the aim of this paper to develop this point (Mesnard, 1998).

6 Other types of indices can be build.

IV. Application

I will apply both methods, the output coincidence for forecasts and the biproportional filter to France, for the period 1980-1997 [7]. I have adopted the grand total of each table as output (vector **x**) and not the distributed production [8], so the output of a column is equal to the output of a row, the account of each sector is at equilibrium and both technical coefficients and allocation coefficients are consistent. The tables are aggregated into 9 sectors [9]. I have made them square by simply removing the following column sectors: T25 *Trade* and T38 *Non market services*.

Tables 1 to 3 about here

Tables 4 and 5 give the inverse matrices for technical and allocation coefficients, while table 6 indicates the result of the biproportional projection of **Z** (year 1980) on $\mathbf{Z}^*$ (year 1997).

Tables 4 to 6 about here

The results are not exactly comparable, but there are three cases of divergence toward a supply driven model for the method of output coincidence for forecasts: *Minerals*, *Trade*, *Transport and Telecommunications*. For these three cases, the biproportional filter indicates that the concerning sectors are not supply driven (and one can suspect that they are demand-driven), when the method of output coincidence for forecasts indicates that they are. There is a clear bias in favor of supply-driven sectors with the method of output coincidence for forecasts. There is also one divergence toward a demand driven model for *Financial Services*. However, I insist on the fact that the results of the method of output coincidence for forecasts could have been very different with any other final demand or added-value vector (and particularly with another definition of these aggregates).

Tables 7 to 8 about here

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[7] The tables used are price-corrected (all are at the base price of 1980). The table of 1980 is "definitive", the table of 1997 is "temporary".

[8] In the French accounting system, in addition to the distributed production, the grand total of a column includes the imports, customs duty, commercial margins, VAT; the distributed production is equal to the total of the intermediate buyings plus the added-value and some transfers; so, as added-value, I take the difference between the grand total and the intermediate buyings. The grand total of a row includes the total of the intermediate sales, the final consumption, the gross formation of fixed capital, the variation of stocks and the exportations; so, as final demand, I take the difference between the grand total and the intermediate sales.

[9] About the stability of aggregated coefficients over time, see (Sevaldson, 1970).

V. Conclusion

The purpose of the method of "output coincidence for forecasts" is to determine what sectors are demand-driven and what sectors are supply driven in an input-output framework. The output of each sector is forecast under the base of each alternative model and the model that produces the best forecast is the better for this sector. This method mixes two effects, a structural effect -- choosing between demand and supply driven models -- and the effect of an exogenous factor -- final demand or added-value--. Depending of the exact value of final demand or added-value, coincidence can be obtained or not for a given sector, so the choice between a demand-driven model and a supply-driven model is affected by the final-demand or by the added-value. This makes the choice faulty in a general way: if one decide that the behavior of economic agents (here, the sectors) can de determined, this behavior cannot be dependent of an exogenous factor. In other terms, the behavior determined by the method of output coincidence for forecasts is not an absolute behavior, but only a "functional" behavior, dependent of the exact value of the exogenous factors: behavior(i) $=f(f_1, ..., f_n, v_1, ..., v_n)$, where f_j and v_j denote the final-demand and the added-value of sector j. This is annoying because this "functional" behavior is not generally applicable.

The alternative method that is proposed -- the biproportional filter -- has not these drawbacks. As generalization of the direct comparison of the variations of technical and allocation coefficients -- what allows to focus the measure of change on the exchange structure itself -- it is a direct method, not an indirect method as the method of output coincidence for forecasts, without any interference of any exogenous factor as final demand or added-value.

The application for France, 1980-1997, indicates that the method of output coincidence for forecasts creates a bias in favor of the supply-driven model.

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VII. Tables

Aggregated sector	Sectors of "NAP 40"
Agriculture ...	T01 Farming, Forestry, Fishing T02 Meat and Dairy Products T03 Other Agricultural and Food Products
Energy	T04 Solid Fuels T05 Oil Products, Natural Gas T06 Electricity, Gas and Water
Minerals	T07 Ores and Ferrous Metals T08 Ores and non Ferrous Metals T09 Building Materials, Miscellaneous Minerals
Manufacturing	T10 Glass T11 Basic Chemicals, Synthetic Fibers T12 Miscellaneous Chemicals, Pharmaceuticals T13 Smelting Works, Metal Works T14 Mechanical Engineering T15A Electric Industrial Equipment T15B Household Appliances T16 Motor Vehicles T17 Shipping, Aircrafts and Arms T18 Textile Industry, Clothing Industry T19 Leather and Shoe Industries T20 Leather and Wood Industries, Varied Industries T21 Paper and Cardboard T22 Printing and Publishing T23 Rubber, Transformation of Plastics
Buildings	T24 Building Trade, Civil and Agricultural Engineering
Trade	T29 Automobile Trade and Repair Services T30 Hotels, Catering
Transport and Telecommunications	T31 Transport T32 Telecommunications and Mail
Services	T33 Business Services T34 Marketable Services to Private Individuals T35 Housing Rental and Leasing T36 Insurance
Financial Services	T37 Financial Services

Table 1. The aggregation scheme

1980	Agri-culture...	Energy	Minerals	Manu-facturing	Buildings	Trade	Transport and Telecom.	Services	Financial Services	Final Demand	Output
Agriculture ...	270 732	196	63	24 955	0	25 520	233	2 305	0	468 699	**792 703**
Energy	18 603	167 784	23 722	48 846	8 091	6 285	28 118	7 129	877	221 557	**531 012**
Minerals	1 962	2 303	83 346	72 775	60 063	1 880	493	810	0	71 271	**294 903**
Manufacturing	50 722	13 485	10 610	439 871	74 100	11 480	13 867	59 304	3 437	1 136 942	**1 813 818**
Buildings	1 033	6 042	381	2 050	231	406	627	2 917	5 891	431 123	**450 701**
Trade	831	263	1 401	2 627	813	3 524	1 866	8 703	823	136 133	**156 984**
Transport and Telecom.	5 632	5 985	10 125	36 106	13 034	4 026	24 126	21 715	4 407	143 731	**268 887**
Services	18 792	12 857	9 866	83 142	48 570	12 646	15 907	103 334	12 802	476 609	**794 525**
Financial Services	1 038	568	829	5 826	5 940	790	636	1 796	3 812	115 447	**136 682**
Added-value	423 358	321 529	154 560	1 097 620	239 859	90 427	183 014	586 512	104 633	3 201 512	**5 240 215**
Output	**792 703**	**531 012**	**294 903**	**1 813 818**	**450 701**	**156 984**	**268 887**	**794 525**	**136 682**	**5 240 215**	

Table 2. Table for 1980

1997	Agri-culture...	Energy	Minerals	Manu-facturing	Buildings	Trade	Transport and Telecom.	Services	Financial Services	Final Demand	Output
Agriculture ...	322 195	82	18	26 579	0	29 155	262	3 793	0	652 127	**1 034 211**
Energy	21 967	131 572	17 340	57 330	9 039	7 886	37 493	11 455	1 511	278 729	**574 322**
Minerals	1 897	13 704	73 056	75 138	52 009	2 019	294	1 147	0	86 226	**305 490**
Manufacturing	65 350	13 689	9 949	643 225	77 183	14 998	22 418	110 662	3 360	1 876 975	**2 837 809**
Buildings	1 308	7 462	311	2 567	205	450	779	5 147	11 980	435 214	**465 423**
Trade	902	283	908	2 756	595	3 834	2 524	12 399	420	168 423	**193 044**
Transport and Telecom.	8 304	7 026	9 786	66 975	15 001	7 352	53 145	59 148	8 055	253 161	**487 953**
Services	34 278	26 771	13 246	160 772	65 040	21 598	25 851	224 065	34 205	838 362	**1 444 188**
Financial Services	3 168	1 791	1 616	18 459	12 291	1 341	2 107	5 507	987 446	145 990	**1 179 716**
Added-value	574 842	371 942	179 260	1 784 008	234 060	104 411	343 080	1 010 865	132 739	4 735 207	**8 522 156**
Output	**1 034 211**	**574 322**	**305 490**	**2 837 809**	**465 423**	**193 044**	**487 953**	**1 444 188**	**1 179 716**	**8522156**	

Table 3. Table for 1997

1980	Agri-culture...	Energy	Minerals	Manu-facturing	Buildings	Trade	Transport and Telecom.	Services	Financial Services
Agriculture ...	1.522538	0.002751	0.004774	0.029356	0.007405	0.256677	0.006146	0.011097	0.003969
Energy	0.063111	1.470860	0.178983	0.069641	0.070377	0.085416	0.176085	0.028532	0.023749
Minerals	0.014176	0.015634	1.401103	0.076307	0.201235	0.027559	0.010360	0.009952	0.012472
Manufacturing	0.138945	0.060580	0.085809	1.340108	0.249892	0.140368	0.092993	0.122074	0.061860
Buildings	0.003247	0.017171	0.004581	0.003052	1.003235	0.004967	0.005211	0.005033	0.045361
Trade	0.002689	0.001665	0.008272	0.003612	0.005417	1.025267	0.009150	0.013587	0.008308
Transport and Telecommunications	0.018118	0.022288	0.059615	0.036057	0.051156	0.039959	1.106398	0.039047	0.044054
Services	0.053302	0.048847	0.069435	0.079998	0.153004	0.116824	0.087480	1.162317	0.124790
Financial Services	0.002846	0.002277	0.004950	0.005099	0.015605	0.006727	0.003553	0.003415	1.030017

Table 4. $(\mathbf{I}-\mathbf{A})^{-1}$ for 1980

1980	Agri-culture...	Energy	Minerals	Manu-facturing	Buildings	Trade	Transport and Telecom.	Services	Financial Services
Agriculture ...	1.522538	0.001843	0.001776	0.067171	0.004210	0.050831	0.002085	0.011122	0.000684
Energy	0.094213	1.470860	0.099400	0.237878	0.059733	0.025252	0.089164	0.042691	0.006113
Minerals	0.038105	0.028151	1.401103	0.469330	0.307547	0.014670	0.009446	0.026812	0.005781
Manufacturing	0.060724	0.017735	0.013951	1.340108	0.062094	0.012149	0.013786	0.053473	0.004662
Buildings	0.005710	0.020230	0.002997	0.012284	1.003235	0.001730	0.003109	0.008873	0.013756
Trade	0.013578	0.005633	0.015540	0.041739	0.015552	1.025267	0.015673	0.068767	0.007233
Transport and Telecommunications	0.053414	0.044015	0.065383	0.243225	0.085746	0.023329	1.106398	0.115378	0.022394
Services	0.053180	0.032646	0.025772	0.182627	0.086793	0.023082	0.029605	1.162317	0.021468
Financial Services	0.016508	0.008845	0.010680	0.067660	0.051456	0.007726	0.006989	0.019850	1.030017

Table 5. $(\mathbf{I}-\mathbf{B})^{-1}$ for 1980

K(1980, 1997)	Agri-culture...	Energy	Minerals	Manu-facturing	Buildings	Trade	Transport and Telecom.	Services	Financial Services
Agriculture ...	318 681.59	210.33	50.96	30 271.13	0.00	28 527.08	350.48	3 992.43	0.00
Energy	18 057.72	148 475.97	15 822.34	48 861.03	4 855.38	5 793.55	34 878.55	10 182.58	8 665.87
Minerals	2 429.58	2 599.87	70 918.02	92 868.44	45 981.21	2 210.80	780.14	1 475.93	0.00
Manufacturing	67 661.55	16 399.18	9 725.24	604 678.58	61 108.96	14 542.76	23 638.62	116 406.95	46 672.16
Buildings	418.84	2 233.33	106.15	856.55	57.90	156.33	324.87	1 740.33	24 314.69
Trade	636.23	183.57	737.04	2 072.65	384.81	2 562.17	1 825.65	9 804.63	6 414.25
Transport and Telecommunications	7 565.83	7 329.65	9 346.05	49 983.50	10 824.61	5 136.02	41 416.47	42 924.26	60 265.60
Services	24 341.50	15 182.38	8 781.22	110 980.98	38 894.09	15 555.60	26 330.36	196 954.98	168 804.89
Financial Services	19 576.16	9 765.72	10 742.97	113 228.13	69 256.05	14 148.70	15 327.85	49 840.90	731 839.53

Table 6. $K(\mathbf{Z},\ \mathbf{Z}^{*})$

Gap in Billion of francs	Columns	Rows	Decision
Agriculture ...	380 510	366 269	supply driven
Energy	358 702	65 097	supply driven
Minerals	191 404	60 779	**supply driven**
Manufacturing	1 266 618	48 448	supply driven
Buildings	44 319	85 546	demand driven
Trade	16 753	9 688	supply driven
Transport and Telecommunications	18 740	14 502	supply driven
Services	66 097	95 291	demand driven
Financial Services	955 339	997 614	demand driven

Table 7. Method of output coincidence for forecasts

σ, in %	Buildings	Rows	Decision
Agriculture ...	4.37	1.35	not demand driven
Energy	12.52	7.23	not demand driven
Minerals	8.32	9.98	**not supply driven**
Manufacturing	11.08	6.30	not demand driven
Buildings	28.21	46.24	not supply driven
Trade	16.43	27.36	**not supply driven**
Transport and Telecommunications	12.38	24.98	**not supply driven**
Services	12.68	24.65	not supply driven
Financial Services	28.38	27.41	**not demand driven**

Table 8. Method of the biproportional filter