HOW REGIONAL AIRPORT PERFORMANCE AFFECTS LABOR MARKET IN UKRAINE

by

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Abstract

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Air transportation is a core element of the logistic system for social and business purposes. The development of the national airport infrastructure is the predeterminant of the aviation success. During 2010 – 2018 years, the aviation sector in Ukraine expand in terms of air passenger traffic. Nevertheless, the increasing passenger traffic distributed disproportionately among regions. Thus, different regions experiencing different effect of the regional airport performance.

In this work, we want to estimate the effect of the regional airport performance in terms of air passenger traffic on regional labor market, in terms of wage in various economic sectors, in Ukraine.

The results show that airport performance affect wages in such sectors: Trade, Agriculture Industry, Information & Technology and Professional services. Moreover, the estimated effect varies across region regardless to the development of the regional airport. The estimated results suggest that the effect of airport performance is large for the regions with big airports, and, surprisingly, for small regions, with small airports the increase passenger flow from 2017-2018 years provides even larger effect on wages in Trade, Agriculture and Industry sectors.

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LIST OF ABBREVIATIONS

ACI – Airports Council International

EU – European Union

GDP – Gross Domestic Product

GRP – Gross Regional Product

IATA – International Air Transport Association

ICAO – Civil Aviation Organization

IV – Instrumental variable

LCC – Low-Cost Carrier

OLS – Ordinary Least Square

PAX – Air Passenger Traffic

PPI – Production Price Index

SAS – State Aviation Service

SSS – State Statistical Service

TTC – The Territorial Community

UkrSATSE – Ukrainian State Air Traffic Services Enterprise

2SLS – Two-Stage Least Square

Chapter 1

INTRODUCTION

Aviation plays a significant role in the world economy and the process of economic development. Being a cornerstone of international logistics systems for all agents of the economy. Acceleration of the business processes and globalization, has made speed and agility key factors of competitive advantage. Fast technological progress made air travel affordable, and widened its role in the global economy. Air transportation facilitates economic connectivity improvement with developing and geographically isolated countries. Especially for people, in the way of labor migration for short- and long-term period, business travel, and, of course, tourism as a time reducer and intensifying factor of business processes.

Aviation sector is a complex system. The main actors of the aviation sector are airports, airline companies, and consumers that can produce necessary demand levels, and the government as a regulator. Such an interrelated system that touches almost every aspect of economic parties has a strong effect on the economic processes within the country's economy. Thus, development of an air transportation system with a wide range of destinations and technological advanced capital gives incomparable advantage for the country and people who are able to use these services. It implies rapid movement of people and goods within the country and around the world, providing significant social benefits influencing the labor market, increasing revenue streams for business, improving connectivity. Such a wide range of positive effects, of course, have a great contribution to economic growth, in terms of regional indicators of the country. Thus, development of the air transportation system can have a positive overall effect on regional development within the country. That is why, it is important to analyze the possible effect of air transport service on regional economic effects, to understand the contribution of the aviation sector better, and to define what magnitude it

brings. The objective of this work is to contribute to the understanding of the effect of regional airport performance on the regional labor market in Ukraine. In this work, we will mainly focus on airports performance. The location and certain characteristics of the airport determine the efficiency, productivity and availability itself of the air transportation services. Thus, it is crucial to sustain and develop such an important link mechanism in the infrastructure of the whole country.

The motivation of the thesis work is to analyze the regional airport system in Ukraine and come up with the result that will determine how it affects the labor market in terms of sectoral wage. As regional airports do not really have any cost advantage compared to Capital City airports, so it is more difficult for them to attract multiple passenger segments. And there is always a question of how to keep the airport busy 365 days a year.

The structure of the thesis is broken down as follows: Chapter 2 reviews the literature involving regional airport developments. Chapter 3 presents the methodology, Chapter 4 describes data overview covering regional airport indicators and regional economic indicators., volatility, and their relationship with airport choice factors. Including step by step analysis framework with methods explained and the preferable model used. Chapter 5 for results obtained and their interpretation. Chapter 6 dedicated to the conclusions and possible recommendations. We want to come up with the answer on how regional airports affect labor market in Ukraine particularly, we want to investigate effect on the wages in specific sectors of Ukrainian economy. We will mainly focus on the sectors that have a significant contribution on Gross Domestic Product. The magnitude of these effect and differences across regions will provide essential understanding of how traffic in regional airports can change labor market in different sectors.

BACKGROUND

By so far we define a significant role of aviation on economic processes within the country. It would be appropriate to present the current situation of air transportation system development in the Ukraine. Nowadays, the Ukrainian aviation and airport infrastructure is made up of approximately 40 airports.There five main airports by passenger flow that have over one million passenger flow in 2019, obviously, the leader is Boryspil Airport: 15.2 million, Zhuliany Airport: 2.6 million, Lviv Airport: 2.2 million, Odessa Airport: 1.7 million, and Kharkiv Airport: 1.3 million. There were several attempts at reconstruction of airports in Kharkiv, Odessa, and Kyiv`s Zhuliany. Even though private investors were engaged into funding, these improvements have a more occasional effect. By the scale, the most significant airport infrastructure projects proceeded in preparation for EURO 2012. Thus, big state-owned airports such as Boryspil, Lviv, and Donetsk, located in the cities where football events took place, were financed from the state budget. But still, out of 40 functioning airports as of 1991, only 20 remained nowadays, and 2/3 require considerable reconstruction. Considerable parts of Ukrainian airports can be titled as Post-Soviet monuments and total failure, or even absence of the development strategy. We are still in the shadow of the previous powerful system. Taking into account all the mentioned above, there will be only 8 included in the analysis, because of the lack of sufficient passenger flow volume. Also, airports located in Kyiv (Boryspil, Zhulyany) were excluded from the analysis, location in the capital city gives incomparable advantage which results in outlying numbers in terms of passenger flow.

The absence of systematic approach of the development process on the part of policymakers, ineffective privatization and regulatory processes, and leaving the aviation sector for himself create insurmountable obstacles for sustainable development of the industry. Obviously, such a state of a thing is completely misleading with the growing demand for air transportation services. Moreover,

Ukraine has not fulfilled the unique geographical location for developing a competitive large transit route and domestic route system. That is where the problem of underperformance of the air infrastructure system can be seen clearly. Providing that Ukrainian economy can not benefit from the positive effect of the aviation sector on economic growth and regional development. Of course, we are not able to exclude other significant factors that affect air transportation such as economic crisis, political instability and war. These factors give a tremendous negative effect on the ukrainian aviation, and furthermore, on the image of the country as a "safe place to visit".

Despite the last year pandemic crisis, that certainly harmed aviation in a tremendous way. To see how hard COVID harms the aviation industry, we can analyze a number of flights worldwide dynamics from 2005 - 2021.

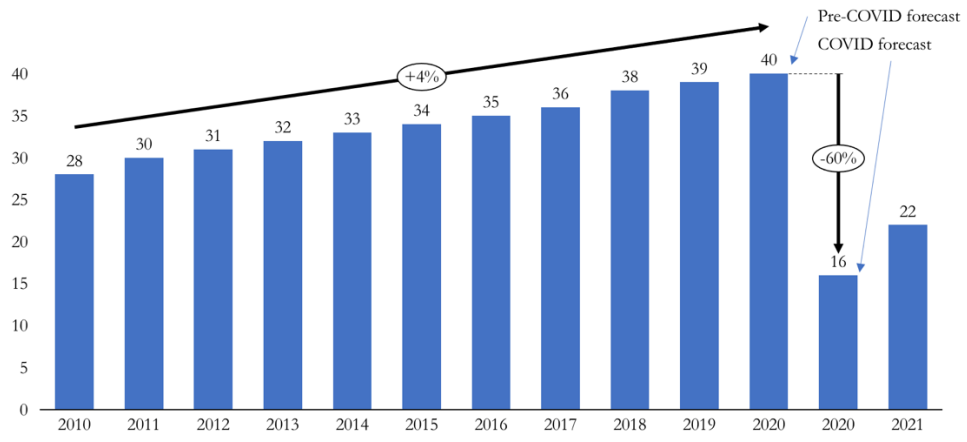

Figure 1. A number of flights performed by the global airline industry from 2004 to 2021, in million persons.

Source: www.statista.com

We can clearly see gradual growth of the sector from the 2010 to 2019 period. If we count compounded annual growth rate (CAGR) for this period, find out that air industry growth at 3 percent annually, which is a very reasonable indicator to say that it demonstrates good dynamics. We can compare the estimated forecast of the number of flights for the 2020 year and real performed numbers, the difference is 59 percent, which is dramatical for the whole industry. Furthermore, as air transportation is a key chain in global logistics chains, business, and travel tourism, we can not even determine the total negative effect on economic processes of each agent and sector.

In 2019, Ukrainian State Air Traffic Services Enterprise (UkSATSE) provided air navigation services to 335,407 flights of foreign and Ukrainian airlines, which is 12 percent more than in 2018, but 37 percent lower than in the record year of 2013.

Nevertheless, good times are coming and the COVID crisis will be overcome, although it will change the air industry radically. Thus, Ukraine as a very geographically potential country in the global air transportation system should be prepared for new conditions, or at least how time for improving today`s very unpleasant situation in the national air transportation sector.

Chapter 2

LITERATURE REVIEW

Aviation demand is the subject of this study because of the importance of its impacts on the economy. Through literature review we will first try to explain the choice of variables dedicated to represent regional economic indicators that can be related to the air passenger flow processes. Then, we will focus on the methodology to provide evidence on the usage of the chosen model and method of achieving results. We find related works have contributed to the study of the effect of the air transportation services on the labor market.

A lot of studies were performed to indicate key factors that influence air industry performance, especially those that concern airports, describing a relationship between air transportation and economic indicators. We want to justify usage of such regional indicators as gross regional product, population of the region, unemployment rate, and share of people attending higher educational institutions that could influence both the demand and supply side of the air transportation service market. These variables are believed to have substantial impact on passenger flow in particular regions. It assumed that a considerable part of Ukrainian airports faced a problem from supply, meaning that some of the airport service indicators functioned inappropriately. In contrast several studies from European markets revealed that there are also demand-side effects.

Chalotta Mellander (2012) using multiple regression analysis for US metros, found that it is not just having an airport but that its size and scale of activities matter to regional development. That contributes to our study as we want to know the difference of the effect across regions, taking into account that the presence of the airport is not enough to provide a significant effect, also its performance and other factors determine the possible effect on the economy of the region. It was also

confirmed airports contribute to economic output per capita, controlling other variables. Another surprising finding was that unemployment has insignificant effect although we will use this variable in our model. We want to test the effect of the unemployment rate in Ukrainian case, and it is assumed that it will have a significant negative effect for both air passenger flow and sectoral wage.

We proceed with the most relevant outcomes from the related works that can help to form our main hypotheses. The effect of income per capita on aviation demand was observed in the Nisa Secilmis and Aylin Koc (2016). The aim of the paper was to identify economic factors affecting aviation demand using cross-sectional analysis methods. To do so they use income per capita, industrial production index, price level and inflation rate as explanatory variables for demand for aviation services. The study was conducted on 28 European Union countries members and Turkey. In this work authors overcome heteroscedastic problems that are common in the case of the horizontal cross-sectional analysis, and come up with consistent results. The practice of EU countries has shown that a 1-unit increase in income per capita is increasing aviation demand by 2.185 points. As it was expected income per capita has a positive significant effect. Same is true for the production index, as it has a significant positive effect that a 1-unit increase in production index is increasing demand by 1.197 points. We can use these results for the assumption that gross regional product can be used as an explanatory variable for air passenger flow, and will have a positive effect on it.

Phillip Tuminaro (2017), in his work related to the analysis of variables that impacting Southern Illinois Airport activity between the years 2000 And 2010, has come up with several findings that should be tested for the Ukrainian case as well. Using lenar linear regression analysis to determine independent variables that affect local civilian operations and itinerant general aviation aircraft operation in Illinois. Main findnings are the following: 1) increase in region population by one person results in decrease of about 6 local civil operations, negative effect of the

population; 2) one million dollar increase in GDP of the region will increase local air operations on 0.5, thus regional capital investments positively affect airport activity; 3) unemoloyment has negative effect on loacal operations, as with an 1 percent increase in unemployment rate, will decrease aviation operations by approx. 3.2 percent.

There is also evidence from Italy, Marco Percoco, uses the Tobit model in his work, and found out that the elasticity of employment to passenger flow is 0.019, implying an increase of 0.2 percent in total employment corresponding to a 10 percent increase in passengers. This also confirms the reverse relationship of unemployment to passenger flow in regional airports.

It is also worth mentioning great works provided for the Ukrainian market that contribute to my work significantly. D. Taranenko (2020) in his work analyzed the effect of air traffic on Gross Domestic Product. Using Granger causality tests confirms the effect of air traffic of big airports on Gross Domestic Product. It states that 10 percent increase in the air traffic on average leads to an increase in regional GDP of 0.47 percent. But for small airports there is no such causality, confirming that there is difference among regions in terms of effect of passenger flow.

In this part we want to understand how regional airport performance affects specifically the labor market. Jacco Hakfoort (2010) published his work about the regional economic impact of an airport on the particular case of Amsterdam Schiphol Airport. In this paper input-output model was used to investigate the possible forward and backward linkages between airport activity and the local labor market. Especially how temporary and non-temporary effects on the demand side of the economy affect airport functioning and vice versa. Through analyzing the direct employment, indirect employment, created by backward linkages and induced effect created by forward linkages on the labor market caused by operation

of airports. In this paper several new approaches were used, extended input-output model, specifically social accounting matrix Model AsterDAM (MADAM) that has been developed from scratch. The results describe the effect as a multiplier, thus one directly created job in an airport creates one indirect and one induced job. In this paper authors also distinguish qualifications and education levels of created jobs.

Taking into account interdependence of the passenger traffic and regional economic indicators, thus, using macroeconomic and demographic data can cause endogeneity problems because of high likelihood of correlating with each other. This problem of endogeneity will be worked through econometric tools described in the methodology chapter. The possible solution to the endogeneity issue is introducing og instrumental variable and implying Two Stage Least Square model that is planned to be used in the following analysis was implied in the research paper about China's case. The main contributions of the work were indicating factors that affect airport sustainable development, highlighting the effect of the airports on social benefits and environment driving forces. The authors use factors that are consistent with some of the chosen variables in thesis work and the hypotheses about sign of the magnitude, also were confirmed, such as positive effect of Gross domestic product of the located region, number of college degree students.

The Baltaci`s (2015) study dedicated to the analysis of the relationship between air transport and economic growth in turkey. To be precise they analyze whether an active airport and its traffic frequency have an effect on a country's macroeconomic indicators . They apply two stage least square (2SLS) models using panel data analysis for 26 sub-regions for the 2004 - 2011 period. In our work we will be using the same approach to obtain consistent results. By using the 2SLS method they address the issue of reverse causality and possible endogeneity issues. They introduce two instrumental variables, first, for the presence of an airport and

second for its distance from the nearest hub-airport, which is relevant to our approach as for one of the instrumental variables we use distance to the main airport Boryspil. Human capital, as an amount of higher education graduates, and employment effects, as the labor force participation, population and immigration speed were used as controlled variables in analysis. The results show a strong positive relationship, suggesting that an increase in the number of active airports and its traffic have a positive effect on regional economic growth. Moreover, they found that newly built airports provide a positive effect on business and employment activity, as a 10 percent increase in passenger amount increases employment in the service sector at 1 percent rate. Additionally, 1 point increase of university graduates increased airport traffic by 0.0000089 percent. Lastly, when the rest is constant, an increase of passenger traffic by 1 percentage point contributes to an increase in Gross Value Added in the region at a 0.016 percent, as expected effect is positive and statistically meaningful.

The research work undertaken for Air Transport Action Group (ATAG) by Oxford Economic Forecasting (OEF) provides facts and figures which show social and economic benefits of aviation on the global level covering regional economic data for Europe, Africa, North and LAtina America, Middle East and Asia Pacific regions. It shows that the aviation industry is an employer for more than 29 millions people and has created the direct effect of an increase in 5 millions jobs, indirect effect amounts to 5.8 millions jobs created through additional purchases of goods and services from aviation companies. Further researches also count induced effects through spendings of industry employees. Moreover, more 15.5 million direct and indirect jobs were created through catalytic impact on tourism. It goes without saying that aviation has a positive effect on employment, in our work we will determine how air transportation affects wages in different sectors. That would expand our knowledge about the situation in other sectors when there is a significant local employment bust.

Ray Rasker (2009) investigates the importance of access to airports for economic development of three distinct western United States (the West) dividing into new classification as a metro, connected and isolated regions. Then test whether there is a difference in their economic performance relying on the presence and performance of the airport as a connector to the economic centers of the country. In order to evaluate the relation between airport access and economic performance, they use least squares regression equations. They found that well connected areas with functions airports had a significantly greater proportion of the population under 21 years of age, and isolated areas have the oldest population, and highest share of population greater than 65 years of age. The percent of the adult population with obtained degrees is also higher in connected areas. Thus, more knowledge-based occupations in engineering, finance, and insurance occurred, and that influence meant wage growth rate in these sectors, implying that in metro and connected areas with well operated airports have higher mean earning per job. That is obvious as more professionals and high-quality jobs are present on the market. This study gives a great fundament for our work, and ensures the relationship between airport performance and regional economic performance.

The paper of Ismail Çağrı Özcan (2013) consist of basic approaches that will be used in our work. As the questions covered by turkish researches and the methodology applied is in line with our main research questions. The Authors use 2000 data from 20 turkish provinces, to study the possible effect of air cargo traffic on the local composition of the employment sector in terms of industries and occupations. This study as many of the mentioned above uses 2SLS model to deal with the causality. Two instrumental variables were introduced, hub - an instrumental dummy variable for provinces having hub airports, and proximity - an instrumental variable and equal to the distance, in kilometers, to the province that has an operating airport. In our work similar instrumental variable Distance was used, as a distance, in minutes, to the capital city airport. The results show that air

cargo traffic stimulates employnet in finance, insurance and real estate, in contrast reducing employment in agriculture, hunting and forestry sectors. Interesting findings provides work of Ismail Çağrı Özcan (2015) with the same logic but for air passenger flow, not cargo. The results provide that 1 percentage point increase in air passenger flow leads to 0.0019 percent increase in employment in construction, 0.0098 percent increase in wholesale and retail trade and 0.0025 percent increase in employment in restaurants and hotels sector. Which helps us to form assumptions about the effect on the wages in our sectors.

In this thesis work the analyzed literature would be applied to the Ukrainian markets, to understand how this animal works in our reality.

Chapter 3

METHODOLOGY

The aim of study is to model the effect of air passenger traffic on regional wages in different sectors. A significant change in air passenger traffic can affect local wages in certain ways, as presence of operated airports can influence business activity and economic process within the region, further higher passenger flow leads to increase or decrease in workers of different qualifications, thus influence wages in different sectors. Vice versa, increase or decrease in wages in particular regions can affect demand on air transportation services. That is where the problem of causality and endogeneity evolves. To overcome this obstacle, we employed 2SLS estimation. For analysis, we follow the approach similar to Ozcan (2013) methodology. We used two instruments namely distance and type of ownership. First, the distance from regional airport to the capital city airport "Boryspil", as it has more than 10 times bigger passengers, wide range of destination and larger number of carriers. So, it is a direct competitor to all regional airports, and people for their will also make a choice from where to fly between nearest airport and Boryspil, because of its development structure of routes and operating air companies. Second instrumental variable is type of ownership of the airport. It is divided into three possible cases: 1) private ownership; 2) state ownership; 3) territorial community ownership. In our sample there is only one airport that is in state ownership – Danylo Halytsky Airport of Lviv. At this point we believe that chosen instrumental variables can be suitable, to confirm the Wu-Hausman test for each instrument was conducted.

As a result, we modelled the first stage estimations as:

$$\text{Air passenger traffic} = f(\text{Distance, Type of ownership}) \quad (1)$$

After running the first step, we continue with 2SLS estimates, we run model including following specifications:

$$\text{Wage at sector X} = f(\text{Air passenger traffic, Population, Education, GRP, Unemployment}) \quad (2)$$

Where:

- Wage at sector X = monthly wage at particular economic sector of the economy, in converted from hryvnia (UAH) to dollar (USD) equivalent
- Air passenger traffic = monthly passenger traffic (domestic+international) log-transformed, in persons, within the airports of each region for the period from 2010 to 2018
- Population = the total population of each region, log-transformed
- Education = the percentage of the population as a students of higher educational institutions at each region
- Gross regional product = the gross domestic product of each region in per capita terms, log-transformed, converted from hryvnia to dollar equivalent
- Unemployment = the ratio of the number of unemployed persons to labor force at each region

The dependent variable (Wage at sector X) is measured in USD and is adjusted to inflation rate, and log-transformed, so to follow methodology in basic papers. The choice of sectors depends on their contribution to Gross Domestic Product and can be influenced by air passenger movements. There are the following sectors: agriculture (AGR), industry (IND), construction (CONSTR), wholesale and retail trade (TRADE), transportation (TRANSP), information and technology (IT), finance and insurance (FIN), real estate (ESTATE), science and professional services (SCIENCE), accommodation and restaurants (HoReCa). Industries are divided due to NACE classification.

The main explanatory variable, air passenger traffic as the volume of air passengers, log-transformed to be consistent with the interpretation of the results and avoid influence of outliers. It represents the arriving and departing passengers at each region, including both domestic and international passengers.

To illustrate the relationship between passenger traffic and average wage we use data from the Odessa region. The results presented in Figure 2. There is exist positive relationship between two variables, as a trend line has upward slope. We chose Odessa region because of consistent and permanent passenger flow and availability of the data.

At Figure 3 presented air passenger traffic at each region. There are following regional airport traffic: Odessa Airport (PAXODS), Lviv Airport (PAXLVIV), Kharkiv Airport (PAXHRK), Dnipro Airport (PAXDN), Zaporizhzhia Airport (PAXZAP), Ivano-Frankivsk Airport (PAXIFO), Kherson Airport (PAXKHE), Chernivtsi Airport (PAXCHER). It is clearly seen that there is seasonality in operation of airports, which not surprising for this industry. Also, small airports such as Ivano-Frankivsk Airport and Chernivtsi has a significantly lower passenger flow than big ones, and periods with no flights at all. There is also absence of data for particular periods.

Next thing to indicate are the controlled variables. They are represented as regional control indicators: the total population at each region, the percentage of the population as students of higher educational institutions at each region, the ratio of the number of unemployed individuals to the labor force of the region. And economic control as the gross regional product in per capita terms at each region.

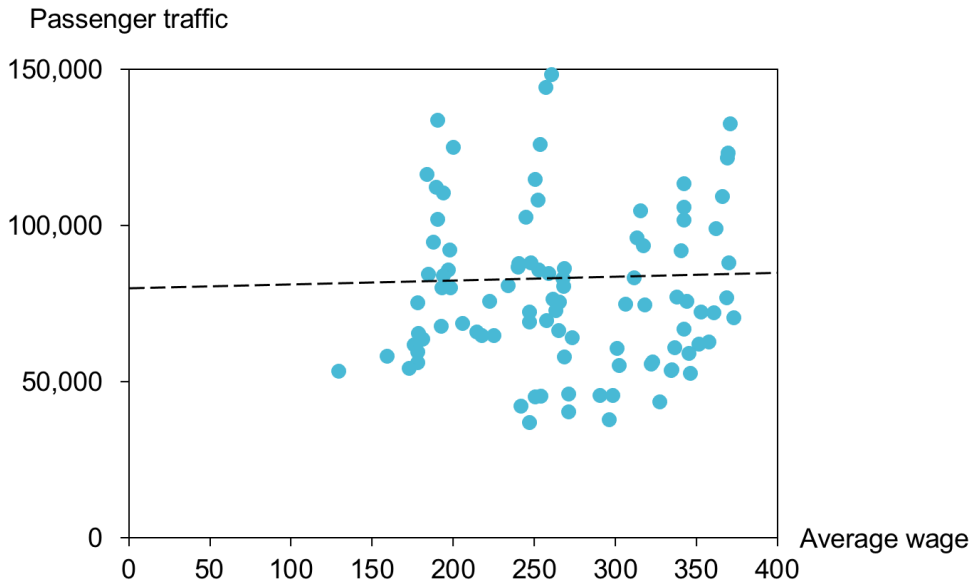

Figure 2. The relationship of the air passenger traffic in number of passengers, and average wage across sectors in USD, Odessa region, 2010-2017.

The main hypothesis is that air passenger traffic can affect the regional labor market in terms of wage in the chosen sectors of the regional economy. Therefore, it is assumed that air passenger traffic should have a significant effect on sectoral wage. Although the magnitude of the coefficient can vary across sectors. The population as an independent variable is supposed to have a significant positive effect on

dependent variables. But the sign of the effect differs among literature. Unemployment commonly has a negative effect in analyzed papers. It is anticipated that education should have a positive effect, as with an increase of higher educated people, wages requirements also increase, as people obtain professional skills and aim to get better jobs. Especially, in some industries like Finance and Insurance, or Science and professional services, as these industries are highly dependent on professional skilled workers. This hypothesis is rather theoretical based, as we can not observe such a situation in Ukraine taking into account imperfect labor market and low trust in the education system. It is believed that passenger traffic has a positive and strong effect on wages in the wholesale and retail sector, as this sector is very dependent on movement of people, goods and services.

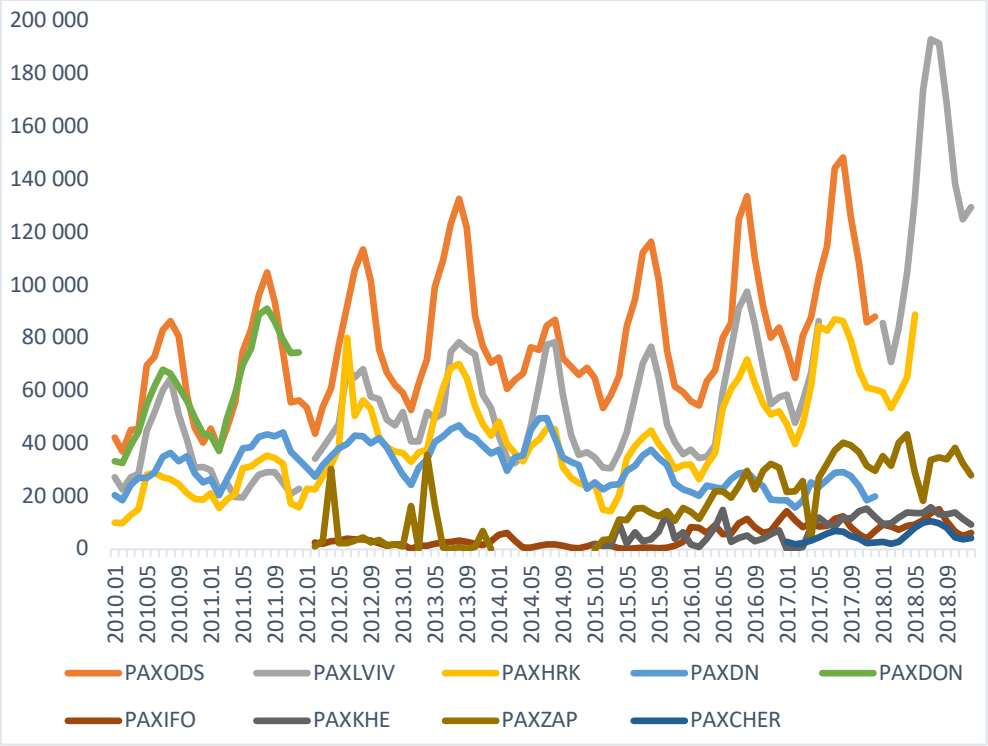

Figure 3. Air passenger traffic at each region

Following the structure of the work, we want to investigate how the magnitude and the effect of the passenger traffic vary across regions. The main assumption that there is a difference among regions with big operating airports and the ones with small. It will confirm relevant studies mentioned in the literature review. Such difference has been present in works of Taranenko (2020), Rasker (2009), and Mellander (2012).

Chapter 4

DATA OVERVIEW

We mainly use data from Centre of Aviation (CAPA) and Official Aviation Guide (OAG), official data providers of the worldwide aviation statistics. Data for passenger flow was manually collected from Euorcontrol database, as Ukraine gained membership in this organization in 2004. Other relevant data for airports with small flight operations was collected from Avianews – Ukrainian News resource about industry, including information about air services of 8 Ukrainian airports by annual passenger flow. Other specific information has been collected manually from regional airports statistics services on the request. We stop at Chernivtsi airport, as a last to be included, smaller airports appear to serve sporadic flights, and will not bring consistent outcomes. It could be clearly seen that all airports have increased passenger flow from 2018 to 2019. Taking into account restrictions of COVID, passenger flow in 2020 reduces ridiculously. Airports located in Odessa, Lviv, Zaporizhzhia, Dnipro, and Kharkiv have passenger flow over 1 million passengers and we can classify them as large. Kherson, Ivano-Frankivsk and Chernivtsi have airports with passenger flow under 400 thousand passengers. We have 4 airports operating under territorial community ownership. There are also 3 airports that are privately owned, and one that is state owned. In the Table 1 provided descriptive statistics for all airports included in analysis.

Thus, we have three airports with an average monthly passenger traffic over 40 000 passengers, these are Lviv, Odessa and Kharkiv airports. Which is not surprising as these airports are located in big cities, moreover they all situated on the geographical edges of Ukraine, which gives them particular advantage. We should also mention substantial capital investments into their development during European football championship in 2012 (EURO 2012). These cities were chosen to host international matches.

Table 1. Descriptive statistics

Variable	Mean	SD	Min	Max
Lviv Airport	58648	35375	19647	193100
Odessa Airport	78890	24950	37054	148402
Dnipro Airport	30850	8240	15835	49724
Kharkiv Airport	41598	19105	9925	88920
Zaporizhzhia Airport	18154	13562	14	43560
Kherson Airport	7912	4871	34	15962
Ivano-Frankivsk Airport	5005	3962	181	15225
Chernivtsi Airport	5049	2649	1936	10687

Dataset consist of 571 observations, for 8 Ukrainian regions for the period during 2010 – 2018 years. Regional indicators were obtained from Ukrainian statistics service (UkrStat) for each region with chosen for analysis airport. We obtain sample that includes monthly wages in 10 sectors of the economy (Wages in X), gross regional product in per capita terms (GRP), the total population of the region (Population), percentage of students of higher educational institutions to the total population (Education), percentage of the unemployed individual to the total labor force (Unemployment), and the main explanatory variable passenger traffic.

The descriptive statistics for each variable presented in Table 2. We can observe that on average highest monthly wages are in Finance and Insurance about 410 USD, and Information and Technologies sectors about 313 USD, which is the

information consistent with literature, and has a clear intuition behind, as it requires high professional skills. The lowest wage suggested to be in Accommodations and Restaurants sector, it is assumed that a big share of the workers are young unskilled individuals, probably combining job with education. Although values of the variables can differ across regions, it is still giving us an overview picture of the state of things during 2010 – 2018.

Table 2. Descriptive statistics of variables.

Variable	Mean	Median	Min	Max
GRP per Capita (USD)	2903	2750	962	7100
Passengers (persons)	37598	31200	14	193100
Population (persons)	2245114	2393739	904646	3355500
Education (persons)	93371	104600	20100	187600
Unemployment (persons)	19750	17785	4562	38826
Wages in Agriculture (USD)	202.3	198.0	63.0	393.9
Wages in Industry (USD)	298.1	282.2	107.4	508.7
Wages in Construction (USD)	206.55	199.82	68.81	389.20
Wages in Trade (USD)	204.71	207.65	81.06	375.76
Wages in Transportation (USD)	297.8	293.5	111.3	509.3
Wages in Inform & Techn (USD)	312.8	300.3	104.6	698.3
Wages in Finance & Insurance (USD)	409.8	386.4	146.8	803.6
Wages in Real Estate (USD)	217.80	209.33	61.72	1186.39
Wages in Science & Prof. Serv. (USD)	271.97	265.78	50.87	550.38
Wages in HoReCa(USD)	157.01	165.87	67.01	276.08

Dependent variable Wages in sector and such independent variables as GRP, Population, and Passengers were log-transformed for more precise and easier interpretation of the results. Education and Unemployment are presented in the analysis in percentage points and not require log transformation. To deal with data transformation we follow methodology of Ozcan (2013), in order to substitute the variable describing underdevelopment of the Turkish province, we use Unemployment in the terms, because it also refers to the negative effect on the development of the region. Thus, we provide necessary treatment for all the variable to obtain well balanced model.

Thus, we provide necessary treatment for all the variable to obtain well balanced model. We want to confirm or reject our stated hypotheses for all sectors. To understand difference in the results across analyzed Ukrainian regions.

Chapter 5

RESULTS

In our analysis 2SLS model was applied, so to overcome endogeneity problem of the main explanatory variable. To do so we follow Ozcan (2013) methodology. The two instrumental variables were introduced. The very next step to validate the usage of chosen instruments. We have Distance – is the time that is need to reach the capital city airport "Boryspil" from region center in minutes terms, log-transformed as well, and Type of ownership, specifically, what kind of ownership are in the airport, considering three types of them (state, private, TTC). To understand that these instruments are applicable to the model to be explained as a function from air passenger traffic, we need to provide Hausman test, following Taranenko's (2020) paper. The diagnostic test was performed to second stage regressions for each of the 10 economic sectors. Wu-Hasman tests the null hypothesis that there is no significant correlation, the preferred model has random effects, and alternative hypothesis, fixed effects. Rejecting null hypothesis at p value less than 0.05 gives us "green light" to use these instruments for 2SLS model. Alternatively, if fail to reject null hypothesis, that would mean 2SLS and ordinary least squares (OLS) models are equally consistent, thus, it is better and more efficiently to use OLS results. In Table 3, the result for all diagnostics tests for each sector were presented. The results imply that OLS efficiently to use for such sectors as: construction, transportation, information and technology, finance and insurance, real estate. While for agriculture, trade, professional services and science, accommodations and restaurants, 2SLS gives consistent results.

Weak instrument testifies the fact that the assumption that instrument is strong, by rejecting the null hypothesis at p value less 0.05. In the meaning that instrument has a correlation with the explanatory variable – passenger flow. And Sargan test

for exogenous variable, that it is, in fact, exogenous, and uncorrelated with residuals.

The results of OLS and 2SLS regression analysis for each sector reported in Table 4 and Table 5. According to the estimated results, the passenger traffic has negative effect on wages in agriculture, industry, professional services and science, and accommodations and restaurant services (HoReCa). Our initial hypotheses were accurate for agriculture and industry. Surprisingly, passenger traffic has negative effect on HoReCa sector. Implying that 1% percent increase in air passenger traffic results in decrease of wages in HoReCa on 0,275 percent, for science workers and those who are employed in professional service sector on 0,258 percent, for industry workers – 0,567 decrease. It means that presence of the operating airport and the increasing business activity in terms of passenger flow negatively affect labor market conditions. To be concrete the wage for below – average educational and skill levels will decrease in consequence, by Ozcan (2013). It can also be explained as significant influencing factor in regions with large proportion of rural population employed in agriculture and industry sectors, and limited alternative occupations opportunities.

On contrast, the main explanatory variable passenger traffic has a strong significant effect on the wages in trade sector, and relatively small, but still significant effect in information and technology, transportation, and construction. The obtained estimations reveal that with an increase on 1 percent of air passenger traffic, wages in trade will increase on 0.17 percent, for workers employed in information and technology services sector increase wage increase will be equal to 0.039 percent, wages in transportation services will increase on 0.05 percent.

Table 3. The result of Haussmann test

	Diagnostics test			
	P-value			
	Weak instruments	Wu-Hausman	Sargan	R^2
Log (Agriculture)	2.73e-07	< 2e-16	2.84e-08	-1.401
Log (Industry)	2.73e-07	< 2e-16	0.0235	0.689
Log (Construction)	2.73e-07	0.217	< 2e-16	0.839
Log (Trade)	2.73e-07	0.773	< 2e-16	0.5737
Log (Transportation)	2.73e-07	0.773	< 2e-16	0.8375
Log (IT)	2.73e-07	0.454	4.01e-10	0.8284
Log (Finance & Insurance)	2.73e-07	0.884	< 2e-16	0.8758
Log (Real estate)	2.73e-07	0.24	< 2e-16	0.6337
Log (Professional services)	2.73e-07	1.69e-13	0.000743	0.449
Log (Accommodations & Restaurants)	2.73e-07	< 2e-16	0.000523	0.0254

Note: Dummies for economic sectors, types of ownership and months of observations for structural differences and seasonality were used. Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '.' 1

We confirm our hypotheses about wage increase in trade and transportation, which is consistent with relevant literature. To put clearance in it, let assume that region

observes increase in air passenger traffic, that will definitely influence local economic activity, in the sectors with the fastest reaction on it, with relative services provided. As trade and transportation are closely related to the velocity of business process, and fast reaction the increasing movement of people, goods and services will be predeterminant factor for increasing wage in mentioned sectors. The number of goods and services provided to the increasing passenger movement will increase demand for labor in these sectors, which in turn affect labor market in certain region. Our main expectations were confirmed, results have practical usage and logical interpretation, taking into account strong interdependence between the airport activity, trade and transportation services.

Additionally, we found interesting findings of the effect of controlled variables on the labor market in analyzed sectors. Except of the effect of the air passenger traffic, we also found evidence of the significant effect of population, education, gross regional product and unemployment on particular sectoral wage formation. As for the population, our main hypotheses were that it has mainly positive effect on wage, regarding the official statistics on distribution of wages across regions in Ukraine. Estimation support our hypotheses, population has a strong significant effect on wages in almost all sectors, except of real estate, trade, and transportation. The largest coefficients observed in agriculture, accommodations & restaurants, and professional services. One possible explanation for that can be that large total population are commonly in regions with large share of urban population, it will influence the labor structure in rural areas where agricultural enterprises are concentrated, and to slowdown movement of labor to urban area of the region, they forced to increase wages. For professional services, and accommodations & restaurants sectors, obviously, larger population results in higher demand for their skills. The results imply that increase in population on 1 percent will be followed up with the increase of wage in agriculture sector on 1.25 percent, for the workers

in professional services sector increase equals to 0.68 percent, and in HoReCa sector on 0.33 percent. Hypothesis was accurate.

Regarding the effect of gross regional product in per capita on wages, we found positive relationship in professional services, trade and transportation. The listed sectors are fundamentals for providing logistics, sales and operational services for goods and services turnover and production. Though, holding other variables constant, a 1 percent higher gross regional product in per capita terms results in 0.39 percent increase in wages for workers occupied in professional services sector, equivalent to 0.10 increase in trade wages, and 0.08 percent increase in transportation services wages.

Education was supposed to have positive effect on the wages, although, it is true not for all sectors, which is not surprisingly, as not all of the jobs require high skilled workers with higher education. Thus, the increase in the percent of students in higher educational institutions to the total population of the region, will in turn increase wages in the following sectors: information and technology, agriculture, accommodations & restaurants, professional services. According the estimations, a 1 percent increase in education variable will increase wage in agriculture on 34 percentage points, in professional services on 15 percentage points, and in HoReCa on 23 percentage points. We supposed that an effect of education can have two-sided effect due to imperfection of educational system. Thus, an increase of students attending higher institutions in the region may imply possible increase in amount of well-educated and high skilled workers, who can find appropriate well-paid job, on the other hand, it is quite common in Ukraine to combine education in university with work to sustain needs of living for students, so increase in employment in HoReCa occupations goes alongside with an increase in number of students in the region. The estimated effect of education is consistent with literature of relevant studies.

The percent of the people unemployed to the total labor force, was used as underdevelopment of the region equivalent, following Ozcan (2013). The effect of it vary across sectors, we have significant negative effect in agriculture, industry and professional services sectors, on contrast, positive effect in information and technology services. Possible interpretation of such estimations, is that IT sector are not dependent on regional development level, as a lot of companies provide services remotely to the companies, even to the international markets. According to the Table 6, a 1 percent increase in unemployment will decrease wages in agriculture on 6.74 percentage points, for industry workers on 3.28 percentage points. We can provide possible comment for this, it is assumed that unemployed people will seek employment opportunities in labor market with lower skill requirements.

In the Table 4 presented percentage difference in the effect of the air passenger coefficients across the regions with the most consistent traffic from 2010 to 2017 years. It states how an increase in passenger traffic where it is statistically significant affect wages in Agriculture, Industry, Trade, Transportation, IT and HoReCa sectors. Thus, increase in the main explanatory variable air passenger traffic on average was one of the determinant factors of decrease wages in Agriculture from 4.7 to 6 percent each year. The highest effect was in transportation, as it was one of the determinants of about 4 percent increase in wages. The results do not imply that actually decrease on that amount, because there also other factors that influence wags, here we present only the effect by passenger traffic. From 2010 to 2017 period airport located in Lviv and Odessa that have higher passenger flow than Dnipro, also observed higher average percentage change in wages. The study shows that the difference across regions exists and affect labor market stronger in regions with higher passenger flow, although the magnitude of the effect is consistent across regions.

Table 4. Regional difference in the coefficients from 2010 to 2017 period

Region	Agriculture	Industry	Trade	Transportation	IT	HoReCa
Passenger coefficient	-0.56	-0.18	0.17	0.05	0.03	0.25
Odesa	-6	-1.7	+1.5	+4.4	+3.4	-2.5
Lviv	-6.5	-1.8	+1.6	+4.8	+3.7	-2.7
Dnipro	-4.7	-1.3	+1.2	+3.6	+2.8	-2

Our hypothesis is true for airports with passenger flow over 400 000 passengers over the year, with sufficient number of observations during 2010 – 2017 period. Unfortunately, due to absence of the Kharkiv`s airport data from 2010 – 2014 we failed to include it in this analysis, but it will be provided for 2016-2017 period. Results for rest of the airports provided in Table 6. It includes percentage change for all airports during 2016 – 2017 period, taking into account war conflict in 2014-2015, we chose to exclude them, so to obtain more precise results. According to Table 7, surprisingly, Kherson`s region labor market was affected the most by air passenger traffic, it has stronger both negative and positive effect. We assume that main explanation for that can be increasing number of flights in Kherson airport from 2016, thus, the development of the airport in the initial pace provides affects labor market of the region even stronger than in region with big passenger flow, and already developed, modern airports.

Table 5. Percentage change in the air passenger effect on sectoral wage from 2016 to 2017 period

Region	Agriculture	Industry	Trade	Transportation	IT	HoReCa
Passenger coefficient	-0.56	-0.18	0.17	0.05	0.03	-0.27
Odessa (%)	-6.9	-2.2	+2.1	+6.2	+4.6	-3.2
Lviv (%)	-7.4	-2.3	+3.9	+2.3	+5.1	-3.4
Kharkiv (%)	-5.6	-1.8	+1.7	+5	+3.9	-2.5
Dnipro (%)	-4.8	-1.5	+1.5	+4.3	+3.3	-2.2
Ivan-Frankivsk (%)	-1.8	-0.6	+0.5	+0.2	+0.1	-0.8
Kherson (%)	-12.5	-4	+3.9	+1.1	+0.8	-5.7
Zaporizhzhia (%)	-1	-3.2	+3.2	+9	+7	-4.6

We test main our hypotheses stated at the beginning, evaluate results, and provide interpretation for them. We can conclude that airport performance in terms of air passenger traffic affect regional labor market by direct, indirect and induced effect, has reasonable intuition behind it.

Chapter 6

CONCLUSIONS

This study attempts to analyze the relationship between airport performance and wages in 10 sectors of the Ukrainian regional economy. We try to provide clear and significant results, that can be applicable in the development of the air transportation system in Ukraine. We determine that air passenger traffic affect labor market in regions with different magnitude, and with difference in strength of this effect across regions. Findings can find their practical usage for both parties that are touched in work. For regional authorities, effect of air passengers on their local labor market would give them a comparable advantage in forecasting the labor market situation taking into account such influencing factor as local airport performance. Thus, widening of the flight destinations or intensification of the existing routes traffic would negatively affect wages in agriculture, industry, accommodations & restaurants sectors, on contrast workers employed in trade, transportation, information and technology would have an increase in monthly wages. That can help to understand economic processes interconnections on regional level. Moreover, we touched the effect of regional economic indicators. We estimate that the total population of the region, as a factor, has overall positive effect on almost all sectors of the regional economy. The amount of students of higher educational institutions has different magnitude of effect, although, further specific analysis for Ukrainian educational processes should be implied. We believe that our findings can contributes to the regional planning, can be give usable tools for understanding of factors that affect labor market at regional level of the economy.

As for our main actors of the research regional airport authorities. Obtained results can have practical usage in forecasting the demand volumes in the specific regions. Regional economic indicators that affect air passenger traffic should be taken into

account while formatting strategical development goals. Indicate difference in the regional economic development, furthermore, realize how regional airport performance can influence economy of the region. We study how it affects labor market, but it is long way to go, to come up with tools that will provide clear vision of determinants of the demand at region for possible air transportation service at initial stage, and explicit analyze for afterwards effects on the economic activity and indicators, bearing in the mind how aviation sector can be essential in the infrastructure system of the whole country within it boards and far beyond.

In our case, the focus on labor market as consequence, wages at different sectors of the economy, can be used for air companies for better understanding their consumer. Implying that increasing air passenger in certain region increase wage in trade sector, thus, people employed in trade can, probably, treated as a potential consumers of air transportations services. Air companies can focus on sectors with positive relationship, to address them with service options.

Last but not least, Ukrainian aviation sector and infrastructure necessary for its successful operation a far away from the level of neighboring countries. Nevertheless, we have fundament, in point of capital buildings, former airports terminals and runaway fields, and visible strategical geographical advantages for significant improvement of our place in global ranking. Increasing connectivity with other countries gives us place to present our goods and service, make affordable domestic and foreign travel services for both inbound and outbounds travelers. From this paper, we found evidence that aviation is not only about air transportation services, it can influence regional economic activity, time reducer and intensifying factor in business process, through passenger traffic this industry can affect local labor market, in terms of wages. We try to shed a light on how this animal works in Ukrainian market. Of course, with the development of air transportation services, increase in number of operators, airports, routes, proper and consistent statistical data access, we can tremendously evolve our work, and

investigate other interesting questions related to the aviation sector. At this point we believe that this study contributes to understanding of air transportation services and labor market conditions interconnection.

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APPENDIX A

Table 6. The results for OLS and 2SLS models for agriculture, industry, trade, transportation

	Dependent variable:									
	log(wage_sector_agr)		log(wage_sector_ind)		log(wage_sector_constr)		log(wage_sector_trade)		log(wage_sector_transp)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
log(passengers)	-0.024**	-0.561***	-0.021***	-0.180***	0.030***	-0.003	0.029***	0.176***	0.050***	0.043*
	(0.010)	(0.103)	(0.004)	(0.033)	(0.007)	(0.028)	(0.006)	(0.035)	(0.006)	(0.026)
log(population)	0.431***	1.255***	-0.029	0.216***	0.279***	0.329***	0.093***	-0.133*	-0.021	-0.010
	(0.055)	(0.205)	(0.024)	(0.066)	(0.036)	(0.055)	(0.032)	(0.070)	(0.034)	(0.052)
log(grp)	-0.278***	-0.406***	0.439***	0.401***	-0.050	-0.057*	0.074***	0.109***	0.082***	0.081***
	(0.047)	(0.119)	(0.021)	(0.039)	(0.031)	(0.032)	(0.027)	(0.041)	(0.029)	(0.030)
education	-10.477***	34.154***	2.779***	16.027***	-2.223*	0.487	-2.567**	-14.773***	3.594***	4.196*
	(1.743)	(9.364)	(0.765)	(3.037)	(1.138)	(2.527)	(1.006)	(3.204)	(1.082)	(2.355)
unemployment	3.289***	-6.746***	-0.301	-3.280***	5.211***	4.602***	0.889***	3.634***	-0.213	-0.349
	(0.464)	(2.193)	(0.203)	(0.711)	(0.303)	(0.592)	(0.268)	(0.750)	(0.288)	(0.551)
Constant	1.686***	-5.957***	2.671***	0.403	1.183***	0.719	3.048***	5.138***	4.798***	4.695***
	(0.522)	(1.921)	(0.229)	(0.623)	(0.340)	(0.518)	(0.301)	(0.657)	(0.324)	(0.483)
Observations	571	571	571	571	571	571	571	571	571	571
R^2	0.607	-1.401	0.907	0.689	0.845	0.839	0.801	0.574	0.838	0.837
Adjusted R^2	0.598	-1.457	0.905	0.682	0.842	0.835	0.797	0.564	0.834	0.834
Residual Std. Error (df = 557)	0.209	0.517	0.092	0.168	0.136	0.139	0.121	0.177	0.130	0.130

Note: *p**p***p<0.01

APPENDIX B

Table 7. The presented results of OLS and 2SLS models for I&T, finance, real estate, professional services, HoReCA

	Dependent variable:									
	log(wage_sector_it)		log(wage_sector_fin)		log(wage_sector_estate)		log(wage_sector_science)		log(wage_sector_HoReCa)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
log(passengers)	0.039***	0.063*	0.0005	-0.003	0.050***	0.101**	-0.028***	-0.258***	0.004	-0.276***
	(0.008)	(0.034)	(0.006)	(0.025)	(0.011)	(0.046)	(0.008)	(0.052)	(0.006)	(0.056)
log(population)	0.224***	0.186***	0.532***	0.537***	-0.057	-0.136	0.329***	0.683***	-0.099***	0.330***
	(0.044)	(0.068)	(0.033)	(0.050)	(0.059)	(0.091)	(0.043)	(0.104)	(0.035)	(0.111)
log(grp)	-0.086**	-0.080**	-0.032	-0.033	0.028	0.040	0.449***	0.394***	0.193***	0.126*
	(0.038)	(0.039)	(0.028)	(0.029)	(0.051)	(0.053)	(0.037)	(0.060)	(0.030)	(0.064)
education	9.264***	7.230**	-3.249***	-2.953	12.546***	8.282**	-3.389**	15.767***	-0.004	23.253***
	(1.408)	(3.084)	(1.051)	(2.285)	(1.881)	(4.169)	(1.378)	(4.741)	(1.118)	(5.081)
unemployment	4.787***	5.245***	1.750***	1.683***	-2.831***	-1.872*	2.043***	-2.264**	1.619***	-3.610***
	(0.375)	(0.722)	(0.280)	(0.535)	(0.500)	(0.976)	(0.367)	(1.110)	(0.297)	(1.190)
Constant	2.262***	2.610***	-1.361***	-1.411***	4.967***	5.697***	-2.487***	-5.767***	4.911***	0.929
	(0.421)	(0.633)	(0.315)	(0.469)	(0.563)	(0.855)	(0.412)	(0.972)	(0.334)	(1.042)
Observations	571	571	571	571	571	571	571	571	571	571
R^2	0.831	0.828	0.876	0.876	0.648	0.634	0.780	0.449	0.777	0.025
Adjusted R^2	0.827	0.824	0.873	0.873	0.640	0.625	0.775	0.436	0.772	0.003
Residual Std. Error (df = 557)	0.169	0.170	0.126	0.126	0.226	0.230	0.165	0.262	0.134	0.280
Note:										*p**p***p<0.01