Study on Comparative Advantage of Mining Sector in South Sulawesi Province, Indonesia

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ABSTRACT

Mining sector is an important sector that contributes to regional development therefore, it has to be managed sustainably. This became basis of this study. Problem examined was comparative advantage of mining toward South Sulawesi. This study used multidimensional scaling and input-output analysis. Those analyses used input-output table data of 2010 in classification of 11 economic sectors and GDRP of 24 districts/cities of South Sulawesi in 2012-2016 which was obtained from BPS (Central Bureau of Statistics) South Sulawesi. Results showed that final value of the mining sector in South Sulawesi was Rp9,007,814,000,000, describing role of mining sector as relatively small compared to other sectors. Shift share described economic growth of mining sector in Luwu Timur was faster than other districts. Export base (LQ) and shift share ere indicators that showed that Luwu Timur was superior to other districts. LQ value from Luwu Timur was 9.39 indicating that mining sector was self-sufficient and able to fulfill its need from its own production. Multidimensional scaling analysis in perceptual map showed that the mining sector in East Luwu had comparative advantage based on LQ and shift share. Perceptual Map showed that Luwu Timur was the district that held the largest role in mining sector in economy of South Sulawesi when compared to other. This role was due to existence of the operated largest nickel laterite mining company in Indonesia.

Keywords: *mining sector; input-output analysis; MDS analysis; perceptual map; comparative advantage*

1. INTRODUCTION

South Sulawesi Province has considerable mineral resource potential which is spread across 19 districts. The utilization of mineral resource potential has contributed to the economy of South Sulawesi as stipulated in the Law on regional autonomy. The law on regional autonomy (Law No. 23/2014) will have broad implications in the development planning system in the regions because regional governments have greater authority in planning the direction of their development. On the other hand, local governments are increasingly being demanded to be more independent in solving development problems in their regions. Regional autonomy also indicates increasing importance of development approach on the basis of regional development compared to sectoral approach. The level of development of a region and measurement of success in development are identical to the level of economic growth

represented by changes or increases in Gross Regional Domestic Product (GRDP) [1].

The non-tax state revenue (PNBP) of the mineral and coal mining sector obtained by the South Sulawesi government that has been identified and reconciled until August 2015 is Rp246,248,400,955 with details of Rp19,900,000,000 originated from land fees and Rp226,248,400,000 originated from royalties [2]. Economy of South Sulawesi in the first quarter of 2016 grew 7.41%, higher than the growth in the previous quarter. Sectorally, the increase in growth was caused by increasing in performance in the secondary sector, namely the manufacturing sector, transportation and warehousing sector, as well as the sector of providing accommodation and drinking food [3]. Contribution of the mining and quarrying sector to absorption of employment opportunities is very small (only 0.4% of the total workforce) which means that it does not provide direct economic impact on the community [2].

Each region always has strategic sectors due to the large contribution made in the regional economy and its sector and spatial linkages. Development of strategic sector has significant direct and indirect impacts [4]. The mining sector has a role as the country's foreign exchange earner in achieving development progress and increasing economic progress. Efforts made to achieve this goal are to encourage leading sectors.

Method that can be used in identifying the mining sector's comparative advantage is multidimensional scaling (MDS) analysis. MDS is a multiple variable technique that can be used to determine position of object based on an assessment of its similarity with another object, also to find out interdependence or interdependence relationship between variables or data [5].

South Sulawesi Province consists of 24 districts/cities that do not have equal potential mineral and mineral resources. This based on the contribution of districts/cities GRDP in 2012-2016 which ranged from 6-8% [6]. The potential of minerals and minerals as a non-renewable resource is one sector in increasing sustainable regional development. Planning for utilization of mineral resources and mature minerals is the main key.

Purpose of this study is to analyze comparative advantage of the mining sector in South Sulawesi Province based on the value of the shift share analysis of 24 districts/cities in the mining sector of South Sulawesi Province. This research is expected to be a consideration for the districts/cities government of South Sulawesi Province in formulating policies relating to the mining sector and the development of regional progress.

A. Shift-share Analysis

Shift-share analysis was first introduced by Edgar S Dunn Jr in 1960. This method was defined as a statistical and an analytical technique for understanding regional development of a national economy [7]. Shift-share analysis uses identical equations to analyse the growth rates by industry for each region. The method uses

three factors: the national effect (factors common among all industries nationally), the compositional effect (industry-specific factors at a national level), and the regional effect (factors unique to each industry at a regional level) [8]. Shift-share analysis is used to analyse and determine shift and role of the economy in the region. This method is used to observe structure of the economy and its shift by emphasizing growth of the sector in the regions compared to the same sector at the higher regional or national level [9].

Shift-share analysis assumes that changes in income, production and labour in a region are divided into three components, namely regional growth component, proportional shift or industrial mix component and differential shift component. Positive proportional shift (S_p) and differential shift (S_d) values indicate a sector in the regional economy is in a good position for the region concerns. Conversely, if the values are negative then the economy of the regional sector can still be improved, among others, by comparing it.

The equation of the shift-share analysis is [10]:

$$Nj = Y \left(\frac{Y}{Y}\right) - Y \quad (1)$$

$$Nj = \left[\left(\frac{Y}{Y}\right) - \left(\frac{Y}{Y}\right)\right] Y \quad (2)$$

$$Dj = Y - \left(\frac{Y}{Y}\right) Y \quad (3)$$

B. Location Quotient Analysis

Location Quotient analysis was proposed by Peter Haggett in 1965. The quotient is the ratio of a ratio. As a basic index in regional analysis and industrial structure analysis, the LQ can be used to measure the spatial distribution status of a regional factor and evaluate regional advantageous and disadvantageous industries [11]. This method is used to determine the base sector and non-base sector by comparing percentage contribution of each sector in the GRDP of a region with a percentage of the same sector contribution to the regional GRDP. The equation of this method is [12]:

$$LQ = \frac{v_i/v_t}{V_i/V_t}. \quad (4)$$

C. Multidimensional Scaling Analysis

Multidimensional Scaling (MDS) analysis is one of multiple variable techniques that can be used to determine position of an object based on an assessment of its similarity with another object, also to determine interdependence or interdependence relationship between variables or data [5]. Multidimensional scaling analysis can be done to see sustainability indexes and attributes. The relative sustainability index analysed using MDS is a series of methods and analyses based on Rapfish analysis procedures [13].

Yerel and Ankara (2010) in their study said that MDS is an appropriate exploration technique to overcome problems with exploration needs. This relationship is

not known through reduction or grouping of variables, but by comparing the variables that exist on each object in question using the perceptual map [14].

MDS is related to making maps to describe the position of an object with other objects based on the similarity of these objects. MDS is also a technique that can help researchers to identify the key dimensions underlying evaluation of objects from respondents (customers). MDS is related to creating maps to describe the position of an object with other objects, based on the similarity of these objects.

Perceptual mapping will produce product positioning according to consumers' perceptions based on their determinant attributes. Attributes are factors that consumers consider in determining perceptions of an item or service and ultimately decide to use or purchase a service product or not.

2. METHODOLOGY

In this research, data were collected primarily from Central Statistics Agency of South Sulawesi Province, namely input-output table 2010, GRDP of South Sulawesi Province 2012-2016 and GRDP of 24 districts/cities 2012-2016. This research also used the results of data analysis in previous studies, namely data analysis of LQ, multipliers, index linkages and tables of Gross Regional Domestic Products in 2012-2016 South Sulawesi Province and Gross Regional Domestic Products of 24 districts/cities in 2012-2016 South Sulawesi Province [15].

The method used were input-output analysis and multidimensional scaling analysis. Input-output analysis consists of multiplier analysis, linkage analysis, shift share analysis (Equation 1,2,3) and location quotient analysis (Equation 4). Multidimensional scaling analysis done based on variables from input-output analysis that depicted in form perceptual map.

3. RESULT AND DISCUSSION

The mining sector of South Sulawesi Province has its own role in the economic growth of each districts/cities of South Sulawesi Province. This role is indicated from formation of demand and supply, trade balance, structure of gross added value, ratio of intermediate demand, and ratio of intermediate input.

South Sulawesi Province produced an output of Rp177,658,501,000,000 in 2010. The final demand of Rp142,939,608,000,000 was fulfilled based on allocation of the total output value produced. Rank 9 is occupied by the mining economy sector with a total output of Rp9,007,814,000,000. This value constitutes 5% of the total output from South Sulawesi Province [15].

South Sulawesi Province in 2010 described its trade balance through a total surplus of Rp734,900,000,000. The mining sector has a positive or surplus trade balance. The value of the mining sector trade balance amounted to Rp5,618,490,000,000. High

value of exports from the mining sector illustrates the existence of a strong economic sector independence compared to other economic sectors [15].

Gross added value based on the input-output table in 2010 was Rp105,055,709,000,000. The gross added value of the mining sector is Rp6,626,460,000,000 or 6.31% of the total 11 economic sectors. This value is relatively small due to the large amount of output produced by the mining sector. The value of the ratio of intermediate demand and intermediate input from the mining economy sector is small compared to the 11 economic sectors of South Sulawesi Province in 2010. The value for the demand ratio is between Rp112,552,000,000 and the input ratio is between Rp293,942,000,000 [15].

A. Multiplier Analysis

Output multiplier analysis shows changes in increasing or decreasing in output of each economic sector. Output has a reciprocal relationship with the final demand and output. The mining sector has an output multiplier value of 8.67. This value indicates that if there is an increase in the final demand in the mining sector by Rp1, the output in all economic sectors increases by Rp8.67 (Table 1).

Table 1. Multipliers of Output of 11 Economic Sectors of South Sulawesi Province [15]

Sector Code	Economic Sector	Output Multiplier
001	Agriculture	18.79
002	Fishery	12.11
003	Mining and Excavation	8.67
004	Food, Beverage, Tobacco Industry	33.33
005	Other Industries	20.06
006	Metal Products Industry	8.37
007	Buildings, Electricity, Gas and Clean Water	11.94
008	Transportation and Communication	9.77
009	Financial Institutions, Leases and Services	27.72
010	Trading	13.35
011	Restaurants and Hotels	3.14

Gross added value (GAV) is remuneration for production factors consisting of wages and salaries, business surplus, depreciation, and indirect taxes. The mining sector ranked seventh with a multiplier value of GAV of 6.38. This value illustrates that when there is an increase in the final demand of the mining sector by Rp1, it can increase the gross added value of all economic sectors by Rp6.38 (Table 2).

Table 2. Multipliers of GAV of 11 Economic Sectors of South Sulawesi Province [15]

Sector Code	Economic Sector	Multiplier of GAV
001	Agriculture	14.10
002	Fishery	9.18
003	Mining and Excavation	6.38
004	Food, Beverage, Tobacco Industry	5.86
005	Other Industries	8.72
006	Metal Products Industry	2.67
007	Buildings, Electricity, Gas and Clean Water	4.18

008	Transportation and Communication	7.51
009	Financial Institutions, Leases and Services	19.91
010	Trading	12.18
011	Restaurants and Hotels	1.24

The multiplier of labour is obtained by adding a line indicating the amount of labour for each sector in the economy of a country or region. Value of the multiplier of labour for the mining economy sector is 0.30. This value illustrates that the mining sector can create jobs for 0.30 workers in each economic sector when there is an increase in the mining sector output of Rp1 (Table 3).

Table 3. Multipliers of Employment of 11 Economic Sectors of South Sulawesi Province [15]

Sector Code	Economic Sector	Employee Multiplier
001, 002	Agriculture, Fisheries	0.88
003	Mining and Excavation	0.30
004, 005, 006	Processing industry	1.47
007	Buildings, Electricity, Gas and Clean Water	1.12
008	Transportation and Communication	0.07
009	Financial Institutions, Leases and Services	0.72
010	Trading	0.18
011	Restaurants and Hotels	0.06

B. Linkage Analysis

Linkage analysis is used to measure relation between economic activities among sectors in a region. Determination of sectors that have a role in economic growth is relatively large compared to other sectors carried out by utilization of this analysis. Value of the backward linkage (BL) index of the mining sector is 0.95. The index value illustrates that when there is an increase in the final demand of Rp1, it requires inputs from other economic sectors of Rp0.95

The mining economic sector of South Sulawesi Province has a forward linkage (FL) index value of 0.88. This value illustrates when there is an increase in final demand for other sectors of Rp1, the output from the mining sector sold throughout the sector will increase by Rp0.88 (Table 4).

Table 4. Linkage Index of 11 Economic Sectors of South Sulawesi Province [15]

Sector Code	Economic Sector	BL Index (α)	FL Index (β)
001	Agriculture	0.93	1.06
002	Fishery	0.92	0.90
003	Mining and Excavation	0.95	0.88
004	Food, Beverage, Tobacco Industry	1.11	0.94
005	Other Industries	1.04	1.38
006	Metal Products Industry	1.09	1.06
007	Buildings, Electricity, Gas and Clean Water	1.08	0.92
008	Transportation and Communication	0.92	1.00
009	Financial Institutions, Leases and Services	0.89	0.97
010	Trading	0.94	1.01
011	Restaurants and Hotels	1.14	0.88

C. Location Quotient Analysis

Development or failure of a region is determined by performance of the region as an exporter to other regions. If the export sector

is a base sector, then other sectors must be able to support the base sector so that when the total economy gets bigger, the supporting economic sectors in it will increase. Value of analysis of the location quotient (LQ) of 24 districts/cities of South Sulawesi Province in the mining sector shows that there are several regions that have LQ values >1. Regions that have LQ values >1 are Maros, Pangkep, Wajo and Luwu Timur Districts with values of 1.29, 1.35, 3.30, and 9.39. The four regions based on LQ values can illustrate that amount of commodity production in the local mining sector can fulfil their own needs without requiring supplies from other regions, while regions that have LQ values <1 describe the area as requiring supplies from other regions to fulfil the needs of the sector [15].

D. Shift-share Analysis

This value illustrates that the mining sector has a positive effect in contributing to the Gross Regional Domestic Product (GRDP) of South Sulawesi Province (Table 5).

Luwu Timur District is in the first position as the district which contributes the most to the GRDP of South Sulawesi Province. This is due to the existence of the largest laterite nickel mining company in Indonesia with a total production in 2016 of 77,581 tons operating in the area and affecting the contribution of Luwu Timur District GRDP.

Table 5. Shift-Share Values of Mining Sector of South Sulawesi

No	District/City	Shift Share		
		Regional Share	Proportional Share	Market Share
1	Kep. Selayar	4,475.31	1,516.26	2,451.31
2	Bulukumba	23,009.99	7,795.93	26,601.60
3	Bantaeng	20,403.06	6,912.68	29,963.23
4	Jeneponto	21,531.96	7,295.16	20,193.96
5	Takalar	16,150.47	5,471.88	4,916.86
6	Gowa	59,499.25	20,158.71	42,991.96
7	Sinjai	22,286.26	7,550.72	13,960.98
8	Maros	156,170.69	52,911.60	189,293.52
9	Pangkep	251,412.24	85,180.03	-34,650.81
10	Barru	23,438.47	7,941.10	4,678.23
11	Bone	89,291.18	30,252.40	68,764.62
12	Soppeng	36,154.88	12,249.50	-1,750.77
13	Wajo	545,522.45	184,826.39	-308,053.15
14	Sidrap	45,888.80	15,547.41	27,250.57
15	Pinrang	39,172.04	13,271.73	26,415.74
16	Enrekang	25,089.45	8,500.46	4,733.25
17	Luwu	35,968.01	-863.83	195,949.76
18	Tator	9,234.37	3,128.66	2,589.19
19	Luwu Utara	18,225.70	6,174.98	20,716.60
20	Luwu Timur	2,050,502.22	694,722.88	1,430,329.82
21	Toraja Utara	5,631.72	1,908.06	8,262.80
22	Makassar	435.63	147.59	-1,296.57
23	Pare-Pare	2,197.80	744.63	23.32
24	Palopo	1,637.94	556.02	-1,772.28

The proportional growth value from the analysis of 24 districts/cities in South Sulawesi Province shows positive values for all districts/cities. Luwu Timur District is in the first position as the district that has the greatest value. This value illustrates that Luwu Timur District specializes in the mining sector at the level of South Sulawesi Province and is relatively faster which is influenced by the composition of the economic sector of Luwu Timur District GRDP.

Shift share analysis with a component of market share growth illustrates several regions of the 24 districts/cities of South Sulawesi Province having positive and negative values. Luwu Timur District is in an

area that occupies the highest position in the value of market share growth. This value illustrates the mining sector in Luwu Timur District has a beneficial contribution to the economy both for the district and province.

E. Multidimensional Scaling Analysis

MDS analysis illustrates existence of regions in four indicators that indicate areas categorized as comparative advantage of the mining sector based on indicators. This means that regions categorized as comparative advantages are regions that have indicators of values above the average compared to the regions in the same quadrant. Comparative advantage shows that an area has an economic sector with certain indicators, in this case the value of export base (LQ) and shift share (Table 6).

Table 6. Variables Input of MDS Analysis

No	District/City	Shift Share			LQ
		Regional Share	Proportional Share	Market Share	
1	Kep. Selayar	4,475.31	1,516.26	2,451.31	0.14
2	Bulukumba	23,009.99	7,795.93	26,601.60	0.31
3	Bantaeng	20,403.06	6,912.68	29,963.23	0.49
4	Jeneponto	21,531.96	7,295.16	20,193.96	0.37
5	Takalar	16,150.47	5,471.88	4,916.86	0.25
6	Gowa	59,499.25	20,158.71	42,991.96	0.49
7	Sinjai	22,286.26	7,550.72	13,960.98	0.35
8	Maros	156,170.69	52,911.60	189,293.52	1.29
9	Pangkep	251,412.24	85,180.03	-34,650.81	1.35
10	Barru	23,438.47	7,941.10	4,678.23	0.52
11	Bone	89,291.18	30,252.40	68,764.62	0.47
12	Soppeng	36,154.88	12,249.50	-1,750.77	0.51
13	Wajo	545,522.45	184,826.39	-308,053.15	3.30
14	Sidrap	45,888.80	15,547.41	27,250.57	0.37
15	Pinrang	39,172.04	13,271.73	26,415.74	0.34
16	Enrekang	25,089.45	8,500.46	4,733.25	0.53
17	Luwu	35,968.01	-863.83	195,949.76	0.37
18	Tator	9,234.37	3,128.66	2,589.19	0.21
19	Luwu Utara	18,225.70	6,174.98	20,716.60	0.41
20	Luwu Timur	2,050,502.22	694,722.88	-1.430,329.82	9.39
21	Toraja Utara	5,631.72	1,908.06	8,262.80	0.14
22	Makassar	435.63	147.59	-1,296.57	0.00
23	Pare-Pare	2,197.80	744.63	23.32	0.04
24	Palopo	1,637.94	556.02	-1,772.28	0.36

The shift share and LQ values are used to calculate the euclidean distance matrix and are transformed into disparity matrices used in mapping. The transformation process uses iterations to obtain the smallest stress level or close to zero. The iteration process was carried out in 14 iterations to obtain the smallest stress level of 0.00082. The iteration value can be seen in Table 7.

Table 7. Young's S-Stress Iterations

Iteration	*S-stress*	*Improvement*
1	0.40673	-
2	0.31213	0.09461
3	0.18596	0.12616
4	0.15003	0.03593
5	0.12990	0.02013
6	0.11783	0.01206
7	0.11027	0.00756
8	0.10535	0.00492
9	0.10202	0.00333
10	0.09968	0.00234
11	0.09798	0.00171
12	0.09668	0.00129
13	0.09567	0.00102
14	0.09484	0.00082
S-stress improvement is less than		0.00100
RSQ		0.95500

The RSQ value indicates the proportion of the input data variance can be explained by the multidimensional scaling model. The model is acceptable if RSQ⩾0.6. The RSQ value obtained is 0.955, meaning that the value can describe the mapping of 24 districts/cities of South Sulawesi Province well. The results of the transformation matrix are mapped in perceptual maps which can be seen in Figure 1.

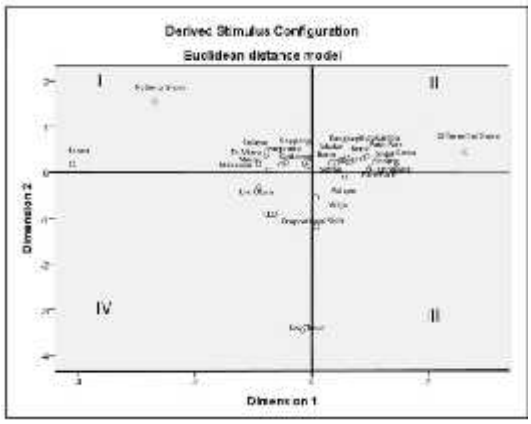

Fig. 1 Perceptual map of comparative advantage 24 districts/cities of mining sector of South Sulawesi

MDS analysis illustrates the existence of regions in four indicators that indicate areas categorized as the comparative advantage of the mining sector based on indicators. This means that regions categorized as comparative advantages are regions that have indicators of values above the average compared to the regions in the same quadrant. Comparative advantage shows that an area has an economic sector with certain indicators, in this case the value of the export base (LQ) and shift share. The superior sector is a sector that must be prioritized in terms of economic development in the region.

Perceptual map of 24 districts/cities in South Sulawesi Province (Figure 1) in the mining sector in two-dimensional images shows the distribution of several regencies divided into four quadrants. In quadrant I (top left) there are seven districts/cities namely Luwu, North Toraja, Makassar, Selayar Islands, Bantaeng, Jeneponto, and Maros which are indication for having similarities in regional share. Quadrant II (top right) consists of 13 districts/cities. These areas are Bulukumba, Takalar, Gowa, Sinjai, Pangkep, Barru, Bone, Soppeng, Sidrap, Pinrang, Enrekang, Tana Toraja, and Pare-Pare. The quadrant is an area that has similarities in the growth of the mining sector market share (differential share).

Quadrant III (bottom right) consists of two districts/ cities namely Wajo and Palopo where the positions of the two regions show similarities in proportional shifts. Quadrant IV (bottom left) is a quadrant consisting of two districts namely Luwu Utara and Luwu Timur. The two regions based on their location on the perceptual map show indications of similarity in the export base (LQ) of the mining sector in South Sulawesi Province.

Perceptual map describes regions that have similarities in LQ and shift share value indicators (national share, differential share, and proportional share) and can be categorized as the mining sector's comparative advantage to the economy of South Sulawesi Province based on these indicators. Luwu District area is in quadrant I which is indicated to have a mining sector comparative advantage on regional (national share) growth indicators. The regional value of regional growth is far greater when compared to other regional growth values.

Quadrant II shows the role of each region based on value of the market share growth (differential share) as large. These areas have similarities in the market share growth indicator (differential share). This means that there is no region that shows the mining sector's comparative advantage of the market share growth indicator (differential share).

Wajo District and Palopo City which are in quadrant III based on perceptual map show areas that have proportional share indicators. Palopo City is in an area that has a role in proportional share but based on perceptual map it cannot be categorized as a comparative advantage. Proportional share indicates that Wajo District is categorized as the mining sector's comparative advantage of

proportional share based on the position in the perceptual map. This is influenced by existence of natural gas resources exploitation by PT Energy Equity Epic Sengkang which was amounted to 15,986,744 MMSCFD in 2016 [16].

Quadrant IV in the perceptual map shows that there are areas that have similarities in the indicator of the LQ index of the mining sector. These areas are Luwu Utara and Luwu Timur Districts. Luwu Timur District is an area that categorized as the mining sector's comparative advantage of LQ indicators based on the results of mapping in the perceptual map.

Double dimensional scaling is also known as perceptual map, which is a method that describes or maps relative impression felt by a number of objects (company, product or other related to perception) [17].

Perceptual map in a multidimensional scaling analysis as a whole illustrates regions that have a role in the mining sector in the economy of South Sulawesi Province based on indicators which are input variables. These indicators are analysis of export base (LQ) and shift share and can be categorized as comparative advantages assessed from 24 districts/cities of South Sulawesi Province. Luwu Timur District as a district in South Sulawesi Province which can be categorized as the mining sector's comparative advantage based on the value of LQ and shift share indicators. This is affected by the existence of the largest laterite nickel mining company in Indonesia which operates with the total production in 2015 reaching 77,581 tons as the largest contributor in the composition of Luwu Timur District GRDP [6].

The LQ value of Luwu Timur District shows that the mining sector has economic sector independence and is able to export based on a surplus in the sector. The shift share indicator illustrates that the mining sector in South Sulawesi Province in Luwu Timur District has the advantage to be developed with the aim of spurring economic growth from Luwu Timur District.

4. CONCLUSION

Luwu Timur District is the district that has a mining sector comparative advantage based on LQ and shift share indicators, which means that the mining sector in Luwu Timur has the largest role in the economy of South Sulawesi Province when compared to other districts/cities.

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