

intra-industry trade; air transport services; measurement

**Martina BLÁŠKOVÁ, Filip ŠKULTÉTY\***

Air Transport Department, University of Žilina

Univerzitná 1, 010 26 Žilina, Slovakia

\*Corresponding author. E-mail: [filip.skultety@fpedas.uniza.sk](mailto:filip.skultety@fpedas.uniza.sk)

## U.S. INTRA-INDUSTRY TRADE IN AIR TRANSPORT SERVICES: MEASUREMENT AND RESULTS

**Summary.** The paper deals with the measurement of intra-industry trade (IIT) in air transport services and its components (passenger and air cargo services) among the United States of America and 31 chosen countries in time period 2000 - 2011. For the purpose of analysis, we used traditional and alternative methods of IIT measurements. Results of the analysis confirm the existence of IIT in air transport services and its components (passenger and air cargo services between The United States of America and 31 chosen countries in time period 2000 – 2011. On the other hand, we are unable to determine the trend of IIT in air transport services between The United States of America and 31 chosen countries in time period 2000 – 2011 because of fluctuating turnover values.

## ВНУТРИОТРАСЛЕВАЯ ТОРГОВЛЯ В США ДЛЯ ОБСЛУЖИВАНИЯ ВОЗДУШНОГО ТРАНСПОРТА: РЕЗУЛЬТАТЫ И ИЗМЕРЕНИЯ

**Аннотация.** Статья посвящена анализу внутриотраслевой торговли (ИТ) в авиатранспортных услугах и их компонентах (пассажирских и грузовых авиаперевозках) между Соединенными Штатами Америки и 31 выбранными странами в период 2000 - 2011 г. Для целей анализа были использованы традиционные и альтернативные методы измерения ИТ. Результаты анализа подтверждают существование ИТ в авиатранспортных услугах и их компонентах (пассажирских и грузовых перевозках) в воздухе между Соединенными Штатами Америки и 31 выбранными странами в период 2000 - 2011 г. С другой стороны, невозможно определить тенденции в ИТ авиатранспортных услуг между Соединенными Штатами Америки и 31 выбранными странами в период 2000 – 2011 поскольку значения колеблются.

### 1. INTRODUCTION

Since 1960 economists deal with the measurement of intra-industry trade (IIT). Table 1 shows a summary of selected studies addressing to a measurement of IIT in goods. As it can be seen, the mentioned studies dealing with a research of IIT in goods used an alternative ways of measuring.

Table 1

The overview of selected studies on intra-industry trade in goods

Author	Year	Method
Turkcan K., Aysegul A.	2010	Grubel-Lloyd index
Leitão N., Faustino H., Yoshida Y.	2010	Grubel-Lloyd index
Ando M.	2006	Threshold method
Brühlhart M.	2002	Grubel-Lloyd index Differentiated Grubel-Lloyd index Marginal Grubel-Lloyd index Greenaway-Hine-Milner-Elliot method Brühlhart method
Ferto I., Hubbard L.J.	2002	Grubel-Lloyd index Threshold method
Azhar A., Elliot, R., Milner Ch.	1998	Grubel-Lloyd index Greenaway-Hine-Milner-Elliot method Marginal Grubel-Lloyd index
Nilsson L.	1997	Grubel-Lloyd index Rajan index

Source: Compiled by authors.

Table 2 shows an overview of studies involved in research and measurement of international intra-industry trade in services. As it can be seen, the research of IIT has used as a basic metric measurement the Grubel-Lloyd index and marginal Grubel-Lloyd index. None of the studies deals with the IIT in air transport services and it's components.

Table 2

The overview of selected studies on IIT in services

Author	Year	Method
Leitão N.	2012-2011	Grubel-Lloyd index Marginal Grubel-Lloyd index Brühlhart method
Sichei M., Harmse Ch., Kanfer F.	2007	Grubel-Lloyd index
Donghui Li, Fabriborz Moshirian, Ah -Boon Sim	2005	Grubel-Lloyd index Marginal Grubel-Lloyd index
Robert C. Shelburne, Jorge G.Gonzales	2004	Grubel-Lloyd index Marginal Grubel-Lloyd index
Donghui Li, Fabriborz Moshirian, Ah -Boon Sim	2003	Grubel-Lloyd index
Hyun-Hoon Lee, Peter Lloyd	2002	Grubel-Lloyd index Marginal Grubel-Lloyd index

Source: Compiled by authors.

## 2. OBJECTIVES AND METHODOLOGY

The aim of this paper is to measure the intra-industry component of international trade in air transport services. Determinants analysed in previous studies formed the basis of our research. We have developed a proposal for measuring the intra-industry trade in air transport services based on previous analysis that aimed to measure the intensity; scale and progress of international intra-industry trade in goods and services. According to the literature research we performed this technique has not yet been applied to measure the intensity, scale and progress of international trade in air transport services. Given the fact that the provided data by International Trade Centre (ITC, 2014) is incomplete, we analysed IIT in air transport services and it's components between the United States

and 31<sup>1</sup> selected countries, whose exports of air transport services amounted in 2011 to more than 73% of world exports of air transport services and import of air transport services amounted in 2011 to more than 72% of world air transport services import.

## 2.1. Intra-industry trade in air transport services measurement capabilities

Brühlhart (2002) divided measuring methods of IIT into three groups, namely static, quasi-dynamic and dynamic methods. Table 3 shows traditional and alternative measurement methods. Some of them we applied on IIT in air transport services.

Table 3

Used measurement methods	
	Method
<b>Static</b>	Grubel-Lloyd index Threshold method Greenaway-Hine-Milner-Elliot method
<b>Quasi-dynamic</b>	Differentiated Grubel-Lloyd index Greenaway-Hine-Milner-Elliot method
<b>Dynamic</b>	Marginal Grubel-Lloyd index Brühlhart method

Source: Compiled by authors.

### *Grubel-Lloyd index*

To determine the intensity of intra-industry component of international trade we used a traditional (static) Grubel-Lloyd index (GLI) considered as a standard tool to measure intra-industry trade in goods and services (Shelburne, Gonzales, 2004). GLI is a static measure of IIT at one time point.

$$GLj = 1 - \frac{\sum_i |X_{ij}| - |M_{ij}|}{\sum_i |X_{ij}| + |M_{ij}|} \quad (1)$$

where: GLj – Grubel-Lloyd index; X<sub>ij</sub> – export of country j in sector i; M<sub>ij</sub> – import to county j in sector i

### *Marginal Grubel-Lloyd index*

This index deals with the changes in trade at the time and counts with a negative numbers – changes tend to be negative numbers. Coefficient assumes values in the interval < 0 ; 1 >. The closer to the value 1, the more intra-industry character of trade change.

$$MGLj = 1 - \frac{\Delta X_{ij} - \Delta M_{ij}}{|\Delta X_{ij}| + |\Delta M_{ij}|} \quad (2)$$

where: MGLj – Marginal Grubel-Lloyd index; ΔX<sub>ij</sub> – change in export in sector i between two points in time; ΔM<sub>ij</sub> – change in import in sector i between two points in time

### *Greenaway-Hine-Milner-Elliot method*

Greenaway et al. (1994) have proposed a measurement that is different from the Grubel-Lloyd index. Sit indicates the absolute value and not proportional. Greenaway-Hine-Milner-Elliot (GHME)

<sup>1</sup> 26 EU members, Norway, Hong Kong, Japan, Canada and Russia.

static method determines the turnover of IIT at the time and quasi-dynamic type of GHME method indicates the annual change IIT turnover.

$$\text{GHME}_{static} = (X_{ij} + M_{ij}) - |X_{ij} - M_{ij}| \quad (3)$$

$$\text{GHME}_{quasi-dynamic} = [(X_{ij} + M_{ij}) - |X_{ij} - M_{ij}|]_t - [(X_{ij} + M_{ij}) - |X_{ij} - M_{ij}|]_{t-1}, \quad (4)$$

where: GHME – Greenaway-Hine-Milner-Elliot method;  $X_{ij}$  – export of country  $j$  in sector  $i$ ;  $M_{ij}$  – import to county  $j$  in sector  $i$

For the purpose of the analysis, we applied three abovementioned measurement methods on IIT in air transport services between the United States and 31 chosen countries between 2000 and 2011. According to the ITC database, availability of the data is quite different in case of air transport services as a whole, air cargo services and passenger traffic as can be seen in Figure 1. Many economists are dealing with the problem of services data availability and reporting. Because the services classification isn't uniform in every country, provided data by the countries may be not compatible and comparable with other countries and services sectors.

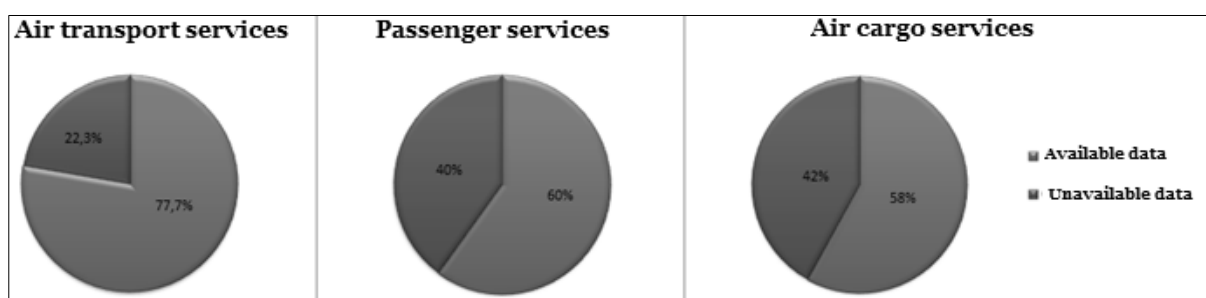


Fig. 1. Data availability on international trade in air transport services, air passenger and air cargo between the United States and selected countries, 2000-2011.

Source: Authors.

Рис. 1. Наличие данных о международной торговле для авиатранспортных услуг, пассажирских и грузовых авиаперевозок между Соединенными Штатами и отдельными странами, 2000-2011  
Источник: авторы.

83 out of 372 analysed cases couldn't be analysed due to the data unavailability in case of international trade in air transport services between the United States and 31 chosen countries between 2000 and 2011, 150 and 156 out of 372 analysed cases couldn't be also analysed due to data unavailability from the passenger air transport services sector and air cargo services sector.

### 3. RESULTS AND DISCUSSION

For the purpose of this paper, we are presenting results of the three applied methods – Grubel-Lloyd index, Marginal Grubel-Lloyd index and Greenaway-Hine-Milner-Elliot method. We are still analysing the results of the other used methods and are not published yet.

#### 3.1. Grubel-Lloyd Index

From 289 measures, 60 values were greater than 0,9 which means high intra-industry intensity of international trade in air transport services. Grubel-Lloyd index equal to the value 1 in three cases between the United States and Slovenia, Latvia and Denmark which means perfect intra-industry trade

in air transport services. Zero values were measured in four cases, which means that trade between chosen countries has inter-industry character.

From 222 measures, 10 values were greater than 0,9 which means high intra-industry intensity of international trade in passenger air transport services. Grubel-Lloyd index equal to the value 1 in 2010 between the United States and Cyprus which means perfect intra-industry trade in passenger air transport services. Zero values were measured in 27 cases, which means that trade between chosen countries has inter-industry character.

From 216 measures, 37 values were greater than 0,9 which means high intra-industry intensity of international trade in air cargo services. Grubel-Lloyd index equal to the value 1 in two (Latvia and Poland), which means perfect intra-industry trade in air cargo services. Zero values were measured in 30 cases, which means that trade between chosen countries has inter-industry character.

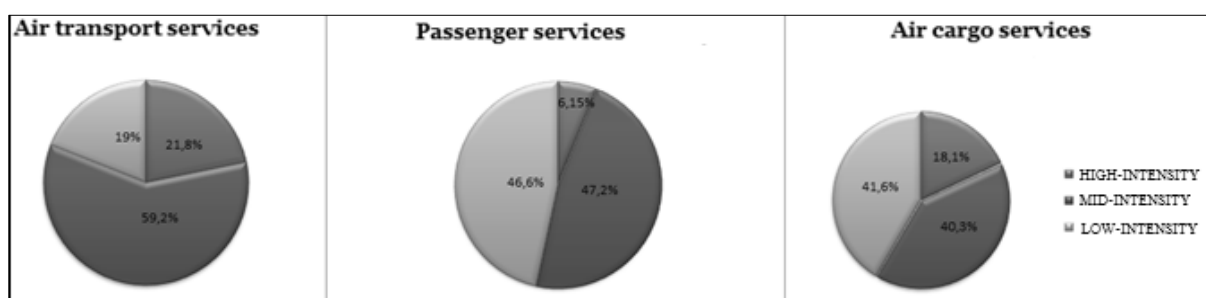


Fig. 2. Intensity of IIT in air transport services and its components between the United States and selected countries, 2000-2011

Source: Authors.

Рис. 2. Интенсивность ИТ на услуги воздушного транспорта и их компонентов между Соединенными Штатами и отдельными странами, 2000-2011

Источник: Авторы.

The largest intra-industry intensity was reflected in air transport services as a whole between the United States and 31 chosen countries in the period from 2000 to 2011. On the other hand the weakest intensity was recorded in passenger air transport services sector.

### 3.2. Marginal Grubel-Lloyd Index

From 254 measures, 104 values were equal to 0, which means that the annual change of international trade in air transport services in these cases had no intra-industry character. On the other hand, 11 measured values were greater than 0,9, which means high intra-industry character of the trade change.

From 190 measures, 94 values were equal to 0, which means that the annual change of international trade in passenger air transport services in these cases had no intra-industry character. On the other hand, 11 measured values were greater than 0,9, which means high intra-industry character of the trade change.

From 183 measures, 94 values were equal to 0, which means that the annual change of international trade in passenger air transport services in these cases had no intra-industry character. On the other hand, 7 measured values were greater than 0,9, which means high intra-industry character of the trade change.

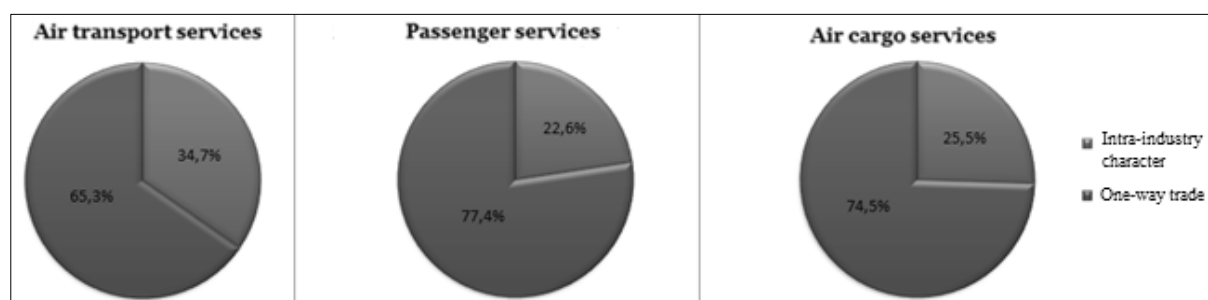


Fig. 3. The annual change nature of international trade in air transport services and it's components between the United States and selected countries, 2000-2011

Source: Authors.

Рис. 3. Годовое изменение характера международной торговли в авиатранспортных услугах и их компонентах между Соединенными Штатами и отдельными странами, 2000-2011

Источник: авторы.

### 3.3. Greenaway-Hine-Milner-Elliot Method

From 289 measures, we recorded the largest turnover of trade in air transport services between the United States and Great Britain in 2002. The smallest turnover value was measured between the United States and Estonia in 2000. Zero value of IIT in air transport services has taken place between the United States and selected countries in two cases with Latvia in 2000 and Lithuania in 2009 and 2010.

From 226 measures, we recorded the largest turnover of trade in passenger air transport services between the United States and Germany in 2007. The smallest turnover value was measured between the United States and Estonia in 2001. Zero value of IIT in passenger air transport services has taken place between the United States and selected countries in 28 cases.

From 222 measures, we recorded the largest turnover of trade in air cargo services between the United States and France in 2001. The smallest turnover value was measured between the United States and Lithuania in 2008. Zero value of IIT in air cargo services has taken place between the United States and selected countries in 34 cases.

As it can be seen from Table 4, it's not possible to determine a clear trend for development of IIT in air transport services (passenger and air cargo services) for the period from 2000 to 2011.

## 4. CONCLUSION

Results of the analysis confirms the existence of IIT in international air transport services (passenger and air cargo services) between the United States and 31 chosen countries between 2000 and 2011. Using traditional and alternative methods, we analysed the intensity, dynamics and turnover of IIT in air transport services (passenger and air cargo services) between the United States and 31 selected countries for the period from 2000 and 2011. Grubel-Lloyd index confirmed the existence of high intensity of intra-industry between the United States and some selected trading partners. Dynamics of trade in air transport services and its components had most of inter-industry nature. The development trend of the IIT in air transport services (passenger and air cargo services) between the United States and chosen trading partners cannot be uniquely determined because of the fluctuating turnover values for each analysed year. We assumed the existence of intra-industry component in the international trade in air transport services and this assumption has been validated through the application of measuring methods. We were able to identify the determinants of intra-industry trade in air transport services by specifying the impact of chosen determinants on international intra-industry trade in air transport services through the econometric analysis. We suggest applying a similar

econometric analysis to further potential research of international intra-industry trade in air transport services that would include a much broader temporal and geographical scope that in our research was limited by the availability of data.

Table 4

Turnover values of international intra-industry trade in air transport services and it's components between the United States and 31 trading partners, 2000-2011

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>TURNOVER (air transport services as whole) 1000 €</b>	16 122 436	13 970 121	18 415 944	16 549 824	18 935 381	20 810 487	22 309 719	20 878 771	20 170 154	15 112 133	16 620 530	17 981 444
<b>TURNOVER (passenger) 1000 €</b>	5 948 930	4 280 680	6 402 566	4 884 329	5 539 435	6 326 717	5 973 815	6 167 309	5 942 555	4 146 741	4 495 668	4 964 138
<b>TURNOVER (cargo) 1000 €</b>	2 123 308	1 828 578	2 210 884	1 610 164	1 988 935	2 977 123	2 935 285	2 882 545	3 004 379	1 957 875	2 102 695	1 757 899

Source: Compiled by authors.

## References

1. Blašková, M. Intra-industry trade: How it is measured? In: *Increasing safety and quality in civil military air transport: medzinárodná vedecká konferencia v rámci riešenia projektu VEGA 1/0884/12 - Základný výskum bezpečnosti na letiskách s nedostatočne rozvinutou navigačnou infraštruktúrou využívajúcich GNSS*. Žilina, 26.04-27.04.2012. P. 22-27.
2. Blašková, M. World trade in air transport services: Values and selected countries ranking. In: *INAIR 2012: international conference on air transport*. Žilina, Slovakia, 20-21 September 2012. P. 15-20.
3. Blašková, M. & U Tomová, A. Applicationa of Grubel-Lloyd index on trade in air transport services between the USA and chose European countries: Evidence of intra-industry flows. *Aero-Journal: international scientific journal of air transport industry*. 2013. No. 1. P. 24-32.
4. Brülhart, M. intra-industry trade Marginal: measurement and relevance for the pattern of industrial adjustment. *Weltwirtschaftliches Archiv* 130: 1994. P. 600-613.
5. Dixon, P.B. & Menon, J. *Measures of intra-industry trade as indicators of factor market disruption*. General paper No. G-113. 1995.
6. Donghui, L., et al. The determinants of Intra-Industry Trade in Insurance Services. *The Journal of Risk and Insurance*. 2003. Vol. 70. No. 2. P. 269-287.
7. Grubel, H. & Lloyd, P. *Intra-industry trade: the theory and measurement of international trade in different products*. 1975. London: Macmillan.
8. Ferto, I. & Hubbard, L.J. Intra-Industry Trade in Horizontally and vertically Differentiated Agri-Food Products between Hungary and the EU. In: *The X<sup>th</sup> EAAE Congress "Exploring Diversity in the European Agri-Food System"*. Zaragoza, Spain, 28-31 August 2002. Available at: <http://ageconsearch.umn.edu/bitstream/24884/1/cp02im16.pdf>
9. International Trade Center Statistics. 2014. Available at: [http://www.trademap.org/tm\\_light/Country\\_SelService\\_TS.aspx](http://www.trademap.org/tm_light/Country_SelService_TS.aspx)

10. Lee, H.H. & Lloyd, P. Intra-industry trade in services. 2002. Available at: <http://cc.kangwon.ac.kr/~hhlee/paper/Lee-Lloyd.PDF>
11. Leitão, N.C. & Faustino, H & Yoshida, Y. Fragmentation, Vertical Intra-Industry Trade, and Automobile Components., *Economics Bulletin* 2010. Vol. 30 (2). P 1006-1015.
12. Leitaο, N.C. Intra-Industry Trade in Tourism Services. *Theoretical and Applied Economics*. 2011. Vol. XVIII. No. 6 (559). P. 55-62.
13. Leitaο, N.C. The determinants of intra-industry trade in tourism services. *Munich Personal RePEc Archive*. MPRA Paper No. 37444. 2012.  
Available at: [http://mpra.ub.uni-muenchen.de/37444/1/MPRA\\_paper\\_37444.pdf](http://mpra.ub.uni-muenchen.de/37444/1/MPRA_paper_37444.pdf)
14. Li, D., et al. The determinants of Intra-Industry Trade in Insurance Services. *The Journal of Risk and Insurance*. 2003. Volume 70. No. 2. P. 269-287.
15. Moshirian, F., et al. Intra-industry trade in financial services. *Journal of International Money and Finance*. 2005. Vol. 24. P. 1090-1107.
16. Nilsson, L. The Measurement of Intra-Industry Trade between Unequal Partners. *Weltwirtschaftliches Archiv*. Springer. 1997. Vol. 133. No. 3. P. 554-565.
17. Shelburne, R. & Gonzales, J. The role of intra-industry trade in service sector. In: Plummer M.G. *Empirical Methods in International Trade: Essays in Honor of Mordechai Kreinin*. 2004. UK: EE Edward Elgar Publishing.
18. Sichei, M. & Harmse, Ch. & Kanfer, F. Determinants of South Africa-US-intra-industry trade in services: A wild bootstrap dynamic panel data analysis. *South African Journal of Economics*. 2007. Vol. 75(3). P. 521-539.

Received 23.11.2014; accepted in revised form 20.05.2015