

# AN INSIGHT INTO TRADE PATTERNS IN HDD INDUSTRY BETWEEN CPTPP COUNTRIES

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## Abstract

The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), also termed as TPP-11, is a mega-regional trade agreement signed by Australia, Brunei Darussalam, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, and Vietnam on 8<sup>th</sup> March 2018 and effective since the 30<sup>th</sup> December 2018. The CPTPP is an advanced, intrusive deal covering issues as trade in goods and services, customs administration, trade facilitation, investment, telecommunications, government procurement, intellectual property, environment, transparency and anti-corruption measures.

According to Baldwin (2014), trade regionalism of the 21<sup>st</sup> century is aimed at enhancing the expansion of the global value chains (GVCs), therefore, hard disk drive (HDD) industry is selected due to its network orientation. Participation in quick, high frequency GVCs in ICT-related machinery industries impacts trade patterns of countries and regions, starting with the largest CPTPP economy in nominal terms – Japan.

The research objective of the paper is to make a review of bilateral trade statistics in eight 6-digit HS tariff codes in HDD industry between selected CPTPP countries and to identify trade patterns using the Grubel-Lloyd and Balassa formulas. An analytical part is preceded by literature review concerning phenomena of trade regionalism, intra-industry trade and production networks.

**Key words:** The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), hard disk drive (HDD) industry, intra-industry trade

**JEL Code:** F14, F15, F23, L63

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## Introduction

The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) was signed by eleven countries of the Asia-Pacific region (Australia, Brunei Darussalam, Chile,

Japan, Canada, Malaysia, Mexico, New Zealand, Peru, Singapore and Vietnam) on 8<sup>th</sup> March 2018 in Santiago (Chile). The establishment of the CPTPP was a direct consequence of withdrawal of the United States from Trans-Pacific Partnership (TPP) agreement, signed on 4<sup>th</sup> February 2016 in Auckland, New Zealand. CPTPP, also referred to as the TPP-11 agreement, entered into force on 30<sup>th</sup> December 2018 after ratification by the governments of Australia, Japan, Canada, Mexico, New Zealand, Singapore and Vietnam. The CPTPP largely transposed the provisions of the TPP, conditionally suspending instead of eliminating 22 out of over 1,000 provisions with the option of reinstating them in a modified form under consensus. CPTPP is a comprehensive, high-quality free trade agreement covering twenty-one areas under thirty chapters, that may serve as a trigger of global value chains (GVCs), enhancing the expansion of networking-friendly industries such as hard disk drive (HDD).

The research objective of the paper is to make a review of bilateral trade statistics in eight 6-digit HS tariff codes in HDD industry between selected CPTPP countries and to identify trade patterns using the Grubel-Lloyd and Balassa formulas. An analytical part is preceded by literature review concerning phenomena of trade regionalism, intra-industry trade and production networks.

## 1 Theoretical frameworks

Goode (2003, 302) identified trade regionalism with a set of actions taken by governments aimed at liberalizing or facilitating trade in the region, and taking the form of regional/preferential trade agreements (RTAs/PTAs). Hamanaka (2010, 124-126), in turn, proposed a wider approach to trade regionalism, distinguishing its four basic forms: regional meeting/trade forum, regional trade cooperation, regional trade agreement (RTA), economic partnership agreement (EPA). The concept of mega-regionalism in trade Meléndez-Ortiz (2014, 13) associated with the deep integration partnerships in the form of RTAs between countries or regions with significant shares in world trade and investment flows and GDP, where two or more signatory countries occupy dominant position or serve as hubs in GVCs.

The CPTPP, despite its relatively short history, has become a subject of several in-depth economic analyzes, including regulatory convergence by Wang (2019), CGE modelling by Ciuriak *et al.* (2017), and Khan *et al.* (2018).

Intra-industry trade, recognized as simultaneous exports and imports in the same tariff codes, product groups, has become an important attribute of contemporary global economy. Measurement of this phenomenon manifesting itself in the horizontal and vertical pattern

enables to study international production networks that expanded rapidly in hard disk drive (HDD) industry in the 21<sup>st</sup> century. Lancaster, Linder and Helpman established demand side theories of intra-industry trade, whereas Helpman, Krugman, as well as Helpman-Krugman – supply side. Models established in the 1980s by Lancaster, Dixit and Norman, Krugman, Helpman and Bergstrand addressed horizontal pattern of intra-industry trade, recognizing horizontal differentiation of products, combined with increasing returns of scale, as a source of intra-industry trade. Since the mid-1970s, however, an intra-industry trade has intensified between developed and developing countries, that inspired establishment of the vertical intra-industry trade model. Measurement of intra-industry trade was addressed, among others, by Verdoorn, Kojima, Balassa, Grubel and Lloyd, Greenaway and Milner, databases of intra-industry trade were established by Greenaway and Balassa. Furthermore, Greenaway *et al.* tested the hypotheses of intra-industry trade, disaggregating this phenomenon into the horizontal and vertical pattern.

International production networks, studied, among others, by Dicken, Athukorala, Hiratsuka, Kimura and Obashi, Bobowski and Drelich-Skulska (2018), used to be recognized as a trigger of intra-industry trade and RTAs, including mega-regional trade frameworks such as CPTPP.

The HDD industry, as pointed by Bobowski (2018), has developed one of the most advanced and dynamic international production networks in East Asia, characterized by relatively long value chains, that enables fragmentation and dispersion of production blocks, mainly due to rising global demand for ICT-related products and digital content. An in-depth studies on HDD industry were made by, among others, McKendrick *et al.*, Hiratsuka, Kohpaiboon and Cheewatrakoolpong *et al.*

## **2 Statistical analysis**

For the purposes of statistical analysis, author selected eight 6-digit HS tariff codes in HDD industry<sup>1</sup> to study bilateral flows between selected CPTPP member states (Australia, Canada, Malaysia, Mexico, Singapore and Vietnam) and Japan in years 2008-2017<sup>2</sup>.

For the purposes of quantitative analysis of intra-industry trade in HDD industry between selected CPTPP countries, the Grubel-Lloyd index was selected by using formula as follows:

$$GL_i = \frac{(x_i + m_i) - |x_i - m_i|}{x_i + m_i} = 1 - \frac{|x_i - m_i|}{x_i + m_i}$$

$$0 \leq GL_i \leq 1$$

where  $x_i$  is the export value of industry  $i$ ,  $m_i$  is the import value of industry  $i$ .

Measurement of the horizontal and vertical intra-industry trade (HIIT and VIIT) indexes involved adaptation of Balassa index as indicated below:

$$HB = \frac{\sum_{i=1}^{N_1} [(x_i + m_i) - |x_i - m_i|]}{\sum_{i=1}^N (x_i + m_i)} \quad VB = \frac{\sum_{i=1}^{N_2} [(x_i + m_i) - |x_i - m_i|]}{\sum_{i=1}^N (x_i + m_i)}$$

where  $N_1$  indicates six-digit codes of industry  $i$  that exhibits HIIT,  $N_2$  indicates six-digit codes of industry  $i$  that exhibits VIIT, while  $N$  indicates a total number of six-digit codes of industry  $i$ , according to equation as follows:  $B_i = HB_i + VB_i$

As indicated in Tab. 1, the largest trade volume in eight selected 6-digit HS tariff codes in HDD industry was recorded between Japan and Singapore, starting with 2012 (165 million USD in exports) and 2008 (811.5 million USD in imports). According to recent data of 2017, Singapore was the first CPTPP partner of Japan, with imports up to 58.2 million USD and exports of 532.2 million USD in eight 6-digit HS tariff codes, followed by Malaysia, Canada, Australia, Vietnam and Mexico. Importantly, units of automatic data processing machines accounted for the highest portion of exports to Japan in each pair, excluding JPN-VNM in 2017, while in case of imports

<sup>1</sup> Selected HS tariff codes were as follows: 847130 – automatic data processing machines; portable, weighing not more than 10kg, consisting of at least a central processing unit, a keyboard and a display; 847141 – automatic data processing machines; comprising in the same housing at least a central processing unit and an input and output unit, whether or not combined, n.e.c. in item no. 8471.30; 847149 – automatic data processing machines; presented in the form of systems, n.e.c. in item no. 8471.30 or 8471.41; 847150 – units of automatic data processing machines; processing units other than those of item no. 8471.41 or 8471.49, whether or not containing in the same housing one or two of the following types of unit: storage units, input units or output units; 847160 – units of automatic data processing machines; input or output units, whether or not containing storage units in the same housing; 847170 - units of automatic data processing machines; storage units; 847180 – units of automatic data processing machines; n.e.c. in item no. 8471.50, 8471.60 or 8471.70; 847190 - magnetic or optical readers, machines for transcribing data onto data media in coded form and machines for processing such data, not elsewhere specified or included.

<sup>2</sup> Selection of countries was based on preliminary analysis of bilateral trade flows in HDD industry among CPTPP members to verify their relative statistical importance. Data were extracted from the UN Comtrade database.

from Japan – only in case of JPN-MAL and JPN-SIN. In case of JPN-MAL, JPN-MEX and JPN-SIN Japan recorded deficits in trade in the studied eight HS tariff codes, with surpluses in case of JPN-AUT, JPN-VNM and JPN-CAN both in 2008 and 2017. The highest export volumes of automatic data processing machines in 2017 were recorded in case of JPN-AUT and JPN-CAN, import volumes – JPN-SIN and JPN-CAN.

Exports of magnetic or optical readers, machines for transcribing data from Japan in 2017 proved to be the highest in case of JPN-MEX and JPN-SIN, imports – JPN-MEX and JPN-MAL. In most cases, after 2008 and 2011 a decrease in both exports and imports to/from Japan was observed in the studied HS tariff codes, related to, among others, consequences of global financial crisis 2008+, as well as Great East Japan Earthquake 2011. When studying long-term trend in years 2008-2017, in case of JPN-AUT there was no group of HS tariff codes (I, II or III) with export or import volume in 2017 which exceeded the value of 2008, in case of JPN-CAN there were two of such: imports of automatic data processing machines (I) and units of automatic data processing machines (II), JPN-MAL – exports of automatic data processing machines (I), imports and exports of magnetic or optical readers, machines for transcribing data (III), JPN-MEX – imports of automatic data processing machines (I), exports of units of automatic data processing machines (II) and magnetic or optical readers, machines for transcribing data (III), JPN-SIN - exports of units of automatic data processing machines (II) and magnetic or optical readers, machines for transcribing data (III), JPN-VNM – imports of automatic data processing machines (I), units of automatic data processing machines (II), imports and exports of magnetic or optical readers, machines for transcribing data (III).

Between 2008 and 2017 exports to Japan from 6 selected CPTPP countries in HDD industry declined by 28.46 per cent, imports from Japan – by 31.35 per cent, with Japan's deficit in eight HS tariff codes lowered by 27.81 per cent (1.01 billion USD in 2008 and 730.29 million USD in 2017). In 2008 Singapore accounted for 65.46 per cent of exports to Japan in HDD industry from six CPTPP countries, Mexico and Malaysia – 17.11 and 15.34 per cent, respectively, in case of imports from Japan in 2008 Vietnam and Canada dominated – 29.29 and 23.41 per cent, respectively, with comparable shares ranging between 12.36 and 16.66 per cent of Malaysia, Singapore and Australia. In 2017 there were no significant changes in terms of shares in exports to Japan – Singapore dominated with 60.01 per cent of shares, followed by Malaysia and Mexico – 20.17 and 16.13 per cent, respectively. In case of imports from Japan, however, there were some noticeable changes, namely, Singapore increased its shares up to

**Tab. 1: Bilateral trade flows in HDD industry, selected CPTPP countries, 2008-2017 (in USD)**

	Japan-Australia (JPN-AUT)			Japan-Canada (JPN-CAN)			Japan-Malaysia (JPN-MAL)		
	I	II	III	I	II	III	I	II	III
Im 08	417,798	2,726,211	40,109	3,300,245	15,794,435	660,897	4,549,026	184,817,184	720,718
Ex08	19,344,119	14,045,236	4,692,519	42,190,714	8,359,339	2,810,344	3,440,890	22,905,503	1,911,313
Im 09	156,197	3,552,358	9,582	2,317,142	12,338,262	455,452	3,979,762	153,930,492	185,201
Ex09	12,213,887	6,744,408	2,596,170	31,697,814	4,954,695	1,614,470	2,255,290	12,129,444	2,315,430
Im 10	175,910	2,850,204	43,255	2,935,382	10,999,552	810,210	3,476,043	261,953,178	1,245,492
Ex10	13,457,903	9,246,634	3,041,629	37,982,187	7,322,908	1,993,988	4,526,455	10,042,943	3,660,158
Im 11	201,842	3,327,134	331,886	1,758,529	11,936,538	941,831	n/a	n/a	n/a
Ex11	31,586,788	9,246,201	2,265,466	24,949,386	5,547,854	1,678,971	n/a	n/a	n/a
Im 12	261,541	2,140,304	528,370	1,712,082	10,841,476	744,185	712,448	261,661,143	2,578,665
Ex12	24,016,377	7,514,668	2,138,830	19,104,834	6,355,730	989,755	6,057,866	13,745,156	1,540,825
Im 13	386,026	891,439	160,765	1,697,938	9,860,628	548,165	1,477,270	222,292,004	3,775,270
Ex13	10,115,054	4,034,425	914,473	13,353,326	4,412,824	502,856	3,566,389	12,559,214	1,549,053
Im 14	179,768	1,609,855	205,057	1,289,015	19,247,824	246,910	1,787,098	193,570,129	4,741,673
Ex14	8,771,386	3,467,346	1,004,244	16,567,403	4,227,131	752,494	2,794,873	20,777,245	1,778,476
Im 15	248,498	1,985,021	176,792	1,180,942	45,924,974	230,541	972,500	146,621,310	3,481,276
Ex15	10,371,452	5,137,233	1,325,397	17,300,544	5,952,402	1,075,477	7,289,443	11,598,120	1,624,446
Im 16	383,258	994,991	207,821	4,148,748	12,980,025	226,203	1,947,063	137,414,727	5,019,243
Ex16	10,087,533	3,784,473	883,427	14,374,768	5,353,187	1,142,415	6,008,400	14,491,214	2,078,982
Im 17	292,618	628,627	105,360	4,511,240	18,115,298	280,448	1,286,361	171,090,140	6,497,737
Ex017	12,221,938	4,053,348	1,621,534	16,162,035	5,139,459	2,044,829	7,101,416	19,431,568	3,263,772
	Japan-Mexico (JPN-MEX)			Japan-Singapore (JPN-SIN)			Japan-Vietnam (JPN-VNM)		
Im 08	1,336,368	203,641,985	7,229,613	9,110,269	798,021,950	4,437,130	9,291	1,699,938	1,342,147
Ex08	3,465,301	1,865,982	600,569	12,158,191	19,519,958	3,978,014	9,734,396	56,668,132	428,693
Im 09	1,570,753	139,622,864	5,469,624	2,887,666	624,934,406	3,876,588	17,256	4,820,911	471,101
Ex09	5,367,487	1,433,771	541,787	9,918,718	15,819,459	2,022,576	7,237,516	13,622,122	904,794
Im 10	1,161,586	157,401,410	6,653,629	3,569,601	745,653,854	2,359,803	11,273	2,002,864	273,729
Ex10	1,600,065	3,540,168	860,838	12,907,100	84,770,076	6,132,128	11,070,517	19,616,151	755,136
Im 11	2,025,876	167,765,469	7,687,666	25,944,503	581,216,418	1,742,153	75,515	2,089,548	1,756,721
Ex11	2,298,345	8,387,558	1,071,804	22,986,084	128,555,577	4,925,842	17,745,452	27,235,974	1,644,108
Im 12	2,399,162	126,857,455	6,773,450	1,979,476	635,259,458	3,336,011	23,777	1,966,641	2,738,402
Ex12	1,929,326	9,259,158	1,544,809	20,532,345	139,270,618	5,191,992	13,049,861	12,442,260	1,917,926
Im 13	3,662,414	80,553,401	6,283,491	2,995,417	546,838,158	2,372,861	58,396	1,182,724	1,205,105

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Ex13	2,581,489	5,102,255	1,718,834	13,338,478	123,595,221	3,317,574	2,220,224	2,102,949	1,729,265
Im 14	3,011,676	159,119,480	3,952,906	3,801,878	563,070,095	3,879,383	21,782	2,425,962	3,290,682
Ex14	1,802,706	6,007,485	2,247,878	12,382,757	111,321,866	5,578,821	4,728,082	3,486,298	1,611,391
Im 15	1,836,798	118,140,533	7,479,218	3,217,431	545,772,666	1,827,559	38,560	3,692,157	3,198,928
Ex15	1,555,740	3,161,732	2,549,667	11,941,603	64,647,718	6,093,452	3,236,133	3,055,167	1,810,824
Im 16	2,941,520	98,656,398	8,201,880	2,855,757	488,651,922	2,405,394	1,472,181	4,134,792	3,458,566
Ex16	1,647,858	3,679,980	3,713,791	7,311,403	49,325,081	6,009,145	3,246,635	4,376,600	1,655,491
Im 17	4,393,244	131,932,301	6,814,325	7,414,375	523,311,629	1,495,130	782,512	2,783,347	5,169,474
Ex017	1,386,354	5,808,141	5,862,678	6,417,074	47,175,171	4,625,785	7,445,852	4,499,398	2,323,191

I - automatic data processing machines (847130, 847141, 847149)

II - units of automatic data processing machines (847150, 847160, 847170, 847180)

III - magnetic or optical readers, machines for transcribing data (847190)

Source: own calculations based on: UN Comtrade Database (2019).

37.16 per cent, followed by Malaysia, Canada and Australia – shares ranging between 19.03 and 11.43 per cent. Vietnam has lost its relative importance as Japan’s export market in HDD industry with 9.13 per cent of shares, thus, slightly more than Mexico, however, preceded by the other CPTPP partners.

**Tab. 2: The Grubel-Lloyd (GL) and vertical intra-industry trade (VIIT) indexes in HDD industry in selected CPTPP countries, 2008-2017**

	Japan-Australia JPN-AUT		Japan-Canada JPN-CAN		Japan-Malaysia JPN-MAL		Japan-Mexico JPN-MEX		Japan-Singapore JPN-SIN		Japan-Vietnam JPN-VNM	
	GL	VIIT	GL	VIIT	GL	VIIT	GL	VIIT	GL	VIIT	GL	VIIT
2008	0.64	0.64	0.58	0.57	0.40	0.40	0.43	0.43	0.34	0.34	0.04	0.04
2009	0.40	0.33	0.60	0.60	0.60	0.60	0.45	0.41	0.31	0.31	0.04	0.04
2010	0.66	0.63	0.66	0.62	0.31	0.24	0.35	0.35	0.54	0.43	0.07	0.06
2011	0.72	0.70	0.71	0.70	n/a	n/a	0.51	0.51	0.64	0.62	0.04	0.04
2012	0.35	0.35	0.76	0.65	0.24	0.24	0.52	0.43	0.56	0.48	0.33	0.33
2013	0.57	0.57	0.51	0.39	0.28	0.28	0.40	0.25	0.43	0.43	0.19	0.19
2014	0.40	0.40	0.23	0.23	0.65	0.61	0.42	0.38	0.16	0.16	0.15	0.15
2015	0.46	0.15	0.37	0.36	0.53	0.53	0.30	0.30	0.24	0.18	0.09	0.09
2016	0.53	0.53	0.71	0.70	0.52	0.48	0.36	0.36	0.36	0.36	0.39	0.39
2017	0.35	0.33	0.66	0.54	0.27	0.27	0.35	0.35	0.27	0.20	0.50	0.50

Source: own calculations based on: UN Comtrade Database (2019).

The Grubel-Lloyd (GL) index increased between 2008 and 2017 to the largest extent in case of JPN-VNM – from 0.04 to 0.50, which was the second best result among CPTPP countries after Canada – 0.66 in 2017 – in fact, both JPN-VNM and JPN-CAN were the only pairs in case of which GL index was higher in 2017 than nine years before (Tab. 2). The other four CPTPP countries recorded comparable GL indexes in trade in HDD industry with Japan in 2017, ranging between 0.27 and 0.35. In 2008 GL index ranged between 0.34 and 0.64 for all pairs, excluding JPN-VNM. The highest GL indexes in the studied period, exceeding 0.70, were recorded in case of JPN-AUT in 2011 and JPN-CAN in 2011 and 2016, the lowest – below 0.10, in case of JPN-VNM in years 2008-2011 and 2015. The vertical intra-industry trade (VIIT) index increased between 2008 and 2017 only in case of JPN-VNM - from 0.04 to 0.50, however, higher index was recorded in respective year in case of JPN-CAN (0.54), while in case of the other CPTPP partners of Japan VIIT index varied between 0.20 and 0.35. In 2008 the highest VIIT index was recorded in case of JPN-AUT (0.64), followed by JPN-CAN (0.57), JPN-MEX (0.43) and JPN-MAL (0.40). Among eight six-digit HS tariff codes studied in years 2008-2017 to calculate VIIT index, there were, however, single codes with horizontal pattern



of trade: JPN-AUT (9 codes), JPN-CAN (11 codes), JPN-MAL (3 codes), JPN-MEX (5 codes), JPN-SIN (8 codes), JPN-VNM (2 codes)<sup>3</sup>. Summing up, the vertical pattern of intra-industry trade dominated in the studied period to the largest extent in case of JPN-VNM and JPN-MAL, to a lesser extent in case of JPN-MEX and JPN-SIN.

## Conclusion

Author studied trade patterns in HDD industry among selected member states of mega-regional trade framework CPTPP. The usage of UN Comtrade database enabled to study bilateral flows in selected six-digit HS tariff codes between Japan and six other CPTPP countries, trade patterns were identified using formulas of Grubel-Lloyd and Balassa.

From the above analysis, the following conclusions can be drawn:

- among key trade partners of Japan in HDD industry in years 2008-2017 there were Singapore, followed by Malaysia and Canada;
- Singapore maintained its dominant shares in exports to Japan in HDD industry among CPTPP countries between 2008 and 2017, whereas increasing its shares in imports from Japan in the studied period at the expense of, among others, Vietnam;
- Japan imported primarily units of automatic data processing machines from the other CPTPP countries, selected four HS tariff codes dominated also in case of exports to Malaysia and Singapore;
- both after 2008 and 2011 a decrease in both exports and imports to/from Japan was observed in the studied HS tariff codes, related to, among others, consequences of global financial crisis 2008+, as well as Great East Japan Earthquake 2011;
- trade volume in HDD industry between Japan and six CPTPP partners declined between 2008 and 2017 to the largest extent in case of JPN-VNM and JPN-AUT – by 67 and 54 per cent, respectively, while in case of JPN-MAL trade volume decreased slightly by 4.4 per cent;
- an intra-industry trade has played an important role in HDD industry of CPTPP countries, with relatively high GL indexes of JPN-VNM and JPN-CAN – those two pairs proved to be the only that recorded an increase when compared to 2008;

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<sup>3</sup> JPN-AUT: 2009-2011 (847130), 2013 and 2017 (847190), 2015 (847141, 847150, 847170), 2016 (847170); JPN-CAN: 2008 (847180), 2010 (847141, 847170), 2011 and 2016 (847190), 2012 (847149, 847170), 2013 (847150), 2015 (847130), 2017 (847150, 847180); JPN-MAL: 2010 (847141), 2014 and 2016 (847180); JPN-MEX: 2009 and 2014 (847130), 2012 (847170), 2013 (847150), 2015 (847160); JPN-SIN: 2010, 2015 and 2017 (847141), 2011 (847130, 847160, 847170), 2012 (847141, 847170); JPN-VNM: 2008 and 2010 (847170).

- Vietnam increased significantly the volume of intra-industry trade with Japan in HDD industry, being the only CPTPP partner of Japan, that increased the vertical intra-industry trade index since 2008, ranked second after Canada in terms of VIIT index in 2017;
- the vertical pattern of intra-industry trade has dominated over horizontal in years 2008-2017;
- successful implementation of CPTPP and its further enlargement in regards of membership might enhance the expansion of GVCs in HDD industry, including CPTPP's developing economies, which, in turn, would stimulate intra-industry trade of the vertical pattern.

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