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EDITORIAL NOTE: This is a first issue of the SSST university journal: SSST-OMNIA SCIENTIA. Its contents are mainly filled with academic works of our students and teaching staff. However, the journal is opened to contributors from all parts of the world. It welcomes articles and book and articles reviews in all scientific fields; natural, technical, social, and humanistic sciences.

We welcome all well-intentioned comments and suggestions and constructive criticism. This would contribute to improvements in the quality of our journal and the achievement of academic excellence we are aiming at.

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ARTICLES

LEJLA KORMAN

The Validity of the Okun's Law in Bosnia and Herzegovina

ABSTRACT

This paper provides an assessment of the relationship between unemployment and economic growth in Bosnia and Herzegovina by examining the validity of the Okun's law in BiH. The analysis includes quarterly time series data on unemployment and GDP from 2009 to 2017. High unemployment is one of the most prominent macroeconomic issues in Bosnia and Herzegovina. Because of that, the understanding of this relationship is of crucial importance for policy makers in the country, as it tells whether higher output levels can lead to a desired fall in unemployment. In order to test the Okun's law validity in BiH, the Okun's coefficient is estimated through a simple regression model using the Okun's law difference version, with unemployment rate as the dependent and GDP as the independent variable. The estimated coefficient's statistical significance and sign are then analysed, as they represent the indicators of the law's validity. Prior to regression, the Augmented Dickey-Fuller unit root test, Engle-Granger co-integration test and the Vector Autoregressive model are applied to test for the stationarity of the variables, co-integration, and causal relationship between them, respectively. The results show that the Okun's coefficient is both statistically significant and negative, accepting both hypotheses of this thesis paper, and implying that the law is valid in Bosnia and Herzegovina. The most important policy implications of the findings are also closely examined and discussed. The paper also provides some recommendations to any further studies of the Okun's law in BiH.

Key words: Okun's law, Okun's coefficient, unemployment, GDP

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1. INTRODUCTION

Sustained economic growth is of crucial importance to both developed and developing countries. Economists argue that, together with employment generating policies, growth in the country's output has the capability of reducing unemployment, which is one of the most important macroeconomic issues, especially for the less developed countries. By reducing unemployment, growth can also upgrade people's living standards. Because of that, decision makers in the countries with high levels of unemployment need to understand the relationship between output growth and unemployment, and whether higher growth may be used to tackle unemployment in their respective economies. Bosnia and Herzegovina is a country with the highest level of unemployment in Europe; the unemployment rate is around 40 percent, according to the data of the Labour and Employment Agency of Bosnia and Herzegovina (2019). The youth unemployment is even more problematic. Almost 60 percent of young people in BiH cannot get a job in the country (Idem), forcing them to emigrate to the Western countries, and resulting in a massive brain drain. In order to address this issue, it is of crucial importance for the Bosnian policy makers to have a more clear understanding of the relationship between economic growth and unemployment in Bosnia and Herzegovina.

This relationship was first formulated by Arthur Okun in 1962, in what is known today as the 'Okun's law'. In his seminal paper, Okun postulated a bi-directional negative relationship between unemployment and economic growth. Specifically, the law says that a 1 percent growth in the country's gross domestic product (GDP) is related to a 0.5 percent fall in the rate of unemployment, *ceteris paribus*. Intuitively, if there is an increase in production, more workers are needed to produce the extra units. Because more workers are hired, there is a reduction in unemployment. Similarly, during the recessionary stages of the business cycle, production falls, workers are let go, and the rate of unemployment rises. Both variables do not change in the same proportion, as output changes more rapidly than unemployment. In his first study, Okun estimated the 0.33 percent fall in unemployment as a result of 1 percent GDP increase. Nonetheless, later studies, which were based on the newer data and modern econometric techniques revealed the 1:0.5 relationship (Attfield & Silverstone, 1998).

Over the years, numerous economists throughout the world recognized the importance of this relationship, and tested the validity of the Okun's law in their economies. The empirical estimates of the Okun's coefficient, which measures the responsiveness of unemployment to output growth, were crucial in their analyses. The coefficient, in almost all studies, was tested for its statistical significance, and whether its sign is negative. It has become a consensus in the

literature that the law does not hold in every country, either because the coefficient is not statistically significant, or it is not negative. Moreover, researchers also agree that there exists a heterogeneity with regards to the value or the magnitude of the coefficient, as it varies from country to country, depending on the economic circumstances (Lal et al, 2010). The estimation of the coefficient is very important, as it shows the cost of unemployment in terms of output (Rubcova, 2010). Since there exists no prior study of this relationship in the case of Bosnia and Herzegovina, the aim of this paper is to contribute to the existing literature by checking the validity of the Okun's law in Bosnia and Herzegovina, primarily because of its obvious high unemployment. The study's primary purpose is to calculate the Okun's coefficient in BiH, analyse whether it is significant and negative, as well as to give some policy recommendations in the light of estimated coefficient. For a country like Bosnia and Herzegovina, which has suffered considerably from the persistence of high unemployment, the knowledge of this relationship is important from the viewpoint of implementation of appropriate economic policies. In the light of the given acknowledgement, a prominent question arises as the main research question of this paper:

Q: Is the Okun's law valid in Bosnia and Herzegovina?

To empirically test the relationship, this thesis paper follows both the Okun's original approach, and the advanced new econometric methodology used in the contemporary studies. Among those, Babalola et al (2013), Akram (2014), Chafer (2015), Kargi (2014) and Pata et al (2018) are given a particular attention because of the similarities between their approaches and the one in this paper. Okun himself used two variables, unemployment and GDP, and three different approaches to coefficient estimation: difference, gap and dynamic. For several reasons, outlined in the next section, this paper uses the difference version as the most appropriate. The time span considered is from 2009 until 2017, on a quarterly basis. The Augmented Dickey-Fuller unit root and the Engle Granger co-integration tests are applied to check the stationarity and co-integration of variables of interest, respectively. This is followed by the Vector Autoregressive model for determining a causal relationship between the variables, and a simple OLS regression model, for both coefficient estimation and determination of the contemporaneous relationship. The paper used time series quarterly data on BiH unemployment and GDP, collected from the databases of the Agency for Statistics of BiH, and the national Labour and Employment Agency.

The rest of this thesis is organized as follows. The introduction is followed by an analysis of the most important aspects of the empirical studies relevant to the development of this paper's hypothesis. The literature review is followed by the theoretical and methodological framework

for estimating the coefficient. This section is followed by the results of the performed analysis and the discussion of their meaning. The obtained results are also compared to those reached by other researchers in similar studies, and their implications are outlined. Finally, the paper concludes with an overview of the main findings, and with recommendations for future studies.

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Ever since the postulation of the Okun's Law in 1962, a vast amount of empirical research has been focused on testing the original Okun's law specification. The list of available literature which reflects the empirical relationship between economic growth and unemployment is extensive, and time-space constraint. The estimates of those studies have been different depending on the data set, the selected time period, and the estimation method. The first empirical test of the relationship between unemployment and output was conducted in 1962 by Arthur Okun himself. Using the US quarterly data from 1947 to 1960, in his seminal paper Okun (1962) found an inverse/negative statistical relationship between unemployment and real GDP. Empirically, Okun estimated that 1 percent increase in the real GDP is associated with an approximately 0.33 percent decrease in unemployment. In other words, in order to tackle unemployment, the economy must continually expand. As such, the law provided the vital link between the labor market and the goods and services market. Intuitively, the increase in production of goods and services in an economy requires a greater use of labor, which can be achieved by recruiting new workers, thereby decreasing the level of unemployment (Okun, 1962). Later, in 1998, Attfield & Silverstone re-estimated the Okun's coefficient for the US by applying the new time series data for both variables and by using more advanced econometric techniques. The authors concluded that coefficient is in fact around -0.5.

Given that papers written on the topic of the Okun's Law almost without exception test the validity of the law (the statistical significance and sign of the Okun's coefficient) in a particular area or over a certain time period as the main hypothesis, the literature review in this section is performed from a methodological point of view to detect and select the variables and approach most fitting to the available data, as well as develop a testable hypotheses based on the literature.

2.1. Variables

The Okun's law involves two common macroeconomic variables, unemployment and output. These variables are used in almost every empirical study, and with all versions of the law (Rahman & Mustafa, 2016). Okun (1962) suggested that the unemployment rate may serve as a

useful indicator of the amount of labor used in the given economy, whereas the real GDP growth rate is an accurate measure of the economy's output and productivity. It is also important to mention that both early and current empirical papers predominantly use unemployment as the dependent, and output as the independent variable (Babalola et al., 2013). As opposed to the common practice of using real GDP as a measure of the economy's output, Kitov & Kitov (2012) modified the Okun's law by regressing the GDP per capita, instead of the real GDP, on unemployment. Furthermore, some studies not only included unemployment and GDP, but also other variables, and thereby also modified the Okun's law in order to examine whether it holds under various circumstances. For example, Dunsch (2016) added a youth unemployment variable to analyse the impact of economic growth on young people specifically. Researchers also attempted to acknowledge the periodic fluctuations in these two macroeconomic variables; Sinclair et al (2015) divided unemployment and output variables into a permanent and a transitory component, and then estimated the correlation between them. He showed that the fluctuation between the main variables is permanent, and confirmed the negative relationship even between the components. Although there are slight variations in included variables, the large majority of studies uses only unemployment and output variables (Knotek, 2007). Faridi et al (2015) also found that both variables usually do not change in the same proportion, as GDP changes more rapidly than unemployment.

2.2. Approaches

While the selection of variables needed to test the Okun's law is rather straightforward, the choice of preferred version is not so obvious. Initially, Okun (1962) specified two empirical relationships as follows, "quarterly changes in the unemployment rate are related to quarterly growth in real Gross Domestic Product (GDP)", and "deviations in the unemployment rate are related to deviations in GDP from its potential." These relationships have later been termed as the difference and gap versions of the Okun's law, respectively (Olusegun, 2015). In his third observation, known as the dynamic version, Okun (1962) suggested that the current level of unemployment is influenced by both the current and the past output levels.

Over time, the preferred version has differed among the researchers, with difference version being the most commonly used one in scientific papers, and the gap version as the second most preferred. Chamberlin (2011), Knotek (2007), and Babalola et al (2013) all used the difference version because of its reliance on the already accessible macroeconomic data and statistics. They further argued that the primary shortcoming of the gap version, used by Sinclair et al (2015), is the fact that potential GDP and the natural rate of unemployment (both of which

are necessary for estimating the Okun's coefficient using this version), cannot be accurately measured; they can only be estimated or even forecasted. Moreover, Gylfason (1997) estimated the coefficient in Sweden using the gap version, and found a significant negative relationship between the unemployment and output. However, his results later proved to be unreliable, as the increase in unemployment, induced by the severe domestic crisis during the early 1990s, was beyond the gap version's predictions. Other researchers, including Meidani & Zabihi (2011), Akram et al. (2014) and Rahman & Mustafa (2016), examined the unemployment – GDP relationship in both short and long run using the dynamic version. They argued that, although very similar to the difference version, the dynamic version of the Okun's law includes the relative variables, namely the past changes in the unemployment rate, omitted from the left-hand side of the difference version. Based on this notion, many researchers nowadays choose the dynamic version over the other two (Rahman & Mustafa, 2016). Nevertheless, the interpretation of the coefficient estimated with the dynamic version is much more complex as compared to gap and difference ones (Babalola, 2013), and is therefore out of the scope of this paper.

2.3. Coefficient

The Okun's coefficient, an empirical measure of the responsiveness of unemployment to GDP growth, can be calculated using either of these three versions (Faridi et al, 2015). The coefficient itself is a valuable tool in forecasting the direction and magnitude of the relationship between the two variables (Rubcova, 2010). As previously mentioned, even though Okun himself, estimated a 0.33 percent change in unemployment due to 1 percent change in GDP, the later studies estimated that approximately a 0.5 percent change in unemployment is associated with a 1 percent change in GDP, depending on the time and space considered (Lal et al, 2010). Both Songer & Stiasny (2002) and Villaverde & Maza (2009) provide evidence that the value of the Okun's coefficient also varies by country and economy, depending on economic circumstances. Other researchers, such as Abu (2016) and Meyer & Tasci (2012) also argue that the Okun's coefficient, because of its variability on a country-to-country basis, should not be considered as the "rule of thumb", and should be tested on its significance and direction (whether the coefficient is statistically significant and negative) rather than for its magnitude (whether the coefficient's value is approximately 0.5 percent).

Indeed, there exists a consensus in the literature that the Okun's coefficient is higher in advanced economies, as opposed to the developing ones. Evans (1989) reestimated the Okun's law in the United States of America using the Vector Autoregressive (VAR) model for the period 1950-1985, and found that the coefficient is both significant and negative, and its magnitude was

-3.3. Lee (2000) investigated the validity and robustness of the Okun's law for 16 OECD countries during the time span from 1955 to 1996. He found that the coefficient varies on a country basis, with the highest coefficient value in Austria (-3.49) and the lowest in Italy (-0.80). All coefficients were statistically significant and negative. Michael et al (2017) also estimated the difference and dynamic versions of the Okun's law for the Austrian economy. They found a significant and negative relationship between Austrian GDP and unemployment, and estimated the Okun's coefficient of -2.8. Pierdzioch et al (2011) investigated the existence of the Okun's law, as statistically significant, in the G7 countries. They covered the time period from 1989 to 2007, and adopted the difference version of the law. The estimated Okun's coefficient among the G7 countries varies from -1.38 in Germany to -4.55 in Canada. Olusegun (2015) assessed the Okun's law validity in the case of the United Kingdom, covering the period from 1971 until 2013. His empirical results showed that in the UK, there exists negative and statistically significant correlation between economic growth and unemployment. He proved that the law is valid in the UK, as well as estimated the coefficient of -1.9. Hamada & Kurosaka (1984) investigated the relationship between Japanese economic growth and unemployment in three stages, from 1953 to 1984. The authors wanted to examine the changes in the Japanese Okun's coefficient over the business cycle in the country. They showed that during large economic expansion (1953-1965) coefficient was -0.54, after which the growth slowed down from 1965 to 1974, and coefficient fell to -0.3. During the following period (1965-1984), Japan experienced unprecedented growth and an increase in economic activity. During the same period, the coefficient significantly increased to -0.75.

Truly, Hamada & Kurosaka's findings that the Okun's coefficient increases and becomes more significant as the economy expands is consistent with the findings of many other researchers. The large volume of literature shows that Okun's statistical relationship varies over time, and over different phases of the business cycle. Rahman & Mustafa (2016) intuitively explain that during the recovery phase, more workers are needed to produce an increased quantity of output, and as a result, demand for labor rises and unemployment falls. On the other hand, in the recessionary phases of the business cycle, less output is produced, less workers are needed, and unemployment rises. Furthermore, Daly and Hobijn (2010) argued that the period of 2007 Great Recession was characterized by a persistent deviation from the Okun's empirical relationship, primarily because during the crisis unemployment increased well in excess of Okun's predictions.

An extensive list of studies on the validity of the Okun's law in developing economies typically show lower quantitative magnitudes of the coefficient in these countries. Furceri (2012)

explored the relationship between output and unemployment in Algeria for the period 1980-2008, and the impact labor market institutions have on the stated relationship. His study showed that there exists a significant and negative relationship between the two variables, but the value of the Okun's coefficient was rather low, only -0.05. Prieto et al (2016) conducted a comprehensive study on the validity of the law in 20 developing countries, while using both difference and gap approaches. Although the Okun's coefficients in all economies have proven to be negative, they are very low, and statistically significant in only four countries: Nicaragua (-0.14), Egypt (-0.34), Bolivia (-0.33), and Philippines (-0.17). Within the sample, the highest coefficient was found in Egypt. Moreover, other economies have even lower coefficients, such as Indonesia (-0.04), Ukraine (-0.04), Pakistan (-0.01), and Morocco (-0.03). In brief, the authors indicated that the average coefficient across the examined developing countries is only -0.14, which is significantly below the Okun's benchmark. With regards to the countries in the region, Nikolli (2014) estimated the Okun's coefficient for Albania. His results showed that the coefficient is statistically significant and negative in the country. However, the coefficient value was rather low (-0.38). Sadiku et al (2015) conducted a study in the case of the Former Yugoslav Republic of Macedonia. Their two main hypotheses were: the coefficient is statistically significant, and the coefficient is negative. The results showed that the Macedonian Okun's coefficient (0.22) is neither statistically significant nor negative.

2.4. Hypotheses

Choosing the data set and the version of the law best fitting for that set is still the primary issue of the majority of studies on the topic of the Okun's law. The available data on both macroeconomic variables for Bosnia and Herzegovina is limited. For example, the country's natural rate of unemployment is not being published, which automatically excludes the use of the gap version. Even the data on actual levels of output and unemployment are time-constrained, primarily because the country started publishing the reliable and standardized macroeconomic figures only in the second half of the 2000s. However, as argued by Chamberlin (2011), Knotek (2007) and Babalola et al (2013), these problems can be alleviated by using the difference version. It should be stressed again that the main aim of nearly all empirical studies on this topic is testing economic (sign and/or magnitude) and statistical significance of the Okun's coefficient for a particular region over a particular time (Knotek, 2007; Sadiku et al, 2015). With all these considerations in mind, and in accordance with the provided review of literature, the following hypotheses are to be tested in this thesis paper:

H1: The Okun's coefficient is statistically significant in Bosnia and Herzegovina.

In a testable form, this hypothesis may be restated as follows:

In Bosnia and Herzegovina, there is a statistically significant relationship between GDP and the level of unemployment.

The second hypothesis is:

H2: The Okun's coefficient is negative in Bosnia and Herzegovina.

This hypothesis can also be restated in a more testable form, and it is:

In Bosnia and Herzegovina, there exists an inverse relationship between GDP and the level of unemployment.

3. METHODOLOGY AND DATA

In order to examine the validity of the Okun's law in Bosnia and Herzegovina, the framework for the analysis of the law must first be developed. This analytical framework was initially developed by Arthur Okun himself in 1962, and it remained almost exactly the same throughout the later empirical studies. The framework used in this paper is primarily based on the work by Babalola et al (2013), Akram (2014), Chafer (2015), Kargi (2014) and Pata et al (2018). As already explained, the law is based on three main versions, and all three have their distinctive properties and model specifications, as well as use different methods of estimating the Okun's coefficient. This particular paper uses only the difference version of the law. The analytical model of this version may empirically be expressed as:

$$(U_t - U_{t-1}) = \alpha + \beta (Y_t - Y_{t-1}) + \varepsilon_t \quad (1)$$

where:

U_t = Unemployment rate in period t

U_{t-1} = Unemployment rate in period t-1

Y_t = Output level in period t

ε_t = Error term in period t

Y_{t-1} = Output level in period t-1

β = Okun's coefficient

α = Intercept term

In the difference version, the changes in GDP (independent variable) are regressed on the changes in unemployment (dependent variable) (Babalola et al, 2013). The coefficient is then determined by applying the Ordinary Least Squares (OLS) technique, and is expected to have a negative sign, confirming the proposed negative relationship between the variables in question. Moreover, the coefficient will also show the intensity of the relationship (Akram, 2014).

3.1. Econometric methodology

3.1.1. Unit root test

Typically, time series macroeconomic data tend to be non-stationary, or I(1) processes. The use of non-stationary data may lead to spurious regressions. Because of that, prior to executing the regression, researchers run unit root tests for stationarity of the variables. There exist multiple tests which can be adopted in order to test the existence of possible unit roots in time series. In 1987, Engle and Granger recommended the Augmented Dickey-Fuller (ADF) test as a preferred and reliable tool in verifying the stationarity of variables in empirical work. Ever since, many other researchers have used the ADF for testing the stationarity of variables of the Okun's law. Adenomon & Tela (2017), Babalola et al (2013) and Ajayi & Mougoue (1996) all adopted the ADF test of unit roots with the single country quarterly time series data, while applying the difference version in coefficient estimation. Because it is widely recommended, and based on similarities in approach and data used in the mentioned studies, this paper will also utilize the ADF test to verify the presence of unit roots in Bosnian GDP and unemployment variables. The ADF test for GDP stationarity is specified as follows:

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \varepsilon_t \quad (2)$$

where ΔY_t is change in output, α intercept, Y_{t-1} output in the previous period, δ the coefficient of Y_{t-1} , and ε_t the error term in period t . Similarly, the ADF specification for unemployment is:

$$\Delta U_t = \alpha + \delta U_{t-1} + \varepsilon_t \quad (3)$$

where ΔU_t is change in unemployment, α intercept, U_{t-1} unemployment in the previous period, δ the coefficient of U_{t-1} , and ε_t the error term in period t . These models are the most

appropriate for situations when the series has an intercept (α), but does not have a time trend (Gujarati, 2015), like the one in this paper. The Augmented Dickey Fuller test null hypothesis is that the series has a unit root, formulated as $H_0: \delta=0$. If it is accepted, the time series contains a unit root, or it is said to be non-stationary. In that case, the series must be differenced prior to running a regression. On the other hand, if the null hypothesis is rejected, the data is stationary, there is no unit root, and it may be used in a regression without having to difference it (Adenomun & Tela, 2017; Salvatore & Reagle, 2002).

3.1.2. Co-integration test

If the results of the ADF test show that the time series are $I(1)$ processes, co-integration or the long term relationship between the variables of interest is ought to be checked. The co-integration tests check the stationarity of residuals of variables. When the residuals of non-stationary time series are stationary (do not contain a unit root), there will be a long term relationship between the series (Kargi, 2014). Only when they are co-integrated, non-stationary variables can be used in a regression. Otherwise, they must be differenced prior to regressing them (Gujarati, 2015). The most commonly used co-integration tests for time series data include Johansen and Engle-Granger tests. Okunade & Karakus (2001) apply Johansen test with multivariate data (more than two variables). On the other hand, the Engle-Granger is more commonly used for examining the co-integration between bivariate data (only two variables) (Bankole & Fatai, 2013; Kargi, 2014). Because the analysis in this paper is limited to only two variables, the Engle-Granger co-integration test will be used for examining co-integration between GDP and unemployment in Bosnia and Herzegovina. The null hypothesis of the EG test says that residuals of variables are non-stationary (variables are not co-integrated). The EG test specification is following:

$$U_t = \alpha + \beta Y_t + \varepsilon_t \quad (4)$$

If Y_t and U_t are both $I(1)$ processes, and ε_t is $I(0)$, then unemployment and GDP are co-integrated. If, however, ε_t is $I(1)$ process, the variables are not co-integrated, and need to be differenced (Gujarati, 2015).

3.1.3. Vector Autoregressive model

After the unit root and co-integration tests are performed, the next step is the Okun's coefficient estimation. Chafer (2015) suggests that a vector autoregressive model should be used first in order to determine the causal relationship between the aforementioned variables. This is

followed by a simple regression model to calculate the coefficient, and estimate the contemporaneous relationship.

VAR model can only be estimated if all time series under consideration are stationary. If they are not, the model can be estimated after differencing the variables once. VAR model is used by Evans (1989), Srinivas (2018) and Pata et al (2018) in their studies on the Okun's law to establish the causality between unemployment and output while applying the difference version. Because of that, the VAR model specification in this thesis is based on their works. The main rationale of the VAR causality testing is that "the past can cause the present and the future, but not the other way round" (Gujarati, 2015). VAR models do not differentiate between exogenous and endogenous variable, and include one equation per every variable, where each equation includes the lagged values of that variable, as well as the lagged values of another variable (Idem). In other words, the dependent variable is affected by its own lag, as well as the independent variable's lag (Pata et al, 2018). The following equations represent the VAR model specification:

$$Y_t = \alpha_1 + \beta_1 Y_{t-1} + \beta_2 U_{t-1} + \varepsilon_t \quad (5)$$

$$U_t = \alpha_2 + \beta_1 U_{t-1} + \beta_2 Y_{t-1} + \varepsilon_t \quad (6)$$

where ε_t are error terms, α_1 and α_2 are intercepts, U_{t-1} is the first lag of unemployment, and Y_{t-1} is the first lag of output. In equation (5), β_1 is the coefficient of the dependent variable (output), and β_2 the coefficient of an independent one (unemployment). Likewise, in equation (6), β_1 denotes the coefficient of dependent variable, in this case unemployment, and β_2 represents the independent variable coefficient (output). In this case, if the lagged values of output better forecast the current values of unemployment than the lagged values of unemployment, then output causes unemployment (Gujarati, 2015).

3.1.4. Regression analysis

According to Gujarati (2015), simple linear regression is a type of model which contains only one explanatory variable, and is called "simple" because the outcome variable is associated with only one predictor. It is a statistical tool for determining the contemporaneous relationship between the variables of interest (Akram et al 2014). The contemporaneous analysis in this paper primarily follows the empirical study of Chafer (2015) in which he estimated the Okun's relationship through simple linear regression, while using the difference approach of the law and including the time series data from Spain. It is important to highlight that before regressing the model, all variables were stationary, as Chafer differenced the time series in order to obtain the

necessary stationary series. After obtaining the new stationary series, he specified the common difference version of the Okun's law model:

$$(U_t - U_{t-1}) = \alpha + \beta (Y_t - Y_{t-1}) + \varepsilon_t \quad (7)$$

in which $u_t - u_{t-1}$ represents the difference between unemployment from period t to period $t-1$, and, $y_t - y_{t-1}$ is the change in the GDP from from period t to $t-1$. Chafer's contemporaneous analysis is concluded by examining the β (Okun's coefficient) primarily for its significance and direction, but also for the magnitude. The dependent variable is unemployment, and explanatory variable is output. Lastly, the LM test for serial correlation is performed to check whether there exists autocorrelation in the error term. If there is, the Newey-West robust errors are applied to correct for the autocorrelation (Chafer, 2015).

3.2. Data

The following section of the paper discusses the data used in this empirical study. Arthur Okun (1962) himself in his seminal paper used the quarterly, time series data on unemployment and GDP in the United States. In order to test the Okun's hypothesis in Bosnia and Herzegovina, the data sample includes quarterly, time series data on GDP and unemployment in BiH. The availability of data for both macroeconomic variables significantly influenced the time period across which the data had been collected. Because of that, data collection represents one of the main obstacles encountered during this research, and data availability is its primary limitation. Following the Okun's example, the majority of researchers' data cover approximately 20 to 30 years (Babalola et al, 2013). In this paper, however, the time span is only nine years long. Precisely, the data were obtained from the first quarter of 2009 until the last (fourth) quarter of 2017, and the figures for preceding years are not available. The quarterly real GDP data set was taken from the quarterly publications /reports by the Agency for Statistics of Bosnia and Herzegovina. On the other hand, the quarterly rate of unemployment was extracted from the quarterly-published Statistical Information Sheets (Statistički informator) produced by the national Labour and Employment Agency of Bosnia and Herzegovina. Lastly, the seasonally adjusted data was acquired for both variables, as suggested by Olusegun (2015).

3.2.1. Descriptive statistics

Figure 1 below shows how the quarterly growth rate of real GDP in Bosnia and Herzegovina fluctuated over the period between 2009 and 2017. The GDP growth rate movement is described due to the non-stationarity of the actual GDP values. It can be seen that the rate increased over time. Initially, BiH had a negative GDP growth rate, and it reached a low in the last quarter of 2009. After that, it continued to significantly fluctuate and reached its peak in the first

quarter of 2014, after which it dramatically dropped, reaching a negative value again. Since then, it has been rising, with substantial fluctuations.

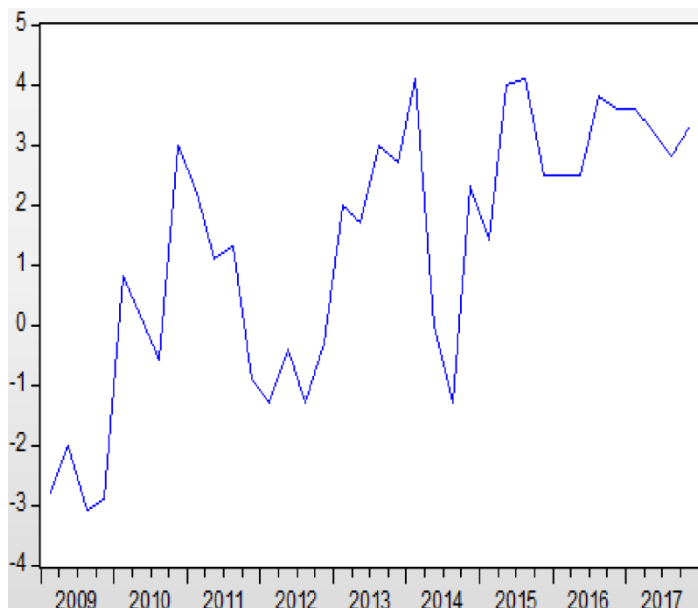


Figure 1: Growth rate of real GDP in BiH

As in the case of GDP, the non-stationarity of the unemployment rate is addressed by generating the series' first difference. Figure 2 illustrates how the first difference of the unemployment rate in Bosnia and Herzegovina had been changing from 2009 to 2017. Overall, it can be seen that, over the time, the rate declined. At the beginning of the period, the rate was approximately 1.1, and it had fluctuated until early 2012. It then recorded a sharp increase, reaching its peak at around 1.8 in the last quarter of 2012. It then plummeted, reaching the lowest value in 2013. During that same year, the rate again rose to 0.5, after which it had been, with modest fluctuations, falling.

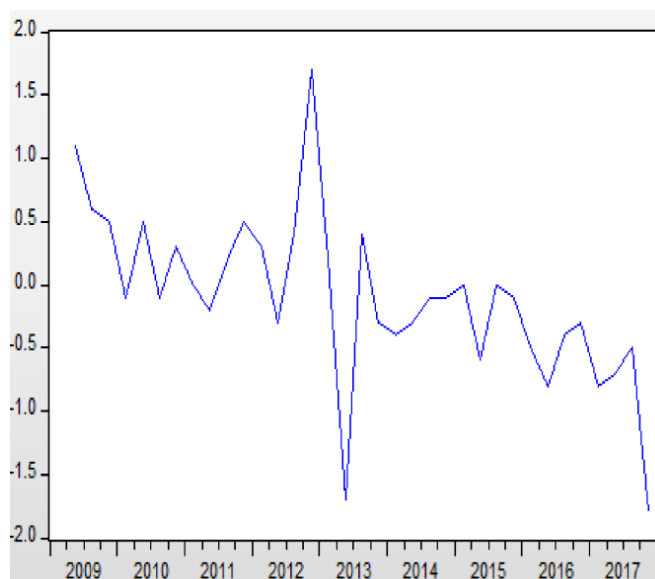


Figure 2: Rate of unemployment (1st lag) in BiH

The table 1 below shows the descriptive statistics of the variables used in this paper. For each of the used variables, the table depicts the number of observation, mean, minimum value, maximum value, and the standard deviation from the mean. It can first be seen that the number of observations for both variables is 36. The average GDP growth rate for the stated period is 1.357, whereas the mean of the first difference of the unemployment rate is -0.097. The mean of the GDP growth rate varies more significantly over the sample than the unemployment rate does because of its higher standard deviation. The maximum and minimum values of the GDP growth rate are 4.100 and -3.100, respectively. On the other hand, the maximum value of the unemployment rate's first difference is 1.700, and the minimum value is -1.800. With regards to the correlation between the variables, the value obtained from the correlation matrix is -0.559, so when GDP rate increases by 1 percent, the first lag of unemployment rate falls by 55.9%.

Variables	Observations	Mean	Minimum	Maximum	Standard Deviation
GDP RATE	36	1.357	-3.100	4.100	2.097
UNEMPLOYMENT RATE (1 st difference)	36	-0.097	-1.800	1.700	0.664

Table 1: Descriptive statistics

4. RESULTS AND DISCUSSION

4.1. Results

This part of the paper presents the results of the tests and regressions described in the previous section. Using EViews 9 software, the tests and regressions are run using GDP and unemployment data for Bosnia and Herzegovina, over a period from 2009 to 2017. The sample includes quarterly data on GDP in millions of convertible marks, and the unemployment rate. Earlier periods were not included because of limited data availability.

4.1.1. Unit root test results

Variable	Level	First difference
	P	P
GDP	1.000	0.083
Unemployment	0.996	0.006

Table 2: Results of ADF unit root test (H0:Unit root)

The first step was testing the stationarity of both variables of interest by using the Augmented Dickey-Fuller (ADF) test for unit root. The table 2 summarizes the results. As can be seen from the table, both variables at level had above 10 percent probability of having a unit root. Therefore, the null hypothesis of the ADF test was accepted for both variables. In order to confirm that both series indeed contained unit roots, or that they were I(1) processes, both variables were differenced, and the new series were again tested for the presence of a unit root. These results proved that the newly generated GDP and unemployment series had a 8 percent and 0.6 percent probabilities of having a unit root, respectively. This implied that the ADF null hypothesis was rejected for both variables, meaning that the new, differenced series are I(0) processes, or they are stationary. For the sake of clarity, the first difference of GDP was labeled as "RGDP" and the first difference of unemployment rate was named "Dunemployment".

4.1.2. Co-integration test results

After the GDP and unemployment variables have been proven to be I(1) processes, they were tested for co-integration. The Engle Granger test for co-integration was used. As explained previously in the paper, this test is the most appropriate when testing for a bivariate co-integration. The test results are presented in the table 3 below.

Variable	Probability
GDP	0.723
Unemployment	0.692

Table 3: Results of EG co-integration test (H0: No co-integration)

The null hypothesis of the EG test is that series are not co-integrated. Based on high probabilities, it can be concluded that there exists no co-integration between the variables in question. This implies that there is no long term or equilibrium relationship between them. Using two non-stationary and non-cointegrated variables in a regression would result in a spurious regression. Because of that, only the differenced series (first difference of both GDP and unemployment rate), which were previously generated after testing for unit roots in the original series, are included in the VAR and simple regression models.

4.1.3. Vector Autoregressive model

Lagged values	T-stat
----------------------	---------------

	RGDP	Dunemployment
RGDP (-1)	2.793	-2.090
Dunemployment (-1)	-0.802	-0.469

Table 4: VAR model T-stats

The next step in the analysis is estimating the unrestricted Vector Autoregressive model to determine the causal relationship between GDP and unemployment in Bosnia and Herzegovina. The results of the unrestricted VAR model are shown in table 4. In order for one variable to have a causal relationship with the other, the absolute value of t-statistics has to be higher than 2. In accordance with that, it can be inferred that GDP does cause unemployment, but not vice versa. As the table shows, the impact of GDP on unemployment is statistically significant due to t-statistics of -2.09. On the other hand, the impact of unemployment on GDP is not statistically significant because of its low t-statistics value (-0.802), implying that unemployment does not cause changes in GDP in Bosnia and Herzegovina.

4.1.4. Regression model

Dependent variable: Dunemployment Explanatory variable: RGDP Sample: 2009Q1 2017Q4		
	Without robust errors	With Newey-West robust errors
Coefficient	-0.177	-0.177
Std. Error	0.046	0.037
T-stat	-3.874	-4.786
Durbin-Watson stat.	1.977	1.977
Adjusted R-squared	0.292	0.292

Table 5: Regression model

Once the causality between the variables is determined, the regression model is constructed, and the Okun's coefficient is estimated. The table 5 above shows the results of that simple regression model, in which unemployment is dependent, and output is an independent variable. As can be seen, the Okun's coefficient is proven to be statistically significant because its

t-statistics is -3.87, which is higher than the critical value of 2.0. Nevertheless, Durbin-Watson statistic of 1.977 implied the possible autocorrelation of residuals. The serial correlation LM test was used to check the serial correlation of errors. The LM test showed that the probability is approximately 57 percent, which implied that there exists serial correlation of errors in the initial model. In order to account for the correlation, and get more robust results, the Newey-West robust errors were applied. As can be seen from table 5, when robust errors are applied, the standard error falls from 0.046 to 0.037, and the Okun's coefficient is even more statistically significant; the new t-statistics is -4.786. The statistical significance of the explanatory variable indicates the acceptance of H1, meaning **that the Okun's coefficient is statistically significant in Bosnia and Herzegovina**. Given the coefficient's statistical significance, its economic significance can now be interpreted. The sign of the Okun's coefficient is negative, implying the negative relationship between GDP and unemployment in BiH, which is in line with Okun's (1962) findings. Because of that, the H2 is also accepted, implying that **the Okun's coefficient is negative in Bosnia and Herzegovina**. As displayed in table 5, the quantitative magnitude of the Okun's coefficient is 0.177. This indicates that when the GDP increases by 1 percent, unemployment in Bosnia and Herzegovina decreases by approximately 0.18 percent. Lastly, as can be seen from the Adjusted R-squared, this model explains 29.2 percent variations in 'unemployment'.

4.2. Discussion

This part of the thesis aims at providing the discussion and evaluation of results provided in the previous section, a comparison with other studies, results' implications, and outlines how certain limitations affect the robustness of results. Overall, the Okun's coefficient in Bosnia and Herzegovina has proven to be both statistically significant and negative, confirming the both hypotheses of the paper. It is significant to see how these results are placed compared to the previous literature. The results of initial unit root tests (non-stationarity of both variables) are in line with Adenomon & Tela (2017), Babalola et al (2013) and Ajayi & Mougoue (1996). Furthermore, the non-stationary variables proved not to be co-integrated; the same results were obtained by Bankole & Fatai (2013) and Kargi (2014). With regards to causality, the Vector Autoregressive model showed that GDP changes cause changes in unemployment, but not vice versa. These findings are in line with other researchers who used VAR method, including Evans (1989), Srinivas (2018), and Pata et al (2018). The value of the estimated coefficient is -0.18. This is in line with both the Okun's theory and contemporary research presented in section 2. The statistical significance and the negative sign of the coefficient confirms that there exists a significant negative relationship between the country's economic growth and its unemployment level. However, the magnitude of the coefficient is not precisely in line with Okun's predictions.

The estimated coefficient tells that 1 percent increase in Bosnian GDP can result in only a 0.18 percent decline in the Bosnian unemployment level.

The vast body of literature agrees on the heterogeneity of the coefficient among countries, as well as shows that the coefficient magnitude cannot be taken as a 'rule of thumb', as its values tend to be lower in the less advanced economies, such as Bosnia and Herzegovina. The estimated -0.18 coefficient is lower compared to the study of Michael et al (2017) who found a -1.8 coefficient for the Austrian economy, and Olusegun (2015) whose study estimated -1.9 coefficient for the case of the UK. It is worth mentioning that the coefficient is lower than all coefficients of 16 OECD countries, estimated by Lee (2000). On the other hand, the coefficient is similar to those calculated by Prieto et al (2016) for Nicaragua (-0.14) and the Phillipines (-0.17). It is higher when compared to Algeria's coefficient of -0.05 (Furceri, 2012), and Prieto et al (2016) estimates for Indonesia (-0.04), Ukraine (-0.04), Pakistan (-0.01), and Marocco (-0.03). The main rationale behind the Bosnia's higher coefficient, as compared to these economies, is the simple fact that, although developing, BiH has higher levels of development and GDP per capita than the listed economies. In brief, the statistical significance of the Okun's coefficient estimated in this paper, and its negative sign, indicate that the Okun's law is valid for the Bosnian economy, and its low magnitude is in line with the literature claims of developing countries having lower coefficient. Therefore, the findings of this study suggest that there exists weak, but significant inverse relationship between GDP and unemployment in Bosnia and Herzegovina. Since the methodological approach of almost all studies under consideration is fairly similar (if not identical) to the one in this thesis, it can be stated that these results provide a valuable insight into the GDP-unemployment relationship in BiH, and that the approach of this study proved to be adequate in examining this important macroeconomic relationship.

4.2.1. Implications of the findings

This section discusses some of the policy implications of the paper's findings. As seen from the presented review of literature, the law is widely replicated among researchers, and is considered to be a useful macroeconomic tool for economists and policymakers in forecasting the reaction of unemployment to a change in GDP, given that one acknowledges its variability on a country and time basis (Knotek, 2007). Bosnia and Herzegovina has persistently recorded the highest unemployment rate in Europe, with the most pronounced adverse impact on the society's most vulnerable groups, such as youth. This high unemployment level in turn exacerbates the problem of "brain drain" from the country. Because of that, it is of vital importance for the country's decision makers to know whether higher output levels may lead to the wanted increase

in employment. Even though Bosnia's gross domestic product has been, with fluctuations, rising since 2009, unemployment has not been declining in sufficient amount. This is also confirmed by the empirical finding of this study; every one percent increase in output has caused only 0.18 percent fall in the level of unemployment. Madrick et al (2006) showed that, during different time periods, in several countries the Okun's coefficient has not been rising in absolute value as a result of economic growth. On the contrary, the coefficient had a declining trend, or, in a slightly better scenario, it leveled off. This means that as GDP was rising, the percentage of fall in unemployment was either the same or it was progressively smaller. Many economists refer to this situation as "jobless growth". Nevertheless, the GDP growth in Bosnia and Herzegovina is still not jobless, and the negative sign of the obtained coefficient and its non-negligible magnitude support these claims. In addition, it is important to highlight that the time lag between the rise in output and the reaction by unemployment affects the numerical relationship (Weber, 1995). This study, due to limited data availability, included only the period from 2009 to 2017. Typically, due to the possible time lag, the unemployment level may take longer to respond to output growth, implying that the negative relationship between the two variables might have been stronger if a longer time span was included.

The low magnitude of the estimated BiH Okun's coefficient also provides a valuable implication for the Bosnian policy makers. Faridi et al (2015) analyzed the output-unemployment relationship for Pakistani economy and obtained the coefficient of -0.36. The authors then argued that the low coefficient value, especially in the developing world, indicates that unemployment can be tackled only by the means of large scale economic growth. Their main recommendation or proposal to the decision makers is the establishment of an environment which can attract and flourish substantial domestic and foreign investments. They claim that even a slight increase in foreign direct investments (FDIs) in a developing, labor intensive country can support the domestic production, and larger domestic production capacities require more workers, leading to higher employment levels. Their second conclusion is concerned with job skills; they argue that the labor force in developing countries is typically less skilled and knowledgeable about production processes, so high unemployment levels can sometimes also reflect the skill mismatch. Accordingly, they stress the need for adopting skill development projects and policies, which they think can accelerate the employment generating capability of the output growth.

4.2.2. Robustness of results

The robustness of the results reported in this thesis could be improved by expanding the time span used for the analysis. The main limitation of this research is the relatively small number

of observations, precisely 36. A more accurate coefficient could be calculated by including the quarterly data before 2009. In contrast, other empirical studies, such as Babalola et al (2013), Akram et al (2014), and Chafer (2015) include at least 80 observations. Another factor impacting the accuracy of the Okun's coefficient, not only in this thesis, but in general, is the presence of informal employment or employment in the grey or informal sector. Islas and Cortez (2013) argue that the existence of high informal employment represents an additional medium through which changes in output can translate into changes in employment. Because of that, informal employment can alter the relationship between output and unemployment. According to official figures by the Labor and Employment Agency, the unemployment rate in Bosnia and Herzegovina is around 40 percent. However, excluding the people who are registered as unemployed but are actually working in the informal/grey sector, the World Bank in several of its studies states that the real unemployment rate in BiH is much lower, around 20 percent. Furthermore, the International Labor Organization (ILO) estimates even lower unemployment rate, approximately 18 percent, meaning that around 22 percent of the unemployed are actually working in grey economy (Tulić, 2019). Dell' Anno & Solomon (2008) claim that, with high informal employment, the changes in output have small impact on changes in unemployment, and this is typically the case in developing countries. In other words, by subtracting the informal employment from the overall unemployment rate in BiH, the relationship between unemployment and output could be stronger than estimated in this thesis.

5. CONCLUSION

To recapitulate, this thesis paper examined the validity of the Okun's law in Bosnia and Herzegovina. The main research question guiding this thesis was: Is the Okun's law valid in Bosnia and Herzegovina? In order to test, and ultimately prove both of the main hypotheses, a simple econometric regression model was run, from which the Okun's coefficient statistical significance and direction were derived using the difference version of the Okun's law. The model included two main variables, GDP and unemployment rate. The findings suggested that the Bosnian Okun's coefficient is statistically significant, and negative. This led to the acceptance of both hypotheses, as well as confirmed that the Okun's law is valid in Bosnia and Herzegovina. Empirically, it was shown that 1 percent increase in the Bosnian Gross Domestic Products leads to a 0.18 percent decline in unemployment. This relationship is weaker when compared to the original Okun's estimates. Nonetheless, it is in line with the projections of other developing countries. It also implies that only strong economic growth, resulting from increased productivity and investments, can possibly lead to lower unemployment. Prior to regression, the Vector Autoregressive model was developed, and it showed the one-directional causal relationship, from output to

unemployment. The Augmented Dickey-Fuller test was run beforehand to test for the stationarity of the variables. Likewise, before running the regression, the Engle-Granger co-integration test was adopted to test for the co-integration between the variables of interest. Lastly, the Newey-West robust errors were applied to the regression model in order to correct for the serial correlation of errors.

The discussion section elaborated on the reasons why such results have been obtained, as well as outlined the main shortcomings of the approach used in this thesis. The main reasons behind the weak negative correlation between output and unemployment in BiH include the time lag between changes in GDP and changes in unemployment, the mismatch of skills demanded and supplied in the labor market, and the artificially high unemployment rate which does not account for the significant portion of people working in the informal or grey sector of the economy. This thesis investigates the previously unexplored Okun's relationship in Bosnia and Herzegovina, and represents the first empirical study of the Okun's law validity for BiH. Based on this thesis paper, some interesting recommendations can be made in this area of research. The primary limitation encountered during the research is the relatively short time span covered, from 2009 to 2017. Therefore, further studies should consider expanding the time period in order to get more precise results. Because changes in unemployment do not immediately respond to changes in output, longer data time span could result in stronger Okun's relationship in BiH. Another way of getting more accurate results is by using the unemployment rate calculated the World Bank and the International Labor Association, which deducts the informal employment, thereby intensifying the impact of economic growth on fall in unemployment.

Further studies can also focus with a greater extent on analyzing the impact of economic growth on youth unemployment in particular. The country's rate of youth unemployment is among the highest worldwide, around 60 percent, and it is a driving force behind a massive brain drain of the best educated young people from BiH. The study which analyses, in more detail, the relationship between youth unemployment and output growth would therefore be of great assistance to policy makers in their efforts of alleviating this alarming issue. One way of doing this is by isolating the youth unemployment rate and regressing on it the changes in GDP, as shown by Dunsch (2016) for the case of Germany and Poland. Only with a comprehensive understanding of this relationship, can the policy makers devise and enact appropriate policies, and possibly slow down the detrimental emigration.

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Female Labor Force Participation in Bosnia and Herzegovina:

**Relationship Between Female Labor Force Participation and Major
Macroeconomic Indicators**

1. ABSTRACT

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1. INTRODUCTION

4.

1.1 BACKGROUND AND THE EFFECT OF UNEMPLOYMENT

In an ideal system, an ideal economy, an ideal country, the unemployment rate would be 0%. It is common sense, that in reality this is hardly ever possible, however, the employment in some cases can be as high as to reach a state of being as close to the ideal as reality allows it to. That kind of an employment situation is described as having the unemployment rate at its natural rate, the rate of unemployment that exists in an economy that is healthy and is considered to be at full employment. (Wolla, 2016.)

High employment is an objective of any developing country, or any country at all that is yet to achieve it. On the other hand, those countries that already achieved a high employment rate are burdened with the objective of maintaining a low unemployment rate. From the perspective of the economy as a whole, the country, the society within it, it is clear that having an active labor force creates a striving environment for each individual within it, as well as the country as a whole. (UN, 2007.)

Unemployment rates can be directly associated with a country's GDP as well as the one that is preferably used in order to compare how well countries do, GDP per capita. "Okun's Law is intended to tell us how much of a country's gross domestic product (GDP) may be lost when the unemployment rate is above its natural rate." (Wen, Chen, 2012)

Income inequality as well as inequality in general are also common issues that are observed on the country level in order to establish a connection between the cause and the effect, to locate the source of what is causing problems to the economy, to the country as a whole. From the point of view of an individual, unemployment is once again a matter of utmost importance. For instance, no single individual would be content with the situation of completing his or her education only to end up in an endless, or what feels like one, pursuit of employment. Being employed, earning income is crucial for a human being in order to be able to live their life on a minimally decent level, or better said normal. (UN, 2012.)

1.2 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT

Moving on to a more precise field of the economy when discussing unemployment, focus is shifted towards the issue of gender inequality. When observing the unemployment rate, one should take in to consideration labor force participation of both genders as well as age groups, and by comparing the labor force participation rates among the categories, one can establish an understanding of how great of an issue the gender gap is. In the last several decades, since the 1972 UN Conference on Human Environment, efforts have been made to decrease the gender gap among other issues and fields of focus, some progress has been made, however, reducing the gender gap, increasing equality between genders continues to be an objective that is encouraged, and prioritized globally. In 2015, 193 member states pledged to ensure economic growth which is inclusive and sustained, as well as environmental protection and social inclusion, the wide picture is fostering just, inclusive, and peaceful societies, through a global partnership. (UNSCC)

Therefore, one of the targets of the 2030 Agenda for Sustainable Development is to achieve “full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value” (Sustainable Development Goal (SDG) 8, target 8.5).

In retrospect, the situation up until 2015 has improved in terms of the gender gap, however only in some regions, and not by a comparable amount. The progress that has been made is deemed slow and only achieved in a few regions of the world. It remains a fact that women in comparison to men suffer more from becoming unemployed or remaining unemployed, opportunities for women to participate in the labor force are more limited, additionally, when an opportunity does appear for a woman the chances are higher that it will be a position of lower quality, perhaps even a position for which the person might be overqualified and underpaid. The low amount of opportunities results in women practically having to accept working low-quality jobs. In terms of those countries from regions where there has been some progress even if it is meager and marginal in narrowing the labor force participation and employment gap, countries where women are shifting to the service sector and away from contributing family work, the issue of quality of their job opportunities is still present. The 2030 Agenda, placed a concrete incentive in the direction of achieving higher equality among the genders, with 17 SDG's (Sustainable Development Goals). The SDG's range from various fields however they encircle the vision

of more jobs, better quality jobs, and universal social protection, focus is set also on recognizing household work and care which are unpaid and underappreciated. Reducing the number of such activities and redistributing them as a manner of delivering the new agenda with goals such as reducing poverty, and inequalities, achieving gender equality, full as well as productive employment, and decent work for all individuals. (ILO, 2016)

In the period from 1995 to 2015, the labor force participation differential among gender has narrowed down very slightly, however, the reason why it narrowed is something to take into consideration before observing this as a positive statement. Both male and female labor force participation rates have globally decreased in those two decades, the reason why the gap between the rates is narrowed is only due to the fact that the male labor force participation rate has decreased slightly more than the female labor force participation rate. In regions that had a large gap between genders, the gap has remained large if not even increased in regions such as Southern Asia and Eastern Asia. In 2015, women have 27 percentage points lower chances of employment in comparison to men, the difference narrowed only by 0.6 percentage points, and as already mentioned does not stand in favor of an improvement of the situation on a global level.

The few regions that have achieved marginal progress are Northern, Southern, and Western Europe where the unemployment gap has been reduced due to the fact that women are entering the labor force in a higher amount, but also because of the economic downturn that caused men to exit the labor force. (ILO, 2016)

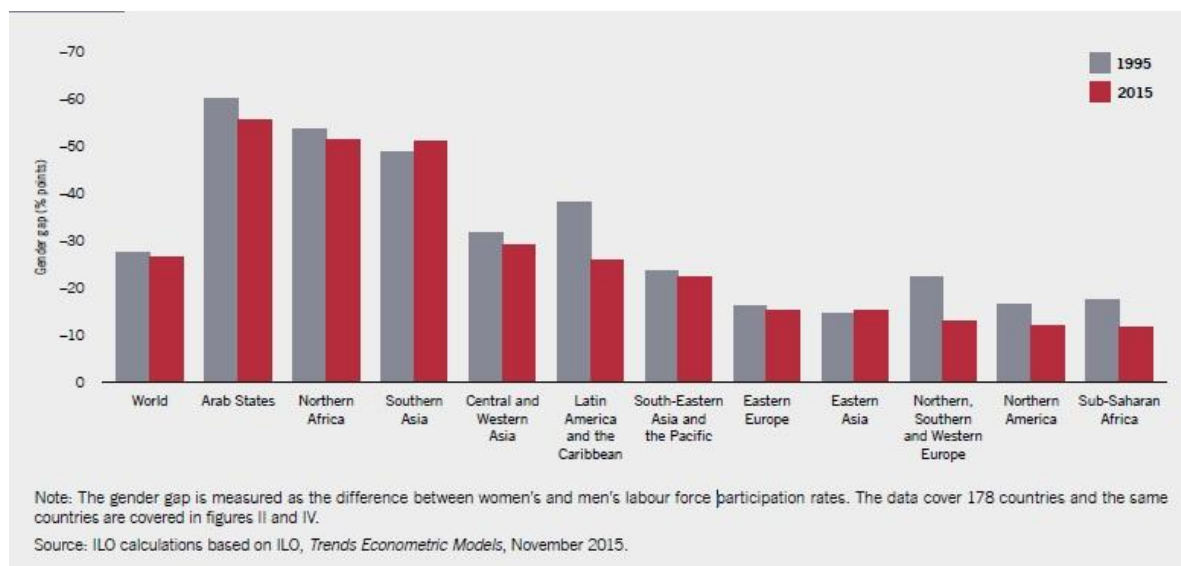


Figure 1 Gender gap (in % points), Source: ILO, 2015

1.3 GENDER EQUALITY LAW IN BOSNIA AND HERZEGOVINA

The Gender Equality Law (GEL) was first passed in 2003, by the Parliamentary Assembly of Bosnia and Herzegovina, it was later revised in 2010. The Gender Equality Law is the basis of the framework that enables further establishment of a network of institutional organizations and mechanisms that set in motion advancements at all levels of administration in Bosnia and Herzegovina in terms of gender equality. It is the most important mechanism in existence that reduces gender inequality in Bosnia and Herzegovina. GEL itself is based on the Convention on the Elimination of All Forms of Discrimination against Women. It advocates in favor of reducing gender inequality in all spheres, both public and private, in addition it prohibits discrimination in any field related to gender or sexual orientation. There are 33 articles within the Law that cover the topic of discrimination, whether if it is discrimination on the basis of gender in media, education, social and health protection, sport and culture, work and employment, and public life. Articles of the Law also have the function of regulating prohibition of violence, as well as obligations of the authorities, compensation of damage, monitoring and supervision of implementing the law, etc. The GEL promotes, regulates, as well as protects substantive gender equality, with the guarantee of equality in opportunities to all citizens, in both private and public life, and finally, it stands to prevent direct as well as indirect discrimination based on gender. (The Agency for Gender Equality of Bosnia and Herzegovina)

The Law covers the following fields of discrimination:

- Discrimination based on gender exists in the situation where an individual or a group of individuals are placed in a less favorable position because of their gender.

One should consider the differentiation between direct and indirect gender-based discrimination:

- Direct discrimination based on gender is present when an individual or a group of individuals of the same gender are treated or may be treated less favorably in comparison to another individual or a group of individuals of different gender in a similar or same situation.
- Indirect discrimination based on gender is present when a legal norm, criterion or practice appears to be neutral and equal for everyone, but in practice places or stands at a possibility of placing an individual or a group of individuals of the same

gender into a less favorable place in comparison to an individual or a group of individuals of a different gender.

Harassment in any form is covered by the Law as well:

- Harassment is in fact any form of an unwanted conduct that is based on gender with the aim or effect of violating an individual's or group's dignity, creating an environment that could be described as insulting, humiliating, degrading, intimidating, or hostile.
- Sexual harassment is any unwanted verbal, or non-verbal, or physical conduct that has a sexual nature with the aim or effect of violating an individual's or group's dignity, in particular in situation when this kind of behavior creates an environment that is hostile, degrading, humiliating, or offensive.
- Violence that is based on gender is any kind of conduct that causes, or may result in, mental, sexual, physical, or economic damage or suffering, as well as a possible threat of such a conduct that would prevent an individual or a group of individual's in enjoying their human rights and freedoms in private and public life. Domestic violence, violence in the wider community, violence occurred in armed conflict, violence committed or tolerated by authorities, all of these are possible fields of exhibition.
- Victimization that exists in a situation where an individual or a group of individuals is placed into a less favorable position because they refused to follow an instruction that would cause them to act in a discriminatory manner, such individuals file a report on discrimination, followed by testimonials and participations in any other required way in the procedure of protection from discrimination that is based on gender.

(The Agency for Gender Equality of Bosnia and Herzegovina)

1.4 PROBLEM STATEMENT

The importance of unemployment as an issue in an economy, and country is obvious and according to Wen, Chen (2012) Okun's law tells us how much GDP is lost when the unemployment rate is above its natural rate, however, Okun's law is not something that can be of great assistance in expecting the effect of the unemployment rate on GDP in a country with an unemployment rate that is very distant from the natural rate of unemployment. Bosnia and Herzegovina is unfortunately such a country, based on data

from the World Bank, the unemployment rate in Bosnia and Herzegovina in the year 2020, was 15.9%. Nonetheless, it is clear that a high unemployment rate has a negative effect on GDP, as well as the well-being of unemployed individuals, this paper is focused on female individuals and their opportunities for employment, and equality. According to The World Bank (2012) a core area within development economics as well as a central topic globally is gender equality. In a country that is struggling with gender equality such as Chile, the issue can be linked with another one, long term economic growth, in accordance with Celade (2013). According to ILO (International Labor Organization) the issue of Gender equality is being addressed since the 1972 UN Conference on Human Environment, the progress made until 2015, is slow and varies from region to region. In 2015 the 2030 Agenda for Sustainable Development was passed and 172 member states pledged to devote themselves to achieve the SDG's of the Agenda. Among others, gender equality, full and productive employment, equal pay for equal value, etc. The report on gender equality made by ILO in 2015, indicates that the issue is still very much present globally, and based on their calculations women stand at 27 % points lower chances of getting employed in comparison to men. There are numerous factors to consider when analyzing why progress towards gender equality varies from region to region, country to country according to Winkler (2016). Some are economic, and some are non-economic, religion, culture, policies, taxes as well as the structure of the economy and stage of economic development are of importance. Nevertheless, gender equality remains a problem in many countries, and in the region of South Asia the gap has even increased in size in the period from 1995 to 2015 according to ILO (2016). Based on the Global Gender Gap Index 2020 ranking made by the World Economic Forum, Bosnia and Herzegovina is ranked 69th among 153 nations included in the ranking. In Bosnia and Herzegovina one of the greatest problems that affect the female labor force participation according to UN Women (2021) is the issue of maternity leave, despite being regulated by GEL, in practice employers terminate employment contracts with women which are pregnant in order to avoid maternity leave payments and legal responsibilities. Maternity leave is not equally regulated on a state-wide level and in particular in the Federation of Bosnia and Herzegovina, in the Federation, maternity leave is for the most part unregulated throughout the 10 cantons. Among the cantons maternity leave varies from canton to canton, with some cantons practicing full remuneration for maternity leave while at the same time other cantons offer none. An additional issue is the difference between women employed in the public sector, where women can be compensated during maternity leave with a 100 % of their salary, meanwhile in the private and real sector, women on maternity leave are compensated from 50% to 90% of their salaries. These issues place single women as well as self-employed women at a disadvantage, additionally increasing their financial struggle. If it is clear that each step made toward gender equality is a step made toward improving the economy why are governments so hesitant to introduce and supervise necessary changes that would increase the well-being of all individuals and especially women. Are the non-economic factors so deeply rooted that they cause gender equality to be forecasted to reach a closure on the overall gap among genders in about a 100 years at the current rate of progress according to the World Economic Forum. The problem of gender inequality in Bosnia and Herzegovina still has a strong presence, although the GEL prohibits gender discrimination of any kind, whether direct or indirect, the actual data indicates that

discrimination continues to exist and that female labor force participation is at damage due to the fact that the GEL may be inadequate to begin with and additional revisions are necessary or it may be inadequately enforced and supervised throughout the country by the government. Another reason why the problem of the gender gap and gender discrimination persist may be due to insufficient significant research done on the problem.

1.5 RESEARCH QUESTION

Given everything above, the main motivation behind this study is to examine the following question: *Is there a long-term relationship between female labor force participation and macroeconomic indicators...*

2 LITERATURE REVIEW

5.

6.

2.1 EXPLANATION OF DIFFERENCES IN FEMALE LABOR FORCE PARTICIPATION ACROSS COUNTRIES

7.

In order to understand why there is such a strong variation present in the female labor force participation from region to region, and also from country to country, even for countries which are within the same region, it is necessary to take into consideration a wide spectrum of factors that influence the female labor force participation. Factors that have an influence on it are not only economic but rather also include non-economic factors, such as religion, political ideology, as well as differences in cultural expectations. One should consider the existing industrial mix and the relative demand for the female labor force, the stage of development of a country and region, then the differences in institutional settings which directly affect the wage-setting within an economy. The matter of if the economy is centralized or decentralized as well as differences in policies that exist from country to country such as taxes and transfer, labor market, and family. The non-economic factors mentioned beforehand can be further explained one by one, beginning with religion as a factor that influences female labor force participation. In Catholic countries such as Italy or Portugal, and Muslim countries such as Turkey, there is a tendency to be patriarchal in a higher measure, and as a result, the female labor force participation rate in such countries tends to be lower. In terms of political ideology, there is the example of former Soviet Union countries where the female labor force is at a higher rate. When it comes to cultural expectations, the question asked is does the culture of a country consider the roles distributed between men and women in an old-fashioned way where the man works, and brings food to the table, meanwhile the woman is expected to be a housewife, cook, clean, raise children, etc. Countries that have moved on from such an understanding of the distribution of roles, chores, and tasks between genders, and have a more equal perspective on the topic, where both the husband and the wife should be employed, should go to work, and in fact, the husband should take part in all the household obligations as well, such countries have a higher female labor force participation.

When it comes to the economic factors, it is important to take into consideration the industrial structure of the economy to understand under what kind of framework does countries economy circulate, providing a steered conclusion in to what kind of parameters set up more job opportunities for women. For instance, having a large service sector, which is the case in the US, that kind of situation enables greater opportunities for part time employment, work that can be done from home such as childcare and meal produced at home. This provides an entry of women into the labor force as well as providing higher chances of becoming employed.

The stage of economic development of a country has a high influence on the shape of the labor market. On the path of economic development female labor force participation is expressed in a U-shaped relation, this would indicate that female participation is high in the early stages of economic development and do considerable amount of work within subsistence agriculture, and as the economy develops in a manufactory based one, their participation pulls back, and after the economy develops further their participation once again increases as educated women step in white-collar job opportunities.

Finally, labor market, tax and family policies are of importance as well and must be considered. For example, labor market policies can have a positive and stimulating influence on female labor force participation if there are enacted policies, anti-discrimination regulations, quotas of minimum percentage of female employees, female board members, etc.

The tax policies mainly reflect to the structure of income taxation and some countries have the so-called secondary earner penalty, where if both the husband and the wife are employed, typically the income from the wife is at harm by the tax, and as a result women are discouraged to work.

On the other hand, a tax policy can be directed in a positive direction, for instance the earned income tax credit that encourages female labor force entry by subsidizing low-earner families for an amount of its income.

Family policies primarily reflect on family leave, maternal, paternity, parental leave, all OECD countries have some kind of a family leave except the US. The logic behind a family leave is assisting in balancing paid work and family, with the focus on mothers, since they remain the primary caregiver to a child. From the countries that are members of the OECD, the most generous, or in other words the best family leave is present in Nordic countries, such as Norway, Denmark, Finland, France, and Sweden. The family leave differs from country to country in terms of the duration of the leave as well as the rate of replacement, the percentage of wage that is being paid to the employee while the employee is on a family leave. (Winkler, 2016)

a.

2.2 LIMITATIONS

To be declared upon completion.

3. METHODOLOGY

The first step in the methodology section is explaining the data. Descriptive data analysis will be conducted with the explanation of why this data was selected. The first step will be dividing the data by gender, upon which a test of difference between variables relevant to average employment of males and females will be conducted. The following step will be conducting the independent samples test/ Levene's Test for Equality of Variances. Upon that logistic regression is conducted with all variables included, the results of the regression will be interpreted and variables that have shown no statistical significance will be removed in the following model. The improved model will also be interpreted in odds ratio as well as the effect of a unit change in the mean value of the explanatory variables on the probability of being in the labor force. Finally, Marginal Effects from the Logit Model Predicting Female Labor Force Participation will be conducted and interpreted.

3.1 DATA EXPLANATION

For the purpose of this study, data from the Labor Force Survey 2021 in BiH will be used, LFS 2021, variables included will be age, age squared, carrier, daughter of the carrier, other relationship with the carrier, relationship with the carrier, type of settlement, has the person ever worked, the highest level of education, high school, university degree, entity, Federation, Republic of Srpska, employed, unemployed, inactive, work-capable population, labor force, (household members, married/unmarried and presence of children descriptive statistics to be additionally incorporated) the source of the data is the LFS 2021 done by the Agency for Statistics of Bosnia and Herzegovina.

The table below contains the descriptive statistics of variables by gender of questionnaires in the econometric study:

	Female							
	N		Mean	Median	Mode	Std. Deviation	Minimum	Maximum
	Valid	Missing						
Age_Q9	1487043	0	48.20	48.00	61	18.740	15	89
Relationship with the Type of settlement	1487043	0	2.13	2.00	2	.857	1	4
Has the person ever The highest level of Completed high school	1487043	0	.45	0.00	0	.497	0	1
Completed university	1060391	426652	.28	0.00	0	.450	0	1
Relationship with the Carrier	1487043	0	.75	1.00	1	.675	0	2
Daughter of the carrier	1487043	0	.48	0.00	0	.500	0	1
Other relationship with Age squared	1487043	0	.13	0.00	0	.341	0	1
Entity	1487043	0	.84	0.00	0	1.011	0	3
Federation of BIH	1487043	0	.22	0.00	0	.414	0	1
Republic of Srpska	1487043	0	.18	0.00	0	.380	0	1
Highest level of Employed	1487043	0	.09	0.00	0	.285	0	1
Unemployed	1487043	0	2674.44	2304.00	3721	1860.940	225	7921
Inactive	1487043	0	1.31	1.00	1	.512	0	2
Work-capable Labor force	1487043	0	.64	1.00	1	.480	0	1
	1487043	0	.34	0.00	0	.472	0	1
	1487043	0	1.62	2.00	2	.879	0	3
	1487043	0	.29	0.00	0	.452	0	1
	1487043	0	.08	0.00	0	.273	0	1
	1487043	0	.63	1.00	1	.482	0	1
	1487043	0	1.00	1.00	1	0.000	1	1
	1487043	0	.37	0.00	0	.482	0	1

Figure 2 Descriptive statistics of variables (Female)

	Male							
	N		Mean	Median	Mode	Std. Deviation	Minimum	Maximum
	Valid	Missing						
Age_Q9	1416950	0	45.87	45.00	38	17.991	15	89
Relationship with the Type of settlement	1416950	0	1.69	1.00	1	.991	1	4
Has the person ever The highest level of Completed high school	1416950	0	.42	0.00	0	.494	0	1
Completed university	692876	724074	.63	1.00	1	.482	0	1
Relationship with the Carrier	1416950	0	.92	1.00	1	.569	0	2
Daughter of the carrier	1416950	0	.67	1.00	1	.470	0	1
Other relationship with	1416950	0	.12	0.00	0	.330	0	1
Age squared	1416950	0	1.34	1.00	1	.566	0	3
Entity	1416950	0	.66	1.00	1	.473	0	1
Federation of BIH	1416950	0	.29	0.00	0	.453	0	1
Republic of Srpska	1416950	0	.03	0.00	0	.175	0	1
Highest level of Employed	1416950	0	2427.37	2025.00	1444	1731.602	225	7921
Unemployed	1416950	0	1.31	1.00	1	.513	0	2
Inactive	1416950	0	.64	1.00	1	.480	0	1
Work-capable Labor force	1416950	0	.34	0.00	0	.473	0	1
	1416950	0	1.88	2.00	2	.666	0	3
	1416950	0	.51	1.00	1	.500	0	1
	1416950	0	.09	0.00	0	.280	0	1
	1416950	0	.40	0.00	0	.491	0	1
	1416950	0	1.00	1.00	1	0.000	1	1
	1416950	0	.60	1.00	1	.491	0	1

Figure 3 Descriptive statistics of variables (Male)

Group Statistics					
Gender of questionnaires		N	Mean	Std. Deviation	Std. Error Mean
Employed	Male	1416950	.51	.500	.000
	Female	1487043	.29	.452	.000
Unemployed	Male	1416950	.09	.280	.000
	Female	1487043	.08	.273	.000
Inactive	Male	1416950	.40	.491	.000
	Female	1487043	.63	.482	.000
Labor force	Male	1416950	.60	.491	.000
	Female	1487043	.37	.482	.000

Figure 4 Group statistics (differences between genders)

Independent Samples Test		Levene's Test for Equality of Variances		Equality of				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Employed	Equal variances assumed	311822.055	0.000	400.920	2903991	0.000	.224	.001
	Equal variances not assumed			399.957	2842023.048	0.000	.224	.001
Unemployed	Equal variances assumed	1007.352	.000	15.869	2903991	.000	.005	.000
	Equal variances not assumed			15.859	2887168.434	.000	.005	.000
Inactive	Equal variances assumed	14956.197	0.000	-401.575	2903991	0.000	-.229	.001
	Equal variances not assumed			-401.409	2891619.863	0.000	-.229	.001
Labor Force	Equal variances assumed	14956.197	0.000	401.575	2903991	0.000	.229	.001
	Equal variances not assumed			401.409	2891619.863	0.000	.229	.001

Figure 5 Independent Samples Test (Levene's Test)

3.2 METHOD

The method of this study will include:

- Levene's Test for Equality of Variances
- Testing of differencec between variables relevant to average employment of males and females
- Effect of a unit change in the mean value of the explanatory variables on the probability of being in the labor force
- Marginal Effects from the Logit Model Predicting Female Labor Force Participation

4. RESULTS

4.1 LOGIT-STATA

```
. logistic i_radsna osnovna_skola srednja_skola univerzitetsko_obrazovanje Starost_Q9 starost2 i_ozenjenUdataVanbracnaZajednica ranije_ra
> dio_la prisustvo_djece_0_17 tip_naselja_2 i_0_17_sum nosilac kcerka ostali_odnos_prema_nosiocu brClanovaHH federacija repsrpska [pweigh
> t= CalibrationWeight], coef
```

```
Logistic regression                Number of obs   =    26,285
                                   Wald chi2(16)    =    1706.69
                                   Prob > chi2       =     0.0000
Log pseudolikelihood = -264553.03  Pseudo R2      =     0.2939
```

i_radsna	Robust				
	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
osnovna_skola	.1974492	.1939405	1.02	0.309	-.1826672 .5775656
srednja_skola	.9817418	.1859548	5.28	0.000	.6172772 1.346206
univerzitetsko_obrazovanje	1.647695	.1982878	8.31	0.000	1.259058 2.036332
Starost_Q9	.3331542	.0167608	19.88	0.000	.3003037 .3660047
starost2	-.0045889	.0001964	-23.36	0.000	-.0049739 -.0042039
i_ozenjenUdataVanbracnaZajednica	.5271211	.1761403	2.99	0.003	.1818924 .8723497
ranije_radio_la	1.277723	.0682524	18.72	0.000	1.143951 1.411495
prisustvo_djece_0_17	-2.043854	.4753352	-4.30	0.000	-2.975494 -1.112214
tip_naselja_2	-.0182975	.059849	-0.31	0.760	-.1355994 .0990043
i_0_17_sum	-.263317	.0463909	-5.68	0.000	-.3542415 -.1723925
nosilac	.4997077	.1707382	2.93	0.003	.165067 .8343483
kcerka	1.188134	.1994639	5.96	0.000	.7971919 1.579076
ostali_odnos_prema_nosiocu	-.1568152	.136542	-1.15	0.251	-.4244326 .1108022
brClanovaHH	.1120716	.0324143	3.46	0.001	.0485408 .1756025
federacija	-.0629672	.083378	-0.76	0.450	-.2263851 .1004508
repsrpska	-.068826	.0923412	-0.75	0.456	-.2498114 .1121595
_cons	-8.80508	.4436136	-19.85	0.000	-9.674546 -7.935613

Figure 6 Logit regression

Variables Federation and Republic of Srpska will be dropped from the model due to their lack of statistical significance.

before have a greater likelihood than those who had not as a reference category, and women who are the household carrier or daughters of household carriers in comparison to women-spouses as a reference category.

Women who live in larger households have greater odds of being a part of the labor force. The decrease in the likelihood of participating in the labor force is affected by the presence of children in the household as well as the number of children. As the number of children increases, the odds for a woman to be a part of the labor force in BiH decreases, ceteris paribus.

The following is the same model with odds ratio as an output.

```
. logistic i_radsna osnovna_skola srednja_skola univerzitetsko_obrazovanje Starost_Q9 starost2 i_ozenjenUdataVanbracnaZajednica ranije_ra
> dio_la prisustvo_djece_0_17 tip_naselja_2 i_0_17_sum nosilac kcerka ostali_odnos_prema_nosiocu brClanovaHH [pweight= CalibrationWeight]
> , or
```

```
Logistic regression          Number of obs   =    26,285
                             Wald chi2(14)      =    1698.73
                             Prob > chi2         =     0.0000
Log pseudolikelihood = -264557.97   Pseudo R2      =     0.2939
```

i_radsna	Robust				
	Odds Ratio	Std. Err.	z	P> z	[95% Conf. Interval]
osnovna_skola	1.219785	.2365558	1.02	0.306	.8340802 1.783852
srednja_skola	2.66854	.4963242	5.28	0.000	1.853352 3.842284
univerzitetsko_obrazovanje	5.191515	1.029801	8.30	0.000	3.519232 7.658442
Starost_Q9	1.395412	.023381	19.89	0.000	1.35033 1.441998
starost2	.9954208	.0001955	-23.37	0.000	.9950377 .9958041
i_ozenjenUdataVanbracnaZajednica	1.694471	.2988207	2.99	0.003	1.19929 2.394109
ranije_radio_la	3.588062	.2440004	18.79	0.000	3.140331 4.099629
prisustvo_djece_0_17	.1293921	.0614984	-4.30	0.000	.0509733 .3284529
tip_naselja_2	.9832794	.0587518	-0.28	0.778	.874615 1.105444
i_0_17_sum	.7685771	.0356586	-5.67	0.000	.701771 .8417429
nosilac	1.648181	.2812544	2.93	0.003	1.179645 2.302812
kcerka	3.279738	.6515348	5.98	0.000	2.222 4.84099
ostali_odnos_prema_nosiocu	.854003	.1160081	-1.16	0.245	.6543827 1.114518
brClanovaHH	1.118316	.0361607	3.46	0.001	1.049642 1.191484
_cons	.0001409	.0000612	-20.42	0.000	.0000601 .00033

Note: _cons estimates baseline odds.

Figure 8 Logit regression odds ratio

Odds ratios greater than 1 indicates an increased chance that the woman in BiH is a part of the labor force. An odds ratio of less than 1 suggests a decreased chance for women to be a part of the labor force.

Odds ratios for presence of children and number of children in the household suggests that the probability of being in the labor force decreases with respect to these variables, which is not a surprising finding. For example, the odds of being in the labor force decrease by about 23% if the number of children increases by one child.

The presence of children in the household, reduces the odds of being in the labor force by about 87% in comparison with women living in the household without children.

The following is the same model with the calculation of the effect of a unit change in the mean value of the explanatory variables on the probability of being in the labor force.

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. margins, dydx(*) atmeans

Conditional marginal effects Number of obs = 26,285
 Model VCE : Robust

Expression : Pr(i_radsna), predict()
 dy/dx w.r.t. : osnovna_skola srednja_skola univerzitetsko_obrazovanje Starost_Q9 starost2 i_ozenjenUdataVanbracnaZajednica
 ranije_radio_la prisustvo_djece_0_17 tip_naselja_2 i_0_17_sum nosilac kcerka ostali_odnos_prema_nosiocu brClanovaHH
 at : osnovna_skola = .3173263 (mean)
 srednja_skola = .4353429 (mean)
 univerzite-e = .0662034 (mean)
 Starost_Q9 = 50.80578 (mean)
 starost2 = 2994.115 (mean)
 i_ozenjenU-a = .5255399 (mean)
 ranije_rad-a = .2820983 (mean)
 prisustvo~17 = .0494238 (mean)
 tip_naselj~2 = .4086512 (mean)
 i_0_17_sum = .5168827 (mean)
 nosilac = .2516374 (mean)
 kcerka = .1740934 (mean)
 ostali_odn~u = .0943341 (mean)
 brClanovaHH = 3.110541 (mean)

	Delta-method					[95% Conf. Interval]	
	dy/dx	Std. Err.	z	P> z			
osnovna_skola	.0034309	.0032647	1.05	0.293	-.0029677	.0098296	
srednja_skola	.01695	.0029714	5.70	0.000	.0111262	.0227738	
univerzitetsko_obrazovanje	.0284424	.0033464	8.50	0.000	.0218836	.0350012	
Starost_Q9	.0057538	.0003436	16.75	0.000	.0050804	.0064273	
starost2	-.0000793	4.44e-06	-17.85	0.000	-.000088	-.0000706	
i_ozenjenUdataVanbracnaZajednica	.0091071	.0031174	2.92	0.003	.0029972	.0152171	
ranije_radio_la	.022063	.0019135	11.53	0.000	.0183126	.0258134	
prisustvo_djece_0_17	-.0353134	.0083417	-4.23	0.000	-.0516629	-.0189639	
tip_naselja_2	-.0002912	.0010333	-0.28	0.778	-.0023164	.0017341	
i_0_17_sum	-.0045454	.0008207	-5.54	0.000	-.0061541	-.0029368	
nosilac	.0086288	.0030241	2.85	0.004	.0027017	.0145559	
kcerka	.0205114	.0036772	5.58	0.000	.0133043	.0277185	
ostali_odnos_prema_nosiocu	-.0027254	.002344	-1.16	0.245	-.0073196	.0018688	
brClanovaHH	.0019311	.0005773	3.35	0.001	.0007997	.0030625	

Figure 9 Logit regression marginal effects

If mean age increases by one year, it increases the probability of being in the labor force by about 0.006, ceteris paribus.

Similarly, if the mean number of children in the household increases by one child, the probability of being in the labor force decreases by about 0.005, *ceteris paribus*.

5. CONCLUSION

Women's labor force participation rates are largely rising across the globe, which bodes well for women, children, families, and society. However, progress is clearly very uneven, and rates have even plateaued in the US. Family-friendly policies represent one lever that can be used to increase women's participation. Father quotas seem to be an especially promising policy. However, in selecting the mix of family policies, policymakers must be careful to recognize that the benefits of some family-friendly policies such as longer paid maternity and parental leave and the "right to request" flexible hours may have unintended negative consequences for women's career advancement. It is also the case that women continue to bear greater responsibility for care of the home and family. Child care subsidies are one way to reduce this unequal burden, and in turn, facilitate women's labor force participation and career advancement. (Winkler, 2016)

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NADEEN MAHOROVIC

Theme: Taoism - The philosophy of flow

9.

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1. Introduction

Taoism, also known as Daoism, is an ancient Chinese philosophical and religious tradition that emphasizes living in harmony with the Tao (道), which can be translated as “The Way” (Chan, 1963). It has evolved over thousands of years, originating around the 4th century BCE, and continues to profoundly impact Chinese culture and other East Asian countries (Kohn & LaFargue, 2021). The Tao Te Ching (道德經) is the foundational text of Taoism, attributed to the legendary figure Lao Tzu (老子), who is believed to have been a contemporary of Confucius (Hansen, 2020). While there is debate over the historical existence of Lao Tzu, the teachings within the Tao Te Ching have resonated with countless individuals across the globe. The text, consisting of 81 short chapters, provides wisdom and guidance for living a harmonious and balanced life in accordance with the Tao (Laozi & Addiss, 1993).

Central to Taoist thought is the concept of ‘flow,’ which can be understood as the natural and effortless way the universe and all living beings operate (Csikszentmihalyi, 2008). Flow is an essential element of the Tao, and those who seek harmony are encouraged to attune themselves to this natural way of being (Komjathy, 2018). By following the principles of Taoism, individuals can experience a sense of deep interconnectedness and a state of effortless action known as ‘wu-wei’ (無爲) (Laozi & Addiss, 1993).

This paper explores the philosophy of flow in Taoism, primarily focusing on the teachings found within the Tao Te Ching. We will delve into the historical context of Taoism, its core concepts, and the practical implications of incorporating Taoist principles into daily life. By providing an in-depth analysis of the flow philosophy, this paper aims to demonstrate the enduring relevance of Taoism in contemporary society.

2. Historical Context

2.1. The Origins of Taoism

The origins of Taoism can be traced back to the turbulent period of the late Eastern Zhou Dynasty (770-256 BCE) in ancient China, a time marked by significant social and political upheaval (Robinet, 2008). The ensuing chaos, culminating in the “Warring States Period” (475-221 BCE), propelled thinkers to seek solutions to the challenges faced by their society, leading to the emergence of various philosophical schools (Kohn, 2001). Among these schools were Confucianism and Mohism, which aimed to establish harmony, order, and moral guidance in a time of disorder and strife.

Amid this vibrant intellectual landscape, Taoism stood out as a unique and alternative perspective, offering a distinct approach to understanding and navigating life’s complexities. Rather than advocating for rigid moral and social structures, Taoism emphasized living in accordance with the natural order of the universe, embracing the principles of balance, simplicity, and harmony (Komjathy, 2018). By encouraging individuals to attune themselves to the ever-changing flow of the cosmos, Taoism provided a refreshing alternative to its contemporaries’ prescriptive and hierarchical teachings, allowing people to discover inner peace and wisdom amid an unpredictable world. As a result, the Taoist tradition, born out of great uncertainty, has continued to captivate and inspire those seeking a more harmonious way of life across the centuries.

2.2. Lao Tzu’ life and Background

Lao Tzu, the enigmatic sage and reputed founder of Taoism is traditionally credited with authoring the seminal text, the Tao Te Ching, a foundational work containing the essence of Taoist philosophy (Hansen, 2020). The historical accuracy of Lao Tzu’s existence has been the subject of much debate among scholars. Despite these uncertainties, Lao Tzu is generally believed to have been a contemporary of Confucius and served as a court archivist during the Zhou Dynasty (Kirkland, 2020). This would have positioned him uniquely to observe and comment on his time’s prevailing social and political dynamics. The name Lao Tzu, which translates to “Old Master,” underscores his status as a revered and wise teacher who, through his writings, has continued to guide generations of followers in their quest for balance and harmony (Komjathy, 2018).

2.3. The development of Taoism overtime

The evolution of Taoism over time is marked by its incredible adaptability and fluidity, enabling the tradition to remain relevant across various historical contexts. In its early stages, Taoism was primarily a philosophical system, as exemplified by the works of Lao Tzu and Zhuangzi (c. 369-286 BCE). Their teachings guided living in harmony with the Tao, or the natural way of the universe, emphasizing balance, simplicity, and adaptability (Kohn, 2001).

As the Han Dynasty (206 BCE - 220 CE) unfolded, Taoism transformed significantly, evolving from a purely philosophical school into a more structured religious tradition. This period saw the integration of elements such as meditation, ritual, and alchemy into the Taoist practice, reflecting a growing emphasis on cultivating

spiritual well-being and pursuing immortality (Robinet, 2008). The addition of these practices enriched the Taoist tradition, offering followers a diverse array of tools for spiritual growth and self-discovery. During the Tang Dynasty (618-907 CE), Taoism continued to evolve, with religious and philosophical ideas coalescing into a cohesive system. This period saw the emergence of numerous Taoist sects, such as the Quanzhen School, which further diversified the landscape of Taoist thought and practice (Kohn, 2001). The proliferation of these sects reflected the wide-ranging appeal of Taoist principles, as well as the ability of the tradition to accommodate different spiritual needs and aspirations.

Throughout history, Taoism has showcased an extraordinary capacity for adaptation, seamlessly incorporating components from other religious and philosophical traditions to shape its distinctive worldview. This synthesis is evident in how Taoism has drawn from Chinese folk religion, Buddhism, and Confucianism, assimilating their ideas and practices into a unique and enduring system (Kirkland, 2020). By remaining open to change and adaptation, Taoism has maintained its relevance, resilience, and appeal over the centuries, providing countless individuals with a profound and transformative path toward harmony, wisdom, and personal growth.

3. Core Concepts of Taoism

3.1. Tao (The Way)

a. Definition and importance

The Tao, or “The Way,” is the central concept in Taoism, representing the underlying, natural order of the universe (Lao Tzu, 1963). It is both the source and the guiding principle of all existence, encompassing everything from the smallest particle to the vast cosmos (Komjathy, 2018). As the fundamental essence of reality, the Tao serves as a constant yet ever-changing force that permeates every aspect of life, giving rise to the rich tapestry of forms and phenomena that constitute the world we inhabit. The Tao is crucial in Taoist philosophy, as understanding and living in harmony with the Tao is the ultimate goal for practitioners seeking a life of balance, peace, and contentment. This pursuit involves developing a deep awareness of the natural patterns and rhythms of existence, enabling individuals to align their thoughts, actions, and intentions with the flow of the Tao (Kohn & LaFargue, 2021). In doing so, they can tap into the infinite wisdom and power of the Tao, allowing them to navigate the complexities of life with grace and ease.

The importance of the Tao in Taoist thought can also be understood in its role as a unifying principle that transcends the dualities and contradictions that often characterize human experience. By recognizing the Tao as the common thread that connects all aspects of reality, practitioners are encouraged to cultivate a more holistic and integrative approach to life, fostering harmony within the individual and in their interactions with the world around them (Komjathy, 2018). The Tao is a source of inspiration and guidance for those who seek to embody its principles daily. Through the cultivation of virtues such as humility, compassion, and simplicity, practitioners endeavor to mirror the qualities of the Tao and attain a state of inner balance that resonates with the natural harmony of the universe (Lao Tzu, 1963). By embracing the Tao as a way of life, individuals can experience a profound sense of connection and unity with all things, transcending the limitations of ego and self-interest to live in accordance with the greater flow of existence.

In addition to its profound philosophical and spiritual significance, the concept of the Tao has far-reaching implications for various aspects of human life, including art, science, politics, and ethics (Kohn & LaFargue, 2021). The Taoist emphasis on harmony, balance, and natural living has inspired countless artists, poets, and philosophers throughout history who have sought to express the beauty and wisdom of the Tao through their creative works. Similarly, the principles of the Tao have informed the development of traditional Chinese medicine, martial arts, and ecological practices, all of which emphasize the importance of living in harmony with the natural world and its inherent cycles.

b. The unnamable and the ten thousand things

The Tao is often referred to as the “unnamable” because it transcends human comprehension and language (Lao Tzu, 1963). Its elusive nature results from its inherent simplicity and profound subtlety, which cannot be adequately captured or defined by human concepts or words (Komjathy, 2018). Despite its ineffability, the Tao is said to give rise to the “ten thousand things,” or the myriad forms and phenomena that make up the manifest world. This idea highlights reality’s interdependent and interconnected nature, emphasizing that everything in existence is part of the same, continuous flow of the Tao. In this context, the ten thousand things can be seen as the diverse expressions of the Tao, each reflecting a unique aspect of its boundless and ever-changing nature. By recognizing the unity underlying the diversity of existence, Taoist practitioners are encouraged to cultivate a deeper appreciation for the interconnected web of life and the essential role that the Tao plays in its unfolding.

3.2. Ying and Yang

a. Definition and significance

Yin and Yang are the complementary, opposing forces that govern the natural world, reflecting the dualistic nature of reality (Lao Tzu, 1963). They are the building blocks of existence, and their interaction shapes the myriad phenomena and processes that make up the universe. Yin represents the feminine, passive, and receptive qualities, while Yang embodies the masculine, active, and dynamic aspects. These two forces are inextricably linked, constantly interacting and transforming into one another, creating a dynamic balance that pervades all aspects of life (Kohn & LaFargue, 2021). The concept of Yin and Yang is significant in Taoism because it helps to explain the interconnectedness of all things and the importance of balance and harmony in the universe. The principles of Yin and Yang serve as a foundational element of Taoist thought, underpinning many of its core teachings and practices. This dualistic framework encourages practitioners to develop a holistic understanding of reality, recognizing the inherent unity beneath the surface of apparent opposites and contradictions (Komjathy, 2018).

The concept of Yin and Yang also has profound implications for personal growth and self-cultivation. Taoist practitioners strive to maintain an equilibrium between the Yin and Yang aspects of their being to achieve a harmonious and balanced life. This involves cultivating flexibility, adaptability, and patience, which allow individuals to navigate the challenges and opportunities that arise as a natural part of life’s ever-changing landscape (Kohn & LaFargue, 2021). Furthermore, the principles of Yin and Yang have influenced various aspects of Chinese culture, including traditional medicine, martial arts, and even cuisine. In traditional Chinese medicine, for example, the concepts of Yin and Yang are used to diagnose and treat imbalances in

the body's energy, with practitioners employing herbs, acupuncture, and other therapeutic modalities to restore harmony and promote overall well-being (Komjathy, 2018).

b. Balance and harmony

In Taoist thought, the harmonious interplay between Yin and Yang is essential for maintaining the natural order and fostering well-being (Lao Tzu, 1963). The balance between these complementary forces is a foundation for the universe's functioning and underpins the myriad processes that sustain life. When Yin and Yang are balanced, harmony, vitality, and flourishing exist in the natural world and human life. Conversely, when one force dominates, it leads to chaos, imbalance, and disharmony.

The emphasis on balance and harmony in Taoist philosophy has profound implications for personal growth, self-cultivation, and social harmony. By recognizing and aligning with the balanced interplay of Yin and Yang, Taoist practitioners seek to cultivate harmony in their lives and surroundings. This involves embracing both the active and receptive aspects of existence, understanding that each has its unique value and contribution to the overall tapestry of life (Kohn & LaFargue, 2021). Cultivating balance and harmony also extends to relationships with oneself and others. Taoist practitioners are encouraged to foster harmonious relationships by embracing the natural flow of interactions and recognizing the interdependent nature of all things. This approach encourages empathy, compassion, and understanding, enabling individuals to navigate the complexities of human relationships with grace and wisdom (Komjathy, 2018).

In the broader context of society, the Taoist emphasis on balance and harmony has important implications for governance, environmental stewardship, and social justice. By embracing the principles of Yin and Yang, leaders can create policies and systems that promote harmony between different social groups, address inequalities, and foster cooperation and unity. Similarly, by recognizing the importance of balance in the natural world, societies can develop more sustainable and ecologically sound practices that protect and nurture the environment for future generations (Kohn & LaFargue, 2021).

3.3. Wu-wei (Action of Non-action)

a. Definition and importance

Wu-wei, or "non-action," is a fundamental Taoist principle that plays a pivotal role in the tradition's understanding of living in harmony with the natural flow of the Tao (Lao Tzu, 1963). This concept is central to Taoist thought, as it emphasizes the importance of effortless, spontaneous, and unforced action in navigating the complexities of life. It is crucial to note that Wu-wei does not imply inaction or passivity; rather, it suggests a state of being where the individual acts with minimal resistance, gracefully responding to situations as they arise. By allowing the inherent wisdom of the Tao to guide their actions, practitioners of Wu-wei can achieve a sense of effortless ease and fluidity in their interactions with the world around them (Komjathy, 2018).

The idea of Wu-wei encourages Taoist practitioners to cultivate an attitude of open receptivity and flexibility, enabling them to adapt and respond to the ever-changing landscape of life with grace and wisdom. By embracing Wu-wei, individuals can learn to recognize and align with the underlying patterns and rhythms of the universe, fostering a deep sense of connection and harmony with the Tao (Kohn & LaFargue, 2021).In

practical terms, Wu-wei can be understood as the art of “going with the flow,” trusting in the natural unfolding of events, and relinquishing the need for control or manipulation. This approach allows individuals to move through life easily and fluently, minimizing struggle and resistance and maximizing harmony and contentment (Komjathy, 2018).

b. Examples from the Tao Te Ching

Throughout the Tao Te Ching, Lao Tzu offers a wealth of examples and analogies to illustrate the concept of Wu-wei, helping readers understand its significance and practical application in daily life. One of the most prominent examples he provides is comparing the ideal Taoist practitioner to water. Water, as he describes, effortlessly flows around obstacles and adapts to its environment while maintaining its inherent nature (Lao Tzu, 1963). It demonstrates strength in its gentleness, persistently carving through the hardest rocks over time. By emulating the qualities of water, practitioners can learn to move through life with grace and ease, aligning themselves with the natural flow of the Tao. Water’s ability to find the path of least resistance serves as a powerful metaphor for the practice of Wu-wei, reminding individuals to stay receptive, adaptable, and open to the unfolding of events in their lives.

Another example found in the Tao Te Ching highlights the value of flexibility and non-resistance. Lao Tzu states that the wind easily breaks a rigid and unyielding tree, while a flexible and pliant tree can bend and sway, ultimately remaining unharmed (Lao Tzu, 1963). This analogy encourages practitioners to embrace a similar flexibility in their thoughts, emotions, and actions, fostering resilience and adaptability in the face of life’s challenges. These examples from the Tao Te Ching provide valuable insights into the practice of Wu-wei, emphasizing the importance of effortless action, adaptability, and alignment with the natural flow of the Tao. By contemplating and integrating these teachings, individuals can cultivate a state of being that enables them to navigate the complexities of life with grace, ease, and a deep sense of harmony with the world around them. The wisdom found in Lao Tzu’s words continues to resonate today, offering guidance and inspiration for those seeking a more balanced and harmonious way of living.

3.4.The three treasures

a. Compassion, frugality, and humility

The Three Treasures are essential virtues in Taoist thought that guide practitioners seeking to cultivate harmony and balance in their lives (Lao Tzu, 1963). By embodying and nurturing these qualities, individuals can foster inner peace and healthy relationships and live in greater alignment with the natural flow of the Tao.

The first of the Three Treasures is compassion, which emphasizes the importance of showing kindness, empathy, and understanding toward others. In practicing compassion, Taoist practitioners recognize the interconnectedness of all beings and the inherent value of each individual. By treating others with kindness and respect, they contribute to the overall harmony and well-being of their community and the world at large. The second treasure, frugality, encourages living simply and using resources wisely. This virtue invites practitioners to be mindful of their consumption and prioritize quality over quantity daily. By adopting a frugal lifestyle, individuals can minimize their environmental impact, promote sustainability, and experience the profound satisfaction of living in harmony with the natural world.

Lastly, humility is a cornerstone of Taoist thought that emphasizes the importance of recognizing one's limitations and being open to learning from others. This virtue fosters a sense of gratitude, respect, and curiosity toward the experiences and wisdom of others. Humility allows practitioners to maintain a teachable spirit, continuously growing and evolving on their spiritual journey.

The Three Treasures of compassion, frugality, and humility serve as valuable touchstones for individuals seeking to cultivate a harmonious and balanced way of living. By embodying these virtues in daily life, Taoist practitioners can nurture a deep sense of inner peace, foster healthier relationships, and contribute to the greater good of their communities and the world as a whole. Through the practice of the Three Treasures, individuals can find a path toward personal growth and spiritual fulfillment that is grounded and deeply connected to the wisdom of the Tao.

b. Their role in cultivating harmony and balance

By embracing the Three Treasures, Taoist practitioners aspire to live in harmony with the Tao, cultivating balance within themselves and their relationships. The core values of compassion, frugality, and humility play a pivotal role in this process, as they contribute to personal growth, societal harmony, and environmental sustainability.

Compassion serves as a guiding principle that encourages individuals to extend kindness, empathy, and understanding toward all beings. This nurtures a sense of interconnectedness and mutual respect. By practicing compassion, Taoists cultivate harmonious relationships with others, thereby fostering a more peaceful and just society. Frugality helps align practitioners with the natural world by encouraging mindfulness in consumption and resource use. This virtue promotes environmental sustainability and engenders a sense of contentment and gratitude for existing possessions. By adopting frugality, Taoists can balance their lives, sidestepping the pitfalls of excess and materialism. Humility plays an essential role in attaining harmony and balance. It allows individuals to recognize their limitations and maintain an open, receptive attitude toward learning from others and their surroundings. This attribute supports continuous personal growth and spiritual evolution, which lie at the heart of the Taoist pursuit of harmony and balance.

The Three Treasures are integral to cultivating harmony and balance in the lives of Taoist practitioners. By embodying compassion, frugality, and humility, individuals can align more closely with the Tao. This fosters a profound sense of inner peace, enhances the well-being of others, and contributes to the overall harmony of the world.

4. The Philosophy of Flow in Taoism

a. 4.1. The connection between Taoism and flow

The philosophy of flow shares a profound connection with the principles of Taoism, as both schools of thought emphasize the need to align oneself with the natural rhythms and processes that govern the universe (Csikszentmihalyi, 2008). The concept of flow, developed by psychologist Mihaly Csikszentmihalyi, pertains to a state of optimal experience in which an individual becomes wholly absorbed in a particular activity, ultimately transcending their sense of self and time (Csikszentmihalyi, 1990).

This notion resembles the Taoist principle of *wu-wei*, or non-action, which encourages individuals to act in harmony with the Tao by engaging in effortless, spontaneous actions (Lao Tzu, 1963). Both Taoism and the flow philosophy underscore the importance of striking a balance, remaining adaptable, and cultivating deep connections with the world around us (Komjathy, 2018). The affinity between Taoism and flow can be attributed to their shared focus on the principles of balance and harmony. By following these guiding principles, individuals can navigate the complexities of life with a greater sense of ease and poise. By embracing the interdependence and interconnectedness of all things, practitioners of both Taoism and the philosophy of flow can develop a heightened sense of awareness and a deeper understanding of the world around them.

As such, the connection between Taoism and flow is both profound and illuminating, revealing the underlying similarities between these two seemingly distinct philosophies. By exploring the convergence of these ideas, individuals can gain valuable insights into the nature of human experience and the transformative power of living in harmony with the natural world.

b. 4.2. How to achieve flow according to the Tao Te Ching

The Tao Te Ching imparts valuable insights on attaining flow by offering guidance on aligning oneself with the universe's natural order (Lao Tzu, 1963). Embracing the principle of *wu-wei* is a critical aspect of this journey, which involves engaging in activities with minimal resistance and allowing the inherent wisdom of the Tao to direct one's actions (Lao Tzu, 1963). Through practicing *wu-wei*, individuals can access a state of flow by relinquishing control, releasing expectations, and fully immersing themselves in the present moment (Csikszentmihalyi, 2008).

Another fundamental component in fostering flow, as the Tao Te Ching outlines, is recognizing and harmoniously balancing the interplay between Yin and Yang forces (Lao Tzu, 1963). By becoming attuned to the complementary, ever-changing nature of Yin and Yang, practitioners can maintain a state of equilibrium and harmony in their lives. This sense of balance facilitates the flow experience, as individuals can more readily adapt to their surroundings and gracefully navigate challenges (Komjathy, 2018). Moreover, the Three Treasures—compassion, frugality, and humility—are crucial in nurturing flow (Lao Tzu, 1963). By embodying these virtues, individuals can cultivate a mindset characterized by openness, curiosity, and interconnectedness, which enables them to fully engage in activities and experience flow with greater ease (Csikszentmihalyi, 2008).

The teachings of the Tao Te Ching provide a comprehensive blueprint for achieving flow by guiding practitioners toward a life imbued with harmony, balance, and a profound connection to the world around them. By embracing the principles of *wu-wei*, Yin and Yang, and the Three Treasures, individuals can unlock the transformative power of flow and live in accordance with the wisdom of the Tao.

c. 4.3. Living in harmony with the Tao

Living in harmony with the Tao is a central goal of Taoist practitioners, as it allows them to seamlessly align their actions, thoughts, and intentions with the universe's natural order (Lao Tzu, 1963). This harmonious alignment requires cultivating a deep understanding of the Tao and its underlying principles, including wu-wei, Yin and Yang, and the Three Treasures (Komjathy, 2018). To achieve this state of balance, contentment, and inner peace, individuals must first recognize the interconnectedness of all things, acknowledging that every element of the universe is part of the same continuous flow of the Tao (Lao Tzu, 1963). By appreciating the complexity of these interconnections, practitioners can develop a greater sense of empathy and compassion for others and the world around them, leading to more harmonious relationships and a deeper connection with their environment.

Furthermore, embracing the ever-changing nature of reality is essential to living in harmony with the Tao. This involves being adaptable and flexible, allowing oneself to flow with the natural rhythms of life rather than resisting or attempting to control them (Lao Tzu, 1963). Practitioners must develop a willingness to let go of preconceived notions and expectations, embracing change as an inevitable and integral part of existence. Moving through life with grace and adaptability, practitioners guided by the wisdom of the Tao find a profound sense of purpose and meaning in their actions and experiences (Komjathy, 2018). By continually refining their understanding of the Tao and striving to live in accordance with its principles, individuals can gradually progress toward a state of harmony and balance, experiencing greater contentment and inner peace in their daily lives.

Living in harmony with the Tao involves an ongoing process of self-discovery and self-cultivation, characterized by a deep understanding of the Tao's principles, a recognition of the interconnectedness of all things, and a willingness to embrace the ever-changing nature of reality. By integrating these elements into their lives, Taoist practitioners can experience greater balance, contentment, and inner peace, navigating the complexities of life with grace, adaptability, and a sense of purpose grounded in the wisdom of the Tao.

5. Practicing non-attachment and non-resistance

Practicing non-attachment and non-resistance are important principles in Taoism, as they encourage individuals to cultivate an open and receptive mindset that allows them to experience the natural flow of life (Lao Tzu, 1963). When developed and nurtured, this mindset fosters a sense of inner peace, harmony, and balance, enabling practitioners to adapt more effectively to the ever-changing circumstances of life (Komjathy, 2018). Non-attachment involves letting go of expectations, desires, and judgments, which can often act as barriers to fully engaging with the present moment (Csikszentmihalyi, 2008). By practicing non-attachment, Taoist practitioners are able to accept the impermanent nature of reality and embrace change as an inherent part of existence.

Similarly, non-resistance emphasizes the importance of yielding and adapting to circumstances rather than forcing one's will or trying to control the outcome of a situation (Lao Tzu, 1963). By practicing non-resistance, individuals can learn to navigate challenges, easily avoiding unnecessary conflict and struggle. This approach fosters harmony in their lives and enables them to maintain a sense of inner peace and contentment, even in the face of adversity (Csikszentmihalyi, 2008). Practicing non-attachment and non-resistance allows Taoist practitioners to align themselves more closely with the natural flow of the Tao, fostering a deeper sense of harmony, balance, and inner peace (Lao Tzu, 1963). By integrating these principles into their daily lives, individuals can develop the resilience and flexibility needed to navigate the complexities of life with grace, adaptability, and a profound sense of interconnectedness with the world around them (Komjathy, 2018).

d. 5.1. The benefits of flow in daily life

Experiencing flow in daily life offers numerous benefits, which can significantly enhance an individual's overall well-being and quality of life. Some of these benefits include increased happiness, enhanced creativity, and a heightened sense of well-being (Csikszentmihalyi, 2008). When individuals enter a state of flow, they become fully absorbed in the present moment, allowing them to transcend self-consciousness and time awareness. This immersion in the activity at hand fosters a sense of inner peace and contentment, which in turn leads to an increased sense of happiness and overall life satisfaction (Csikszentmihalyi, 1990).

In addition to the emotional benefits of experiencing flow, engaging in activities that promote flow can also contribute to personal growth and a deeper connection with the world around us. When individuals are in a state of flow, they are more likely to tap into their creative potential, which can lead to the development of new skills, insights, and ideas (Csikszentmihalyi, 2008). Furthermore, the experience of flow often encourages individuals to seek out new challenges and opportunities for growth, which can foster a greater sense of fulfillment and satisfaction in life. By cultivating flow in daily life, individuals can not only improve their own well-being but also enhance their relationships, work, and overall engagement with the world around them, ultimately leading to a richer, more meaningful existence (Csikszentmihalyi, 1990).

e. 5.2. Comparisons to other concepts of flow in philosophy and psychology

The concept of flow, while closely aligned with Taoism, also shares similarities with other philosophical and psychological concepts that emphasize the importance of living fully in the present moment and connecting

with a deeper sense of purpose. In Buddhism, the idea of mindfulness and the state of being present in the moment bear a striking resemblance to the experience of flow (Kabat-Zinn, 1994). Mindfulness encourages individuals to engage fully with their experiences, remaining attentive and non-judgmental in the present moment, which in turn fosters a sense of deep connection and immersion similar to that of flow.

Another concept with parallels to flow can be found in the Greek notion of “eudaimonia,” or flourishing, which involves living in accordance with one’s true nature and values (Waterman, 1993). Eudaimonia emphasizes the importance of cultivating a life that reflects one’s unique strengths and virtues, which can lead to a sense of fulfillment and well-being akin to the experience of flow. Furthermore, psychologist Abraham Maslow’s concept of self-actualization, which involves the realization and fulfillment of one’s potential, also bears similarities to the experience of flow (Maslow, 1968). Self-actualization, like flow, encourages individuals to engage deeply with their passions and interests, ultimately leading to the attainment of their fullest potential.

While the concept of flow has its roots in Taoism, it shares common ground with various other philosophical and psychological ideas that emphasize the importance of living in the present moment and connecting with a deeper sense of purpose. By exploring these various concepts, individuals can gain a broader understanding of the potential benefits and pathways to achieving optimal human experiences, ultimately enhancing their well-being and sense of fulfillment in life.

6. Practical Applications of Taoist Philosophy

f. 6.1 Personal Growth and Self-cultivation

Taoist philosophy, with its emphasis on harmony and balance, provides a framework for personal growth and self-cultivation. By integrating principles such as wu-wei (non-action) into their daily lives, individuals can learn to act with minimal resistance, allowing the natural flow of the Tao to guide their actions and decisions (Lao Tzu, 1963). In doing so, they can develop a deeper understanding of themselves and their place in the universe, ultimately fostering personal growth, contentment, and inner peace (Komjathy, 2018).

The Three Treasures—compassion, frugality, and humility—also play a critical role in self-cultivation. Compassion encourages empathy and kindness towards others, promoting a sense of interconnectedness and respect for all beings. Frugality, on the other hand, teaches individuals to live simply and mindfully, fostering gratitude and a deeper appreciation for life’s experiences. Humility, the third treasure, helps individuals recognize their limitations and maintain an open, receptive attitude toward learning and growth. By embracing these virtues, individuals can align themselves more closely with the Tao, nurturing their personal development and overall well-being (Lao Tzu, 1963; Komjathy, 2018).

g. 6.2. Achieving balance in relationships and social interactions

Incorporating Taoist principles in relationships and social interactions can lead to more balanced and harmonious connections with others. Practicing compassion and empathy, for instance, allows individuals to

better understand and appreciate the feelings and perspectives of others, fostering an atmosphere of mutual understanding and respect (Lao Tzu, 1963). By prioritizing these values in their interactions, individuals can create more meaningful relationships and contribute to a more compassionate and supportive social environment.

Moreover, the concept of Yin and Yang, which emphasizes the interconnectedness and complementary nature of opposites, can provide valuable insights for maintaining balance in interpersonal dynamics (Lao Tzu, 1963). Recognizing and embracing the contrasting qualities in oneself and others can help individuals navigate the complexities of relationships with greater ease and adaptability (Komjathy, 2018). By appreciating the unique contributions each person brings to a relationship, individuals can foster a sense of harmony and balance, ultimately leading to more fulfilling and resilient connections with those around them.

6.3. Taoist-inspired strategies for leadership and decision-making

The principles of Taoist philosophy, such as *wu-wei*, can be highly beneficial for leaders seeking to make effective decisions and guide their teams successfully. Embracing the concept of *wu-wei*, which emphasizes the importance of effortless and spontaneous action in harmony with the natural flow of events, can enable leaders to adapt to changing circumstances and make informed decisions with minimal resistance (Lao Tzu, 1963). By allowing the inherent wisdom of the Tao to guide their actions, leaders can develop a greater sense of intuition and responsiveness, ultimately leading to more successful outcomes (Ames & Hall, 2003).

In addition to *wu-wei*, Taoist-inspired leadership also incorporates the values of the Three Treasures—compassion, frugality, and humility. By embodying these virtues, leaders can foster a supportive and collaborative environment, promoting the well-being and growth of their team members (Lao Tzu, 1963). A compassionate approach to leadership encourages open communication, understanding, and empathy, while frugality and humility help leaders to allocate resources wisely and recognize their limitations, allowing for continuous learning and improvement (Ames & Hall, 2003). Through the application of these Taoist principles, leaders can cultivate a harmonious and effective leadership style that benefits both their team and the broader organization.

6.3. Environmentalism and the interconnectedness of all things

The teachings of Taoism highlight the interconnection of all elements within the universe and stress the significance of living in harmony with nature (Lao Tzu, 1963). This viewpoint fosters environmental consciousness and sustainable lifestyle practices. Seeing the world through this interconnected perspective encourages individuals to be aware of the consequences of their actions on the environment and the fragile balance of ecosystems. By acknowledging this interconnectedness, people are motivated to adopt sustainable practices and reduce their ecological footprint, ultimately supporting environmental stewardship (Komjathy, 2018).

The principles of frugality and humility, which are part of the Three Treasures in Taoist philosophy, also contribute to fostering an environmentally aware mindset. Frugality promotes the judicious use of resources and waste reduction, while humility nurtures an appreciation for the intricacy and splendor of the natural

world (Lao Tzu, 1963). By embracing these values, individuals cultivate a profound respect for the environment and a dedication to preserving it for future generations (Girardot, 2001). This Taoist-inspired perspective on environmentalism underscores the importance of coexisting harmoniously with nature and recognizing the interdependence of all living beings, ultimately encouraging the development of a more sustainable and empathetic relationship with the world that surrounds us.

7. Conclusion

h.

I've always been interested in the aspect of exploring different ways to change the way we think. As I conclude this exploration of Taoism, I can't help but be moved and inspired by the depth and profundity of this age-old philosophy. Its teachings have personally resonated with me, giving me a fresh perspective on my own encounters and connections. I have found new paths for personal development and inner serenity that will result in a more balanced and fulfilling existence by embracing the fundamentals of the Tao, such as living in harmony with nature, engaging in non-attachment and non-resistance, and practicing compassion and humility.

In my personal life, I've discovered that applying some principles of Taoist ideals has given me more flexibility and ease when navigating the challenges of modern existence. The concept of wu-wei, or non-action, has been particularly illuminating, teaching me the value of letting go of control and trusting in the natural flow of life.

By encouraging environmental stewardship, sustainable living, and a deep respect for the interconnectedness of all things, Taoism offers a robust framework for addressing the global challenges we face today, such as climate change, social inequality, and political strife. If more individuals were to adopt Taoist-inspired values and practices, we might see a shift towards a more compassionate, harmonious, and sustainable global society.

The timeless wisdom of Taoism has the potential to guide us toward a more harmonious, compassionate, and sustainable world for generations to come. As individuals and as a collective, we would do well to embrace the teachings of the Tao and seek to live in accordance with its principles, fostering a world that cherishes balance, harmony, and the interconnectedness of all living beings. By embodying these ideals in our daily lives, we can contribute to the creation of a more just, equitable, and flourishing global community.

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Nejira Pasic

State Capacity and Economic Models in Labour Migration Policy Design: A Theoretical Perspective

Abstract

Labour migration presents a critical phenomenon for states and policymakers, globally, as it, profoundly impacts local economies experiencing labour shortages. This paper examines the intersection of state capacity and economic models in labour migration policy design, offering a conceptual and theoretical framework to understand how governance, institutional capacities, and economic theories may shape policy outcomes. It emphasises the dual dimensions of state capacity—bureaucratic strength, judicial independence, and constitutional safeguards—in addition to the economic factors and sub-factors which contribute to the effectiveness of policies. The analysis focuses on the role of state capacity in shaping labour migration policies. Bureaucratic strength guarantees effective implementation processes of policies, while the independence of the judiciary makes sure that legal protections and rights of foreign workers are safe, enhancing social security. Additionally, the tradition of immigration in the receiving country strongly influences the state's readiness to deal with new flows of migration. Moreover, four economic models—Production/Output Model, Heckscher-Ohlin (H-O) Model, Specific Sectors Model, and Fiscal Model—are integrated into the analysis. These models showcase how the economic and political implications of labour migration intertwine, contributing to productivity gains, sector-specific labour demands, fiscal contributions, and wage dynamics. Methodologically, this paper employs an interdisciplinary approach, synthesizing points from migration studies, labour economics, and political science, specifically state politics. By approaching this topic through a dual lens, integrating state capacity with economic theory, the paper shows how administrative efficiency, economic viability, and political feasibility interplay to shape migration policies. The findings highlight that high-capacity states are better positioned to implement concrete and effective migration policies, balancing sectoral labour force scarcity with long-term economic benefits, while low-capacity states may experience issues related to inefficiencies and social resistance. Integrating state capacity measurement factors with different economic models showcases a comprehensive approach to labour migration policy design.

Keywords: *labour migrations, economic models, state capacity, migration policy*

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13. Introduction

Labour migration is a crucial and constantly developing characteristic of globalisation, whereby state economies that are suffering from a structured or sectoral labour shortage feel the profound implications of global migration (Glom, 1992). When we speak about labour migration, we oftentimes majorly consider outwards oriented migration, when individuals seek a better future elsewhere. While present and impactful today, more than ever, we find ourselves in the situation to finally pose the question of what happens when entire sectors leave to seek a brighter future elsewhere? What happens when a country is left in a labour drought while the thirst for production increases?

Labour shortages and the balance between the supply and demand of labour in various sectors have always been considered to be in a perpetual state of healthy fluctuation, with the movement of people as capital runs from one side of the seesaw to the other, trying to catch that ideal balance, without ever truly accomplishing that task (Lynham, 2018). Some countries have experienced some near-ideal balances, while most countries in Central and Western Europe, specifically in the past few decades, have been on the end of the seesaw that is firmly grounded as a receiving country (Joly, 2000). Be this due to an internal shortage of human capital, or the idea that this geographical area is seen by a lot of developing countries as a safe haven for a better, more fruitful future, or likely both, the countries that have been the receiving countries have managed to self-regulate through effective migration policies, that are usually crafted by the combination of the most fitting economic model that explores the benefits of immigration, to the capacity of the country to be perceived as an attractive labour market (ibid). Migration policies are a reflection of both a state's capacity to manage migration and the economic rationale driving such policies.

These migration policies, while open to adjustments with every new country's leadership structure, are nonetheless commonly founded on different economic models of migration which emphasise the different aims, structures, and outcomes of labour immigration for the receiving country through the lens of the relevant actors involved, the direct projected economic, and political outcomes and consequences (OECD, 2016). These different models that will be discussed throughout this paper represent the ideal bases for migration policies. Additionally, these migration policies may be classified as restrictive, moderate, or open, based on multiple combined factors affecting the state's capacity to open their policies to labour immigration. Consequently, the way in which a country's policies are perceived directly influences the decision of potential labour migrants to choose the said country as their destination (ibid). From the strength of the bureaucracy, the demand for entry, to the tradition of immigration of that country, this paper tackles this conceptual classification of state capacity to welcome migrant workers, in addition to elaborating on the different economic modules that may be taken into consideration when speaking about migration policies.

This paper takes a look at the intersection of state capacity and economic theory, thus providing a conceptual and theoretical overview to comprehend the factors influencing labour migration policy creation. The conceptual framework of state capacity in accommodating migrant workers and evaluating the economic models that inform migration policies are specifically scrutinised. By combining key state capacity elements, such as the strength of bureaucracy, constitutional safeguards, and judicial independence, with theoretical economic models (Production/Output Model, Heckscher-Ohlin (H-O) Model, Specific Sectors Model, and Fiscal Model), it emphasises the relationship between the dynamics of the economic market and the governmental structures. The analysis considers an insight into the craftsmanship of migration policies through an interdisciplinary dimension that takes into account administrative effectiveness, political viability, as well as economic benefits.

1. Conceptual Classification of State Capacity

Numerous scholars have undertaken the conceptual debate and exploration of the underpinnings of the capacities of the state with regard to labour migration, due to both its complexity and importance. De Haas, in his article *Migration and Development: A Theoretical Perspective*, discusses the evolution of migration policies, focusing on, amongst other things, the balance between selective facilitation for foreign workers and restrictiveness that is imposed in entry policies (2010). The article defines migration as a complex phenomenon impacted by social, economic, and structural factors. De Haas claims that migration goes beyond an individual's decision, and encompasses the realms of systemic inequalities and structural pressures. Furthermore, he explains how factors like sociopolitical conditions and labour market need help shape migration flows (ibid).

Moreover, a comprehensive study was conducted by Freeman and Kessler in 2008. The article presents political modes that may have a significant impact on immigration, specifically focusing on liberal democracies, and they single out how political systems of states are able to take a serious toll on the design of economic and political policies regarding immigration, swaying from the interests of the leadership in office. Additionally, the article emphasizes the link and relationship between wage differentials and labour market structures that may be a cause for fluctuating trends in migration worldwide (Freeman & Kessler, 2008). According to neoclassical economic theory, the decisions and motivations for migration are primarily influenced by international wage disparities. As out-migration increases and the costs and risks of migration decrease, differences in wages between origin and destination countries emerge as a key driver of migration flows. This process is grounded in a rational cost-benefit analysis, where individuals are motivated to migrate in pursuit of greater economic gains (De Haas, 2010).

On the other hand, segmented labour market theory provides a more structural perspective, whereby it argues that migration isn't only a direct outcome of the choices of individuals, rather, it is highly influenced by the characteristics of the receiving countries' labour market structures and opportunities. For instance,

low-skilled labour may be in scarcity due to internal factors like low wages, poor working conditions, or similar reasons, which automatically creates space for importing labour force (Freeman & Kessler, 2008). Another viewpoint on the context of decisions and motivations for migration is covered by the social capital theory. It highlights that relationships that foreign workers may have with other migrants are defined as social capital, as these relationships may be used as a tool or leverage to further motivate migration. Additionally, this theory suggests that existing networks or migrant communities shorten the path of new potential labour markets in the search for information and resources, which automatically eases the barriers to enter the country (Palloni et al, 2001) (Lorincz & Nemeth, 2022) .

As an additional factor to shaping migrations, one must also note the crucial role of the state. States have the power and tendency to impact labour migration through policies and regulations, visa systems, border controls and labour agreements, in order to govern entry and labour within the country. Based on the particular needs of the domestic labour market, states may impose restrictions or employ migration attraction strategies. As the article concludes, migration isn't a phenomenon solely faced by one factor, it is a dynamic interconnection of economic structures, social networks, and state governance and regulations (Freeman & Kessler, 2008).

Furthermore, an impactful review of migration theories that cover the persistence of migration flows and the different roles that the demand for labour has, was undertaken by Massey and colleagues, whereby they emphasise through an interdisciplinary point of view how the labour market factors, economics, public finance, in addition to political science all significantly shape migration policies (Massey et al, 1998). Concerning the economic perspectives he outlines, Massey speaks of migration's effects on wages, income, and trade. He speaks of how migration influences labour supply, wage levels, and income distribution in both the recipient and the sending countries. Additionally, Massey outlines the importance of public finance in the interplay of migration and labour politics. They emphasise the fiscal impacts of migration, looking into the way foreign workers contribute to government revenue via direct and indirect taxes, thereby affecting the budgets of the state by their usage of public benefits (ibid). Similarly, from a political science point, migration policy is also influenced and shaped by public factors, including the primary one being the state institutions and their collaboration with interest groups. Massey explains how through the lens of political science, states pursue national interests through any means, therefore theoretically, based on the needs of

the state interests (in labour specifically), states would adjust their policies to accommodate these needs (1998).

With regard to the importance of judicial and administrative ties to migration policies, as well as the wishful tendencies to employ pull migration strategies to attract foreign workers, Hampshire explores and pinpoints the various paradoxes in migration policy creation (2015). Focusing on the modern liberal democracy, he claims that the bureaucracy, as a key institutional structure presents perhaps the largest obstacle for effective and optimal policy creation. Additionally, Hampshire explains how judicial independence, although theoretically guaranteed in a liberal democracy nowadays, in practice presents a significant battle that oftentimes results in inadequate outcomes regarding migration policies (ibid).

Finally, Michael Piore's dual labour market theory uncovers the demand-driven nature of labour migration, primarily putting focus on the importance of structural economic factors when creating migration policies, specifically in the case of advanced economies (2001). These economies, according to Piore, are divided into a primary and secondary labour market, each with different main characteristics. The primary market appears to offer stability and higher wages, whereas the secondary market presents the opposite, thereby creating space for native workers to purposefully avoid the secondary market, and forcefully opening doors to foreign workers into the secondary market. The theory puts forth the argument that migration policies are also shaped by labour market rigidity and technological change (manual to technologically performed labour that translates from secondary to primary markets) (ibid).

The conceptual classification of factors influencing a state's capacity to implement migration policies showcases the delicate relationship between governance, socio-economic factors, and the overall preparedness of the state's institutions, whereby each of these factors significantly impacts to which extent migration policies will reflect the needs of the domestic labour market, as well as whether and to which extent the set policies would be effective (Paquet, 2020). Therefore, the indispensable factor that is the state bureaucracy must come into play. The strength of the administration must be taken into account as it is pivotal and ensures the proper implementation of migration policies. Weak bureaucracies hinder the administration and implementation of policies, regardless of how good they are for the economy of the state, which consequently may be another factor in scaring away foreign workers (Lindberd, 2023).

The demand for entry into a country is a key factor, often driven by labour shortages or broader economic opportunities. When specific sectors, such as healthcare, the service industry, or construction, experience workforce deficits, migration policies are designed to align the skills of incoming migrants with the needs of the host economy (Emilsson, 2016). However, balancing these economic demands with public opinion and maintaining social cohesion can be challenging, especially in environments where immigration faces significant opposition.

Constitutional protections create the legal foundations for safeguarding migrants' rights (Palloni et al, 2001). Comprehensive legal and policy frameworks guarantee suitable equitable treatment, discrimination prevention, as well as the access to services for migrant workers. These protections strengthen their security and also place the destination country on a desired position. A lack of such policies and safeguards increases the possibility and ability of exploitation (ICMC, 2006). Additionally, Palloni also argues that judicial independence is yet another pillar of effective migration policy guidance. Independent courts make sure that there is constant oversight in the enactment of migration policies and protection mechanisms, thereby providing reassurance to labour migrants regarding their legal safety in receiving countries. In the case of the absence of such provisions, workers may lose confidence in the system's fairness and attraction (2001). Furthermore, the social capital theory in addition to the theory of traditional markets by Massey explains how the tradition of immigration contributes to the state's capacity to handle labour immigration, specifically relating to population management, inclusion policies, and language training programmes that had been established with earlier waves of immigration. In contrast, countries that are just entering the field of hosting labour migrants might have issues not only with the administration but also with attracting new workforce due to the fact that they are mostly unfamiliar grounds (ibid).

State capacity plays a crucial determining role in shaping migration policies, functioning aside a continuum influenced by political will, economic resources, and institutional development (Massey et al, 1998). So-called high-capacity states are better equipped to create and implement detailed robust policies that attract foreign workers, while managing social turbulences and economic fluctuations. In contrast, so-called low-capacity states tend to be troubled with overburdened or broken systems that cannot meet the expectations of foreign workers to the full extent (ibid). These overlaps and collaborations are deeply intertwined and need to be studied in an interdisciplinary fashion, as a state's capacity has a direct impact on its potential and ability to balance administrative efficiency, economic benefits, and political feasibility.

2. Economic models of migration

In addition to the parameters of state capacity to enter the labour migration playing field and set effective migration policies, one complementary aspect must not be overseen. In order to fully comprehend the relationship between labour migration and the political and economic outcomes, we turn to the economic models of migration that aim to encapsulate the interplay of political and economic factors. This paper focuses on four economic models of migration- Production/Output Model, Heckscher-Ohlin (H-O) Model, Specific Sectors Model, and Fiscal Model, each of which presents the main principles and connects the dots between the political and the economic realm of consequences and potential benefits.

Firstly, the Production/Output Model speaks about the effect that fluctuations or alterations in the workforce have on a state's economic output and total production. The model claims that a stream of labour, specifically when considering labour-intensive industries, may cause a sharp and significant rise in the general economic productivity. This model is vastly taken into account in countries that are experiencing a labour shortage, where they may need to turn to hiring foreign workforce to fill the gaps (Quispe-Agnoli & Zavodny, 2002). When it comes to the economic and political consequences, the model suggests that for the economic aspect, additional labour will lower the costs of production overall boosting the outputs and efficiency. On the other hand, the model acknowledges the fact that a rise in immigration in the labour market may cause wage compression. In terms of the political consequences, the production/output model particularly focuses on the negative impact immigration in the labour market may have on the jobs and wages of the domestic population (Freeman & Kessler, 2008).

The second most popular economic model of migration is the Heckscher-Ohlin (H-O) model that creates the notion that states should export primarily the products and goods that are the most efficient to produce when taking into consideration their resources. This model is relevant for labour migration specifically because it claims that countries with an abundance of a workforce should focus on the production on labour-intensive goods, while at the same time countries with a contrasting scenario are to import labour-intensive goods, or in the strongest scenario, import labour directly (Leamer, 1995). The H-O model argues that a natural flow of labour migration will occur from countries with labour scarcity to countries with an abundance in labour, contributing to the general balance of production, powers, capabilities, and wages. In terms of economic consequences, the H-O model suggests that labour migration is beneficial to countries that suffer from labour

shortages. On the other hand, political consequences emphasise that protectionist sectors may be opposed to labour immigration out of job displacement insecurities, as well as identity issues (Baskaran et al, 2010).

The Rybczynski effect, within the context of the Heckscher-Ohlin framework. It describes the relationship between supply and output, specifically related to labour and production. When one rises, so does the other, and vice versa (Hanson, 1999). This conceptual model can be applied to labour migration to see how labour influx can shape the economy. If labour supply increases in the receiving country, low-skilled labour sectors grow. Additionally, sectors that aren't labour-intensive, rather focus more on capital have to reallocate their resources to facilitate these new changes in the labour market (ibid). This principle highlights how migration may cause sectoral changes in production, balancing economic activity as a direct response to changes in the availability of the labour force.

Furthermore, a complementary aspect of the H-O model is the Specific Sectors Model, or the Ricardo-Viner model, and it provides a viewpoint that takes into consideration specific economic sectors. It goes beyond perceiving the economy as a homogenous phenomenon, and focuses on those specific sectors in the economy that are suffering from a labour shortage therefore relying heavily on foreign workforce. The model argues that immigration can significantly aid those specific sectors, as those sectors are often low-wage sectors, like agriculture or construction, and migrant labour may keep those wages at the same level (De Melo et al, 2001). Interestingly, this model does not claim that labour immigration is generally beneficial for all sectors, rather that only sectors in need may benefit economically. On the political aspect, the RV model stresses how lobby groups in a sectoral focus may contribute significantly to the migration policies, as specific interests of specific sectors may need to be taken into consideration, leaving the policy landscape in an inequitable position as not all sectors would have the same opportunities (Leamer & Levinsohn, 1995).

Lastly, the Fiscal Model focuses on the financial points of immigration, considering the public finance realm through the costs and benefits of labour migrants. The model provides an analysis of the difference between the public goods consumed versus the public taxes paid by the foreign workers. Theoretically, we may argue that a steady flow of labour immigration may have a positive outcome on the overall tax revenue of the country, especially if the country is experiencing continuous and growing labour shortages and population aging (Hennessey & Hagen-Zanker, 2020). This model particularly focuses on the economic effects of migration and claims that they may be positive if the appropriate administrative bodies properly regulate the influx of migrants in a legal manner that ensures their contribution to the system of public goods. If this influx is poorly managed, the welfare system may suffer more than it may gain, causing significant fiscal

struggles (OECD, 2021). Similarly, the political debate within this model provides the argument that it may be uncertain whether labour migration contributes to or takes away from fiscal revenues, therefore differently influencing policy-making. Politically, the fiscal model often becomes the focus of debates over whether immigrants are a "drain" on public resources or a net contributor to the economy. In some cases, the political discourse surrounding immigration can be dominated by concerns about fiscal sustainability, influencing how policies are designed to ensure that migrants contribute positively to the national economy (Clemens, 2022).

Each model offers a unique viewpoint through which we can understand the impacts of migration, showcasing the delicate relationships between labour supply, economic benefits, and political needs. They all show how migration can simultaneously boost and challenge local economies, providing advice for policymakers to help design effective and fair migration policies that concern both economic benefits and political considerations.

14. Conclusion

In order to be fully able to comprehend what the most effective way of migration policy-making is, state capacity measurements need to be integrated with understanding various economic models of migration that cover economic and political consequences of immigration. This joint understanding showcases how bureaucratic and institutional capacities of the state work with different economic models and how they are able to produce joint results in migration policy. A crucial aspect to consider is the strength of a country's institutions through the bureaucracy, as this element is in charge of the implementation of migration policies and oversees and governs the labour migration processes to ensure efficiency. With a capable and strong bureaucracy, policies are able to be swiftly adjusted to fit the newest needs of the country, be they of economic or political nature.

According to the Production/Output Model, a rise in labour abundance in sectors that depend on low-skilled workers increases productivity, which needs to be coordinated and implemented by a steady and well-organised bureaucracy that can swiftly carry the process of labour migration integration and regulation. Moreover, the independence of the country's judiciary is crucial for the safeguarding of the labour migrants in terms of both security, as well as economic participation, especially when we look through the lens of the H-O model and the Specific Sectors model. An independent judiciary's job is to ensure the protection of the labour migrants' rights which leads to a stable market and production in general. When workers feel safe, they are more likely to contribute to the economy, and this stability supports the thesis of the H-O model. As for the SS model, a stable and independent judiciary ensure continuous workflow into these sectors in need.

Furthermore, a country's tradition of immigration plays a significant role in measuring the capacity of the state to manage labour migrations internally and shaping policies, especially in terms of fiscal policies. Countries that have a successful tradition of labour immigration tend to adjust and design fiscal policies that go hand in hand with the contributions of the migrants to the public finances in addition to the goods they consume, which is highlighted by the Fiscal model. Such countries better understand how to effectively implement relevant policies that optimise economic gain while overcoming or minimising issues with the overburdening of the public services. Moreover, another parameter for measuring state capacity that is considered through the economic lenses is political feasibility, as it provides a challenge to drafting successful migration policies. Political resistance tends to rise from domestic groups out of fear of wage suppression, which is battled by the Fiscal model and the P/O model of economic migration that argue for the numerous

economic and social benefits of immigration. Additionally, these resistances are able to negatively impact policies that may have a positive outcome on the economy otherwise.

Concluding the debate, we can argue that an integration of state capacity parameters with different models of migration is crucial for creating migration policies that may positively contribute to the pull strategies that countries with a labour scarcity may utilise in order to maximise economic and social benefits, while maintaining political interests of the sectors in need. This complex intertwining of seemingly separate concepts and models can serve as a basis for addressing immediate labour shortages and also contribute to the long-term economic stability of the country.

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ADNA KASAPOVIC - The Chicago School – The New Classicism

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1. Introduction

Modern economics can be divided into four different economic school of thoughts. One of them is the Chicago School of Economics. Other schools of economic thought are: Classical School, Marxian School and Keynesian School.¹ Chicago School began in 1946 when Milton Friedman joined the faculty of economics at the University of Chicago. George Stigler, who arrived two years later – in 1948, build the school's unique identity together with his colleague Milton Friedman. Several other prominent economists at Chicago – among them Gary Becker and Robert Lucas – continued this tradition. Chicago School's tenets fit within the broader classical – neoclassical tradition. This school's perspective is a variant of neoclassicism and is referred to as a 'new classicism'. The Chicago School of economics is best known for its free market advocacy and monetarist ideas. (Khan, 2013) The Chicago School is also linked to the legal and economic approach to case law developed at the University of Chicago Law School. (Wirtschaft & Wirtschaftssysteme, 2020)

2. Historical Background

Many of the important developments in economic thought since the time of Marshall rationalized greater government involvement in the economy. Economic theory of market socialism convinced many that the state could just as efficiently allocate resources and produce goods and services as could private enterprises. Theories of economic development implied that only government is able to break the cycle of poverty in developing countries. The Keynesian revolution basic premise that government should use fiscal, monetary, and income policies to stabilize the economy became the new conventional wisdom. However, Chicago School opposed these ideas. Chicago School tried to maintain & straighten the classical, marginalist and neoclassical tradition at a time when it had diminished popularity. (Khan, 2013)

3. Main Ideas and principles

Just as every school of economic thought has its main ideas and tenets that represent it, so does the Chicago School have its own. The first idea was that the free markets are best to allocate resources in an economy. The second idea was that the Chicago School strived for minimal government intervention. This basically secured economic freedom and free trade. As a matter of taxes, its cutting and reforms would serve the market in a best way. Great attention was paid to the inflation adjustment and inflation targeting. In this school of thought, supply and demand of the money must be kept in an equilibrium in the free market. This school had the ideology of Globalisation and International trade. Privatisation and marketisation also came in the first sight. (Khan, 2013)

The Chicago School's antitrust approach to regulatory policy is an excellent demonstration of its general principles. The traditional approach of antitrust regulatory policy is to limit the concentration of market power, for example by dissolving a company that has become a monopoly. The Chicago School, on the other hand, argues that even if there are just a few large companies in an industry, consumers are best protected through competition. Such large companies may have gained their dominant market position through efficiencies, which provide greater benefits to consumers than a market that is legally forced to include many smaller companies. Even if a company gains monopoly power, the Chicago school prefers to allow the market to fix the problem rather than relying on government intervention, which can be more detrimental to efficiency. The Chicago School principles have been applied to a variety of areas, including market and non-market based activities. For example, Becker assumed that people make rational, selfish economic decisions to explain aspects of human behavior that traditionally have not been studied by economics, including crime, racial discrimination, marriage, and family life. In the field of law and economics, the Chicago School argued that legal rules and court decisions should be aimed at promoting efficiency. The role of the law is simply to change the incentives of individuals and organizations to achieve this goal. For example, in the field of tort, according to the law, the goal should not only be to minimize the cost of accidents, but also to minimize the cost of accident prevention. If liability rules dictate that individuals must take precautionary measures against accidents that are more expensive than the accidents themselves, the result is allocatively inefficient. (Wirtschaft & Wirtschaftssysteme, 2020)

4. Key Economists

Since the Chicago School of economic thought is one of four such schools, it was home to many economists who contributed to the development of this school. Taking into account that there is a large number of key economists, this paper is going to briefly introduce only three of them: Frank Knight, George Stigler and Milton Friedman. However, there are other names which must not be left out: Ronald Coase, Robert Fogel, Gary Becker, Richard Posner, Robert E. Lucas, Eugene Fama and Friedrich August Hayek.

4.1. Frank Knight

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Frank Knight was born in 1885 and lived to 1972. He was an early member of Chicago School and was one of the faculty members of the University of Chicago. He considerably contributed to the microeconomics. His notable work from 1921 'Risk, Uncertainty and Profit' brought a term 'Knightian uncertainty' to life, which was then used in economic science. His beliefs were different from later economists of Chicago school. He believed in free market economy and less government intervention. (Khan, 2013)

4.2. George Stiegler

George Stiegler lived from 1911 to 1991 and he was a follower and a student of Frank Knight. He actively studied history of economic thought, conducted a large research and published an article named 'Information in the Labour Market' in 1962. This article later developed a theory of search unemployment. Under the sight of Knight, Stiegler developed his thesis named 'Economic Theory of Regulation'. He won a Nobel prize for this work in 1982. (Khan, 2013)

4.3. Milton Friedman

Milton Friedman was born in 1912 and lived to 2006. He was one of the most influential economists of the twentieth century. Friedman was also a student of Frank Knight just like his fellow colleague George Stiegler. He was honored with a Nobel Prize in 1976 for his contributions to economics. His principles were based on the laissez-faire government policy. He believed that this policy in an economy is more desirable than government intervention. (Khan, 2013)

Milton Friedman's Research Program

Friedman advocates a largely free market economy. The advantages and benefits of the market economy such as the effectiveness of free markets, economic freedom and efficient allocation of resources are emphasized, socio-politically he advocated the idea of negative income tax. Direct interventions in economic processes are predominantly viewed as ineffective or harmful. For example, inflation arises from a discretionary monetary policy. Friedman emphasizes the relevance and usefulness of neoclassical theory in explaining economic behavior. Following Friedman's approach, economic theory does not consist of an abstract and often mathematically formulated building of doctrines, but of economic analysis instruments with which a multitude of practical problems can be solved. Theoretical generalizations should be tested empirically. When confronted with Keynesian theory, the central position of the concept of equilibrium for Friedman's frame of reference becomes apparent. (Chicagoer Schule (Ökonomie), n.d.)

5. Key laws and theories

Various theories and laws were developed and discovered under the auspices of the Chicago School of economic thought. This paper is going to list few of them, however it is inevitable to say that there are many of such theories and laws. In 1976 Milton Friedman developed 'Theory of natural rate of unemployment'. Friedman defined this as the level of unemployment that resulted from real economic forces, the long-run level of which could not be altered by monetary policy. (Michael, 2017). Another significant theory that was developed by Milton Friedman is 'Quantity Theory of Money'. George Stiegler

developed 'Economic Theory of regulation' and 'Deregulation Theory'. Eugene Fama developed 'Modern economic theory'. (Khan, 2013)

6. Impact on the society

The Chicago School of economic thought strictly trails the neoclassical price theory and libertarianism. The concept of Keynesianism was rejected by the side of Chicago School. The contribution of the Chicago School was to demonstrate the market power, externalities and the peoples choices, in 'public policy' as well as in economic sciences. (Khan, 2013) The Chicago economists have given up their intellectual influence in other areas as well, particularly in pioneering public choice theory and law and economics, which has led to revolutionary changes in the study of political science and law. Other Chicago-affiliated economists have demonstrated its impact in areas as diverse as social economy and economic history. (Wikibrief, n.d.)

7. Criticism

The Chicago School has been criticized on many points. For example, behavioral economists question the assumption that people are rational maximizers of self-interest. Instead, they argue that certain decision heuristics and prejudice people are the ideal decision makers the Chicago School assumes to prevent them from being. Others argue that the Chicago School's efficiency goal can only be achieved at the expense of justice and equality in society. (Wirtschaft & Wirtschaftssysteme, 2020)

8. Conclusion

To summarize, the Chicago School of Economics is a neoclassical school of economic thought associated with the work of the faculty at the University of Chicago, some of which constructed and popularized its principles. Milton Friedman and George Stigler are considered the leading scholars of the Chicago School. At the heart of the Chicago School's approach is the belief in the value of free markets (*laissez-faire*). Simply put, the Chicago School claims that without government interference, markets will produce the best results for society (ie, the most efficient results). A main assumption of the school is the model of human behavior with rational actors (self-interest maximization), according to which people generally act in order to maximize their self-interest and therefore react to appropriately designed price incentives. At the level of society, free markets populated by rational actors will result in resources being distributed on the basis of their most valuable uses (allocation efficiency). (Wirtschaft & Wirtschaftssysteme, 2020)

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Geolocation Methodology Using MEMS Gyroscopes: Practical Applications

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Abstract—This study presents a novel method of geolocating distant objects using MEMS gyroscopes and GPS mounted on the UAV drone and its applicability to practical problems. The proposed methodology with hardware details was elaborated and shown. The study explored existing literature on geolocation techniques using a comparative approach and critical evaluation. The central part of the paper demonstrated various scenarios where the method could be applied, including civilian, police, and military purposes. Multiple scenarios were observed and elaborated, including wildfire detection, airstrike coordination, and border surveillance using UAVs and a proposed geolocator system. This system provides cost-effective, scalable, and simple real-time solutions for geolocation tasks using UAVs in many scenarios.

Keywords-Geolocation; UAV; Drones; MEMS gyroscope; GPS; military; police; civil.

16. Introduction

Unmanned Aerial Vehicles (UAVs), including drones and robots, are extensively utilized in various scenarios today, from observing

remote objects or environments to more vital functions such as drones employed in emergency rescue operations and military applications. Contemporary combat is advanced through the utilization of UAVs, particularly drones, which serve various functions, with geolocating the target of interest being the most critical aspect. Geolocation is the process of determining the coordinates in space, land, and at sea in relation to the terrestrial reference system [1]. Defining point coordinates is the main aim of the geolocation. Furthermore, the reference system defines geolocation as representing only a scientific convention or agreement. It is a definition of mathematical, physical, and geodetic rules and constraints that describe the process of writing geolocation using the form of algebraic numbers, such as coordinates in a reference system [1].

The operational space of the traditional war theater was changed by the invasion of Ukraine by the Russian Federation, where Ukrainians enhanced their underwater technologies, such as naval drones [2]. Additionally, the use of flying drones on the

battlefield in the conflict in Ukraine has increased the applicability of UAVs, specifically drones, in military missions. When used on the battlefield and in army operations, drones need to obtain the target object's precise location, representing the crucial technical problem in drone technology [3]. As a part of the UAV, drones have revolutionized many fields in the modern world, ranging from their use in military operations, border monitoring, life-saving operations, and environmental crisis monitoring like forest fires and floods.

Micro-Electro-Mechanical Systems (MEMS) sensors are miniature systems that combine small mechanical structures with electronic circuits [4]. In combination with GPS, MEMS gyroscopes provide an innovative method of geolocating target objects by measuring angles with geographic coordinate transformation. This innovative method is usable in many scenarios, particularly when determining GPS coordinates of distant objects that need to be taken from more than tens of kilometers away.

This technology is used for military purposes, and numerous other applications of the same technique are concealed and classified as top secret within the industry sector. Additionally, various technological implementations were discovered to pinpoint the precise geolocation of targeted objects, each exhibiting different levels of accuracy. This paper aims to present a novel

distant object geolocation methodology using MEMS gyroscopes in drones and its applicability to real-world industry problems and scenarios. Additionally, this study critically evaluates the other implementations of GPS coordinate determination with their respective accuracy rates.

The document underscores and emphasizes the use of geolocation methods in various areas:

- **Civilian applications:** supporting environmental monitoring and management in critical situations, such as monitoring wildfires and detecting floods.
- **Police applications:** monitoring borders and locating suspicious activities and objects to protect the overall state security.
- **Military applications:** supporting object geolocation, tracking and monitoring, reconnaissance missions, and operational planning.

The document is organized into five chapters. The first chapter introduces the paper. The second chapter includes a review of existing literature. The third chapter discusses the proposed methodology. The fourth chapter demonstrates how the methodology can be applied to real-world situations. The fifth chapter assesses the methods and their areas of application, while the sixth chapter provides a summary of the conclusions drawn from the work.

17. Literature Review

This section presents five scientific resources and their methodologies for geolocating distant objects using IMU sensors, UAVs, and GPS. The primary findings of these five papers illustrate various implementations of geolocation strategies within the industry. Each study offers unique contributions to the topic, showcasing innovations in achieving accurate geolocation.

a. Monitoring an Object Using GPS and IMU Sensors

Wahyudi et al. [5] demonstrated the approach of integrating the IMU sensors with GPS for object tracking, covering both the orientation and location of the object. Additionally, this paper highlights the problems caused by the high-frequency vibrations from the UAV motor on the MEMS gyroscope, providing a solution as a complementary filter to enhance gyroscope readings. The created system showed, through iterative testing, a spatial accuracy of 2.67 meters with angular precision of 0.96° for both GPS and IMU systems. The paper shows the implementation of object tracking using GPS and IMU sensors, where sensor data is processed by the microcontroller and displayed on the PC. The research demonstrates the feasibility of a low-cost object-tracking system processed in real-time. The proposed methodology in this scientific article was written in 2018 and was accessed through the IEEE Xplore database.

b. Geolocating an Object based on the integration of RTK GPS and Thermal Video Imagery

Hosseinpour et al. [6] present a precise geolocation method that combines RTK GPS with thermal video imagery obtained from the UAV. This paper demonstrates the accurate geolocation methodology of ground target objects by addressing the limitations of traditional GPS systems that have an accuracy in the range of 5-10

meters. This is achieved by utilizing the RTK GPS, which obtained high precision accuracy. Furthermore, integrating IMU sensors with the applied Kalman filter to enhance the geolocation data provided a precise and low-cost geolocation methodology. The applicability of this novel technique can be seen in situations like disaster monitoring, where real-time response and accuracy are crucial. The paper was written in 2015 and accessed from the Semantic Scholar database.

c. Assessing Remote Object Positions in Space Utilizing Precise Analytical Solutions of Hyperbolic Equations

Kuptsov et al. [7] propose a novel analytical method using hyperbolic equations for determining distant object coordinates. The technique has been proven to minimize the Time Difference of Arrival (TDoA) errors, consequently enhancing computational efficiency and accuracy, as demonstrated by the authors. The main advantage of this methodology is that it operates effectively with minimal sensor data. This advantage makes this technique usable in environments and embedded systems with hardware limitations. While not relying on the MEMS gyroscopes or GPS, this method provides valuable insight into different solutions to the geolocation of target objects problem. The paper was written in 2020 and was accessed from Sensors Journal.

d. Geopositioning of objects in real-time through monocular detection and tracking for aerial cinematography

Alález et al. [8] demonstrates a real-time methodology of geolocation that combines UAV positional and angular data with monocular visual tracking where GNSS and IMU orientation data are processed, achieving the geolocation accuracy of 5 meters of error in 100 meters.

Experimental flights and iterative testing have proved that this method suits geolocation problems. This research mainly addresses the orientation and angle errors propagating into WGS84 coordinates. The paper was written in 2023 and was found in the IEEE Xplore database.

e. Evaluation of Measurement Uncertainty in Geolocation of Distant Objects

Kuščer and Diaci [9] elaborated on the impact of azimuth and elevation angle uncertainties on the geolocation accuracy using Monte Carlo simulations. The paper analyses the uncertainties inherently present in geolocation systems due to angular errors. The results of the experiment conducted by the authors showed that azimuth errors were dominant at longer distances, whereas positional errors were more present at shorter distances. The study also emphasizes the importance of system calibration in achieving high accuracy in remote object geolocation and reducing uncertainties. The study was published in 2013 and accessed through the Semantic Scholar database.

All these scientific sources match the proposed topic of geolocating distant objects using MEMS gyroscopes in different ways. All papers emphasized UAV geolocation, IMU integration, angle-based measurements, and WGS84 global coordinate system. Kuščer [9] elaborated on how minor sensor errors and inaccuracies like gyroscopic drifts affect geolocation accuracy. Aláez [8] showed time implementation of real-time geolocation using UAV with IMU and camera data, highlighting the negative impact of attitude determination inaccuracies. On the other hand, Hosseinpoor [6] elaborated on the need for high GPS accuracy and denoising the sensor reading with a Kalman filter to enhance the final geolocation process. Kuptsov [7] presents remote coordinate detection using TDoA measurements. Wahyudi [5] discusses how combining GPS and IMU data with filtering solutions enhances object repositioning with minimum hardware requirements. Overall, this

paper's selection of these literature sources presents modern and experimentally tested techniques for geolocating the target objects. The sources were selected based on their relevance to this paper's proposed topic and methodology.

18. Methodology

This chapter outlines the methodology proposed for this study and elaborates on the most significant aspects and details. This method geolocates distant objects using a MEMS, MPU-6050, gyroscope, and GPS data. Using the combination of angle measurements obtained from the gyroscopic readings, GPS data, and mathematical and trigonometrical transformations, WGS84 global coordinates of the distant object are obtained. The system design, algorithm, and some technical details of experimental validation are described here.

a. Method for geolocating distant objects

The proposed methodology is based on complex mathematical calculations and transformations using the two measured angles of the object, taken by the MEMS gyroscope, from the two different points in the plane, where the condition that both the angle points and the object lie in the same plane must hold. GPS data is obtained for each angle measurement point. Using the trigonometric formulas and transformations with the knowledge of the coordinate system transformation, global WGS84 coordinates of the distant objects are obtained. The process can be summarized in three steps:

- Measuring the angles to the distant object using a MEMS gyroscope.
- Calculating horizontal and vertical distances to the object using trigonometric functions.
- Obtaining the WGS84 coordinates of the target system.

This proposed methodology is designed for drones flying at certain altitudes. However, it can also be applied to any UAV object, including drones, ground vehicles, and robots.

b. System design

The geolocation system was built as an embedded system using the following components:

- **Microcontroller:** 32-bit STM32F103C8T6 for data processing and program execution.
- **MEMS gyroscope:** MPU-6050 is used to take the angle measurements from the drone.
- **GPS module:** NEO-6M to provide GPS data for the two points for angle measurements.
- **Display and auxiliary components.**

The embedded system is carefully designed and intended for use on UAV drone vehicles above the ground. The display is used to observe the final WGS84 coordinates of the target object after successful data collection and mathematical calculations.

Fig. 1 illustrates the block diagram with its components describing the embedded system used for this methodology for real-time operation.

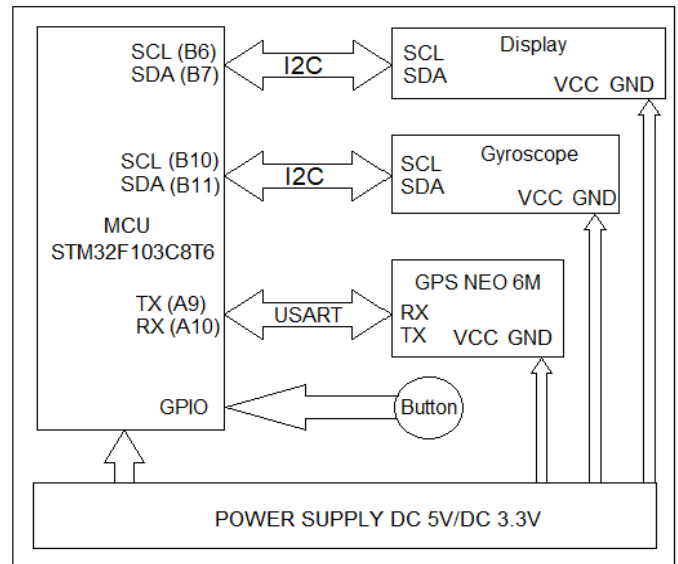


Figure 1. Block diagram of the geolocation embedded system.

c. Algorithm implementation

The software implementation of the geolocation-embedded system is shown here. The algorithm implementation is written in the C++ programming language and in the microcontroller's programming memory.

The system's input data are the measured gyroscope angles at two different positions, angle α_1 and angle α_2 , and the GPS coordinates taken at the same measurement points, noted as $M_1 (\phi_1, \lambda_1, h_1)$ and $M_2 (\phi_2, \lambda_2, h_2)$. The algorithm's final output is the GPS position of the object $T (\phi_t, \lambda_t, h_t)$.

The algorithm solution can be summarized in three steps:

1. Taking angle measurements at two different positions with corresponding GPS data.
2. Performing trigonometric calculations by calculating the horizontal and vertical distances (p_t and q_t) to the objects based on the calculated angles.

3. Calculating final coordinates in the form of the latitude ϕ_t , longitude λ_t , and altitude h_t using the WGS84 coordinate transformation equations.

d. Experimental testing

Hardware and software realization of the system was tested using the experiment under real-life conditions. A static distant object was targeted from two positions using the embedded system mounted on the UAV drone. Obtained coordinates were compared against reference values, where solid accuracy for the 50-meter with a radius of a distance of 10 km was achieved.

19. Applying the methodology concept to real industry problems

This chapter examines the applicability of the proposed method in three different areas, including civilian, police, and military use of the geolocation system. Additionally, some other implementations of the geolocation techniques will be examined and classified according to their respective use in the selected area.

a. Civilian Applications

The geolocation methodology integrating drones, MEMS gyroscopes, and GPS modules is a cost-effective and versatile solution for many civilian applications. Below are some real-world civilian applications of the proposed methodology.

i. Disaster Monitoring

In the modern world, the ever-increasing climate changes and natural disasters, including wildfires, floods, and storms, affect millions worldwide. Additionally, many disasters are created by humans, such as wildfires caused by burning trash in the forests. To mitigate and prevent the adverse effects of such disasters from increasing, it is crucial to know the exact location of the affected

environment and the objects surrounding that area. Using UAV objects such as drones, it is easier to have a distant view of the affected areas.

The proposed geolocation system can effectively calculate the precise location of any natural disaster, such as wildfires and floods, in the WGS84 coordinate system using a UAV drone. Calculating the exact location of any disaster from a distant location can help respond more effectively by marking and identifying high-risk zones and monitoring the overall progression of the disaster. Additionally, the government can prevent personnel loss by sending the UAV object directly to the disaster area.

Many literature sources cover the usability of the UAV or UAS (Unmanned Aircraft System) for disaster monitoring. The authors in [10] demonstrated how a UAS can, using the onboard infrared/visual cameras, obtain automatic information on fire propagation and help in forest fire fighting.

ii. Environmental Monitoring

The proposed methodology can help conserve and protect environments and wildlife, including endangered animal species. A system that efficiently geolocates animals in remote areas can help mitigate many natural problems. Furthermore, this system can precisely track animal movements in addition to the RFID tags commonly attached to endangered species.

The geolocation system mounted on the UAV drone can minimize human-animal conflicts in wildlife while obtaining crucial knowledge about animal migration patterns and habitat exploitation. Governments can utilize this system for their ecological initiatives and legislative efforts.

The authors in [11] conducted systematic research on UAV remote sensing technology and research advances in marine monitoring and management. It demonstrated

the high usage of UAV objects in marine management mapping, marine disaster and environmental monitoring, and marine wildlife monitoring, emphasizing the need to use UAV objects for obtaining remote sensing data.

iii. Search and Rescue Operations

The proposed methodology of distant geolocation using a UAV drone is beneficial in search and rescue operations. It allows for the geolocation of target objects, including crashed planes, helicopters, and survivors. Additionally, obtaining the coordinates of lost hikers in the mountains is especially valuable due to the complicated terrain.

Additionally, after environmental disasters, such as earthquakes, hurricanes, and tsunamis, the UAV geolocation systems can precisely locate vulnerable individuals and thus increase their chance of surviving. The authors in [12] highlighted the increased need for UAVs in search and rescue (SAR) operations due to their flexibility and mobility. Furthermore, they emphasize the vital contribution of drones in increasing mission success rates and facilitating effective and successful SAR activities.

iv. Infrastructure Monitoring and Urban Planning

Due to the overpopulation of cities and urban areas, precise monitoring and planning of various infrastructure buildings, including bridges, highways, and dams, is required to ensure public safety and their operability. Furthermore, UAV objects such as drones can monitor and geolocate traffic jams, providing a good and accurate solution for optimizing the overall traffic in large urban areas by geolocating the specific problem in real-time.

This proposed geolocation system can be applied in various urban planning scenarios, providing accurate and real-time coordinates of traffic jams or accidents. On the other hand, geolocating infrastructural problems, such as cracks and anomalies, can help civil engineers prevent accidents in non-urban areas, such as dams built outside the city. This can prevent massive accidents or mitigate those that are arising.

v. Agricultural Management

The UAV geolocation system can monitor arable fields and crops in large, cultivated areas such as Posavina in Bosnia and Herzegovina. The proposed system can provide the exact location of the regions affected by drought or pests and help farmers monitor them more efficiently. This is especially useful for large areas up to several kilometers of land, which can be seen in the fields of Ukraine. Additionally, the farmers can easily use this methodology for livestock tracking and monitoring, thus saving time and resources. Each animal and crop in the field can be located precisely and monitored for the most effective use.

b. Police Applications

The geolocation system with UAV drones can assist in many police-oriented scenarios and help maintain the security and safety of the citizens. This section examines five significant applications of the proposed system for police applications across the state.

i. Border Monitoring and Surveillance

Congress of the USA has expressed a great interest in using UAV objects, especially drones, for surveillance of their international borders [13]. The authors in [13] demonstrated several benefits of using UAV drones for border monitoring, including their ability to monitor remote areas better than the special agents.

The proposed methodology can be easily implemented with minimal costs and hardware requirements for border monitoring, where any illegal attempts can be localized and located. The system can easily geolocate individuals or groups, such as illegal immigrants, and send the WGS84 coordinates to the police border department. With this system, in risky areas where police personnel cannot penetrate, many resources, including human lives, can be saved, helping police officers respond more quickly and promptly to any border breaches or illegal activities.

ii. Suspects/Vehicles Geolocating

Using UAV drones equipped with geolocator systems can help police personnel monitor suspects, including stolen items such as vehicles, above the ground in real-time and obtain the suspects' exact coordinates. Additionally, ground units can easily plan their routes and interception mechanisms by having the suspicious individuals' location.

Furthermore, using the geolocation system from the air, police personnel can quickly locate illegal immigrants, their routes, and stolen items across inaccessible areas and environments. This system minimizes the risk of losing a target during high-speed, real-time police operations. After obtaining the exact location of the target objects or individuals, the system can quickly transfer those coordinates to the police command center and act promptly.

iii. Crowd and Riot Monitoring

During large crowds, created due to gatherings on holidays such as New Year's concerts, it is necessary to maintain public safety and monitor any suspicious activities. UAV objects like drones or robots are effective and optimal solutions in these scenarios. Using the geolocator system on drones can help locate suspicious activities and individuals of interest when large

gatherings occur. In this way, protection and public safety are enhanced even more. This is particularly useful in urban environments where police officers cannot penetrate quickly and efficiently as UAV objects. Maintaining the security of crowds and gatherings worldwide is a crucial concern nowadays due to the large number of terrorist attacks in the Western hemisphere. This can be especially useful for monitoring and surveillance in crowded pilgrimage areas due to the vast number of pilgrims in one place, such as India and Saudi Arabia.

In addition, riots and public gatherings, common in France, must be adequately monitored. With minimum hardware requirements, the proposed system can easily be used during riots to obtain the precise location of individuals or groups disturbing public order and peace.

iv. Drug Traffic Monitoring

Due to the increase of drug production in the areas of South America and Western Europe, it is crucial for special units, including police officers and agents, to locate the drug cartel networks and individuals of interest. Most of the drug production is located in remote and inaccessible areas such as villages, mountains, and forests. Therefore, police must employ a cost-effective geolocation system to track and locate illegal activities quickly. One of the critical advantages of this approach in monitoring illegal activities is that it can quickly find any object from a larger distance without needing to get close, which negatively affects the mission.

The elaborated system can effectively geolocate hidden drug plant areas and easily transfer coordinates to the police units, preventing drug traffic activities on time.

v. VIP Events Management and Monitoring

During public events, it is vital to ensure the safety of VIPs, including political leaders, celebrities, corporate chiefs, and executives. Traditional protective measures included only ground surveillance and monitoring, which is not sufficient in modern times, where major attacks and assassinations come from the air.

UAV objects like drones provide a bird's-eye view of the VIP surroundings, identifying possible threats and illegal activities. The geolocation system proposed in this paper can quickly obtain the WGS84 coordinates of the target objects and/or individuals from the air, thus further securing the VIP gatherings.

vi. School Safety Monitoring

Nowadays, many terrorist attacks take place in primary and secondary schools, where many children are murdered. This was especially the case in America and recently in Serbia when mass school shootings were in place.

During and after the attack, the drone's geolocator system can easily locate the suspect in dynamic scenarios and provide real-time coordinates of the attackers.

Furthermore, drones with a geolocation system can quickly locate suspicious vehicles and individuals, preventing mass school attacks. This system can also be implemented to find explosive devices near school environments and prevent false and fake news and information.

c. Military Applications

The proposed methodology's most significant application is for military purposes in modern warfare conditions. Due to their mobility, drones are used in almost every war worldwide. They are used for many

purposes, including attacking target objects, but the most helpful aspect of drones' usability is their ability to locate a distant object precisely. This section covers several scenarios where this methodology can be applied for modern military purposes.

i. Precise Artillery Targeting and Air strike Coordination

There are many examples of precision targeting in modern military operations. Precision is essential since it minimizes collateral damage and maximizes the effectiveness of airstrikes. The proposed system, which can be implemented as part of any UAV objects, either drones or ground vehicles, can allow armed forces and logistics to obtain precise WGS84 coordinates of distant objects and conduct airstrike attacks effectively, minimizing losses and collateral damage.

An example scenario of how this system can be used for airstrike coordination: the UAV object, e.g., a drone, flies at a higher altitude and detects the enemy targets, such as bunkers, vehicles, or artillery positions, using a simple camera. At higher altitudes, drones do not need to get closer to perform angle measurements and geolocation, but they can do so up to 10-20km and thus remain unnoticed. In addition, it does not have to travel far to lose battery life in these operations. The geolocation can be conducted effectively from greater distances. Furthermore, by measuring the angles and GPS coordinates and employing triangulation, UAV objects determine the exact WGS84 coordinates of distant objects. The coordinates can be transmitted remotely using the LoRA interface to the military headquarters, which will then perform coordinated airstrikes at the target position. This will minimize collateral damage since only localized targets will be attacked.

There are many real-life examples of how drones equipped with geolocation systems were used in modern

warfare purposes. One of the most famous examples of the applicability of geolocation systems on UAV drones was the case of the US killing of Qasem Soleimani, elaborated in the Congressional Research Service [14]. According to this paper, Soleimani was the second most influential figure in Iran, as head of the IRGC-QF. The report states that Soleimani was killed by a US drone attack while leaving the Baghdad International Airport using the precise geolocation system for targeting a victim.

ii. Rescue Operations in Combat Zones

The most time-sensitive missions and operations in war are rescue operations in combat zones. They include locating and saving missing soldiers, injured soldiers, pilots, and civilians. UAVs with geolocation systems can help in search and rescue operations in military missions by providing exact coordinates of wounded or missing soldiers.

UAVs can easily search and analyze combat zones for soldiers and provide their actual GPS coordinates. Additionally, UAVs, such as drones, can easily improve the overall geolocation system by integrating thermal and infrared cameras for better visualization and coverage of the environment, especially at night. This can quickly be incorporated into any drone and improve the geolocation system. There are many examples of how drones equipped with geolocation systems helped in military missions to search for and rescue soldiers.

iii. Effective Naval Operations

The elaborated system can be modified and improved technically using special hardware for naval operations and underwater geolocation. UAV objects, including underwater drones, can detect underwater activities and target submarines or other underwater drones for airstrike coordination. This involves using specialized drones that can operate in underwater conditions and

where this system can easily be integrated. In this case, additional hardware improvements must be considered, but it does not require too many resources.

On the other hand, this system can be used for naval operations on coasts and open seas, where targeting ships and submarines from the sky is crucial. This includes locating undefined enemy ships in restricted areas, enabling proper localization, and further airstrike operations. Furthermore, illegal activities such as smuggling and weapon trafficking can be easily located from a higher distance in open sea areas using this system.

iv. Enemy Target Surveillance

It is crucial to precisely conduct localization with enemy target surveillance for gathering intelligence and monitoring enemy troops. The proposed system can be used for conducting target surveillance in many aspects, where providing the exact WGS84 coordinates can help military troops organize and conduct attacks more efficiently.

This includes general geolocation of enemy targets, including their operation and providing the coordinates for additional planning and missions. For instance, the geolocator system can monitor enemy convoys in real-time and provide their exact location, including their supply to combat zones in remote terrain. Furthermore, a UAV object equipped with this system can locate enemy camps and provide their coordinates for planning military missions. This aspect also includes border surveillance, where localizing enemy troops crossing the border is necessary for additional planning. This system can monitor critical infrastructure and locate suspicious activities on bridges, highways, airports, and oil fields.

The army can employ this system to locate enemy activities on critical infrastructure, prevent enemy attacks

on gas plants and oil refiners, and avoid enormous damage to the state and environment. For instance, it can locate suspicious activities around nuclear power plants and prevent severe damage.

v. Battlefield Mapping and Organization

Before launching any attack on the battlefield, proper mapping and strategic planning must be considered. The geolocator system can, in real-time, provide location information in any environment, helping the commanders prepare and organize complete missions. The system can be improved with thermal imagery or LiDAR cameras, which can provide a better visual perception to drone navigators, and the geolocation system can give the exact coordinates of any location of interest. Military personnel can easily plan further actions and organize their activities with the actual coordinates.

The proposed system, enhanced with additional hardware features, can help organize resources and manage the supply chain by navigating it through safe areas and providing military staff with their coordinates. UAVs can geolocate supply drop zones for helicopters, where they can safely handle supplies like food and ammunition.

20. Critical evaluation with results

This chapter analyses the proposed geolocation methodology and evaluates its strengths, weaknesses, and experimental results for applicability in selected areas, including civilian, police, and military purposes. It emphasizes how this system can be enhanced to increase its usability in many areas.

a. Summary of the Experimental Results

The proposed methodology's hardware and software realization was validated through an experiment. Several experimental measurements were taken at various locations, simulating the real-world conditions where the geolocator system will be used.

Fig. 2 shows the target object's position used for this experiment, marked as a yellow square. The circle marks the area within which the object was taking all experimentally determined positions of the target object.

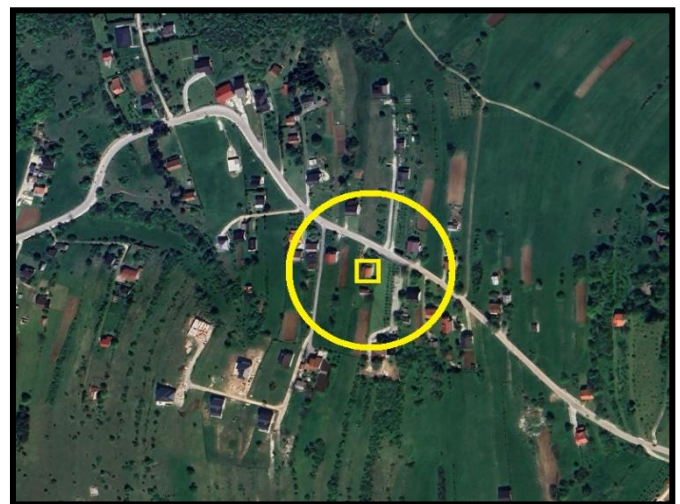


Figure 2. Map of the distant object used for the experimental testing.

Several experimental measurements were taken at various locations. The results showed that the accuracy of the proposed method is influenced by the precision of the two gyroscope angles. This can be improved using advanced denoising filter solutions and angle variables with more decimal points. Overall, the system has demonstrated that this pilot one proposed model has reasonable accuracy rates, with slight improvements that need to be made.

b. Strengths and Weaknesses of the Proposed Method

There are many advantages of the proposed method, including:

- Reasonable accuracy
- Cost-effective solution
- Minimal hardware and software requirements
- Real-time performance
- Fast execution of the algorithm
- Scalability
- Versatile usage

On the other hand, some of the disadvantages of the proposed model are:

- Gyroscope sensitivity
- Limited applicability in bad environmental conditions (fog, storms, winds)
- Demanding measurement process
- Dependence on the GPS (can limit the applicability of the method in tunnels, dense forests, and urban areas)

In summary, the proposed method can be applied in various areas of real industrial problems, and its advantages outweigh its disadvantages. In the next section, future improvements of this method will be considered.

c. Potential System Improvements

While being an effective and powerful geolocation solution, this elaborated methodology can be further improved using more technologically advanced additional hardware and software solutions.

The improvements that would enhance the applicability of the proposed system and its accuracy include the following:

i. Integration of Cameras and Thermal Imaging

UAV objects, such as drones equipped with geolocator systems, can significantly be improved by integrating more advanced hardware solutions, like high-resolution cameras, to capture distant objects' visual data and improve the identification process from a UAV object. Furthermore, thermal imaging sensors that detect heat points can further enhance the system for use in conditions like darkness, fog, smoke, and forests.

ii. Integration of the AI Solutions

Integrating AI models into this system can significantly improve the autonomous detection of distant targets, classification of them, and prioritization of unique targets. This inclusion can allow the UAVs to operate autonomously and with minimal human intervention, crucial for military purposes.

iii. Enhanced Network Communication

Integrating more secure networking solutions can improve communication between the UAV and the command center. This system requires sharing real-time data remotely, and it can be enhanced by sharing data remotely with command centers and other UAV objects in the air or ground. This can include integrating this system's cloud solution, where many users will store and process geolocation data remotely in real-time. Additionally, the system must be protected from cyber-attacks that can reduce its operability.

iv. Overall Hardware Improvements

The system can be designed to use more lightweight hardware components for better mobility. Additionally, the UAVs can be created with better battery solutions that will extend their range and duration of operability. Furthermore, the system can be adapted for underwater environments requiring specialized hardware solutions. Efficient power systems and light materials can extend the system's operability and flexibility in remote areas and battlefields.

21. Conclusion

To conclude, UAV objects, including drones and ground vehicles, are widely used nowadays in many scenarios. UAVs equipped with geolocation solutions significantly impact many industries and real-life problems. This paper elaborates on a method of geolocating distant objects using MEMS gyroscopes and GPS readings on UAV drones. The methodology was designed to provide accurate WGS84 coordinates of distant objects using specialized hardware and software components. The study was tasked with exploring the applicability of the proposed method in various fields, addressing the most critical problems.

The most significant literature sources on geolocation techniques were examined, including their strengths and weaknesses, and compared to the proposed technology. Furthermore, the study covered the most critical areas where this methodology can be applied, including civilian, police, and military purposes. Many scenarios show how this method can be used accurately in many cases while maintaining the general security of civilians and military personnel is the most critical aspect. The proposed geolocation system has demonstrated significant potential in addressing real-world challenges in all three contexts. Furthermore, the system's advantages and disadvantages were analyzed, emphasizing that the method's strengths outweighed its weaknesses.

In the end, future enhancements, like AI integration, enhanced network security, and advanced hardware inclusion, showed how this method can be enhanced to improve its usability in many other real-world scenarios. The proposed methodology represents a significant innovation in geolocation technology, providing a versatile and cost-effective solution for various challenges in various sectors and fostering innovation and efficiency in police, civilian, and military spheres.

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Deniz Durmus:” Complexity Economics in defiance of Mainstream and Neoclassical Economics”

Concepts of mainstream economics and neoclassic economics, along with concepts like rationality and equilibrium, are common targets of contention of complexity economics. Hence, this paper aims to clarify these concepts by revisiting the foundational concepts of economics. More specifically, this paper questions a) whether neoclassical economics and mainstream economics are the same in contemporary economics thought, and b) in today’s thought, where, in the spectrum of economic viewpoints, does complexity economics stand. Literature survey implies that mainstream economics is rather a sociological concept, associated with prestige and influence. Neoclassical economics used to be the sole economic thought within mainstream economics. However, neoclassical economics per se and its hegemony in mainstream economics has been challenged, and is now in question. This paper suggests that complexity economics is, in fact, challenges not mainstream but neoclassical economics and its rational-individual-oriented, equilibrium-based approach.

Keywords: Complexity economics, neoclassical economics, heterodox economics

23. Introduction

The heterodoxy of complexity economics had been very much in emphasis especially in the literature from its early days. Moreover, complexity economists seem to use heterodoxy as a term to stress the nonconformity, disagreement, or to challenge either mainstream economics, neoclassical economics, orthodox economics , or sometimes a combination of these terms (e.g. neoclassical mainstream) (Elsner 2019). The terms “mainstream”, “orthodox”, “neoclassical” economics, are used almost interchangeably.

As Colander (2000) suggests, economics is not a molded field, but rather a liquid, constantly evolving with interwoven ideas and concepts. It evolves as societies evolve, as technology and science advance. In the textbook, starting from its 4th edition in 1958, Samuelson illustrated a genealogy of school of economic thoughts at the end of his book (see Appendix 1). The tree depicted the influences between different economic doctrines. However, it is worth noting that he only included the economic denominations he thought had a significant dominance over the economics, hence it is somewhat reductionist and does not reflect the richness of the spectrum of economic thoughts.

According to his first genealogy in 1958, economics was built with a foundation of philosophy, 17-18th century mercantilism tradition, and physiocracy of the 18th century enlightenment era. Later, at the end of the 18th Century, Adam Smith with his influential work "The Wealth of Nations" brought a new school into economics, namely, "classical economics". Classical economics asked "big-picture" questions like the famous "why some nations are rich but are poor", with a focus on moral philosophy and psychology. Until the middle of the 19th Century, Smith, Ricardo, Malthus, and Mill, led classical economics all with their own variations. These variations, albeit interesting and worth investigation, for the time being, fall outside the current focus of this study. Afterwards, at the end of the 19th Century, Marshall founded neoclassical economics, a new school of economics thought, as a continuation of the classical economics. Neoclassical economics dominated economics until the 1980s.

Davis (2008b) argues three important periods of economics as an academic field. The first period is the era of Alfred Marshall. Marshall and Cambridge University had a vast influence in economics, defining economics as a science, taking marginal equilibrium theory as

a base for their work. Their work then in the 1930s was taken over by the Lausanne University with general equilibrium theory, as a much extensive version of marginal equilibrium theory. The second crucial period of economics is the Great Depression during which the privileged economists were looked upon askance by the public. This is the period of the rise of Keynesian economics which is named after John M. Keynes, who is also known as the founder of modern macroeconomics. The third important period in economics is post-WWII during which economists benefited greatly from mathematics, physics, operations research, and engineering. Specifically, the Cold War affected economics research in terms of quantitative research, and mathematical deduction have gained importance leading the field of economics to revolve around mathematics-based neoclassical economics.

[Figure 1 to the next paragraph. Kreps' Hourglass Shape of Economics (1997), illustrated by Boettke et al. (2008)]

Boettke et al. (2008) uses Kreps' hourglass economics analogy (Kreps 1997) to explain the change in economics. The figure implies a timeline, starting at the top and proceeding towards the bottom. Kreps asserts that in Adam Smith's day, economics was much more focused on political economy and moral philosophy, where history, morality, and psychology were at the center of studies. This period is depicted as the wide top in the figure to emphasize the interdisciplinary nature of early economics. In the 20th century, political economy revamped as economics in which mathematical tools, and mathematical deduction had taken the center field. This period witnessed the rise of neoclassical economics, and the use of equilibrium models with formal methods. Economics, during this period, distanced itself from other social sciences, while historical and philosophical aspects from earlier political economics

were left out for the sake of mathematical tractability. For this reason, this period was depicted as the narrowest period in the figure. Beginning in the 1990s, at the end of the Cold War, economics transformed itself once again into the Smithian political economics, embracing a much wider interdisciplinary stance. Hence the figure re-widens.

In recent years, however, especially after 1990s, neoclassical economics and mainstream economics have been increasingly criticized. Davis also provides an overview of the current economics movements:

Recent economics can be described as a traditional neoclassical core surrounded by two sets of approaches that challenge it: (a) heterodox research programs (many of them long-standing, others more recent) that have survived the standardization process, and (b) a collection of new research programs which largely derive from the influence of other sciences on economics. The former include institutional economics, Marxist economics, radical political economy, social economics, feminist economics, Post-Keynesian economics, and neo-Austrian economics. The latter include behavioral economics, game theory (in various forms), experimental economics, evolutionary economics, and complexity economics" (Davis 2008b, 8).

Given that definitions and concepts are experiencing change over the years, the interchangeable usage of these terms incite ambiguity, confusion, and a lack of coherence in the literature. In the complexity economics literature, it is not very clear whether complexity economics is an adversary to mainstream economics, neoclassical economics, or both as these two oftentimes are used as synonyms. While we acknowledge that economics as a field is very diverse, complex, and clear-cut definitions are almost impossible to be made, this paper attempts to bring a clearer vision with an updated outlook to the concepts, by which we hope

to extent our understanding in complexity economics in terms of where, in the spectrum of paradigms of economics, it sits.

This paper's structure is as follows. In Section 2, we will introduce mainstream economics (Section 2.1), neoclassical economics (Section 2.2) and its relation to mainstream economics (Section 2.2). In Section 3, we will provide an overview of complexity economics, and its relation with neoclassical economics, then conclude the paper with our remarks in Section 4.

24. Neoclassical Economics in Relation with Mainstream

a. Mainstream Economics

The word "mainstream" was a term that was commonly used after the World War II by the scientific community to emphasize the core features and structures of a certain scientific field. Concurrently, the term "mainstream economics" is known to be used first by Samuelson in the 9th Edition of his "Economics" textbook co-authored with Nordhaus in 1985 (Backhouse 2016; Cherrier 2016).

Samuelson brought the term "neoclassical synthesis" where he merged Keynes and Marshall. According to Backhouse "neoclassical synthesis was modern economics—it was a marriage of the classical microeconomics of Marshall, and the modern theory of income determination" (Backhouse 2016, 3). However, in the 7th Edition of the textbook which was published in 1967, as a new chapter, he introduced the concept of "New Economics" which was influenced by John Kennedy's fiscal policy. It was called "new economics" because,

“... it was the first time in the history of the United States [that] Kennedy added to a deficit in order to stimulate employment and growth.” (Samuelson, 1967, p. 342; 1970, p. 338, as cited in Backhouse, 2016, p. 5).

In the 8th Edition, Samuelson did not include the neoclassical synthesis to the genealogy but instead he added “New Economics” (Backhouse 2016; Cherrier 2016).

The 9th Edition in the 1973 introduced a new chapter of “evolution of economic doctrines”, and the genealogy were updated accordingly in the 10th (1976) and 11th (1980) Editions (Figure 2). He introduced Kuhn’s Structure of Scientific Revolutions, and he stated that “An old school dies. A new school is born” (Backhouse 2016, 7). This was the first time he included neoclassical economics into the genealogy, also updated New Economics as “Post-Keynes Mainstream Economics” as a result of subsided influence of Keynes economics. He explains this “Keynesian revolution” as Post-Keynesians “provide the developed macroeconomics to match its overdeveloped microeconomics” (Backhouse 2016).

[Figure 2 near here. Samuelson's economic genealogy published in 1980. Taken from Backhouse (2016). For full picture see Appendix 1]

Another viewpoint on mainstream economics is provided by Colander, Holt, and Rosser (2004) whose idea adopts a sociological perspective. According to their definition, mainstream economics is the,

“...ideas that are held by those individuals who are dominant in the leading academic institutions, organizations, and journals at any given time, especially the leading graduate research institutions. Mainstream economics consists of the ideas that the elite in the profession finds acceptable, where by ‘elite’ we mean the

leading economists in the top graduate schools” (Colander, Holt, and Rosser 2004, 35).

Dequech (2007) definition of mainstream economics slightly varies from the Colander, Holt, and Rosser’s by which he aims to put more emphasis on prestige and influence rather than the ‘elite’. In Dequech’s definitions,

“Mainstream economics is that which is taught in the most prestigious universities and colleges, gets published in the most prestigious journals, receives funds from the most important research foundations, and wins the most prestigious awards” (Dequech 2007, 281).

Moreover, Dequech argues that sociological outlook on mainstream economics encompasses the most general characteristics of the mainstream. Methodological, theoretical, and political aspects of the mainstream might change over time, but its sociological characteristics (influence and prestige as aforementioned) are abiding, and can be applied to any period of economics history (Dequech 2007, 283). Sociological outlook also provides another body of research on the influence of Nobel prize laureates in economics, and how their critiques are likely to be accepted by the public (Boettke, Fink, and Smith 2012; Mata 2009; Davis 2008b; Dequech 2007; Colander, Holt, and Rosser 2004). Yet, in most cases, the scope of granted research in economics, PhD programs, and undergraduate and graduate level courses at prestigious universities are accepted to be a showcase of the mainstream (Davis 2008b; Dequech 2007; Colander, Holt, and Rosser 2004). While, economists such as Colander et al. (2004), Lawson (2013), Dequech (2007) favor the sociological aspect in the definition of

mainstream economics, they agree that current mainstream economics is grounded upon mathematical modeling (Lawson 2012).

b. Neoclassical Economics

Thorstein Veblen, in the 1900s, coined the term “neoclassical” and referred to it as a school, though the foundation of neoclassicism was laid by Walras and Marshall between 1890 and 1910 (Samuelson and Nordhaus 2009). Neoclassical economics is sometimes used equivalently to mainstream economics, and sometimes used in a way to critique mainstream economics. Due to the complex nature of economics as a field, the terms, notions, definitions seem to be used somewhat loosely, and sometimes ambivalently, which in turn, results in impertinent critique of neoclassical economics and hence gives rise to claims such as “economics is in crisis” (Lawson 2012).

In the most general sense, Lawson (2013) groups scholars of neoclassical economics into two types by how they “interpret” neoclassical economics. The first group considers neoclassical economics as a continuity of classical economics. The second group are those who seek an analytical coherence among the features of neoclassical economics’ varieties in some form of a “meta-theory” without giving too much consideration into its historical tradition. Aspromourgos (1986) calls the former Marshallian economics as with its prominent economists such as Veblen, Hamilton, Homan, and Mitchell. He calls the latter as marginalists with economists such as Hicks and Stigler.

Similarly, Dequech (2007) admits that the definition of neoclassical economics has changed over the years and not everyone’s understanding of neoclassical economics is the same. He provides the commonalities of neoclassical economics as:

“1. the emphasis on rationality and the use of utility maximization as the criterion of rationality,
2. the emphasis on equilibrium or equilibria, and
3. the neglect of strong kinds of uncertainty and particularly of fundamental uncertainty” (Dequech 2007, 280).

Similar to Dequech, Arnsperger and Varoufakis (2006) explain neoclassic economics with three axioms: individualism, instrumentalism, and equilibrium. Individualism, they define as the idea that a socioeconomic phenomenon can be understood from individual behavior. Individualism does not concern itself with other agents of economics, like institutions or historical events. Instrumentalism concerns model consistency. As long as an individual with consistent preferences can reach her maximum utility, neoclassicism tells us all other individuals with the same preferences will behave the same, and there is no need to search for any underlying reasons. Arnsperger and Varoufakis also add that rationality is no longer at the core of neoclassicism that was once built by David Hume. The word rationality was redefined as consistency (Boland 1997, 168). Rational-choice is known as the concept where individuals make optimal choices depending on their personal preferences and market conditions. However, in the recent years, psychologists and behavioral scientists have proven that the individuals do not make rational choices. This empirical work has strengthened the base of behavioral economics (Davis 2008b, 9–11).

Finally, equilibrium is where individuals’ behaviors give rise to system stability. At the equilibrium, system settles into a state. System stability can tell us something about an individual’s behavior at that point. This gives a rather static outlook to economics. Three

properties of equilibrium given by Dixon is the most commonly accepted by the economics sphere:

“P1. The behavior of agents is consistent.

P2. No agent has an incentive to change his behavior.

P3. Equilibrium is the outcome of some dynamic process (stability)” (Dixon 1990).

Backhouse provides an extensive list of definitions of equilibrium, while he summarizes that there are four key components to the concepts of equilibrium, similar to Dixon’s:

“1. Equilibrium as the absence of endogenous tendencies for change.

2. Equilibrium as balance of forces (using a mechanical analogy).

3. Equilibrium as correct expectations.

4. Equilibrium as meaning that no agent has any reason to change his or her behavior” (Backhouse 2004, 296).

Lawson delivers an extensive literature survey on the different interpretations of neoclassical economics over the years, and he summarizes the varieties as follows:

“... sometimes individual knowledge is assumed to be in some sense ‘perfect’ or ‘complete’, sometimes systematically limited, and very often knowledge specifications do not figure explicitly at all. Behavior is often treated as rational in some technical sense, though not always, and where it is, there is significant variety in the particular specifications. Further, there is wide disparity over the equilibrium states that are part of the essential framework of neoclassicism, and, where they are accepted as so, disagreement as to whether such states are held axiomatically always to prevail, or whether their possible existence is a matter of study, or something else; and so on.” (Lawson 2013, 949).

As aforementioned in the introduction, economics was heavily dominated by neoclassical economics until the 1980s. Mathematically induced solutions to economics problem had brought a certain convenience which brought success to neoclassical economics. The neoclassical economists had abandoned more and more historical, philosophical, sociological aspects of economic system for the sake of computational ease. However, in the 1980s, neoclassical economics was tottered by various heterodox economics. Davis (2006) explains this downfall with three views: “the breakdown view”, “the outside takeover view”, and “the maturity view”.

The breakdown view suggests that general equilibrium theory of neoclassical economics hindered progress of neoclassical economics. Davis explains this with Arrow’s impossibility theorem which states that “neoclassicism is a highly unified conceptual structure that is the source of its own limitations, ..., in terms of its inability to explain social choice” (Arrow, 1963 as cited in Davis, 2006, pg. 14).

The outside takeover view implies that economics “imports” methods outside economics. Non-neoclassical methods compete until one gained the most “influence”. He also asserts that this transformation is the very nature of any scientific field.

The maturity view tells that neoclassicism had reached its boundaries, and there is not much else left to solve with neoclassical economics. Colander (2000) advocates for the maturity view with his famous “neoclassicism is dead” argument. Hence as Davis says “neoclassicism is not an unsuccessful program but a finished one” (Davis 2006, 16). Whatever the reason is, the dominance of neoclassicism has ceased to exist, Davis concludes. The end of neoclassical hegemony within the mainstream is discussed in Section 2.3.

c. Neoclassical Economics vs Mainstream Economics

The trends in the recent two decades have brought a discussion whether the dominion of neoclassical economics have been obliterated in the mainstream, and whether mainstream has been leaning more towards pluralism. In the literature, oftentimes neoclassical economics and mainstream economics are used coequally where the interchangeable usage of these terms incite ambiguity, confusion (Elsner 2019; Davis 2008b; Colander, Holt, and Rosser 2004). Moreover, the latest edition of Economics still asserts that mainstream economics is a merge of Keynes and Neoclassical Economics (Figure 3).

[Figure 3 near here. Samuelson's economic genealogy taken from Economics (2010). For full picture see Appendix 2.]

A significant distinction is made by Davis (2017), who divides mainstream economics into two periods: pre-1980s economics where neoclassical economics dominated economics, and post-1980s where game theory, behavioral economics, and mechanism-design theory had emerged.

In addition, he also investigates mainstream economics as a bubble using George Soros' boom-bust theory (Davis 2017) Soros argues that,

“Every bubble has two components: an underlying trend that prevails in reality and a misconception relating to that trend.... A boom–bust process is set in motion when a trend and a misconception positively reinforce one another.... Eventually, market expectations become so far removed from reality that people are forced to recognize that a misconception is involved.... Eventually, a point is reached when the trend is reversed, it then becomes self-reinforcing in the opposite direction” (Soros, 2013, pg. 323 as cited in Davis, 2017, pg. 525).

Consequently, Davis argues that,

- “1. The ‘underlying trend’ of mainstream economics is the postwar development of rationality theory on the model of economics as a natural science;
2. The reinforcing ‘misconception’ attendant upon this vision is the view that modeling economics as a natural science improves its descriptive capacities as a science; and
3. The recognition that this was a ‘misconception’ is represented by the shift in post-1980 economics (associated in particular with the development of game theory, behavioral economics and mechanism-design theory) to the view that economics functions performatively toward the world, or constructs the world in its own image, rather than seeks to provide accurate descriptions of it.” (Davis, 2017, pg. 525).

Hence in the 1980s, mainstream economics was criticized for its positive discrimination towards neoclassical economics (Davis 2017). Davis also states that mainstream economics has been criticized for “[being] monolithic, exclusionary, and the very antithesis of a pluralistic profession” (Davis 2008a, 53). Lee (2008) and Mata (2009) also explain, how in the 1900s, heterodox economists were discriminated by the “class-elite power” in higher education, especially the Marxists and the Institutionalists.

Although neoclassical economics had always been challenged in the 1960s and 1970, the beginning of 1990s had brought the rise in a pluralism movement in economics (Davis 2008a; Economics Education n.d.). In 1993, ICAPE (International Confederation of Associations for Pluralism in Economics) was founded to “[promote] greater diversity in theory and method in economic science” with the idea that “the new spirit of pluralism will foster a more critical and constructive conversation among practitioners of different approaches. Such pluralism will

strengthen standards of scientific inquiry in the crucible of competitive exchange” (Sent 2006, 82).

This pluralism movement, which can also be thought as the collective movement of heterodox schools of economic thought, suggests a “recognition of the misconception” phase in mainstream economics that Davis touched upon. Heterodox economics, on the other hand, refers to the ideas and practices that provide an alternative approach as opposed to mainstream economics of the 1930 – 1980s era (Lee 2008, 24). Heterodox economics, in general, is hard to define because heterodox economics is usually adopted from other scientific fields outside economics (Davis 2006). For example, behavioral economics is promoted by the ideas from psychology, complexity economics by physics, game theory by mathematics, and neuroeconomics by neuroscience. Concurrent to the Colander-Holt-Rosser definition, Dequech defines heterodox economics as the schools of economic thoughts that are deployed by the lesser prestigious schools and economists and have a less influence in economics as a field. Hence, he asserts that it would be better if heterodox economics is renamed as “nonmainstream economics” (Dequech 2007, 295). This definition would enable us to collect all heterodox economics under an umbrella.

Peach (2003) claims that neoclassical economics still constitutes the fundamental features of mainstream economics, such as the Newtonian equilibrium approach, optimization, and individualism. Whereas, Colander (2000) asserts that “neoclassicism is dead”, and he provides six neoclassical properties not pertinent to today’s mainstream. These properties are provided by Lee,

“a. a focus on resource allocation at a given moment in time,

- b. some variation on utilitarianism,
- c. a focus on marginal trade-offs,
- d. the assumption of far-sighted rationality,
- e. methodological individualism, and
- f. the method of general equilibrium.” (Lee 2008, 56).

Lee (2008), on the other hand, provides a rather modest argument. He asserts that both Peach and Colander’s arguments are on the extreme ends where in the former, mainstream is neoclassic economics, and the latter is today’s mainstream, encapsulating non-neoclassical approaches. He states that “neoclassical economics might be dead, but its individualism-instrumentalism-equilibrium nexus remains in mainstream economics”. Moreover, Arnsperger and Varoufakis (2006) claim that mainstream economics is in a crisis because of that individualism-instrumentalism-equilibrium nexus of neoclassic economics, which is accounted for economic models to be far from reality. They also add that individualism-instrumentalism-equilibrium nexus abet “the discursive success of neoclassical economics which gives it an effective (politically driven) stranglehold over alternative modes of economic reasoning” (Arnsperger and Varoufakis 2006, 6).

Davis (2006), also makes a point that, during the period where neoclassical economics was dominant in the mainstream, institutional and evolutionary economics was considered to be heterodox. However, in the recent years, properties from heterodox economics are more in use by the mainstream economists. Similarly, Colander, Holt, and Rosser (2004) state that mainstream economists such as Schelling, Akerlof, Bewley, and Krugman had implemented the concepts from heterodox economics. Likewise, psychologist and behavioral economists Kahneman’s winning the Nobel Prize in Economics in 2002, imply a change within the

mainstream. Yet again, the influence of neoclassicism in the mainstream has been regressing over the years, and certainly, the hegemony of neoclassical economics has been marginalized. Mainstream economics has become more receptive to heterodox economics over the years, but still there is an ongoing debate of whether mainstream economics is pluralistic (Davis 2008a; Dow 2008; Economics Education n.d.; Lee 2008; Arnsperger and Varoufakis 2006).

25. Complexity Economics

We already provided complexity economics' definition and its features in **[Author's name, 2021]**. To summarize, complexity economics is one of the branches of complexity science. Complexity, in a general sense, is the study that concerns with how the behavior of a system's individuals changes the system's overall behavior, and in turn how the system's overall behavior changes individuals' behavior. Arthur (2015), argues that "complexity is not a theory, but a movement in the science". Science itself is distancing itself from equilibrium-based, Newtonian mathematics, and favor for algorithmic, and Turing type approaches. Hence complexity has stretched out to various fields of science, including health, computer, political, cognitive, sociology etc. (Castellani 2018). Consequentially, the complexity movement also swayed economics in 1980's, during which neoclassical economics had already been criticized for its failure in practice as we discussed in Section 2. As behavioral economics was founded on the idea that individuals are not rational beings, nonequilibrium based economics is based on complexity economics.

Complexity economics emerged from the Santa Fe Institute's (SFI) Economics Program started by physicist Philip Anderson and economist Kenneth Arrow, then lead by Brian Arthur who named the field as "complexity economics" in his 1999 paper (Fontana, 2010). Fontana

states that in 1986, the CEO of Citicorp, John Reed funded the SFI Economics Program. Reed apparently was,

“... annoyed by the failure of his economist colleagues and consultants to predict such large-scale economic phenomena as cascading failures in Latin American and credit card debt payments, and was therefore willing to fund research on a new kind of economics” (Fontana 2010, 169).

Also, advancement of technology and computers paved the way to the emergence of complexity economics (Arthur 2015; 2021). As technology advances and calculation power increases, economists have been able to solve more complex problems. Also, they do not need reductionist approaches as much as they used to, by being able to implement non-equilibrium in economic systems. Thus, as Colander (2000, 41) and Arthur (2021; 2015) argue, complexity economics does not hail from the heterodox tradition but from a neoclassical view.

Arthur gives an insight into why complexity is coherent in economics:

“One of the earliest insights of economics – it certainly goes back to Smith – is that these aggregate patterns form from individual behavior, and individual behavior in turn responds to these aggregate patterns: there is a recursive loop. It is this recursive loop that connects with complexity... complexity is about formation – the formation of structures – and how this formation affects the objects causing it” (Arthur 2015, 2)

Arthur also discusses that the economics considers two types of problems: allocation and formation. Allocation refers to the problem where limited amount of goods and services are allocated in the market, whereas formation deals with how structures, trends, and behaviors are formed (Arthur 2015; Tabb 1999). Mathematics-dominated neoclassical

economics has dealt well with the allocation problems. However, in regards to formation, in which relationships, history, economic development, institutions, innovation, etc. are the key concepts, complexity economists believe that complexity economics can have a significant impact, and can bring the political economics back into the economics (Arthur 2021; Boettke, Leeson, and Smith 2008; Tabb 1999).

If we take Arnsperger and Varoufakis' three axioms of neoclassical economics, individualism, instrumentalism, and equilibrium, we see that complexity economics contradicts all three of them. We already explained individualism, instrumentalism, and equilibrium in Section 2.2. Complexity economics contradicts individualism, because for complexity, the behavior of individuals are not sufficient to determine the system's behavior. Complexity regards economics as a system with many different agents, such as institutions, businesses, individuals, etc. In that regard the word "agent" represents a much broader term than "individuals", and is more suited to explain the nature of economics. Further, and most importantly, for complexity economists, the interaction between agents plays a crucial role in system's behavior.

Neither the concept of instrumentalism aligns well with complexity economics. Complexity economists regards historical changes and acknowledges cognitive aspect of agents. Due to the sensitivity to initial conditions, and emergence properties, an individual's consistent preferences do not actually tell anything about the system as a whole. Preferences can always change, and the system constantly evolves which brings us the other property of complexity economics.

Equilibrium-based economics are quite the very opposite of complexity. Complex systems constantly evolve, and they are nonlinear. The system never settles into one point, it changes as its agents changes, as its agents change the system. In that regard, complexity science sees economics as a much more dynamic and organic structure.

Moreover Arthur (2021) argues that complexity economics does not share commonalities with many heterodox economic views, although some heterodox economics have a “complexity vision”, hence complexity economics can be seen as a school of economic thought overarching many economic schools of thought including the ones of mainstream and heterodox economics. However, others argue that the components of complexity science can be found within other economic thoughts, such as institutional economics (Grabner 2017; Colander 2000).

As aforementioned, complexity economics is a hail from the neoclassical view. However, this does not necessarily mean that it contradicts mainstream economics. As we provided in Section 2.1, mainstream economics is a socially constructed phenomenon based on prestige and influence. If we align this view with Kuhn’s structure of scientific revolutions, the challenging paradigm (extraordinary science) needs to collect a certain number of advocates to be considered as the dominant paradigm (ordinary science). In that case, complexity economics has to acquire more economists to promote itself from heterodox economics to become one of the mainstream economic thoughts. On this issue, Elsner (2019) asserts that complexity economics is not able to become mainstream in the prevailing media, or in governmental practices and policies, because it still lacks an exhaustive ideology and verbiage that current neoclassical economics has. Moreover, mainstream economics need to be more pluralistic.

26. Conclusion and Remarks

In this paper, we argue that, in contemporary economics, mainstream economics is a sociological concept based on prestige and influence. The word “mainstream” was first used by Samuelson, in his influential book “Economics” at the end of 1950s, depicting it as a phenomenon consisting of neoclassical economics. Neoclassical economics, on the other hand, dominated the mainstream until the 1990s. Hence, mainstream and neoclassical economics was used almost as synonyms. As economics as a research field and the economy itself have gone into a crisis, neoclassical economics and the mainstream have been criticized. Mainstream has been criticized for being monolithic and discriminatory, and neoclassical economics, for being reductionist and for its lack of construing reality. This scrutiny has brought the pluralist movement in the beginning of the 1990s, by the heterodox economists. Mainstream is still not purely pluralistic, but Colander’s argument that “mainstream economics is a complex system of evolving ideas” (Colander, Holt, and Rosser 2004, 489), has gained a recognition in the economics sphere. Schools of thought that used to be considered as heterodox, such as institutional, behavioral economics have been more welcomed by the mainstream economics of today, as well as graduate programs have become more open to “non-neoclassical” research.

Regarding neoclassical economics, it brought mathematical deduction into economics, which benefited mainstream economists greatly. However, as Boettke et al. (2008) suggested, economics squeezed itself in equations and mathematical formalism, forgoing its historical and philosophical foundations built by Adam Smith. We discussed the most commonly used properties of neoclassical economics: instrumentalism, individualism, and equilibrium (Arnsperger and Varoufakis 2006; Dequech 2007). As more and more neoclassical methods

were used with a neglect of reality, economics has gone under a crisis, especially in the 1980s and 1990s.

The crisis led to the rise of the pluralism movement in the 1990s and degraded the influence of neoclassical economics in the mainstream. Complexity economics, as one of the economic thoughts, emerged from the crisis of the 1980s, weakening the neoclassical dominance. Complexity is the movement in science concerning how parts of the system give rise to system behavior and vice versa. This perspective also suggests the property of emergence due to system evolution. Complex systems evolve. In addition, the behavior of a complex system cannot be understood just by looking at each part's behavior (the whole is not the sum of its parts), the interaction between parts plays crucial role. Hence complexity economics challenges neoclassical economics with regards to its equilibrium and individual-based perspective. Complexity economists also assert that, this new era in economics also brings back the Smith's tradition of political economy, which allows us to rethink economics from an interdisciplinary perspective, taking advantage of non-equilibrium, dynamic, and procedural tools.

In regards to mainstream economics and complexity economics, complexity economics does not actually challenge the mainstream, if we take perspective of Colander, Holt, and Rosser. Complexity economics needs to receive more attention by the economists to "become" mainstream. For this, there are two aspects that we need to consider. One, mainstream economics needs to be more open to pluralism, and two, complexity economics has to "develop" a language, as well as methods, to gain more attention by the scholars of economics.

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Analysis of Women Unemployment in the Balkan region during COVID-19 Pandemic

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Abstract

This work examined gender-differentiated unemployment patterns across Bosnia-Herzegovina, Croatia, and Serbia during the initial phase of the COVID-19 pandemic in 2020. Using statistical analyses of sectoral employment data, we find significant cross-country variations in pandemic's labor market impact, with BiH experiencing the highest job loss rate (13%), followed by Croatia (5.62%) and Serbia (1.37%). Women faced systematically higher job losses across most sectors, even in traditionally female-dominated industries, with particularly stark disparities in the health sector. Our findings suggest that pre-existing inequalities in Balkan labor markets were exacerbated during the crisis, highlighting the need for gender-sensitive policy responses to economic shocks.

Key Words: COVID-19, Unemployment, Gender Studies, Labor Market, Sectoral Analysis

28.

29. Introduction

The COVID-19 pandemic has precipitated unprecedented disruptions in the labor markets, particularly during the implementation of lockdown measures. The extensive supply chain disruptions and sharp decline in economic activity caused by a pandemic led to widespread job losses and persistent structural changes in labor market dynamics (Privara, 2022; Dvorak et al., 2020).

While some sectors demonstrated adaptability through the transition to remote work options, the industries requiring physical presence and human interaction experienced disproportionate adverse effects. The combination of an reduced economic activity and stringent lockdown measures severely impacted the tourism sector with many businesses struggling to survive despite government intervention (Nundy, et al., 2021; Verick et al., 2021). The accommodation and food services sector was particularly affected, experiencing

up to 50% revenue losses due to lockdowns and social-distancing measures, with many establishments facing a complete zero in-person dining (Dube et al., 2020; Larue, 2020). The transportation industry faced similarly severe impacts, with a seminal study by Mack (2021) revealing that workers in this sector were 20% more likely to face unemployment compared to other industries.

Furthermore, the pandemic has exacerbated pre-existing inequalities in the labor market outcomes, amplifying structural disparities in employment opportunities and job security. Minority groups, young, less educated, and women have been disproportionately affected by the pandemic-related job losses and the income reductions (Adams et al., 2020). The adverse labor market effects on women have been pronounced even in the developed economies (Koczan, 2020). A research conducted across the United States, Germany, and Singapore demonstrates that working mothers, in particular, faced greater workplace adjustments compared to working fathers, likely due to the traditional gender roles in the household responsibilities (Reichelt, 2020). Notably women face a 24% higher probability of job loss compared to men and anticipate income reductions 50% greater than their male counterparts due to the pandemic's economic impact (Dang and Nguyen, 2020).

The gender disparity in unemployment is particularly pronounced in the Balkan region, where women encounter systematic barriers in the labor market, independent of their education attainment. The research conducted by Regional Cooperation Council (2022) demonstrates that women in Western Balkan countries experience higher unemployment rates compared to both their male counterparts and the EU-27 average. This disparity is particularly striking given that women in the Balkan generally achieve the higher levels of education than men, yet this educational advantage fails to translate into equitable labor market outcomes or wage parity.

These persistent gender disparities can be attributed to several structural and sociocultural factors. A primary driver is educational segregation, where women are underrepresented in STEM disciplines, thereby reinforcing occupational segregation and perpetuating gender inequalities in the job market (Smyth, 2005). Moreover, in post-Yugoslav Balkan countries, attempts at retraditionalization, influenced by religion-affected gender roles, have shaped gender roles and constrained women's labor market participation (Dobrotic, 2022).

Research consistently demonstrates that the traditional cultural norms and gender role expectations significantly influence the women's workforce participation, particularly in the societies with conservative perspectives on gender roles (Uunk, 2015; Kanas, 2021).

While gender disparities in unemployment across the Balkans have been a well studied topic in the literature, there remains a significant research gap concerning these disparities during COVID-19 pandemic period. Although existing studies provide broad perspectives on unemployment patterns, indicating the higher unemployment rates among women compared to men, there is limited research examining these gender differentials at the sectoral level. Despite the well-

documented phenomenon of a gender-based occupational segregation, with certain sectors showing higher female participation rates due to the sociocultural norms, a comprehensive analysis of sector-specific unemployment patterns during the pandemic remains notable absent from the literature.

Our research addresses this gap by examining if women experienced disproportionately higher unemployment rates, even within traditionally female-dominated sectors. This analysis is particularly significant in the context of policy design as it might suggest the need for sector-specific support measures to protect the women’s employment during economic crises.

The study examines gender-differentiated unemployment patterns across three Balkan countries: Bosnia and Herzegovina, Croatia, and Serbia, selected primarily based on the comprehensive data availability. These countries are characterized by high unemployment rates in the long-term, negatively affected by a high emigration rate of younger generation (Vidovic et al., 2017).

Our preliminary study of these countries’ pre-COVID-19 data shows the gender disparity in these labor markets extends beyond the unemployment rates to encompass broader participation and earnings inequalities. Labor force participation rates reveal substantial gender gaps, with women’s participation lagging significantly behind men’s. As shown in Table 1, Bosnia and Herzegovina exhibits the most pronounced gender gap, with female participation at merely 32.9% compared to male participation of 51.7%, representing an 18.8% point difference. While Croatia shows somewhat higher overall participation rates, the gender gap persists with 45.2% of women participating in the labor force compared to 57.6% of men, a difference of 12.4 percentage points. Serbia demonstrates the highest female labor participation among the three countries at 47.1%, yet still maintains the substantial gap of 15.6 percentage points compared to the male participation rate of 62.7%.

Table 1: Labor Force Participation Rates (2019)

Country	Women	Men
Bosnia - Herzegovina	32.9%	51.7%
Croatia	45.2%	57.6%
Serbia	47.1%	62.7%

These substantial gender gaps in overall labor force participation are further complicated by pronounced sectoral segregation patterns across all three countries. The distribution of employment across sectors reveals deeply entrenched gender-based occupational divisions (Figure 1). In Croatia, women comprise 79% of the education sector workforce and 78.3% of healthcare workers, while representing only 35.4% of the manufacturing sector. Bosnia and Herzegovina shows similar pattern, with women constituting 69.1% of the education sector and 72.1% of healthcare workers, but on 37.5% of the manufacturing employees. Serbia’s sectoral segregation is particularly evident in

its unemployment patterns, where women represent 78.4% of unemployment in health and social protection sectors, 70.3% in economics and administration, while comprising only 16.3% of the mechanical engineering sector.

Given these pre-existing disparities and sectoral segregation patterns, our study examines how the COVID-19 pandemic affected gender-differentiated unemployment patterns across these three Balkan countries. The analysis focuses specifically on April 2020, a critical period marked by the implementation of initial lockdown measures and characterized by heightened economic uncertainty, which precipitated significant workforce reductions. The used data are obtained from the respective national statistical institutions of each country. Our sectoral analysis encompasses a strategically selected range of industries, including the traditionally female-dominated sectors as the Health, Education, Accommodation and Food Services, as well as male-dominated sectors such as the Manufacturing and Trade, to realize how pre-existing gender segregation influenced pandemic-related job losses.

30.

31. Bosnia and Herzegovina (BiH)

To examine gender-differentiated unemployment patterns in BiH during the initial phase of the COVID-19 pandemic, we analyzed the official unemployment rates and the sectoral employment data from the Agency for Statistics for Bosnia and Herzegovina.

Our findings reveal striking gender disparities in unemployment trends during the first two quarters of 2020. As shown in the Table **Error! Reference source not found.**, women experienced the 2.11 percentage point increase in unemployment during the second quarter, while men faced a comparatively modest 0.86 percentage point increase. Statistical significance of these gender differences was confirmed through a chi-square test (Table 3).

Table 2: BiH – Unemployment rates by gender and quarter in 2020

Quarter	Unemployment Rate (%)		Difference
	Women	Men	
Q1	42.39	21.42	20.97
Q2	44.50	22.28	22.22
Change	+2.11	+0.86	+1.25

Table 3: BiH – Chi-square test results for gender differences in unemployment

Statistic	Value
X ²	110.78
Degrees of freedom	1
Critical value ($\alpha=0.05$)	3.841
p-value	< 0.001

To further investigate the sectoral variations in gender-based employment impacts, we conducted a paired t-test analyzing gender disparities across key economic sectors (Table **Error! Reference source not found.**). As illustrated in Figure , these sectoral disparities in relative job losses between men and women were consistent across all examined sectors. The visualization has clearly demonstrated that women experienced higher relative job losses compared to their male counterparts in each sector.

The analysis revealed that women have consistently experienced more severe job losses

compared to men across all examined sectors during Q2. The human health and social work sector exhibited one of the most striking gender disparities, where women experienced the substantial 6.82% decline in employment while male employment remained remarkably stable with only a 0.62% decrease. This pattern is particularly noteworthy given healthcare sector's critical role during the pandemic and its traditionally female-oriented workforce composition. While the accommodation and food services sector showed the highest overall job losses for both genders, reflecting the sector's particular vulnerability to COVID-19 containment measures. Women in this sector experienced an 18% reduction in employment compared to 14.5% for men, indicating that while gender disparities persisted, the sector's challenges affected workers of both genders substantially.

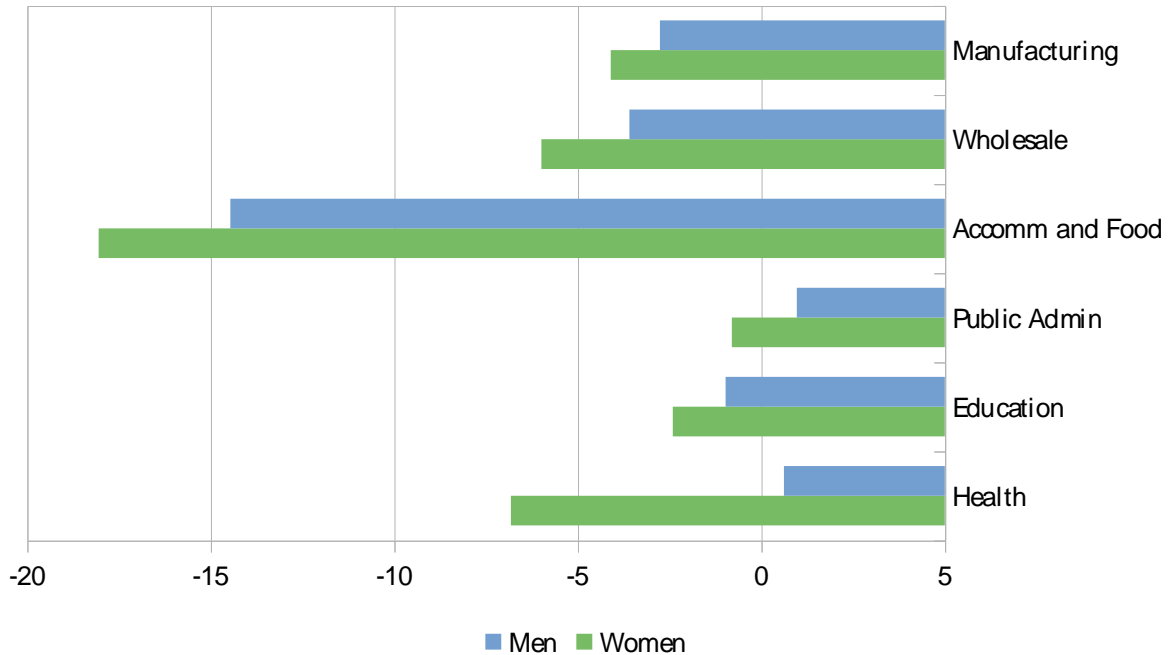


Figure 3. Relative Job Loss Comparison by Sector in BiH (Q2 vs. Q1)

A manufacturing sector exhibited a similar pattern of gender disparity, with women facing a 4.10% decline in employment compared to 2.8% for men. A wholesale sector demonstrated another significant gap, with women experiencing the 6% reduction in employment versus 3.6% for men. Even in the traditionally stable sector such as the public administration and education, women faced disproportionate job losses, with the education sector seeing the 2.42% reduction in female employment compared to less than 1% for men.

Table 4: BiH – paired t-test on women and men job losses (January – June 2020)

Sector	Job Loss (%) (Q1 – Q2)		Difference (Women – Men)	Relative Loss	
	Women	Men		Women	Men
Manufacturing	-0.4802	-0.3439	-0.1363	-4.1005	-2.7679
Wholesale	-0.8736	-0.3286	-0.5449	-5.9958	-3.5967
Accommodation and Food Services	-0.7406	-0.3731	-0.3674	-18.0547	-14.4619
Public Administration and Defense	-0.0452	0.0527	-0.0979	-0.8089	-0.97036
Education	-0.2152	-0.0246	-0.1905	-2.4176	-0.9733
Human Health and Social Work	-0.5359	0.0116	-0.5475	-6.8202	-0.6188
				t-statistic	-3.15
				p-value	0.0253

The paired t-test results provide a strong statistical evidence for the systematic nature of these gender disparities across sectors, suggesting that the pandemic’s economic impact in BiH manifested through distinctly gendered patterns of the job losses, consistently disadvantaging women across the economic spectrum. The particularly stark contrast in the health sector, where female job losses were more than 11 times higher than male job losses, warrants further investigation into the structural and organizational factors that may have contributed to this disparity.

32.

33. Serbia

The analysis of Serbian employment data reveals distinct gender-based patterns in job losses during the initial phase of the COVID-19 pandemic (Table 5). Using the one-tailed proportion test, we examined four strategic sectors that: (i) traditionally have high female employment rates, and (ii) were significantly impacted by COVID-19 restrictions. These sectors include health (health,

pharmacy and social protection), education (education and upbringing), textile (and leather processing), and trade (craft and related trades).

Table 5: Serbia – one-tailed proportion test (April 2020)

Sector	Number of employed		Newly registered unemployed		% of lost jobs		Z value	p-value
	Women (N ₁)	Men (N ₂)	Women	Men	Women (P ₁)	Men (P ₂)		
Health	94388	30502	447	127	0.47	0.41	1.3531	0.08851
Education	115993	41941	291	52	0.25	0.12	4.9205	0.000
Trade	168520	124168	859	432	0.51	0.35	6.1609	0.000
Textile	27753	6540	354	43	1.27	0.68	4.013	0.000

We can conclude that women have lost much more jobs than men for all the investigated sectors in April 2020. Considering the Health sector, there exists a slight difference, or more precisely, it is statistically significant at the sign. level of 10%; while for the other sectors, the difference is statistically significant for all significance levels (10%, 5% and 1%).

The findings from the proportion test was confirmed by F-test (Table 6).

When we check the tables for both tests, we can see that we obtained the same result for the Health sector: we showed the difference at the significance level 10%. For the Education and Textile sector, the results of F-testing showed the difference at the levels 10% and 5%, while the proportion test showed the difference at all levels. The result of F-testing for the Trade sector is showing the difference only at level of 10%.

A general conclusion is that a proportion test is more precise and more appropriate for our data set.

Table 6: Serbia – F-test (April 2020)

Sector	F value	p-value
Health	12.39	0.0747
Education	31.31	0.0310
Textile	67.77	0.0145
Trade	14.26	0.0655

These findings are noteworthy as they demonstrate that even in the sectors traditionally dominated by female workers, women faced disproportionately higher job losses during the pandemic. Our analysis indicated that pre-existing gender inequalities in the Serbian labor market may have been exacerbated by the pandemic, even in sectors where women traditionally held stronger positions.

Note that a big part of the labor force in Serbia belongs to the informal sector and we were able to finish our research based on the available data. The situation is the same in Bosnia and Herzegovina. The Croatia belongs to European Union so their official data showed that there was no difference in job losses between men and women during investigated period of COVID-19 pandemic.

34. Cross-Country Comparisons

To have an idea of what the big picture looks like in the comparison between countries, we first run two-tailed proportion test and later ANOVA test. Both tests are done on percentage of a total lost job in the country, not separating by gender. So, we decided to investigate the most affected sectors in all three countries.

The two-tailed proportion test comparing the total job losses between BiH and Serbia reveals huge differences at all significance levels for all the investigated sectors (Table 7).

Table 7: BiH and Serbia – two-tailed proportion test (April 2020)

Sector	Number of employed		% of lost jobs		Z value	p-value
	BiH (N ₁)	Serbia (N ₂)	BiH (P ₁)	Serbia (P ₂)		
Trade	149519	292688	11.3	3.16	109.718	0.000
Transport	37558	95752	12.9	0.27	108.111	0.000
Personal services	17138	27116	14.8	0.67	60.307	0.000

The Personal service sector in BiH experienced significantly higher job losses (14.8%) compared to Serbia (0.67%). Similarly the Trade sector in BiH showed the higher job losses (11.3%) versus Serbia (3.16%), yielding a significant difference. Also, The transport sector followed the same pattern, where BiH experiencing almost 13% job losses compared to Serbia’s 0.27%. These results

consistently demonstrate that BiH faced significantly more severe employment disruptions across all the three sectors compared to Serbia, suggesting that BiH's labor market was more vulnerable to a pandemic's economic shock.

The comparison between BiH and Croatia reveals the significant differences in sectoral job losses, which was presented in the following table (Table 8).

Table 8: BiH and Croatia – two-tailed proportion test (April 2020)

Sector	Number of employed		% of lost jobs		Z value	p-value
	BiH (N ₁)	Croatia (N ₂)	BiH (P ₁)	Croatia (P ₂)		
Trade	149519	205168	11.3	3.02	99.0218	0.000
Transport	37558	73133	12.9	1.77	76.6002	0.000
Personal services	17138	19608	14.8	12.0	7.8838	0.000

In the personal services sector, BiH experienced close to 15% job losses compared to Croatia's 12%. The trade sector demonstrated an even more notable disparity, with BiH recording 11.3% job losses versus Croatia's 3%. Similarly, a transport sector in BiH suffered the employment losses at almost 13% compared to Croatia's 1.77%. So, these findings suggested that while both countries experienced substantial employment disruptions, BiH consistently faced more severe job losses across all examined sectors.

In order to compare the percentages in all three countries, we used one-way ANOVA test comparing overall job loss percentages in these three sectors as well (Table 9). The analysis showed significant differences in the overall magnitude of job losses between countries (Figure).

Table 9: Cross-country comparison of job losses: One-way ANOVA (April 2020)

Panel A: Mean job Losses by Country (%)				
Country	Mean	Personal Services	Trade	Transport
BiH	13.00	14.80	11.30	12.90
Croatia	5.62	12.07	3.02	1.77
Serbia	1.37	0.67	3.16	0.27

Panel B: ANOVA Statistics					
Source of Variation	SS	df	MS	F	p-value
Between Groups	207.89	2	103.94	8.402	0.018
Within Groups	74.23	6	12.37		
Total	282.12	8			

Note: SS = sum of squares; df = degrees of freedom; MS = mean square; F = F-statistic. Job losses are expressed as percentages. Statistical significance at $p < 0.05$

According to the results BiH experienced the highest mean job loss rate (13%), followed by Croatia (5.62%), while Serbia showed the lowest mean job loss rate (1.37%). The p-value of 0.018 indicated that differences in job losses between countries are statistically significant at the conventional 5% level. Pairwise comparisons through two-tailed proportion tests further substantiate these findings.

A between-group sums of squares compared to the within-groups sum of squares indicated that the variation between countries accounts for a larger portion of the total variance than the variation within the countries. This substantial cross-country heterogeneity in the job losses, consistently demonstrated through both ANOVA and proportion tests, supports the conclusion that country-specific factors played a significant role in determining the severity of pandemic-related job losses. A systematic pattern of higher job losses in BiH, particularly pronounced when compared to Serbia, might be attributed to the differences in economic structure policy responses, or relative robustness of labor market protections between the three countries.

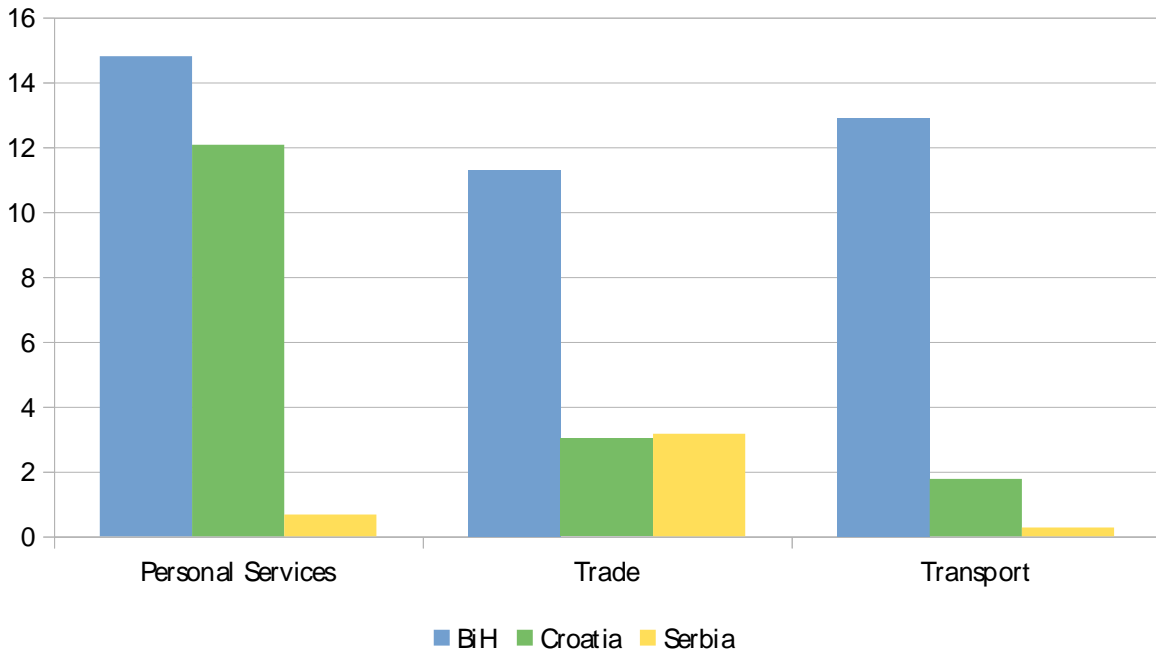


Figure 4. Cross-Country Comparison of Job Losses by Sector (April 2020)

35.

36. Conclusion

A focus of our research was to investigate the unemployment rate in BiH and our region during the COVID-19 pandemic. Specially, we investigated the differences by gender. By the documents of UNDP and UNICEF, it was revealed that the affected categories in BiH were single parents, children, women and persons with disabilities. Also, the reducing working hours in a large number of firms represented additional crucial problem in BiH, since the official data showed the highest total number of the reduced working hours in the whole Balkan region. To be more precise, if we would consider both numbers: number of newly registered unemployed persons and a number of reduced working hours during the third quartal of 2020, we would be able to give the same conclusion as that the total number of the unemployed persons in BiH increased by 170000. So, we only can hope that this paper will help to improve a situation during the crises in future.

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Application of QE in Constrained Optimization Problems

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Abstract. A main aim of this paper is to investigate the equality constrained optimization problems and to apply QE in solving them. So, we applied the Lagrange multiplier method first. Later, we used quantifier elimination method in solving the obtained system of differential equations. We solved the original problems of maximization of the Cobb-Douglas utility function that appear in economy.

1 Introduction

The optimization problem consists of maximizing or minimizing a real function by choosing the input values systematically from an allowed set and computing a value of a function. The generalization of optimization theory and techniques to other formulations constitutes a large area of its applications in physics, engineering, economy and other areas.

Generally, there exists two different optimization problems: unconstrained and constrained optimization problems. The unconstrained problems do not appear very often in the practical applications. The author K. Sundaram investigated such problems in [3].

The constrained optimization differs from the unconstrained optimization because the aim of the first one is not to find a global maximum or minimum. However, constrained optimization methods use the unconstrained optimization methods as a sub-step.

The aim of this paper is to investigate the equality constrained optimization problems. We used the Lagrange multiplier method in order to solve them. Also, we use quantifier elimination method in solving a system of differential equations. The QE method was not applied in the constrained optimization problems in the existing literature.

The author Huijuan Li presented a rule for Lagrangean multipliers in [1]. He also introduced its application to the field of power systems economic operation. The theorem of Lagrange provides a powerful characterization of optima of equality constrained optimization problems.

The first real quantifier elimination procedure was published by the author A. Tarski in [16]. During the 1970s G.E. Collins developed the first elementary recursive real quantifier elimination procedure [6,7] based on cylindrical algebraic decomposition (CAD). Its implementation was presented by D.S. Arnon [4]. After that period, CAD has undergone many improvements.

In this paper, we illustrated the application of QE method through the example of solving a radical equation. This method was presented in [17]. We also used a method in the originally presented examples of maximizing a Cobb-Douglas utility function. Specially, the mentioned problems of maximization of the Cobb-Douglas utility function appear in economy.

2 Lagrange Problem

Suppose we are given an open set $U \subset \mathbf{R}^n$. Suppose we are given continuous functions,

$$f: U \rightarrow \mathbf{R}, \quad g: U \rightarrow \mathbf{R}^m, \text{ where it holds } m \leq n.$$

Lagrange Problem: Maximize the objective function $f(x)$ subject to $g(x) = 0$:

$$\text{Max } f(x), \text{ where } x \in U \text{ and } g(x) = 0.$$

The components of $g = (g_1, g_2, \dots, g_m)$ are called constraint functions, while

$$D = \{x \in U | g(x) = 0\} \text{ is called the constraint set.}$$

The method is named after the Italian/French mathematician J.L. Lagrange.

Our aim is to evaluate the points $x^* \in D$ which represent (local) maximum of a function f .

Now let us introduce a definition of a local and global maximum (resp. minimum) for the Lagrange problem.

A point $x^* \in D$ is called a local max (resp. min) for the LP problem if there exists $\varepsilon > 0$ such that for all $x \in B_\varepsilon(x^*) \cap D$ it holds:

$$f(x^*) \geq f(x) \quad (\text{resp. } f(x^*) \leq f(x)).$$

Moreover, this point is a global max (resp. min) if it holds: $f(x^*) \geq f(x)$ (resp. $f(x^*) \leq f(x)$), for all $x \in D$.

Let us introduce the Lagrange method in the simplest case, where $n = 2$ and $m = 1$, that is equivalent that we have two variables and one equality constraint. Note that the theorem of Lagrange will be precisely formulated later in this paper.

Suppose we are given an open set $U \subset \mathbf{R}^2$. Suppose we are given continuously differentiable functions,

$$f: U \rightarrow \mathbf{R}, \quad g: U \rightarrow \mathbf{R}.$$

$$\text{Max}\{f(x_1, x_2) | (x_1, x_2) \in U, g(x_1, x_2) = 0\}.$$

Based on the Lagrange theorem, we will proceed as follows to evaluate all possible candidates for the points (x_1^*, x_2^*) .

Let us write the Lagrangean function first.

$$L(x_1, x_2) = f(x_1, x_2) - \lambda g(x_1, x_2),$$

where a constant $\lambda \in \mathbf{R}$ is called a Lagrangean multiplier.

Now let us evaluate the partial derivatives of $L(x_1, x_2)$ by the variables x_1 and x_2 .

$$\frac{d}{dx_1} L(x_1, x_2) = \frac{d}{dx_1} f(x_1, x_2) - \lambda \frac{d}{dx_1} g(x_1, x_2)$$

$$\frac{d}{dx_2} L(x_1, x_2) = \frac{d}{dx_2} f(x_1, x_2) - \lambda \frac{d}{dx_2} g(x_1, x_2)$$

The solution (x_1^*, x_2^*) of the Lagrange problem can only be a point for which it holds:

$$\frac{d}{dx_1} L(x_1, x_2) = \frac{d}{dx_2} L(x_1, x_2) = 0,$$

for a suitable $\lambda = \lambda(x_1^*, x_2^*)$.

The next step follows.

Solve the system of three equations and evaluate all possible solutions $(x_1^*, x_2^*, \lambda^*) \in U \times \mathbf{R}$

$$\frac{d}{dx_1} L(x_1, x_2) = \frac{d}{dx_1} f(x_1, x_2) - \lambda \frac{d}{dx_1} g(x_1, x_2) = 0$$

$$\frac{d}{dx_2} L(x_1, x_2) = \frac{d}{dx_2} f(x_1, x_2) - \lambda \frac{d}{dx_2} g(x_1, x_2) = 0$$

$$\frac{d}{d\lambda} L(x_1, x_2) = -g(x_1, x_2) = 0$$

The previously described three conditions together represent the **first order** conditions for LP

Note that both partial derivatives $\frac{dg}{dx_1}$ and $\frac{dg}{dx_2}$ must be different from zero at the point (x_1^*, x_2^*) .

The restriction that U does not contain the critical points of a function g is called a **constraint qualification** in a domain U . This restriction implies the constraint qualification in some neighbourhood of a point (x_1^*, x_2^*) .

Now we will describe a general Lagrange problem when a function $f(x_1, x_2, \dots, x_n)$ is a function of n variables, where n can be any natural number.

Evaluate Max (Min) $f(x_1, x_2, \dots, x_n)$ subject to $g(x_1, x_2, \dots, x_n) = 0$.

Define the Lagrangean with the multiplier $\lambda \in \mathbf{R}$,

$$L(x_1, x_2, \dots, x_n) = f(x_1, x_2, \dots, x_n) - \lambda g(x_1, x_2, \dots, x_n) \quad (1)$$

The Lagrange theorem is presented below.

Theorem 2.1: Suppose we are given an open set $U \subset \mathbf{R}^n$ and functions $f: U \rightarrow \mathbf{R}$, $g: U \rightarrow \mathbf{R}$ that are continuously differentiable. Let $x^* = (x_1^*, x_2^*, \dots, x_n^*) \in U$ be a local extremum for a function $f(x_1, x_2, \dots, x_n)$ under the equality constraint $g(x_1, x_2, \dots, x_n) = 0$. Suppose that it holds that at least one of the partial derivatives $\frac{dg}{dx_i}(x^*)$ is different from zero, where $1 \leq i \leq n$. Then there exists a unique number $\lambda^* \in \mathbf{R}$ such that the following holds:

$$\frac{df}{dx_i}(x^*) = \lambda^* \frac{dg}{dx_i}(x^*), \text{ for all } 1 \leq i \leq n.$$

Constraint qualification: We assume that at least one of the partial derivatives $\frac{dg}{dx_i}(x^*)$ is different from zero, where $1 \leq i \leq n$.

Note that the theorem of Lagrange only provides necessary conditions for the local extreme values and these conditions are not sufficient.

Now we will present the sufficient conditions for the global extremes. Suppose we have the following preliminary conditions as in *Theorem 2.1*.

Suppose that we are given the open set $U \subset \mathbf{R}^n$ and functions $f: U \rightarrow \mathbf{R}$, $g: U \rightarrow \mathbf{R}$ that are continuously differentiable. We define the Lagrangean $L(x; \lambda)$ (1); let $(x^*, \lambda^*) \in U \times \mathbf{R}$ be a critical point of $L(x; \lambda)$ or equivalently it satisfies the first order conditions.

Theorem 2.2: 1) If $(x; \lambda^*)$ is a concave function of $x \in U$, then x^* is the global maximum.
2) If $(x; \lambda^*)$ is a convex function of $x \in U$, then x^* is the global minimum.

We can see the sufficient conditions for the local minimum and maximum presented in [2].

3 Quantifier Elimination

Let us show the example of a formula with quantifiers which is equivalent to a formula without quantifiers.

Suppose we are given a formula $\varphi(a, b, c)$ in a set of real numbers \mathbf{R} ,

$$\exists x(ax^2+bx+c=0).$$

By the quadratic formula, we have the following equivalence:

$$\varphi(a,b,c) \leftrightarrow [(a \neq 0 \wedge b^2 - 4ac \geq 0) \vee (a = 0 \wedge (b \neq 0 \vee c = 0))],$$

so φ is equivalent to a quantifier free formula.

Now let us introduce some basic definitions which are of importance for quantifier elimination.

The language L is recursive if the set of codes for symbols from L is recursive. The first order theory T is recursive if the set of codes for axioms for T is recursive. An L-theory T is complete if for every sentence φ in a language L the following holds:

$$T \vdash \varphi \text{ or } T \vdash \neg \varphi.$$

For each theory T arises question of its decidability, i.e. the existence of algorithm which for given $\varphi \in \text{Sent}_L$ gives an answer whether $T \vdash \varphi$ or $T \not\vdash \varphi$. In the case of recursive complete theory in a recursive language, the answer is affirmative.

A theory T of a language L admits quantifier elimination if for every formula $\varphi(\bar{v}) \in \text{For}_L$ there exist a quantifier free formula $\psi(\bar{v}) \in \text{For}_L$ such that:

$$T \vdash \forall \bar{v} (\varphi(\bar{v}) \leftrightarrow \psi(\bar{v}))$$

Every logic formula is equivalent to its following prenex normal form:

$$Q_1 x_1 \dots Q_n x_n \varphi(x_1, \dots, x_n, y_1, \dots, y_m),$$

where $Q_i \in \{\forall, \exists\}$ and φ is a formula without quantifiers in DNF; formula of the form $\forall x \varphi$ is equivalent to $\neg \exists x \neg \varphi$; $\exists x (\varphi \vee \psi) \leftrightarrow \exists x \varphi \vee \exists x \psi$ is a valid formula. Using the previous we see that an L-theory T admits quantifier elimination if and only if for every L-formula of the form $\exists x \varphi(\bar{y}, x)$, where φ is a conjunction of atomic formulas and negations of atomic formulas, exists equivalent quantifier free formula $\psi(\bar{y})$.

The examples of theories which admit QE are the theory of dense linear order (DLO), theory of algebraically closed fields (ACF) and theory of real closed fields (RCF).

3.1 Theories of ACF and RCF

The language of fields is $L = \{+, -, \times, 0, 1, =\}$, where + and \times are binary function symbols, - is unary function symbol, 0 and 1 are constant symbols and = is relational symbol.

We could axiomatize the class of algebraically closed fields by adding, to the axioms of fields (1), the axiom (2):

1. Axioms of field
2. for each $n > 1$,

$$\forall x_0 \forall x_1 \cdots \forall x_{n-1} \exists x (x_0 + x_1 x + \cdots + x_{n-1} x^{n-1} + x^n = 0)$$

A set $A = (1, 2)$ is a set of axioms of algebraically closed fields; for any term t of a language L there exist a polynomial $p(x_1, \dots, x_n)$ with coefficients in \mathbf{Z} such that $t = p(x_1, \dots, x_n)$ is a consequence of a set A . The set of axioms of algebraically closed fields allows quantifier elimination.

As example of ACF, we can take the field of complex numbers, which is the algebraic closure of the field of real numbers.

In order to know how to eliminate quantifiers in a theory of algebraically closed fields, it is sufficient to know how to eliminate the existential quantifier in the formula of the form:

$$\exists x (t_1 = 0 \wedge \cdots \wedge t_k = 0 \wedge t \neq 0),$$

where t_i represent an atomic formula of a language L . So, every t_i is polynomial by x whose coefficients are polynomials by the other variables with coefficients in \mathbf{Z} .

The language of ordered fields is $L = \{+, -, \times, 0, 1, =, >\}$, where $+$ and \times are binary function symbols, $-$ is unary function symbol, 0 and 1 are constant symbols and $=$ and $>$ are relational symbols.

We could axiomatize the class of real closed fields by adding, to the axioms of ordered fields (1), the axioms (2), (3):

1. Axioms of ordered field
2. $\forall x \exists y (x = y^2 \vee -x = y^2)$
3. $\forall x_0 \forall x_1 \cdots \forall x_{2n} \exists x (x_0 + x_1 x + \cdots + x_{2n} x^{2n} + x^{2n+1} = 0)$, for any $n \geq 1$

Models of a set of axioms $A = (1, 2, 3)$ are real closed fields. The set A allows quantifier elimination; for any term t of a language L there exist a polynomial $p(x_1, \dots, x_n)$ with coefficients in \mathbf{Z} such that $t = p(x_1, \dots, x_n)$ is a consequence of a set A .

The basic examples of a model of real closed fields are set of real numbers \mathbf{R} and real closure of a set \mathbf{Q} . The set A allows quantifier elimination.

In order to know how to eliminate quantifiers in a theory of real closed fields, it is sufficient to know how to eliminate the existential quantifier in the formula of the form:

$$\exists x (p_1 = 0 \wedge \cdots \wedge p_k = 0 \wedge q_1 > 0 \wedge \cdots \wedge q_m > 0),$$

where p_i, q_j are polynomials by x whose coefficients are polynomials by the other variables with coefficients in \mathbf{Z} .

4 Application of QE in constrained optimization problems

While there are applications of QE in the existing literature in many other areas, that is not a case in solving of radical equations or constrained optimization problems. This fact is giving a strength to our work, as we introduce a new approach in solving of the systems of differential equations that represent one part of solving of constrained optimization problems. Specially, the problems of maximization of the Cobb-Douglas utility function appear in economy.

Example 4.1 Solve the following radical equation:

$$\sqrt{x-16} + \frac{1}{2}\sqrt{x+16} = \frac{10}{\sqrt{x-16}}.$$

Proof: Let us introduce the following notation:

$$y = \sqrt{x-16}, z = \sqrt{x+16}$$

Now, the equation is equivalent to:

$$(\exists y)(\exists z) \left(y + \frac{1}{2}z = \frac{10}{y} \wedge y^2 = x - 16 \wedge z^2 = x + 16 \wedge y > 0 \wedge z \geq 0 \right),$$

where it holds $x - 16 > 0 \wedge x + 16 \geq 0$. Let us evaluate z as a function of y from the equality $y + \frac{1}{2}z = \frac{10}{y}$. It follows:

$$z = \frac{20 - 2y^2}{y}$$

Now we substitute the previous value of z into the equality $z^2 = x + 16$. We have:

$$\frac{(20 - 2y^2)^2}{y^2} = x + 16$$

After some basic calculation, the previous equality is equivalent to:

$$4y^4 - 96y^2 - xy^2 + 400 = 0$$

Let us introduce the following notation:

$$t_1 \equiv 4y^4 - 96y^2 - xy^2 + 400, t_2 \equiv y^2 - x + 16$$

We will apply the algorithm of QE to the following formula:

$$(\exists y)(t_1 = 0 \wedge t_2 = 0 \wedge y \neq 0)$$

Using the method for QE we have

$$T_1 = A_2 t_1 - A_1 y^2 t_2,$$

where coefficients are equal $A_1 = 4$, $A_2 = 1$. Our formula is equivalent to:

$$A_2 \neq 0 \wedge (\exists y)(T_1 = 0 \wedge t_2 = 0 \wedge y \neq 0), \text{ or equivalently}$$

$$1 \neq 0 \wedge (\exists y)(3xy^2 - 160y^2 + 400 = 0 \wedge y^2 - x + 16 = 0 \wedge y \neq 0)$$

When we combine the two equalities from the previous formula we get a quadratic equation by a variable x . A resulting value of a variable x follows easily:

$$x = 20 \text{ or } x = 49\frac{1}{3}$$

Since we have a condition $x \leq 26$, the only solution is $x = 20$.

The following problem is originally formulated.

Example 4.2 Maximize the Cobb-Douglas utility function:

$$u(x_1, x_2, x_3) = x_1^2 x_2^3 x_3^2, \text{ where } x_1, x_2, x_3 \geq 0,$$

under the budget constraint: $x_1 + x_2 + x_3 = 12$.

Proof: Since $u(x_1, x_2, x_3)$ is a continuous function defined on a compact domain:

$$D = \{(x_1, x_2, x_3) \mid x_1 + x_2 + x_3 = 12, x_1, x_2, x_3 \geq 0\},$$

by the Weierstrass theorem it follows that the global maximum exists.

Note that if any of the variables x_1, x_2, x_3 is equal zero, then a value of a function u is equal zero, which does not represent a maximum.

Let us form the Lagrangean:

$$L(x_1, x_2, x_3) = x_1^2 x_2^3 x_3^2 - \lambda(x_1 + x_2 + x_3 - 12)$$

Now we evaluate the partial derivatives and set up the following equalities:

$$\frac{dL}{dx_1} = 2x_1x_2^3x_3^2 - \lambda = 0$$

$$\frac{dL}{dx_2} = 3x_1^2x_2^2x_3^2 - \lambda = 0$$

$$\frac{dL}{dx_3} = 2x_1^2x_2^3x_3 - \lambda = 0$$

We can express a variable x_3 from a condition of a constraint in the following way:

$$x_3 = 12 - x_1 - x_2,$$

and reduce a number of variables. When we substitute this value into our system, we get the following equivalent system:

$$4x_1^2x_2^4 - 3\lambda = 0$$

$$2x_1^3x_2^3 - \lambda = 0$$

We will solve the previous system by a quantifier elimination method. So, we have a formula:

$$(\exists x_1)(\exists x_2)(4x_1^2x_2^4 - 3\lambda = 0 \wedge 2x_1^3x_2^3 - \lambda = 0 \wedge x_1 > 0 \wedge x_2 > 0)$$

Let us introduce the following notation:

$$t_1 \equiv 4x_1^2x_2^4 - 3\lambda, \quad t_2 \equiv 2x_1^3x_2^3 - \lambda$$

We will apply the algorithm of QE to the following formula:

$$(\exists x_2)(t_1 = 0 \wedge t_2 = 0 \wedge x_1 > 0 \wedge x_2 > 0)$$

Using the method for QE we have

$$T_1 = A_2t_1 - A_1x_2t_2,$$

where coefficients are equal $A_1 = 4x_1^2$, $A_2 = 2x_1^3$. Our formula is equivalent to:

$$A_2 \neq 0 \wedge (\exists x_2)(T_1 = 0 \wedge t_2 = 0 \wedge x_1 > 0 \wedge x_2 > 0), \text{ or equivalently}$$

$$2x_1^3 \neq 0 \wedge (\exists x_2)(2x_1^3(4x_1^2x_2^4 - 3\lambda) - 4x_1^2x_2(2x_1^3x_2^3 - \lambda) \wedge x_1 > 0 \wedge x_2 > 0)$$

Since a condition $2x_1^3 \neq 0$ is always satisfied, after some basic calculation we have:

$$x_2 = \frac{3x_1}{2}, \text{ where } x_1 > 0, x_2 > 0$$

When we combine the obtained equality with a condition of a constraint $x_1 + x_2 + x_3 = 12$, the result easily follows:

$$(x_1^*, x_2^*, x_3^*) = \left(\frac{2}{3}, 1, \frac{31}{3}\right)$$

Now we need to check a condition for constraint qualification. We have:

$$\frac{dg}{dx_1} = \frac{dg}{dx_2} = \frac{dg}{dx_3} = 1 \text{ at any point } (x_1^*, x_2^*, x_3^*),$$

so the constraint qualification holds. Since we obtained only one solution, we can conclude that $(x_1^*, x_2^*, x_3^*) = \left(\frac{2}{3}, 1, \frac{31}{3}\right)$ represents a maximum.

Example 4.3 Maximize the Cobb-Douglas utility function:

$$u(x_1, x_2, x_3) = x_1^{1/2} x_2^2 x_3^2, \text{ where } x_1, x_2, x_3 \geq 0,$$

under the budget constraint: $x_1 + x_2 + x_3 = 6$.

Proof: Since $u(x_1, x_2, x_3)$ is a continuous function defined on a compact domain:

$$D = \{(x_1, x_2, x_3) \mid x_1 + x_2 + x_3 = 6, x_1, x_2, x_3 \geq 0\},$$

by the Weierstrass theorem it follows that the global maximum exists.

Note that if any of the variables x_1, x_2, x_3 is equal zero, then a value of a function u is equal zero, which does not represent a maximum.

Let us form the Lagrangean:

$$L(x_1, x_2, x_3) = x_1^{1/2} x_2^2 x_3^2 - \lambda(x_1 + x_2 + x_3 - 6)$$

Now we evaluate the partial derivatives and set up the following equalities:

$$\frac{dL}{dx_1} = \frac{1}{2} x_1^{-1/2} x_2^2 x_3^2 - \lambda = 0$$

$$\frac{dL}{dx_2} = 2x_1^{\frac{1}{2}}x_2x_3^2 - \lambda = 0$$

$$\frac{dL}{dx_3} = 2x_1^{\frac{1}{2}}x_2^2x_3 - \lambda = 0$$

We can easily obtain the following equality from the system: $x_2 = x_3$ and reduce it. After some basic calculation and the application of QE method as in the previous example, we obtained the solution:

$$(x_1^*, x_2^*, x_3^*) = (4, 1, 1).$$

Now we need to check a condition for constraint qualification. We have:

$$\frac{dg}{dx_1} = \frac{dg}{dx_2} = \frac{dg}{dx_3} = 1 \text{ at any point } (x_1^*, x_2^*, x_3^*),$$

so the constraint qualification holds. Since we obtained only one solution, we can conclude that $(x_1^*, x_2^*, x_3^*) = (4, 1, 1)$ represents a maximum.

5 Conclusion

Considering application of a quantifier elimination, an interesting example of solving the radical equation was presented in this paper. A main aim of this paper is to investigate the equality constrained optimization problems and to apply QE in solving them. So, we applied the Lagrange multiplier method first. Later, we used quantifier elimination method in solving the obtained system of differential equations. Note that the QE methods were not applied in the constrained optimization problems in the existing literature.

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BOOKS AND ARTICLES REVIEWS

Tahir Mahmutefendic

Essays in Absurd Economics and Politics

(Eseji iz apsurdne ekonomije i politike)

BOSANSKA RIJEČ TUZLA, BOSNIA AND HERZEGOVINA, pp 216

Reviewed by Dr Enes Osmancevic

Brave, Interesting, and Original Intellectual Polemics

The book “Essays in Absurd Economics and Politics”, by Dr Tahir Mahmutefendic is a brave, interesting, and original intellectual polemics with some conventional economic and political theses. In fact, we are dealing with a collection of ten essays, some of which have been previously published in academic journals as original and scientific works. This time they are presented to a wider, but intellectually demanding audience.

The essays are classified into two groups: The essays in economics, and the essays in politics. They are socioeconomic and politico-economics analysis not only theoretical, but also relevant practical occurrences and social phenomena which are intertwined, so that it is not easy to

determined what belongs to the realm of economics and what to the realm of politics. This is why Dr Mahmutefendic decided to embark on multidisciplinary approach using philosophical, sociological, logical, historical, economic, political, and communicative methods and knowledges. At the core is economic theory and analysis in which Dr Mahmutefendic, the economist by trade, explores causal relations in politics and society i.e. the relations between social institutions- states, financial, educational and communicational systems, lucidly questioning some conventional wisdoms.

In the first five essays Dr Mahmutefendic conducts the polemics with the foundations of the neoclassical economic school and its main tenet according to which the main aim of human existence is a maximization of utility. Linked to this is also the analysis of the relationship between individuals and community, legality and distribution of power and wealth, changes in financial markets and their impact on economic crises, revealing the mechanisms of plunder and manipulation through various economic technics and operations. In the analysis of modern economic and financial movements the emphasis is laid on a discrepancy between economic theory and laws which enables profit to be privatized through stock exchanges and losses to be socialized, i.e. to be distributed across a society. In this brilliant socioeconomic analysis Dr Mahmutefendic introduces ethical aspect of individuals' behavior, stock exchange speculators, managers, politicians and governments, pointing out at the absurdity of the existing models and practices. The analysis of economic growth in Yugoslavia and the successor states is particularly interesting. It points out that Yugoslavia reconstructed its economy two years after WWII, and that the successor states, namely Bosnia and Herzegovina, Montenegro, and Serbia are still below a prewar level of development.

A second part of the book-Essays in Absurd Politics, starts with the analysis of the last wars in Croatia and Bosnia and Herzegovina through conflicting dichotomies-war as a conflict of civilizations and the war as an expression of REAL POLITIK, through a behavior of domestic participants and international factors, but also through theoretical approaches to civilizations and conflicts. The book continues with the analysis of the independence of Kosovo in a wider geopolitical context, understanding the conflict as a clash between a historical right which belongs to the Serbs and ethnic right which belongs to the Albanians.

Dr Mahmutefendic further explores the relationship between European tradition of racial-ethnic tolerance through a historical perspective, linking them up with participants of the political events in Bosnia and Herzegovina and logically questions the relationship between cosmopolitanism and patriotism, tackling the questions of plurality of human identity, complexity and comprehensiveness of communications as bonds between people, and specificity of the languages as determinants of national identity. In these essays the author espouses opinions and judgements with which we do not necessarily need to concur as well as with drawing of historical parallels. This could be the area for polemics after the publication of this manuscript. But, let us not judge quickly.....

In the last essay "The Roots of Fascisation of the School System" the author elaborates his thesis on the fascization of a society which is not confined only on the educational system, corroborating his arguments with examples from the UK, where he works, and from Bosnia and Herzegovina, where he was born. Resolutely arguing with a thesis that people are goods as any other good, and consequently that education is business ruled by the market laws, the author emphasizes the importance of critics of misunderstanding of educational process, the relationship between teachers and pupils, but also the need to reform the educational system.

Although the book scientifically analyzes social phenomena, it is written in a journalist style, with citation of relevant literature, which can contribute better understanding of topics explored, but also initiate discussion about statements and explanations in this book, which I recommend to the reading audience with pleasure.

Vjekoslav Domljan:" Drawing on Vital R(N)ational Interest", (Potezanje vitalnog R(N)acionalnog interesa), Lijepa riječ, Tuzla, Bosnia and Herzegovina, 2018, pp 276

Reviewed by Tahir Mahmutefendic

The book "DRAWING ON VITAL R(N)ATIONAL INTEREST by Professor Vjekoslav Domljan is a collection of essays written as columns at Buka portal in a period between 23 November 2016 and 16 July 2017. A title of the book announces its bipolar structure; rational versus national interest which is elaborated in the introduction: entropolis versus etnopolis, eutopia versus dystopia. To use a philosophical vocabulary, epistemological, what is, is contrasted to ethical cognitive, what needs to be. In other words, being versus becoming.

And being, what it is in Bosnia and Herzegovina, could be succinctly summarized in the following:

1. GDP per capita and the standard of living are among the lowest in Europe;
2. A high rate of unemployment, among the greatest in the world. As a result, there is a strong brain-drain.
3. Suboptimal growth rates which do not guarantee a substantial reduction of unemployment in the future;
4. High macroeconomic instability expressed in huge deficits in a balance of payments, and to a lesser extent, fiscal deficits. Macroeconomic instability is the result of the fact that Bosnia and Herzegovina is one of rare countries in the world with a negative domestic saving. Nacional saving is positive due to remittances from abroad, however insufficient to finance investments;
5. A lowest degree of computerization and digitalization in Europe;
6. Unfavorable economic structure, based mainly on the achievements of the Second Industrial Revolution;

7. Unfavorable production and export structure in which prevail the products of low technological and developmental level, with the exception of antibiotics made in Bosnalijek;
8. A highest production of negative externalities in Europe expressed in an inverse Kuznetz U curve, which is a logical consequence of the previously mentioned production structure;
9. Inflated public sector, which is the largest employer and a pillar of ethno-cartels' power;
10. Huge burden on the private sector, which causes crowding-out and creates a big informal economy that creates 25 per cent of the country's GDP;
11. Bad tax structure with a prevalence of indirect, regressive taxes;
12. Health and tax system burdened with unfavorable ratio between employed and unemployed. This ratio is 1.13:1, compared to 2.8:1 in the communist Bosnia and Herzegovina.

To overcome this situation the following is needed:

1. Create a vision and development strategy;
2. Significantly reduce corruption and strengthen a legal state;
3. Release a creative energy of entrepreneurs by creating market economy from the bottom; In other to achieve this a radical reform of the fiscal policy is needed with an increase in proportion of government revenue collected through direct taxes on income and property;
4. Strengthen competitiveness of the domestic exporting companies and reduce import liberalization;
5. Introduce new financial instruments and regulate financial markets;
6. Significantly increase expenditures for research and development, which are currently around 0.15 per cent of GDP.
7. Modernize educational system by replacing learning by rote with problem-solving learning. Also, educational system should be unified without ethnocentric divisions;
8. Introduce software and robots in production and gradually move from the Second to the Third and Fourth Industrial Revolution;
9. Change the structure of public expenditures by shifting from unproductive to productive investment in infrastructure and R & D;
10. Support the creation of production chains and cluster structures, bonding producers with investors, innovators and exporters;
11. Apply a proper price policy using goods reserves.

Experiences of countries which started at much lower level of development compared to Bosnia and Herzegovina have shown that these policies can produce a modern economy and high level of income.

Ethnocratic structures have neither knowledge nor interest to introduce these changes. Maybe because after the implementation of reforms they would find themselves in prison due to their criminal activities.

Multiethnic political parties are still weak and do not have a coherent strategy as how to overcome the existing state of affairs. Advices expressed in this book are mostly aimed at them.

The book was written in a popular style. Economic concepts are explained in a simple and clear manner with the use of many examples from everyday life, sometimes in anecdotal form. This makes the book accessible to a wider reading audience.

The book could have been of interest for the following groups of readers:

- Professional economists, academics as well as those who work in practice;
- Non-professionals interested in economic topics;
- Ordinary citizens, witnesses and victims of the current occurrences.

We could only express our hope that this extremely successful monography will be made available to citizens of Bosnia and Herzegovina before the general elections scheduled for autumn this year.

Tahir Mahmutefendic: "The Balkans Transition and Globalization Themes", Lijepa riječ Tuzla, Bosnia and Herzegovina, pp 188

Reviewed by Kadrija Hodzic

The book is aimed at scientific and practitioners' audience. Its main goal is to present primary research and original scientific contribution in explaining problems and challenges linked to economic transition in the Balkans.

The book is a collection of the author's already published essays and tracts about transition in the Balkan countries set in a wider context of globalization. The texts in the book are comprised in the narration about inner economic upheaval linked to the transition of the Balkan countries from socialists to market economies with the emphasis on the states which are not yet integrated into the EU and therefore left to hang in the milieu of modern globalism and multilateralism especially against the European integralism.

The book is structured into two blocks. A first block is divided into four parts- A first part starts with difficulties and economic challenges of transition in Kosovo, while a second part evaluates the results of transition in the Yugoslav successor states with the convincing focus on

macroeconomic effects of the break-up of the Yugoslav community. A third part presents the unsuccess of transition in providing welfare and gives an overview of distribution of income and wealth and the state in health and education systems. A last part deals with economic failure of the communist countries. The author contrasts a neo-liberal stance on the evil communist system with comparison of advantages and disadvantages of the capitalist and communist systems.

A second block is dedicated to book reviews which authored published some years ago. Topics of those books written by prominent domestic and foreign authors are in line with the author's negative attitude towards transition. The author emphasizes a lack of democratic tradition, the absence of a legal state and a rule of law, a widespread corruption, a power of ethno-cartel structures and a lack of adequate institutions which would support a free market economy. Mahmutefendic entirely shares ideological values of the writers of the books as regards the attitude towards a neo-liberal approach to a valorization of the effects of the transition.

A manuscript is methodologically well designed. It is an important contribution to a critical approach to the results of the transition in the Balkan countries. The author uses and correctly applies a voluminous literature relevant to the topics.

The manuscript has an original theoretical and analytical character. It has a critical approach and therefore has all the characteristics of an original scientific work, espousing anti-liberal attitude towards a packet of transition measures.

The language of the book is clear and precise. This facilitates its reading and understanding of the complex transition processes such as reshaping of a previously monopolistic model, restructuring of the ownership, introduction of democracy and a new exposure to the world market.

The book represents a valuable contribution to the critics of a neo-liberal concept of a transition in the Yugoslav successor states. It offers a wide range of theoretical concepts about transition and is a useful guide to academic and business community.

**Tahir Mahmutefendić: “The EU Core and the Peripheries-Convergence and Divergence”,
Jahorina Business Forum Proceedings, pp 21 2024**

Reviewed by Amina Kamarić

Tahir Mahmutefendić's article, *The EU Core and the Peripheries-Convergence and Divergence*, examines the economic disparities between the five areas of the European Union- EU core and peripheral regions, as the title of the essay announces. By exploring historical, institutional, and economic factors, the paper questions the convergence and divergence of peripheral countries with the EU core. Utilizing both quantitative and qualitative methods of data analysis, the article provides a detailed insight into the development patterns across the EU.

Apart from the abstract, introduction and conclusion, the body part of the article is organized into six segments, namely the parts about the EU Core and four peripheral EU regions: the Southern Periphery of the EU, the Eastern Periphery of the EU, EU Northern Periphery, EU Western Periphery, with the additional section about Convergence and Divergence within the EU. The EU core countries' ability to outperform the economic growth of the EU average is shown to be due to the theoretical explanation of the gravity model, long independence period, access to the sea, the early industrialization, long democratic tradition and the legacy of colonialism, which many of these six countries share. However, the EU Southern and the Eastern peripheries are identified as less developed than the EU core region. Reasonably, the late industrialization, political instability, the feudal structure, extractive economic institutions and also the early loss of the independence, lengthy periods of dictatorship, and communist past are among the most prominent reasons, respectively. In contrast, the author shows that the Northern periphery is more developed compared to the EU core opposing the gravity model but primarily thanks to the long period of independence, access to the sea, rich natural resources, early industrialization, a long democratic tradition and the Weberian thesis which emphasizes the dominance of Protestant countries in regard to "hard work, parsimony and devotion to a chosen job". Additionally, Ireland as the only country of the Western EU periphery has experienced the strongest convergence with the EU and is also economically more developed than the EU core.

The author has pointed out the two extremely opposing examples of countries related to the progress in the membership of the EU. On the one side, the earlier mentioned Ireland which experienced vigorous growth by focusing on high-tech services, life sciences, knowledge economy, FDI, and agrobusiness, and on the other side, Greece, of which the economy diverged with the rest of the EU after 1981, mainly because of policy mismanagement and weak governance. These cases highlight the critical role of the economic institutions in shaping the economic outcomes.

While developing the comparisons of GDP p.c. in PPP of the core and peripheral countries, Mahmutefendić combines both the secondary sources and his own calculations in quantitative analysis and that way supplements the detailed qualitative analysis of the researched topic. Furthermore, his description of the issues is deep and thorough, leading logically to clear

conclusions. In addition, the article is well-researched and intensively supported by data, without the need for additional explanations.

Referring to the article's structure, it follows a coherent and logical flow of ideas being easily accessible to the reader. The author clearly describes the reasons of (under)development for each of the EU regions, one by one, as the answer to the article's title. Moreover, each argument is supported by well-structured reasons, making the explanations both lucid and persuasive. Not only can economically literate individuals understand and easily follow this essay, but also anyone who is inspired by the topic itself, because the majority of the economic terms mentioned are additionally followed by the supporting explanation. The polished language of the author, with no grammar mistakes, makes even those at first sight less understandable phrases easy to grasp. The author's skill in drafting academic papers is also evident in the selection of relevant sources, correctly cited and alphabetically arranged, most of which are written in English, with a few in South Slavic languages.

In conclusion, *The EU Core and the Peripheries-Convergence and Divergence* represents a significant contribution to the informative analysis of regional differences in the EU. This comprehensive article leveraged by the author's combination of historical context, theoretical support, and empirical data provides the sturdy foundation for both academic inquiry and practical discussions about the development of the observed EU regions.

Tahir Mahmutefendić: "Are Inequality and Democracy Inversely Correlated?", *International Journal for Business and Management Studies*, Volume 2, Issue 09, 2021, pp 23

Reviewed by Zerina Zeković

In the essay *Are Inequality and Democracy Inversely Correlated?* Professor Tahir Mahmutefendić puts the following hypothesis to the test: a higher level of inequality is inversely correlated with a higher level of democracy and *vice versa* (as is evident from the title of the essay). What is not noticeable from the title but is emphasized by the author in the introduction is that the hypothesis must be modified for countries that have retained a parliamentary

democracy. The reason behind this is to avoid further difficulties that might arise when comparing countries that are parliamentary democracies with socialist countries.

The first part of the paper deals with a careful analysis of political and economic changes during the Age of Keynesianism, characterized by a resurgence of democracy and a revitalization of European economies. Several factors contributed to a rise in levels of democracy in this period: 1) unprecedented economic prosperity, 2) the welfare state, 3) progressive taxation, 4) nationalization of private companies, 5) the strength of trade unions, and 6) the existence of socialist/communist countries.

This period was followed by an era of great policy changes — the age of neoliberalism — which is extensively researched in the essay's second part. In comparison to the era before it, this one was marked by a great surge of inequality, and the following factors all played a major role in that spike: 1) globalization, 2) technological revolution, 3) liberalization, deregulation, privatization, 4) weakening of trade unions, 5) tax reforms, 6) monopolies, monopsonies, rent, 7) weakening of the welfare state, and 8) the collapse of communism.

The last part of the essay states that the age of neoliberalism suffers a problem, a political trilemma. What this means is that countries desire three goals: national sovereignty, democracy, and globalization, however, they can only achieve two. The author claims that a solution to this trilemma lies in the fact that globalization needs restructuring. More specifically, globalized labor has to increase, whereas financial globalization and trade have to decrease.

As concise as it might look *prima facie*, the essay is quite dense and comprehensive. Additionally, a person unfamiliar with economic (as well as political) terminology and theory might not easily grasp everything the paper offers. On a positive note, the essay successfully achieves two things: a transparent plan (or map) of its content, and an exceptional practice of argumentation with clear points and elaborate examples. The first makes for an easy way of navigating the essay and its parts despite its density, while the second facilitates the reader's attempt at interpreting and understanding the work. Finally, we want to emphasize that this panoptic undertaking of the topic is a great recommendation to any professional in the field of social sciences, student, or layman that are interested in the subject.

**PETAR DJUKIC: "A STOLEN TIME – NOTES AND ANALYSES IN THE TIME OF COVID"
(OTETO VREME-ZABELEŠKE I ANALIZE U VREME KOVID VIRUSA,) BELGRADE 2024, pp 306**

Reviewed by Ljubomir Madzar

In this book, the author, Professor Petar Djukic, conducted research which significantly contributed to our scientific insights and professional knowledge. The impact of COVID is much stronger and structurally more influential than it is normally portrayed in professional literature, not to mention its perception among a wider audience. According to some analysts a corona virus reduced life expectancy for two years. This is a higher reduction compared to all wars in a recent history of humankind! Even professional economists are not aware of the magnitude of this shock.

Perhaps, even the author has not been aware of the magnitude of the problem he decided to tackle which is the greatest compliment to this monography.

A strength of the book is certainly a myriad of implications and consequences comprised. They include social, humanitarian, ecological, and cultural implications, which the author brilliantly analyzes.

I belong to a group of the readers who are particularly interested in the changes generated in economic policy, and which were the subject of a widespread criticism. The study lays a ground for deliberations on alternative economic policy scenarios.

The Professor's Djukic book is unconventional and original because of its contents and problems it analyzes. It is extremely useful and valuable since it contributes to the new area of multidisciplinary research. In a nutshell, neither the publisher, nor the readers would regret that this excellent book saw the light of the day.

**Vjekoslav Domljan: "Road to Employment" (Put u zaposlenost), Ekonomski Institut Sarajevo,
Sarajevo 2014, pp 438**

Reviewed by Zarko Papic

The book "Road to Employment" , as the author states in a preface, is the result of many years of academic work on production of knowledge by research and communication and spreading that knowledge through lecturing and publications aimed at professional and a wider audience. It consists of introduction, and four parts divided into 14 chapters: A-Defect BiH economy, B-In ethno-Harberger triangle, C- Vital National Interest, and D- Effective Bi H economy. In appendix the author gives economic program for 2014 elections. The book, which has 263 pages, ends with a complete list of resources.

The monography of Professor Domljan has got two characteristics which distinguishes it from the greyness of our economic theory and makes it original.

Firstly, it is thorough critics of a transition process in Bosnia and Herzegovina. The main causes of macroeconomic imbalances are a wrong privatization, excessive foreign trade liberalization, and the bloated public sector. Tricky and challenging topics such as a currency board, a lack of independent monetary policy, and rise in unemployment are also raised in the book.

The author focuses on full employment as a result of a new model of development based on improvement of competitiveness. This can be achieved by supply economy, with the emphasis on production and technology, and export-oriented strategy, which would replace consumption with production economy. The author pays a particular attention to research and development and education as the pillars of a sustainable development. On the basis of thorough critical economic analyzes the author suggests "New developmental Trajectory", whose main characteristics are worth quoting: "A New Developmental Trajectory should be focused on the improvement in general conditions of economic growth and development, supporting innovations, improvement in training and education, modernization of infrastructure, support of knowledge re-industrialization, and reform of public institutions. (p 160)

New economic policy should reform a fiscal system, reduce public expenditure and increase spending on social development and improvement of a business environment, boosting investment and regional development.

“The main points of A New Development Trajectory are public expenditures, international capital, FDIs, innovations, smart cities-regions, creative economy, and chains of value.” (p 165)

A brilliant analyzes of a poor state of the Bosnian economy has resulted in perfectly designed “A New Economic Trajectory”.

The manuscript is written in a modern style, while the results of theoretical and empirical analysis are presented in a popular and accessible language. A particular value is provided by witty and humoristic subtitles (“Picking somebody else’s fruit tree”, “A bank of Ignorance”, “Where is this boat sailing?” etc.), which illustrate the analyzes that follow. Similar is with footnotes, which correctly cited are extended with historical comments and jokes, that brilliantly enrich the freshness of the text.

Unacademic nature of the script is strongly expressed in Appendix: “The Elements of Economic Program for General Elections in 2014.

If Bosnia and Herzegovina were lucky the political parties would use this program to move the country to a path of prosperity.

Marko Attila Hoare:” How Bosnia Armed”, Saqibooks, London 2004, pp 160

Reviewed by Tahir Mahmutefendic

The book *How Bosnia Armed* is mainly a story about ARBiH (The Army of Bosnia and Herzegovina), according to the author the most controversial and most enigmatic military phenomenon in recent history. The enigma about ARBiH from a military point of view stems from the fact that at the end of the war it emerged neither victorious nor defeated. It remained controversial because its political and ideological aims have never been clearly defined.

Attila Hoare finds a striking similarity between the Partisan movement and ARBiH. At the beginning of the WWII the Partisan movement was multinational, but predominantly Serb in its composition. At the beginning of the Bosnian war ARBiH was multinational, but predominantly Muslim. The Partisan movement protected Serbs from genocide. ARBiH protected Muslims from genocide. At the beginning of the WWII Partisans collaborated with Chetniks before they became enemies. At the beginning of the Bosnian war ARBiH collaborated with HVO (the Croatian Defence Council) before they started fighting each other, especially in 1993. As WWII progressed more Muslims and Croats joined the Partisans so that at the end of the war the

movement became genuinely multinational. On the other hand, ARBiH experienced increased national homogenisation, so that at the end of the war it became not only the army of one nation, but also the army of one political party, SDA (the Party of Democratic Action). The largest part of the book is devoted to the analysis of the external and internal factors which contributed to national homogenisation of the ARBiH.

ARBiH was created at the beginning of the war from disparate units such as TO (Territorial Defence), the Patriotic League, the Green berets, MUP (police forces) and various paramilitary groups. Unlike its Serb and Croat counterparts it lacked weaponry, internal cohesion and above all clear political aims and military strategy and tactics. Before the war the clash erupted between TO and the Patriotic League regarding military strategy. The Patriotic League advocated a more aggressive approach towards JNA (The Yugoslav People's Army). Their leaders, especially Sefer Halilovic, later commanding the Chief Staff of the ARBiH, suggested encircling the barracks of the JNA and disarming the soldiers and officers in order to obtain necessary weaponry. The political leadership of SDA with Alija Izetbegovic adopted a conciliatory approach towards the JNA. They wanted to co-operate with the JNA, hoping that the federal army would protect all the citizens of the Republic. Muslim leaders in East Bosnian towns foiled the plan of the Patriotic League to destroy bridges on the river Drina on 25th February 1992. TO handed in its weapons to the JNA. The weapons were later used to shell Sarajevo.

Izetbegovic's conciliatory approach towards the JNA resembles the approach adopted by the Chilean president Salvadore Allende. Having the experience of the Spanish Civil War, where the majority of the officers sided the nationalists, Allende wanted to develop a friendly relationship with the army. He even gave General Pinochet extraordinary responsibilities to protect the country in a situation of crisis.

In both the Chilean and the Bosnian case a co-operation with the army was not possible since army and political leadership pursued entirely different political goals. In other words it was naive beyond comprehension. Marko Attila Hoare expresses it succinctly with the following passage on page 61: ".....General Divjak, writing after the war and his own retirement, has described Izetbegovic and the Bosnian political leadership in these days as guilty of "defeatist behaviour" and of "incompetence and superficial knowledge and monitoring of the military and political situation ", for " How else to describe the early assessment of the situation by those in responsible positions in the government? First, that there would be no war in Bosnia and Herzegovina; then that while it was possible that the war would break out, it could never do so in Sarajevo; after which they said that an agreement would be reached with the JNA to transform part of the force into the TO of the Republic of Bosnia and Herzegovina!", For a competent professional former JNA officer like Divjak the last of these aspirations was particularly laughable".

Confusion within the ranks of the ARBiH was increased at the beginning of the war when Muslims, former JNA officers defected from the federal army and offered their services to the Bosnian government. They were mistrusted and suspected as KOS (Counter intelligence service) agents. Marko Attila Hoare reveals interesting details which show that KOS tried to influence the

political life in BiH even after the international recognition. The parts of the book describing the activities of KOS agents and double agents, sitting on the fence and waiting for who was going to win the war, resemble most suspenseful thrillers.

There were three currents in the ARBiH. The first one consisted of former JNA officers, who were brought up in the spirit of "Brotherhood and Unity" and who wanted the ARBiH to be built as a genuine multinational military force. The second current espoused a sort of a secular Muslim nationalism, similar to Zionism. The third one wanted to create an exclusively Muslim army, whose moral and spiritual development would rely on the principles of the Islamic faith. Owing to the combination of external and internal factors it was the third current which would eventually prevail.

The first blow to the multinational character of the ARBiH was dealt by VOPP (Vance-Owen peace plan). According to this plan Bosnia and Herzegovina was supposed to be divided into 10 semi-autonomous provinces along ethnic lines. Croats were delighted with the plan since their three provinces were given 30% of the country's territory. Muslims initially accepted the plan, according to which they were supposed to cede some territory to Croats and in return gain some land which was under Serb control. But when Serbs refused the plan Muslims did not want to give up the territory under their control to Croats. A fierce fighting broke out between the ARBiH and HVO in which both sides committed atrocities against civilians.

A further blow to a multinational character of the ARBiH was dealt by the Owen-Stoltenberg plan. This plan envisaged a swap of territories, putting Sarajevo under the UN administration and the eventual right of the Serb and Croat entities to secede and join Serbia and Croatia respectively. Although Izetbegovic refused the plan it seemed at the end of 1993 and in the beginning of 1994 that the international community was willing to endorse a full partition of the country and the creation of greater Serbia, greater Croatia and a rump Bosnian state with a Muslim majority. In this atmosphere the Muslim leadership started purging the Bosnian army, police forces and political institutions from non-Muslims. Jovan Divjak, a deputy commander of the ARBiH was dismissed and retired. Dragan Vikić, the legendary defender of Sarajevo, lost his place as the commander of the special police forces and was replaced by a Muslim. Mirko Pejanović, a Serb member of the BiH presidency also lost his post.

The Washington agreement in March 1994, sponsored by the USA, ended the hostilities between the ARBiH and the HVO. The agreement was a precursor to the formation of the Muslim-Croat federation. It gave a respite to the ARBiH and strengthened it militarily since it envisaged a full co-operation not only with the HVO but also with the Croatian army. However, at the same time it prevented incorporation of the HVO units into the ARBiH. This reinforced an exclusively Muslim character of the ARBiH.

But it was an internal development which was decisive in national homogenisation of the ARBiH. During the first two years of the war lawlessness reigned in cities and towns controlled by SDA, especially in Sarajevo. Criminal elements within the ARBiH, who enjoyed popularity and the support of Sefer Halilović, terrorised citizens, especially Serbs and Croats. Izetbegovic was

put under pressure to stamp out the criminal elements and to restore law and order. After a fierce battle in which many policemen were murdered the most notorious criminal Musan Topalovic Caco was killed. Stamping out the criminal elements restored law and order and gave more security to ordinary citizens but at the same time strengthened the role of SDA in the ARBiH. From top to the bottom of the army structure people loyal to SDA were given responsibilities. Negative selection went to the extent that commanding positions of the lower units were sometimes given to petty criminals, whose education consisted of three years of primary school. At the same time the ARBiH took the role of a promoter of SDA policy and developed a personal cult of Izetbegovic. All of this took place at the expense of military competence. Attila Hoare records that on the eve of the fall of Srebrenica General Rasim Delic, the commander of the ARBiH, spent the whole day giving a press conference in Sarajevo and in the evening went with his colleagues to a theatre.

In 1992 a prominent Sarajevan, living in London, asked the following question: "There are 15 generals in Sarajevo. Why does Alija Izetbegovic not use their services?" Attila Hoare broached the subject on a couple of places in the book. At the beginning of the war the Partisan veterans of all the nationalities condemned the shelling of Sarajevo and offered their services to the Bosnian government. In June 1992 the Bosnian presidency decided to offer the post of the Commander of the General Staff of the ARBiH to General Dzemil Sarac and the posts of his deputies to Generals Mirko Vranic and Milan Acic. However, all of them declined the offer due to their advanced age. At the same time they gave their blessings to the new army and were included in the Military Council, an advisory body attached to the General Staff of the ARBiH. They attended only two sessions of the Council, which proved to be a dysfunctional body. It would be interesting to know, considering the different political and ideological backgrounds, whether Izetbegovic genuinely wanted to use the expertise of the Partisan veterans or was only paying lip-service.

Throughout the book Attila Hoare expresses his sympathies with the ARBiH. He deplores a failure of SDA to appeal to Serbs and Croats and which, together with external developments, led to a national homogenisation of the ARBiH. However, he states that the ARBiH was not entirely innocent. He mentions concentration camps in Celebici, near Konjic and near Visoko in which thousands of Serb and Croat civilians were detained and tortured. Also he mentions atrocities committed by the members of the ARBiH in Central and East Bosnia. These atrocities were, however, on a much smaller scale than those committed by the Serbian and Croatian military forces. Also, they were the result of independent actions of splinter groups, criminal elements within the army, and mujahedeen volunteers, and were not orchestrated from the top.

In conclusion Attila Hoare states that "the campaign waged by the ARBiH was successful as a Bosnia and Herzegovina liberation struggle, except insofar as Bosnia-Herzegovina's independence was formally recognised by Serbia and Croatia and the international community; it was unsuccessful, however, as a Muslim-Bosniak national- liberation struggle." The ARBiH also managed to retain control of the country's economic and demographic heartland including three and a half major cities.

Attila Hoare used a wide range of sources; books, archive sources, journals, magazines and newspaper articles. He has a very good command of Bosnian/Serbo-Croat, which enabled him to use more sources in that language than in English. He analysed a specific angle of the Bosnian war and he did it as an objective and competent scholar. The book is warmly recommended to readers.

Marko Attila Hoare: "The Bosnian Muslims in the Second World War: A History, Hurst & Company, London 2013, pp 478

Reviewed by Tahir Mahmutefendic

Marko Attila Hoare's *The Bosnian Muslims in the Second World War* follows on his book *Genocide and Resistance in Hitler's Bosnia*. Unlike the previous work, this book is more specific in topic and covers the period from 1941 until 1950.

Through a galore of facts and syntagms which can befuddle even natives of the land, such as pro-Chetnik Partisans, pro-Partisan Chetniks, Croatian Communists, Croatian non-Communist Partisans, Muslim Communist Partisans, Muslim non-Communist Partisans, Muslim Ustashasa, Muslim Chetniks, Croatian Green Cadre soldiers, Croatian members of Handschar division, through a myriad of relations, fickle allegiances and frequently swapping sides of war participants, skilfully leads us to the theme of his book.

In the beginning of the war Partisan leadership was multi-ethnic, while rank and file consisted predominantly of Serb peasants escaping from and fighting against Ustasha genocide. Partisan leadership was aware that in order to win the war they had to conquer cities and towns where Muslims made up an absolute majority. Therefore, winning Muslims' support became essential in an overall struggle with German and Italian invaders and their domestic collaborators.

Initially, a majority of Muslims viewed the new Croatian puppet state, i.e. the NDH, with hope that their position would improve compared to the one they had in the Kingdom of Yugoslavia and with loyalty to the new regime. The most ardent supporters of the new state were former members of the Muslim branch of the HSS, Hakija Hadzic, Ademaga Mesic and Alija Suljak. They removed from political life Muslim notables, who were leaders of the JMO and who were suspicious of the new regime and particularly leaders of the pro-Serb cultural society Gajret.

A several months after the establishment of the NDH a vast majority of Muslims became disillusioned in the new state. Disappointment with the new regime stemmed from three causes: Firstly, the NDH leadership wanted to obliterate borders between Bosnia and Herzegovina and Croatia, denying any peculiarity to the former. Protests of some politicians of all the three main ethnic groups and requests for autonomy for Bosnia and Herzegovina within the NDH ended up with harsh repression from the authority; arrests of Bosnian Muslims and Bosnian Croat protesters and murder of three Bosnian Serb politicians.

Secondly, the NDH leaders wanted forcibly to assimilate Bosnian Muslims into a Croatian nation with obsequious declarations that the former were the purest stock of the Croatian nation since they did not intermingle with other races while Croats in Croatia had mixed with Germans, Hungarians and Italians. Thirdly, Muslims bore the brunt of Chetniks' and sometimes even Partisans' retaliation for Ustasha atrocities against Serb civilians, and the NDH authorities were either unwilling or unable to protect them. As a result Muslims' attitude became increasingly anti-Ustasha and pro-German.

Muslim notables hoped that they would get support from Germans in their desire to establish an autonomous Bosnia and Herzegovina and even an independent state. These efforts culminated in formation of the 13th SS Handschar division, a so called Himmler's division, and memorandum to Hitler. In a memorandum to Hitler, Muslim notables asked him to support the establishment of an independent Bosnia and Herzegovina as a German protectorate. They suggested the secession of border land territories to neighbouring countries and exchange of population in order to achieve a rump Bosnia and Herzegovina with a Muslim majority.

Partisan leadership shared views of an autonomous Bosnia and Herzegovina with Muslim notables. Their slogans were full of Bosnian patriotism whose aim was to gather all the three main Bosnian ethnic groups. They had in mind a Bosnian statehood within a new Yugoslav federation, although the words federation and Yugoslavia were not mentioned before 1943. However, Muslim masses did not join the Partisan movement in large numbers before 1943 fearing Ustasha and German reprisals.

Muslims were soon disappointed in the Germans for two reasons. First, Hitler never paid much attention to the idea of autonomous Bosnia and Herzegovina. Second, Muslim youth were forcibly recruited to 13th SS Handschar division and sent to various fronts abroad including the Eastern front, while they expected to stay at home and defend Muslim villages from Chetniks and to a lesser degree from Ustashes. This disappointment culminated in a mutiny in Villefranche-de-Rouergue in 1943. In the absence of soldiers of this division, various local militias were formed in Muslim villages to protect civilians. They increasingly collaborated with the NOP.

A decisive moment came in 1943 with two very important events; the capitulation of Italy on 8 September and the first session of a communist assembly of Bosnia and Herzegovina, ZAVNOBIH, on 25th November. During the first two years of the war Chetniks were the minions of the Italians who armed them and supported them. After Italy capitulated, the Germans took over the role of Chetnik supporters. In order to motivate them for all-out war with the Partisans, the Germans promised the creation of the Great Serbian Federation, which would include the Serbia proper, Sanjak, Montenegro, and East Bosnia. This caused a panic among Muslims and Bosnian Croats. At the same time Bosnian statehood was cemented at the first session of the ZAVNOBIH held in Mrkonjic Grad. These two events prompted a massive influx of Muslims and to a lesser degree Bosnian Croats into the Partisan movement.

In 1944 the Ustashas and especially the Chetniks toned down their militant nationalism in order to attract Muslims to their ranks. In the congress at village Ba in Western Serbia, held in January 1944, Zivko Topalovic, one of the founders of the KPJ, advocated the creation of Bosnia and Herzegovina as the fourth federal unit in future Yugoslavia. However, he was a single voice in the sea of Great Serbian sentiments spearheaded by Dragisa Vasic and especially Stevan Moljevic, who could see his Bosanska Krajina nowhere but in Greater Serbia.

Draza Mihailovic tried to court Muslims by promising them that after the war Sarajevo would become an Islamic centre of Europe. This promise sounded rather hollow after atrocities which Chetniks committed against Muslim civilian population and had a very limited appeal.

Marko Attila Hoare discusses in length various proposals for a Bosnian coat of arms and flag after the war. At the end it was decided that the flag would be red in colour, symbolising the blood of all Bosnian citizens spilt in struggle for freedom. In the background there was a picture of the town Jajce. This was supposed to link the present with the past; the town which was the seat of the first session of ZAVNOJ, and at the same time the seat of them medieval Bosnian kings.

An especially interesting chapter from the legal point of view is the one entitled: "Did Bosnia and Herzegovina have the right to secede from Yugoslavia?" In this chapter Marko Attila Hoare juxtaposes two very important issues: 1. Federation versus confederation, and 2. A right of republics for self-determination including secession versus the right of peoples for self-determination including secession.

The first important issue requires a clarification of differences between federation and confederation. In federation the original sovereignty belongs to the federal state. Federal state devolves to constituent units as much power as it wants. In practical terms this means that federal units, states, republics etc. can pass their constitutions and laws if they do not contravene federal constitution and federal laws. In confederation the original sovereignty lies with the states, which pass on to confederative bodies as many powers as they want. For the beginning these powers usually include monetary policy, customs union, foreign trade, foreign affairs and army.

Hoare lucidly points at the place which reveals the ambiguity of the legal arrangements in the new Yugoslav state. On the page 311 he quotes a prominent Bosnian politician Dusko Sakota:

"Our federation was established in order to resolve the national question. Thus, that the principle of the Federation has been consistently realised is manifested in the fact that the People's Republics are sovereign states. They are limited only in the rights that the peoples of Yugoslavia have, through their own decision, transferred to the Federative People's Republic of Yugoslavia. The transfer of these rights was necessary to achieve economic and political co-operation and the reciprocal assistance of the peoples' republics; their common defence, state security and independence; and with a goal of a unified democratic manner of state and social order of all the People's Republics in the composition of the FNRJ. Other than these most

important affairs of importance to all the peoples, exercised through the Federal government in the general interest, the People's Republics exercise their government independently, maintaining their sovereignty."

This would suggest a confederative model of the new Yugoslav state.

A paragraph on page 313 reads:

... "The Commission for the Preparation of the Draft Constitution had consulted senior officials of the Yugoslav government responsible for constitutional affairs to ensure that the Bosnian constitution would be in keeping with the Yugoslav Constitution; these officials submitted their last set of corrections, all of them fairly minor, to the People Government on 7th November."

This would suggest a federative model of the new Yugoslav state.

The other issue, another source of ambiguity, became increasingly relevant before and during the Wars for Yugoslav Succession, waged from 1991 until 1995. Croats and Muslims understood that the republics had the right for self-determination including secession. Serbs, on the other hand, interpreted the legal arrangements in Yugoslavia, as if the peoples had the right for self-determination including secession. With this they assumed that the territories with a Serb majority had the right to secede from Croatia and Bosnia and Herzegovina and join Serbia.

The book is a result of many years of thorough and meticulous research. The best proof of the time the research took is the fact that the first interview was held with Zvonko Vonta Ivanovic on 9 June 1996 and the last one with Mirko Dubajic on 6 October 2000.

The book has more than 1,600 footnotes. A bibliography is equally impressive, containing more than 400 sources. They are classified in the following groups: 1. Archives, 2. Published documents, 3. Newspapers and journals-historical, 4. Historical texts, 5. Autobiographies, diaries, eyewitness accounts and works of fiction, and 6. Secondary sources. As in his previous books Marko Attila Hoare consulted more resources in Bosnian/Serb-Croat than in English. One source is in Italian.

The Bosnian Muslims in the Second World War represents a brilliant political, historical and to a lesser extent legal analysis. I warmly and with pleasure recommend it to readers.

