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THIRTEENTH AIR NAVIGATION CONFERENCE

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COMMITTEE A

Agenda Item 4: Implementing the global air navigation system and the role of planning and implementation regional groups (PIRGs)

4.1: The economic benefits brought by aviation

AIR TRANSPORTATION AND ECONOMIC PRODUCTIVITY

(Presented by the United States)

EXECUTIVE SUMMARY

Civil air transportation is an integral part of the global economy. In most State economies, the economic output of civil air transportation is small when compared to the overall economy. Even in large economies such as the United States, air transportation economic output ranks low. Among sixty three industry sectors monitored by the United States Bureau of Economic Analysis in 2017¹, air transportation was ranked forty-first. Despite its small size, air transportation is efficient in providing transportation services to its customers, and providing opportunities for technological change and economic development. This paper presents a framework for multi-factor productivity, which recognizes air transportation's economic importance for facilitating the prioritization of resources for national planning and sustainable economic development

1. INTRODUCTION

1.1 Air transportation is an integral part of today's global economy. Civil air transportation seeks to make air travel faster and more affordable, while facing formidable economic challenges. The industry continues to enable the transportation of more people and cargo than ever, contributing to higher standards of living and new business opportunities.

1.2 The aviation industry is much more than just moving passengers and cargo to various destinations. It enables leisure and business travel to most places around the globe within a relatively reasonable period. At the individual level, leisure and business travelers choose air transportation because the benefits exceed the costs. On a society or economy-wide level, recent productivity research investigates how efficient the air transportation industry is in providing transportation services to its customers.

¹ U.S. Bureau of Economics Analysis, "Table 1, Gross Output by Industry" https://www.bea.gov/industry/gdpbyind_data.htm, 2016.

1.3 In the United States, civil air transportation is a robust part of the economy. According to the United States Bureau of Economic Analysis, the government agency responsible for producing macroeconomic statistics of the United States'. economy, output of the air transportation industry ranked forty-first among sixty three industries in 2014. However, its small size belies its larger impact on the rest of the economy. What is this larger impact? One way to determine this impact is to estimate the contribution of air transportation to economic productivity in the United States.

1.4 Several prior studies examined air transportation productivity trends, and most found rapid productivity growth across various periods. Missing from these studies is a quantifiable way to measure to what extent the industry contributes to the nation's productivity growth (Anthony Apostolides, "An Analysis of Labor and Multifactor Productivity in Air Transportation: 1990-2001," United States Department of Transportation; John Duke and Victor Torres, "Multifactor Productivity Change in the Air Transportation Industry," *Monthly Labor Review*, March 2005, pp. 32-45).

1.5 The paper reviews recent productivity research conducted by the Federal Aviation Administration (FAA) and United States Bureau of Labor Statistics (BLS).² In addition, the paper presents a framework to calculate and recognize civil air transportation's economic importance for facilitating the prioritization of resources for national planning and sustainable economic development using an economic model called multifactor productivity (MFP).

2. DISCUSSION

2.1 Productivity is defined as the relationship between producing a good or service, or output, and the input(s) needed to produce that good or service within a time period. Why is productivity important? Economy-wide, real productivity measures how efficiently an economy is producing output. Positive productivity growth implies a country is producing more output with the same levels of inputs or producing the same level of output with fewer inputs. This is one indicator of a higher standard of living. At an industry level, it describes the competitiveness of the industry, as well as how much the industry contributes to the nation's overall economic growth.

2.2 For airlines, which make up a large part of civil air transportation, production is estimated by measuring the output of services produced. To estimate the productivity of the industry, output is compared to the allocation of purchased or leased inputs into producing those services. Inputs include aircraft, fuel, flight crew (including pilots and flight attendants), maintenance personnel and materials, check-in staff, and ticketing services. These inputs are divided into five categories: capital, labor, energy, materials, and services input components. These inputs are abbreviated as KLEMS.

2.3 Productivity is measured in two ways—single or multifactor. Single factor productivity (SFP) measures the change in output due to the change in a single input category, such as labor. MFP measures the change in output over and above all the measured inputs. Commonly, MFP is attributed to

² U.S. Department of Transportation Federal Aviation Administration, *The Economic Impact of Civil Aviation on the US Economy*, November 2016, https://www.faa.gov/air_traffic/publications/media/2016-economic-impact-report_FINAL.pdf and U.S. Department of Labor Bureau of Labor Statistics, *Economic productivity in the air transportation industry: multifactor and labor productivity trends, 1990–2014*, March 2017, <https://www.bls.gov/opub/mlr/2017/article/economic-productivity-in-the-air-transportation-industry.htm>

influences not included in the model—for example, research and development, new technology, economies of scale, managerial skill, and changes in the organization of work.³

2.4 Of the many available SFP measures, labor productivity (LP) is the most widely used. In air transportation, labor productivity captures the growth in output of transporting people and cargo based on the growth of one input, labor. Labor input is the number of hours worked by employees in the air transportation industry, considering the various skill sets and experience possessed by these workers. During 1997-2014, output rose while labor input declined (Appendix A: Figure 1 refers).

2.5 A weakness of LP is that it attributes the change in output only to the change in labor. The change in output may be due to other reasons. These reasons may include changes in technology, employee effort, organizational efficiencies, and changes in other factors of production, such as capital, energy, materials, and purchased services. Therefore, LP is difficult to interpret because it only focuses on one input, labor.

2.6 According to FAA and BLS research results, using long term data from the Bureau of Transportation Statistics between 1990 and 2014, air transportation industry LP grew 4.1 per cent per year (solid line, Figure 2), more than twice the 2.0 percent growth of the total United States non-farm business sector (dashed line). (LP declined during recessions: 1990-91, 2001, 2007-09; gray panels, Appendix A: Figure 2). Between 2002 and 2007, air transportation LP grew ten per cent, the highest among any industry in the United States. This growth was driven mostly by the output growth of low-cost air carriers. Legacy air carriers contributed to this LP growth through mergers and labor outsourcing, in addition to cutbacks in labor hours. Thus, LP may be overstated.

2.7 Another measure of productivity is MFP, which is a much broader measure than LP that includes all inputs or factors used in the production process, not just labor. MFP is the output growth that cannot be accounted for by the changes in input. The exact source of MFP growth cannot be easily identified, as it may be attributed to research and development, new technology, economies of scale, managerial skill, or other organizational changes.

2.8 Research shows that air transportation's MFP averaged a 3.3 per cent annual growth rate between 1997 and 2014 (Figure 3 in the Appendix refers)⁴. Air transportation MFP growth outpaced the United States Non-farm business MFP growth by three times during this period, 3.3 versus 1.1 per cent (solid versus dashed lines, Appendix A: Figure 3). Air transportation MFP growth was fueled by a moderate rise in output of 2.1 per cent per year, and a decline in the use of inputs by -1.2 per cent per year. The decline in the use of combined inputs was the result of higher information technology, capital investments in internet websites, and changes to service agreements with travel agents beginning in the late 1990s. The changes in service agreements affected the pricing structure of commissions, paid for airline ticket sales and resulted in an increase of ticket sales through airlines' own websites. Furthermore, the outsourcing of maintenance workers began in 2000, bringing an 8 per cent decline in labor inputs along with a rise in outside equipment purchased services. Contracting out for maintenance rose 10.5 per cent during this period⁵. Most of these changes occurred prior to 2007, the period consistent with the highest growth in air transportation MFP. This is shown by the relatively steep slope of the MFP curve (solid line) and the air transportation MFP numbers that appear in the small table at the bottom of Figure 3 (Appendix A). During 1997-2000, 2000-02, and 2002-07, MFP growth was 4.3, 3.8, and 5.8 per cent, respectively, all far higher than the economy-wide MFP.

³ U.S. Department of Labor, Bureau of Labor Statistics, "Industry Productivity Measures," *BLS Handbook of Methods*, August 2016. <http://www.bls.gov/>

⁴ KLEMS input estimates first became available in September 2005 for the years 1997-2003.

See http://www.bea.gov/scb/pdf/2005/09September/0905_Industry.pdf

⁵ FAA calculation using Form 41 Financial data from the Bureau of Transportation Statistics.

2.9 Figure 4 (Appendix A) shows the average annual MFP growth rates for the top five and bottom five industries from 1997-2014. The MFP growth rate for the air transportation industry was 3.3 per cent during this period, second to the 6.1 per cent growth rate for computers and electronic products.

2.10 The air transportation industry directly accounts for roughly 1.4 per cent of the nation's real GDP growth from 1997-2014; it accounts for the 7.3 per cent share of the nation's MFP growth (Appendix A: Figure 5). Air transportation is the seventh leading contributor to the nation's MFP growth—the second highest growth among the sixty three industries studied. Therefore, the airline impact on economy wide productivity is higher than its impact on real GDP.

Note. — The previous section reported on work completed in November 2016. Since that time, additional data became available for analysis—1987-1989 and 2015-2016.

2.11 The new analysis between 1987 and 2016 reveals that the air transportation industry had an even more disproportionate impact on the national economic productivity growth with respect to its size than previously reported. Over the longer period of analysis, the United States air transportation industry had a 3.5 per cent impact on MFP growth. Air transportation continues to be in the top fifteen industries leading productivity growth in the United States between 1987 and 2016. Among the industry categories followed in the United States, air transportation had the ninth largest contribution to MFP growth, ranked forty-second of sixty industries by employment numbers, and forty-first of sixty industries in value added economic output.

2.12 Looking at specific periods yields even higher percentages than the overall longer-term statistics. In the latest business cycle, 2007 – 2016, in which aggregate MFP has slowed considerably, air transportation represented roughly 5 per cent of the United States' aggregate MFP growth, and grew an average annual rate of 1.1 per cent every year during the period. Air transportation is the leader among all of the transportation industries, with respect to productivity growth (Appendix A: Table 1).

3. CONCLUSION

3.1 The air transportation industry has evolved rapidly in the last twenty years. Understanding the dynamics and, more importantly, understanding how the industry influences the economic productivity assists policymakers in prioritizing scarce resources and improving opportunities for economic growth and development.

3.2 Productivity analysis demonstrates that the air transportation industry impacts economic growth by providing fast and efficient services. The rate of the industry's ability to innovate and become more efficient has been a positive force during the last recession and recovery business cycle for the United States. Furthermore, the air transportation industry contributes a disproportionate share of productivity growth relative to its size and employment.

3.3 Economic productivity analysis is a means to demonstrate how air transportation investment has a far-reaching positive return on investment beyond the typical economic impact analysis and benefit cost analysis. The research conducted by the FAA and BLS offers a unique tool for states to use to foster continued investment and improvement of aviation infrastructure across the globe.

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APPENDIX A

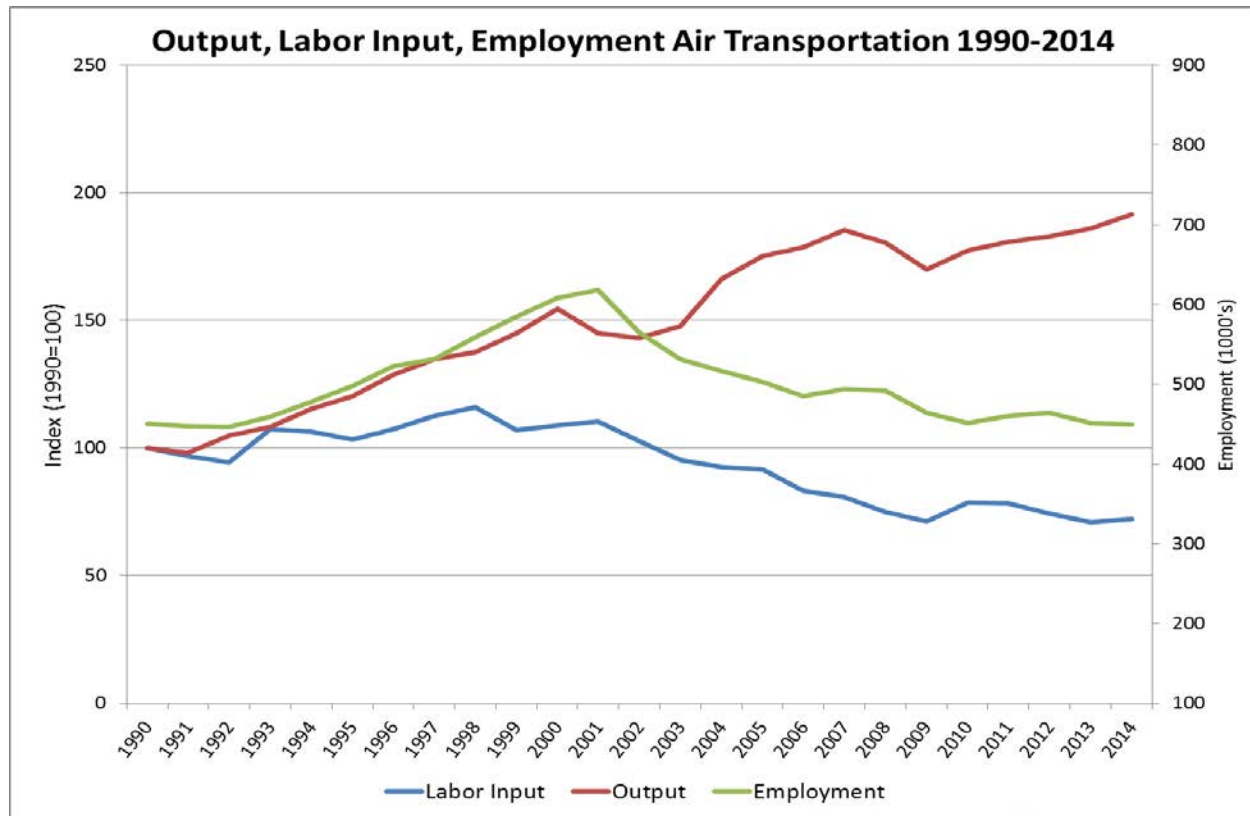


Figure 1. Air Transportation Output, Labor Input and Employment, 1990-2014

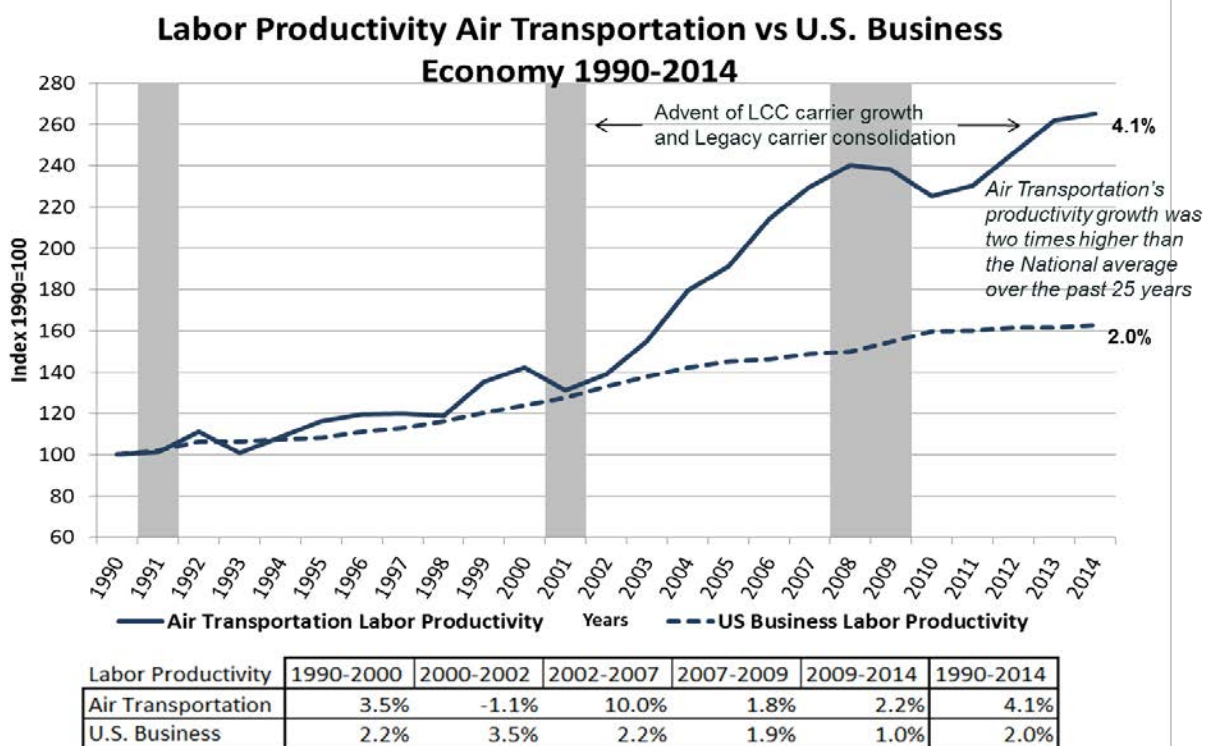


Figure 2. Labor Productivity by Industry, 1990-2014

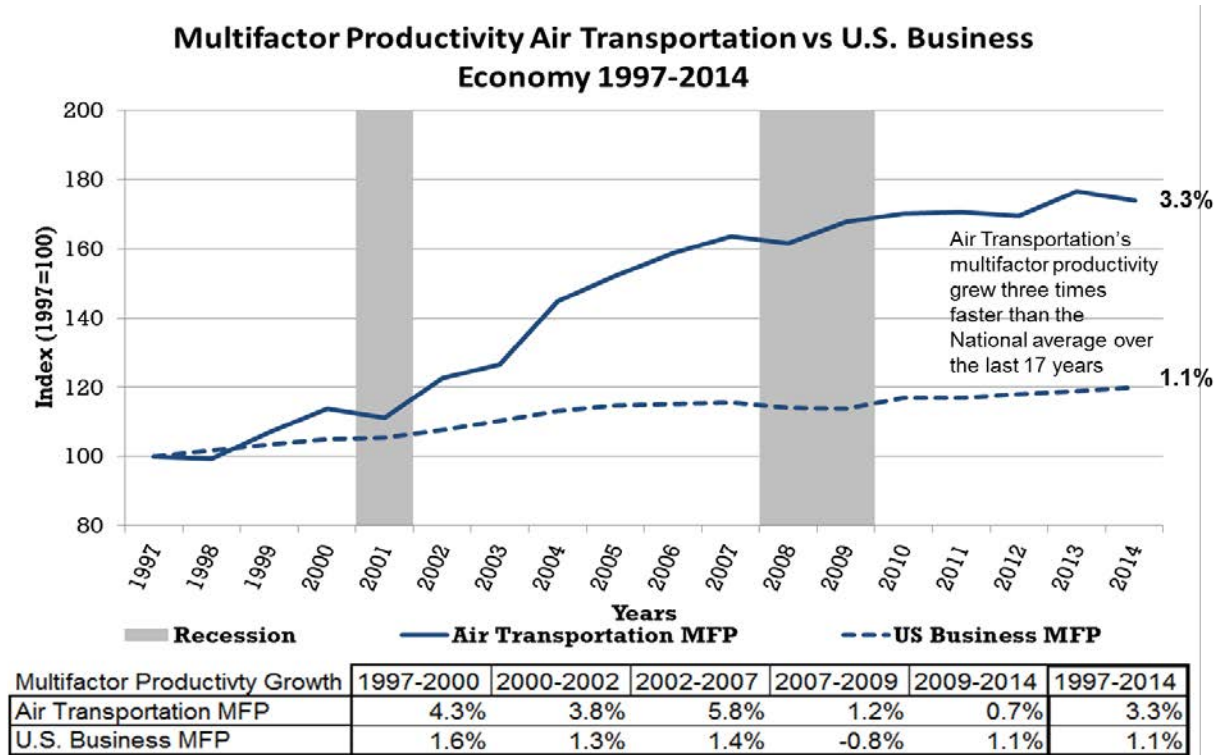


Figure 3. Multifactor Productivity, 1997-2014

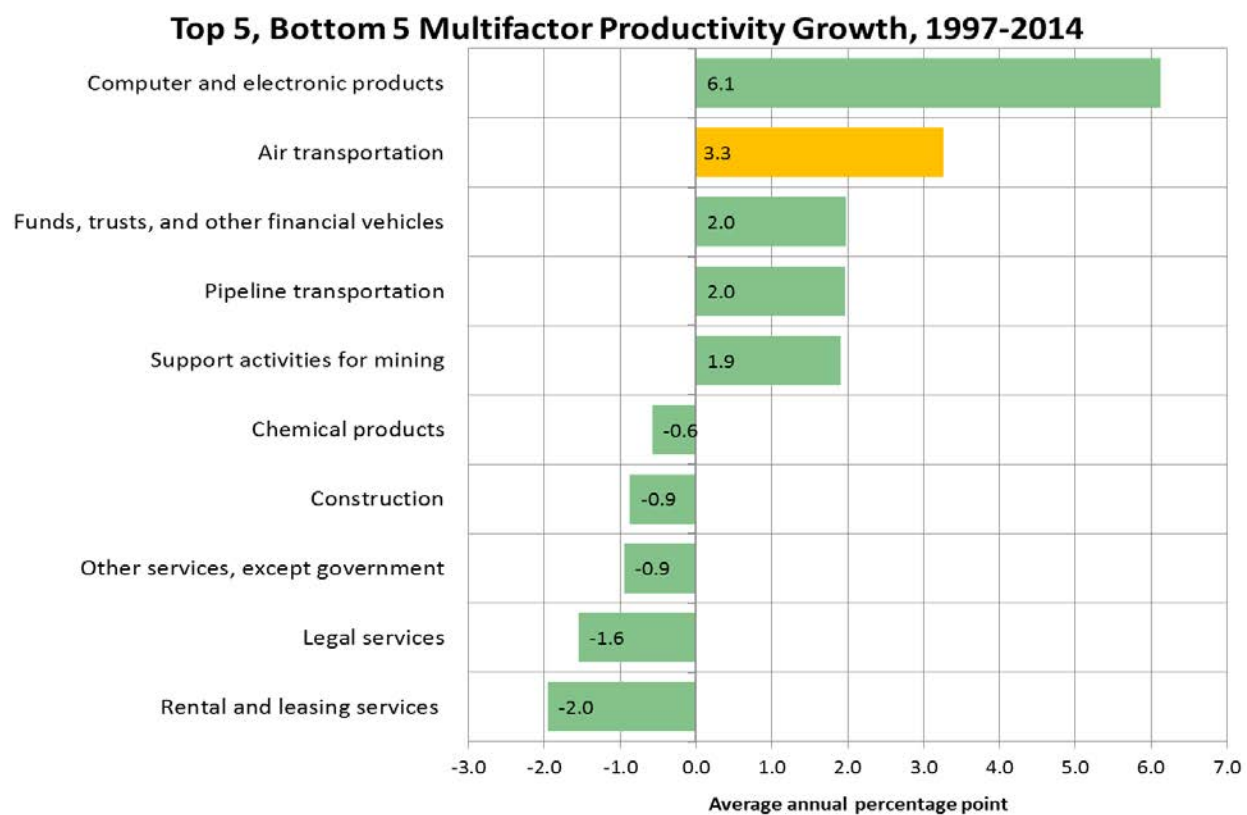


Figure 4. Multifactor Productivity by Industry, 1997-2014

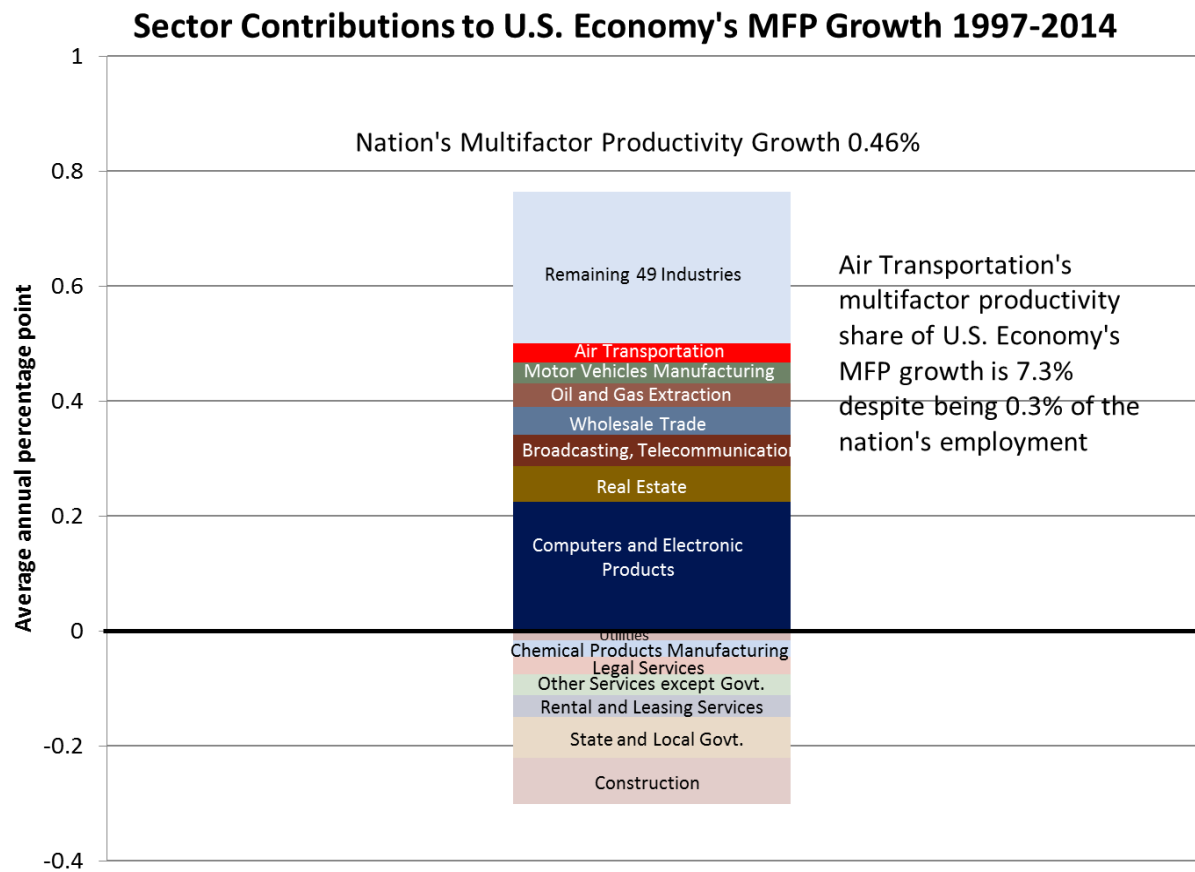


Figure 5. Contribution to Overall US Productivity Growth

<u>Transportation Industry Multifactor Productivity Growth</u>	1987-2016	2007-2016	2000-2007	1990-2000
Air Transportation	2.5	1.1	5.3	3.4
Rail Transportation	1.2	-0.2	0.7	1.6
Water Transportation	1.2	0.3	1.5	0.1
Truck Transportation	0.4	-0.1	-1.0	3.5
Transit and Ground Passenger Transportation	-0.5	-1.7	-0.1	0.2
Pipeline Transportation	0.9	-1.0	0.5	0.7
Other Transportation and Support Activities	-0.5	-0.7	0.8	-0.3
Warehousing and Storage	1.8	0.6	0.8	1.4

Table 1. Multifactor Productivity Growth – U.S. Transportation Industries