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Abstract. Inflation and unemployment were two of the main issues that plagued the Socialist Federal Republic of Yugoslavia (SFRY) from 1965 to her disintegration. Economic history has taught us that uncontrolled inflation is a characteristic of the countries with a lack of democracy, but SFRY was more economically liberal and decentralized than any other communist country. Using the World Bank annual data from 1965 to 1990 for unemployment and inflation, the OLS (Ordinary Least Squares) findings demonstrate that unemployment is significant and positively affects the inflation rate, which stands against the theoretical paradigms known as the Phillips curve. The impulse response function (IRF) indicates that the positive shock of unemployment positively affects inflation in the short run. The Johansen test reports that unemployment and inflation were integrated into the short-run confirming the expectations-augmented Phillips curve. Moreover, contrary to theoretical expectations is the cointegration in the long run where the relationship between inflation and unemployment rate turned into an upward steeper slope. To this end, the results help the scholars to be informed on the historical relationship between inflation and unemployment in the context of SFRY, a formerly communist country with a differentiated economic model. The relevance of our findings goes beyond economic concepts by understanding them as one of the main factors contributing to the bloody disintegration of the SFRY.

Keywords: SFRY, self-management socialism, inflation, unemployment, Phillips curve.

JEL Classification: E24, E31,J64, N14, P24.

1. Introduction

Former Yugoslavia was unique in many ways, especially with her economic system of workers known as self-management socialism. Effectively introduced in 1952, self-management recorded the fastest economic growth in the world until 1965, which can be considered as its golden age. Thereafter the growth continued to be impressive, though it was facing several structural distortions such as regional development disparities, rising unemployment, and inflation until its collapse in 1990 which also led to the country's disintegration and the emergence of seven successor states. Unlike the disintegration of the Soviet Union whose place and the role was assumed by Russia, no Yugoslav newly independent state gained the right to succession of her legacy. The Yugoslav model fared much better than almost all socialist countries which had adopted the Soviet style of a centralized economy. The economic model of decentralized socialism and partial-market economy may be the primary cause to which comparatively better economic performance may be attributed, as it was also partially an open economy to both socialist and capitalist countries. In addition, the self-management model allowed a greater scope of private ownership, especially in agriculture known as "small economy" which could sell the products in the green market. The latter's importance grew in the last phases of self-management to keep many people working in subsistence agriculture as the social sector of the economy was unable to absorb an increasing number of the unemployed, especially after 1980 to its end in the 1990s.

The monetary system of SFRY was organized into eight united banks (each for a federal unit of six republics and two autonomous provinces), which were coordinated by the National Bank of Yugoslavia. According to articles 260, 261, 262, and 263 of the 1974 SFRY Constitution and amendment XXXV, the National Bank of Yugoslavia (NBY) and National Banks of the Republics and Autonomous Provinces, were unified monetary system institutions responsible for the monetary policy, issuing, and controlling the amount of money in circulation, guaranteeing stability and liquidity of the currency at home and abroad, supervising the exchange rate, and undertaking measures to implement credit policies in the republics and autonomous provinces in which it operated. Commercial banks and

other financial institutions should have obeyed the monetary and credit policies of the NBY. The activity of the NBY was led by the Council of Governors which appointed the Governor of the NBY. The NBY was accountable for her activity to the SFRY Parliament with a Dinar (YDIN) as official currency. This system was similar to the Federal Reserve (FED) in the United States, and the Eurozone, but it had two main differences. First, only the NBY had the right to print the money as opposed to the FED consisting of twelve regional banks having that right, while in the Eurozone this is done by all member countries. Second, the amount of money in circulation or YDIN was regulated by the NBY in Belgrade even though eight regional banks had an active role in monitoring and controlling the monetary system. In the case of the Eurozone, the national central banks have the right in issuing the Euro (€) while the supervision is made by the European Central Bank. Compared to the FED, the Yugoslav monetary system was different as the first consists of twelve central banks and the latter had only one with the right to issue the currency. The study by Aliu and Nadirov (2016) show that the lack of capital market during the transformation of the financial system in former Yugoslav countries made these countries to face high interest rates on the banking industry.

Unemployment in SFRY was a concern that continued to rise from 6.6% in 1965 to 16.1% in 1987 (Woodward, 1995). Along with it, the inflation rate also rose steadily and by 1987 it reached 167% per year (OECD, 1988). As unemployment and inflation surged during the 1980s and its later period, more people were leaving the SFRY as individual workers in search of a better perspective in Western developed countries, from where they were contributing through remittances and various goods which were of higher quality. The remittances were mainly in German Marks (Deutschemark – DEM), which sparked the black market currency exchange. The DEM became the most popular foreign currency in SFRY which also dictated the last currency reform in late 1989 for monetary stabilization through denomination when YDIN was pegged to the DEM at a rate of 7:1. From December 28, 1989, until January 20, 1991, the official currency exchange rate between YDIN and DEM rose to 9:1, while in the black market it was 11:1 (Slović and Knežević, 1997).

The importance of this study is in demonstrating how the Philips curve behaves in a specific economic system (self-management socialism) or how is it different from others, namely centralist socialism and market economy capitalism. As it was a separate socialist economic model and to some extent unique that gained the attention of many researchers and economists, it was necessary to have Section 2 of this paper to get familiar with its foundations. This would form the basis of understanding the background of two variables taken as a measure for the Philips curve, unemployment, and inflation respectively. A subsection was devoted to the references or studies dealing with the Philips curve in various countries. Section 3 discusses the methodology employed and the data used, among others, explaining why the period 1965-1990 was chosen. The empirical analysis is carried and the results are reported in Section 4. The last section concludes and addresses a remark.

2. The Yugoslav model of self-management or market socialism

The origin of self-management as an alternative model of socialism can be traced back to the political events during and in the aftermath of WWII. Unlike the former communist countries in Central and Eastern Europe (CEE) that were liberated by the Soviet Union, had their model copied from it, and were its satellite states, the Yugoslav communists largely fought their way to liberation and independence. Initially, they adopted the Soviet model until 1948 when Yugoslavia was expelled from the Cominform (Communist Information Bureau). Following this Yugoslav-Soviet split and economic blockade by the Eastern Block against Yugoslavia, the West, namely the U.S., the U.K., and France approached Yugoslavia with grants-in-aid as long as it wanted to stay independent or defiant from the Soviet block of influence and subordination. A package of the Marshall Plan when officially was declared to have been terminated, reached and was delivered to Yugoslavia. In November 1951, the West granted Yugoslavia US$500 million. The U.S. by 1955 had been granted US$ 1.187 billion as non-repayable aid for economic and military purposes. A further USS$ 420 million were received from United Nations Relief and Rehabilitation Administration – UNRRA (Banac, 1988: 138-9). The U.S. foreign aid to Yugoslavia was not delivered for any benefit in return but to reduce the Soviet Union's influence there. While receiving this aid, the Yugoslav communists began to moderate their anti-Western rhetoric and increased anti-Soviet sentiment by denouncing its bureaucracy and hegemony. At the same time, the Yugoslav communists went on their way of an economic model which from 1948 to 1952 evolved into

alternative socialism known as self-management, a combination of planning and market socialism. There was neither a theory about it except interpreting the ideas of Carl Marx, nor the Yugoslav communists after the split with the Soviet Union knew how the system they were about to implement would operate (Mulaj, 2010). Moreover, the reforms undertaken in many countries of the former Yugoslavia did not yield the excpected results (Aliu, 2014).

The foundations of theoretical differentiation for Yugoslav socialism from the Soviet model were laid by Kardelj and Djilas (1951) who maintained that socialism is not a static but an evolutionary system. Later, Kardelj (1954) provided the concept and theory of the Yugoslav political and economic system. The economics of self-management was officially introduced and applied in 1952. In principle and reality, self-management socialism was more different and complicated than centralist socialism elsewhere. Though still a communist in nature, the essence of self-management involved considerable differences, such as i) social ownership over the means of production or socially-owned enterprises (SOEs), which implied that the enterprises were managed by workers who had the right to generate benefits without the right to being owners or alienate the assets which were left in trust to them by the state; ii) planning at the national level was not mandatory like in centralist socialism but only indicative as the enterprises had their objectives, which was to maximize the workers' salaries and welfare; iii) SOEs could compete with each other and there was a market; iv) apart from cooperation with the Eastern Block and capitalist countries, Yugoslavia was one of the three founding members and primary initiator of the Non-Aligned Movement which became the third most influential block in the world after NATO and the Warsaw Pact.

From 1953 to1965, the SFRY recorded the fastest economic growth in the world expressed by different indicators, outperforming both capitalist and central communist countries. Output growth in self-management during that period averaged 11.8% compared to 8.7% in communist and 7.1% in capitalist countries. Labor combined factor of productivity level and welfare also grew faster, with the Gini coefficient at 0.25 (Mulaj, 2007 *op.cit.)*. The growth rate remained impressive after 1965 but was steadily associated with rising unemployment and inflation. The interest in studying the Yugoslav self-management or a third-way economic model grew sharply both from macro as well as micro perspectives. At the micro-level or the firm behavior, Ward (1958) who coined the term Illyrian Firm for the SOEs in SFRY, demonstrated a theory that these firms were more independent than those in centralist socialism controlled by the state why less independent than capitalist firms in making decisions. Given that the workers in SOEs were also decision-makers who could elect and dismiss the management board by votes, the SOEs were expected to be less investment-oriented as the workers would prefer to distribute much of the firm's profit to their own higher salaries. This was not proven by any empirical study or econometric analysis at the time. At the national level and with the workers' management in SOEs, the experience served Horvat (1982) to demonstrate how it can be a better model compared to both capitalism and centralist socialism. For his contribution, he was nominated by the American Society of Economists for the Nobel Prize for the economy in 1983. The elements of the Yugoslav model were introduced in many of China's township enterprises with similar rights to the workers' management which provided the bulk of China's fastest economic growth in the world.

Self-management had transformed the SFRY from a largely backward and mainly rural country into a more industrialized economy. It did not face shortages like other communist countries as it was a semi-protected and semi-open economy. It restricted or imposed quotas to imports of those goods that could be produced at home, and allowed imports to avoid shortages which were more industrial goods rather than food items. Soft budget constraints did apply for the SOEs which were considered vital for the community and economy, thus not allowing them to go bankrupt. The system was experiencing several structural distortions such as degrading of the working discipline, rising of trade deficit, growing unemployment, and inflation. Nominal interest rates were not adjusted by the rate of inflation, thus making the borrowers, namely the SOEs, pay back far less than even they got as a credit, i.e. the rate of inflation was significantly surpassing the interest rate or borrowing persistently occurred at the negative real interest rate. The work by Borio (1990) identified such financial arrangements and erosion of financial discipline as the main source of inflationary pressures. The losses were covered by the government as subsidies while SOEs with profitable records often covered the losses of their counterparts. The spiral of these distortions contributed to an annual inflation rate of 76.8% from 1980 to 1988, to be followed by hyperinflation of 240.5% in 1988 and over 2 000% in 1989 (Bartlett, 1991). Consequently, the real earnings dropped by -10%, fixed investment by -3%, and imports by -9.6%. These indicators of downward economic trends were directly reflected in rising unemployment.

Just as inflation, the unemployment rate in the SFRY accelerated considerably during the 1980s, which was also a feature of socialist countries before they transitioned into political pluralism and an open market economy. The number of unemployed by 1989 had risen to 1 244 900 among all categories of the unemployed, with considerable variations across eight federal units ranging from 2.9% in Slovenia, 7.9% in Croatia, to as high as 36.6% in Kosovo (Bartlett, 1991). This run counter to the core ideology of socialism whose main objective was employment and the long-term mission of abolishing unemployment. Woodward (1995) saw the rising unemployment, among others, by decentralized decision-making and fragmentation in politics as well as the economy. A similar view is held by Uvalić (2018) who reiterated that decentralization among the federal units after the 1974 Constitution entered into force with aim of making the republics and autonomous provinces more independent and self-sufficient. Moreover, the author considers that this led to uncoordinated economic strategies, low regional labor mobility, which by the end of the 1980s culminated in the rise of nationalist movements.

Faced with a deteriorating financial performance and rising unemployment, the last government of the SFRY (then called the Federal Executive Council) in 1989 with the assistance of the International Monetary Fund initiated a program of monetary stabilization to halt the hyperinflation. For a while or as long as it was implemented, the currency reform was successful. The program along with other economic reforms was interrupted by the outbreak of the civil wars in the SFRY which marked the beginning of the disintegration of the country. The horrors of the wars created some beliefs that the SFRY did not collapse because of economic reasons, though a detailed analysis into many complications in the political and economic system with a downward trend, were the main factors contributing to her bloody disintegration.

2.1. Theoretical background and studies on the Phillips curve

From what we discussed and understood in the introductory part and Section 2, the Yugoslav self-management socialism since 1965 began to show some patterns of rising inflation and unemployment which intensified in the 1980s until the whole model collapsed in the early 1990s. Therefore, a short to the medium-run inverse relationship is observed between these two variables, better known as the Philips curve. This subsection will only look at the studies and their findings of it in various countries to see how it might be similar or different from the one that this study will investigate in a country with a unique economic system – self-management socialism in the SFRY. Initially, the Philips curve was seen as a short-run phenomenon in a trade-off between unemployment and inflation. Later, Akerlof *et al.* (2000) suggested its moderate manifestation in the U.S. economy were, a given decrease of inflation from 2% to 0%, made unemployment increase by 1.5% in the long run or permanently. In a further explanation, that would imply that the workers may in general prefer to accept their real wages increase by 2% if inflation is 3%, and even a decrease by 1% if there is no inflation rate or 0%. Modified versions of the Philips curve continue to be researched in distinguishing between its short-run known as “expectations-augmented Phillips curve” and long-run called “NAIRU” (non-accelerating inflation rate of unemployment). Blanchard (2000) presented the expectations-augmented Phillips curve as a measure of monetary policy to allow fluctuations by increasing inflation to decreased unemployment and the other way around.

The measure of the Philips curve becomes more difficult if sticky prices are taken into account without expecting future prices where, one part of the model can be correctly specified and the other misspecified that can yield inconsistent estimates (Roberts, 1995). Some authors, such as Golosov and Lucas (2003), Gertler and Leahy (2006) argue that the model of sticky prices captures the behavior of microdata and their exhibition to adjustment, though this is not enough or is too simple to hold for macroeconomic figures like the tradeoff between output and inflation. In an analytical framework, McLeay and Tenreyro (2019) show that the Philips curve is not easy to be identified with macroeconomic data, but this does not imply it does not exist. The identification is stronger with disaggregated panel data rather than with aggregate data. Despite considerable research and measurements as empirical observation, the theory and explanation of the Philips curve still appear to be in evolution. For the relevance of this paper, we will take into consideration the reference to some studies in particular countries what it was found and how was it interpreted.

The work by Kustepeli (2005) with two data sets for Turkey, the annual one from 1980 to 2001 and semi-annual from 988:2–2003:1 by using linear and non-linear specifications found no evidence of the Phillips curve. The most

important finding was reported to be the significance of inflation over the unemployment rate, from where the former (inflation rate) was recommended to be addressed for resolution or lowering it by appropriate monetary and fiscal policies. Using the Generalized Method of Moments (GMM) for India from 1970 to 2010, Ray (2011) found no long-run relationship; the positive trade-off between inflation and unemployment was revealed only in the short-run where the variables were stationary. Kitov and Kitov (2013) measured the Philips curve in Japan from 1980 to 2003, which they then updated up to 2012. The rise in unemployment was followed by a decrease in inflation. Their projections showed that in the long run, the GDP deflator is negative ranging between -0.5% to -2%. Mallick (2019) observed different paths of the Phillips curve in Australia over different periods as a result of monetary policy and business cycles. Before 1977 it experienced an upward slope, from 1977 to 1993 the slope appeared downward, and from 1993 onwards the trade-off became flat. These patterns were explained by the monetary policies targeting inflation and labor relations in different periods. For Brazil, de Lima and Marques (2019) employed ARDL models of cointegration with Granger causality test to find how monetary policy instruments affect unemployment, from 2012 to mid-2018. In the long term, unemployment was found to be negatively related to inflation, exports, GDP, and investments contributed to generating new jobs. Lemaire (2020) used OLS and GMM to estimate four versions of the Phillips curve for Egypt with quarterly aggregated data from 2003q1 to 2019q1. Among other findings, unemployment was found negatively related to the real exchange rate. Furthermore, an economic boom with a fixed exchange rate causes higher inflation but lower unemployment. The most recent study on the subject for Egypt by Omran and Bilan (2021) through the time-series data from 1980 to 2019, used VAR and Impulse response function tool (IRF) and found a positive relationship between inflation and GDP but these negatively affected the rate of unemployment. Elsewhere, for example in the Eurozone as a block of independent countries using the same currency (the Euro, €), Ball and Mazumder (2020) tracked the inflation rate in 94 industries for 20 years through HICP (Histogram of industry price changes) and weighted median of inflation, which was explained by a simple Phillips curve involving core inflation and the difference between potential and actual output.

China is an interesting case as it went through an economic transition from centralist socialism to an open market economy without changing its one-party or communist political system. Egan and Ledin (2017) investigated the Phillips curve framework from 1987 to 2014, where they found a non-linear relationship between inflation and output. They named it a concave Phillips curve, implying an upward-slopping curve that flattens when the output rises beyond its potential or natural level. Unlike capitalist or market economy countries where the Phillips curve has originated and intensively studied through various techniques and dimensions, this phenomenon cannot be as applicable for study with the past data of former communist countries with the planned economy because, production, prices, and employment were controlled by the state. Although employment was kept at high levels or unemployment remained very low, the control of prices gave rise to shortages in production as well as consumer goods, to the extent that queuing to buy basic food items became a norm (Kornai, 1980). In the Soviet Union as the largest socialist economy, this phenomenon was referred to by Nuti (1989) as inflation for goods, excessive demand, or repressed inflation with more harmful effects than an open normal inflation. How would one measure the Phillips curve under those circumstances or how it will look like? Self-management socialism in SFRY did not experience shortages as elsewhere in communist countries, inflation was rapidly rising in the last decade of its existence, and in parallel, the unemployment rate too. This is what makes the study of the Phillips curve in this paper more specific than the rest.

3. Methodology

The methodology is organized into two subsections, where subsection 3.1 discusses the data, while section 3.2 the methods used for estimation that includes: Ordinary Least Squares (OLS), Vector Autoregression (VAR), and Johansen cointegration test.

3.1. Data

The inflation and unemployment data for SFRY are obtained on an annual basis from the World Bank (2021) database. First, we investigated the trade-off between inflation and unemployment (the Phillips curve) from 1965 to 1990. This period was taken for analysis after the golden age of self-management (1952-1965) or when things went

through the course of structural distortions associated with the rising unemployment and inflation until the political and economic system collapsed. The starting point for the data analysis begins with their graphical presentation. It is clear from Figure 3 that inflation and unemployment in the case of Yugoslavia do not have a negative inverse relationship, which contradicts the assumptions of the Phillips Curve. The period from 1985 to the 1990s was followed by uncontrolled inflation and at the same time with an increase in the unemployment rate. Figure 1 indicates the annual inflation rate for the Socialist Federal Republic of Yugoslavia from 1965 to 1990.

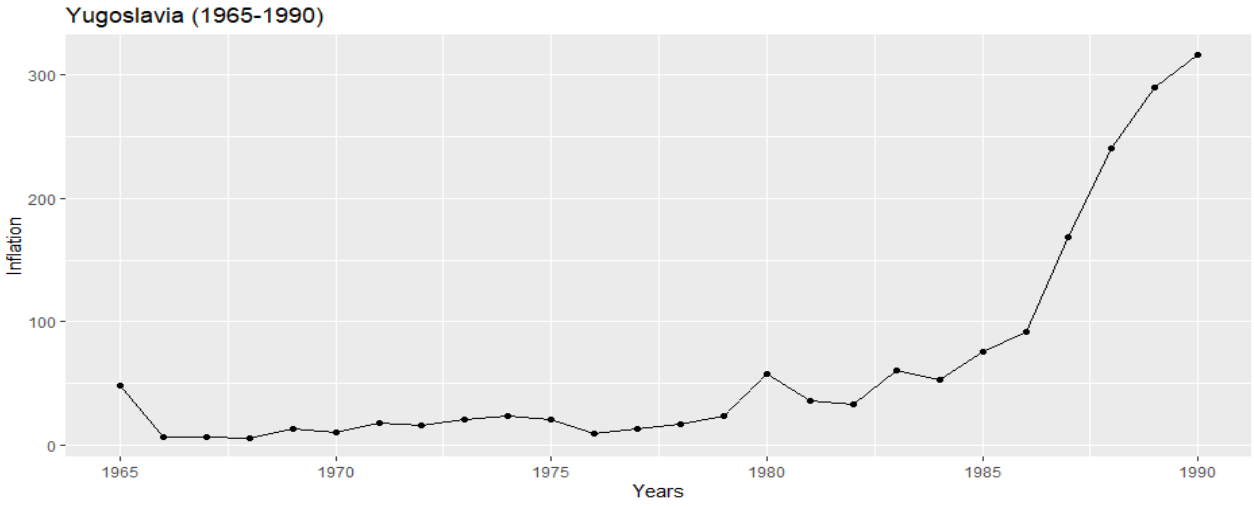

Fig. 1. Inflation rate in the SFRY from 1965 to 1990.
Source: Authors elaborations based on the World Bank database [prepared in R Studio]

At a first glance, for some 20 years or from 1965 to 1985, the inflation rate in SFRY appears to have experienced a moderate rise, then accelerated sharply until the last observed year which also marked the beginning of the end of self-management socialism and its monetary system. Over the same period, the unemployment rate experienced a similar trend, though its upward trend had begun to rise a decade earlier or since 1975, as shown in the figure below.

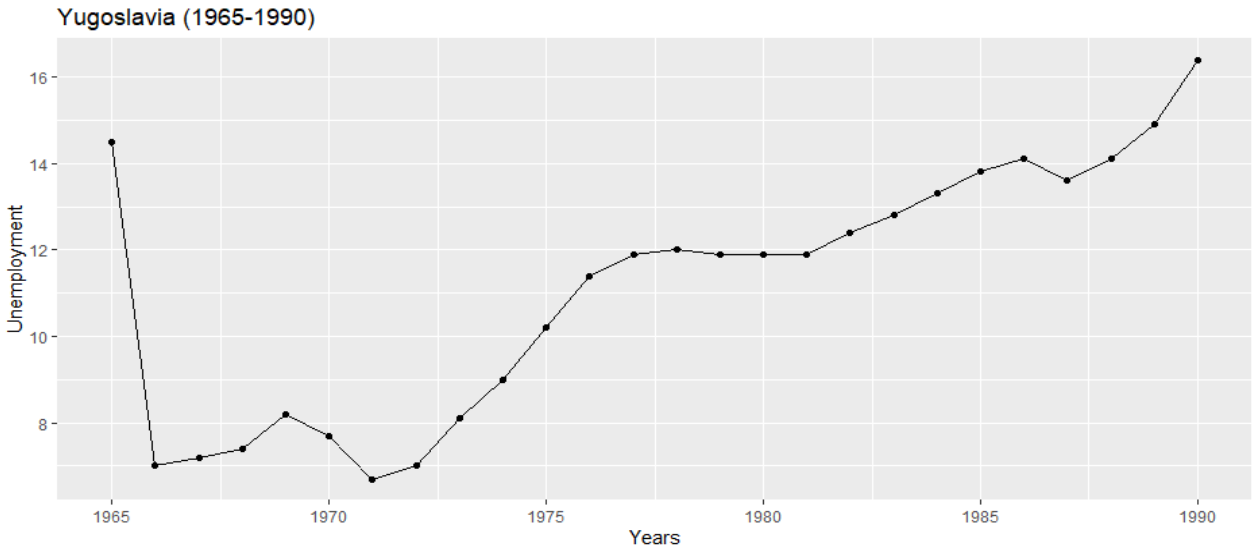

Fig. 2. Unemployment rate from 1965 to 1990 in SFRY.
Source: Authors elaborations based on the World Bank database [prepared in R Studio]

The unemployment rate in SFRY was relatively low from 1952 to 1965. As already noted earlier, from 1974 SFRY introduced a greater scale of decentralization between the eight federal units to manage their own political and economic affairs. As the figure suggests, this was the period when the unemployment rate began to rise and in 1990 it exceeded 16%. Since both inflation and unemployment rates were on the rise, Figure 3 presents their relationship or the Philips curve.

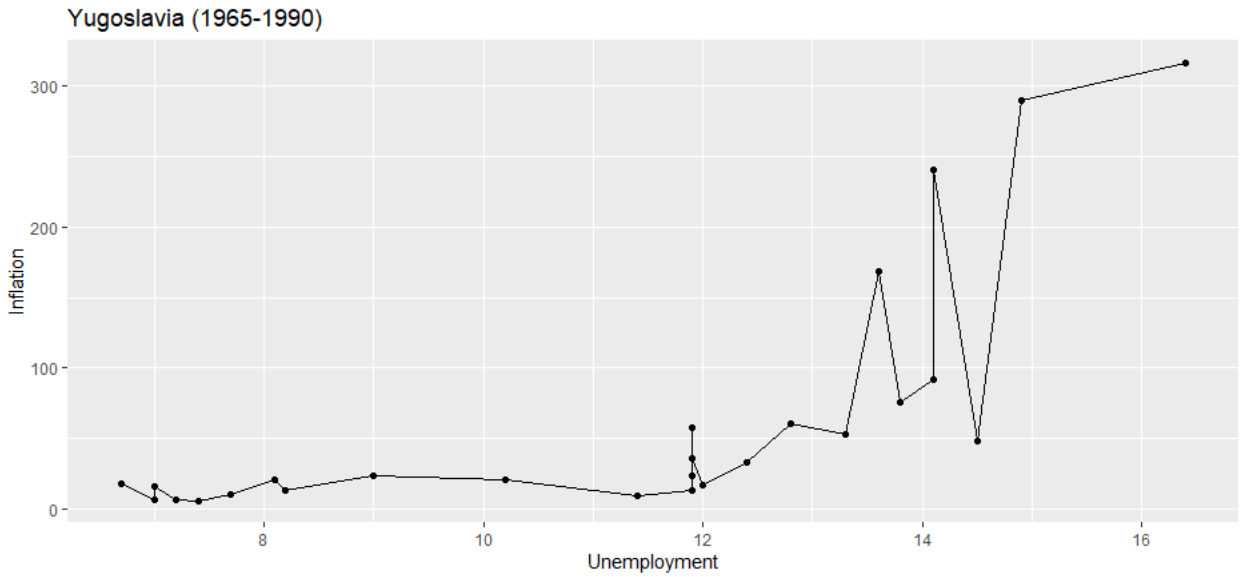

Fig. 3. Relationship between inflation and unemployment rate in SFRY, from 1965 to 1990.
Source: Authors elaborations based on the World Bank database [prepared in R Studio]

To verify whether the data are stationary or non-stationary, three types of unit root tests were conducted. The following test was conducted to identify variables for the non-stationarity issues, such as the Augmented Dickey-Fuller test (ADF), Phillips-Peron test (PP), and Kwiatkowski, Phillips, Schmidt, and Shin test (KPSS). To this end, ADF and PP are a unit root test were to reject the null hypothesis, the p-value > 5%. The PP test in contrast requires that the p < 5% and not less than 5% reject the null hypothesis that the data are non-stationary.

Table 1. Augmented Dickey-Fuller (ADF) test, Philip-Peron (PP) test, and KPSS test.

	ADF p-value	**ADF (I dff) p-value**	**PP p-value**	**PP (I dff) p-value**	**KPSS p-value**	**KPSS (I dff) p-value**
Unem	0.09	0.13	0.01	0.01	0.01	0.09
Infl	0.99	0.43	0.99	0.02	0.02	0.02
Log10(Unem)	0.18	0.04	0.01	0.01	0.01	0.1
Log10(Infl)	0.71	0.02	0.04	0.01	0.01	0.1

Source: Authors elaborations based on the World Bank database [prepared in R Studio]

According to Table 1, results regarding the stationary issues of variables (unemployment and inflation) are mixed. To this end, three types of tests indicate that data are non-stationary when we do not imply any transformation on them. The exception is inflation *(Infl)* which occurs to be stationary in the case of the PP test. Whereas when we set the *log* transformation and also imply first differencing *(I dff),* then all the data are presented stationary in all three types of tests. Figure 3 shows the data collection process, tests, and models used to measure the Phillips curve in the case of Yugoslavia.

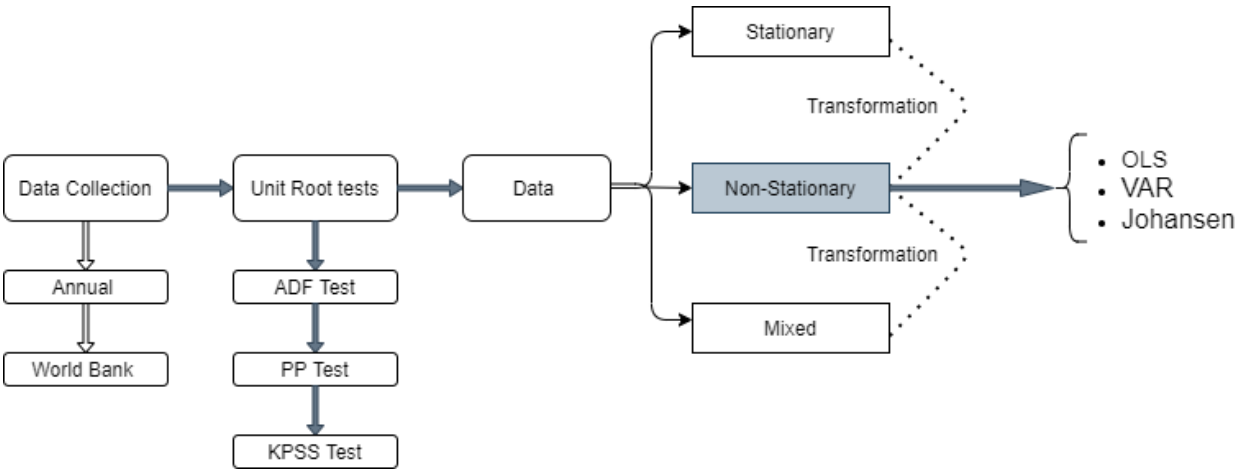

Fig. 3. Schematic diagram of data preparation and testing.
Source: Authors elaborations [prepared in R Studio]

Applying the correct methodology to the type of data we possess is crucial to the validity of the results we obtain. The unit root tests indicate the method's to be used as identical methods are not preferred for stationary and non-stationary time series data. If all the data are stationary OLS and VAR are applied without giving us biased results and the other way around. However, making non-stationary data using differencing and log transformation can damage their long-run relationship. As our data from the unit root tests appear non-stationary, the Johansen co-integration test and ADRL model are preferred. Apart from that, we have implemented also OLS and VAR models to get information about the coefficients.

To determine the persistence of the model we have used the autocorrelation function in R studio (ACF) and partial autocorrelation function (PACF). Figure 4 presents ACF and PACF for inflation and unemployment in Former Yugoslavia for the period 1965 to 1990. The blue line indicates the significance thresholds (horizontal line) while only the vertical lines that exceed the threshold are considered significant. After the data were detrended with log transformation and differencing, only one lag of unemployment and inflation exceed the significance threshold and both on the positive side. However, in the case of PACF, all the lags (unemployment and inflation) are within the significance threshold.

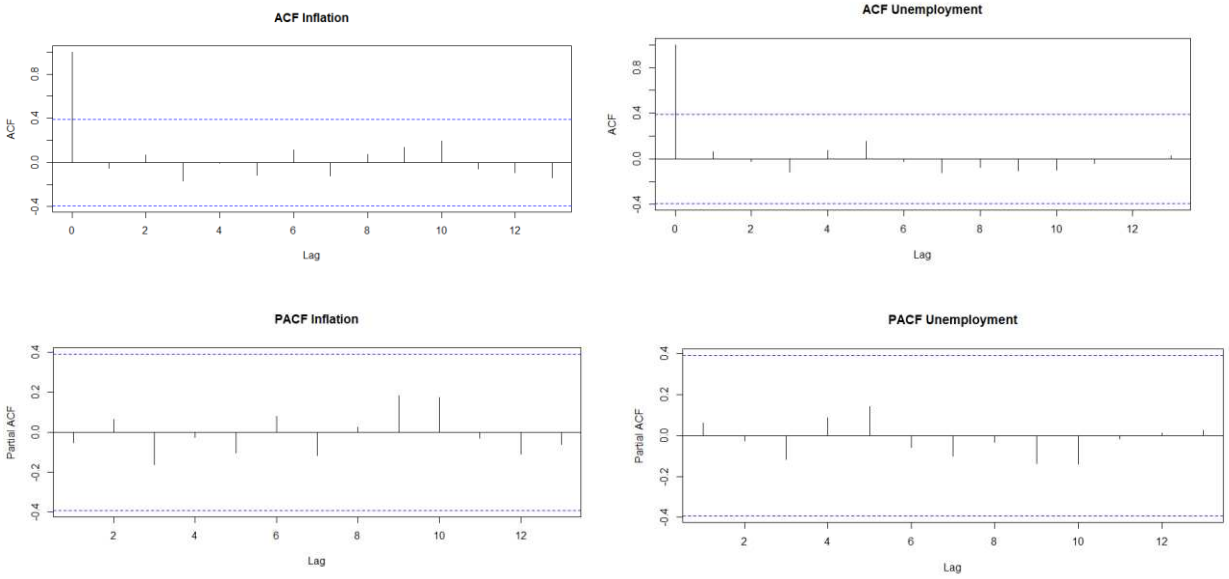

Fig. 4. Indicates autocorrelation function (ACF) and partial autocorrelation function (PACF)
Source: Authors elaborations based on the World Bank database [prepared in R Studio]

3.2. Methods

3.2.1. Ordinary Least Square (OLS) method

The first step in performing OLS is conducting unit root tests to identify whether the data is stationary or non-stationary. If the tests indicate that the data is stationary then we can start implementing OLS while otherwise we have to transform them. The OLS model with two variables is known as a bivariate linear regression.

$$Y_i = b_i + b_2 X_i + e_i \quad (1)$$

or

$$= Y_i - b_i - b_2 X_i - e_i \quad (2)$$

Where Y_i stands for the dependent variable (inflation rate in Yugoslavia) while the X_i indicates the independent variable (unemployment rate) and e_i for the error term. While b_i and b_2 represent the estimated coefficients. The time-series data that are differenced one time than they are considered to be integrated at order one I(2) and if two times differenced at order two I(2) and so on. When the data are transformed into stationary by using differencing then they miss the long-run relationship. For this purpose, the OLS is not preferred for the non-stationary data that are transformed into stationary.

3.2.2. Vector Autoregression (VAR) model

Vector Autoregression (VAR) model it is widely used technique in forecasting, policy analysis, data description and structural inference. The model captures the feedback causality effect within dependent and independent variables based on their past data. The bivariate VAR model is generally constructed with two variables and one lag.

$$y_t = a_1 + b_{11} y_{t-1} + b_{12} x_{t-1} + u_t \quad (3)$$

$$x_t = a_2 + b_{21} y_{t-1} + b_{22} x_{t-1} + v_t \quad (4)$$

or the Matrix form

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = \begin{bmatrix} a_1 \\ a_2 \end{bmatrix} + \begin{bmatrix} b_{11}\, b_{12} \\ b_{21} b_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ x_{t-1} \end{bmatrix} \begin{bmatrix} u_t \\ v_t \end{bmatrix} \quad (5)$$

The variables y_t dhe x_t must be stationary and if they are not then log transformation and differencing must be applied. An additional important process in the VAR model is determining the number of lags within the model. The four diverse information criteria were used to determine the optimal lags, such as Akaike Information Criterion (AIC), Hannan-Quin (HQ), Schwarz (SC), and Akaike Final Prediction Error (FPE).

3.2.3. Johansen cointegration test

The cointegration test analyzes the short and long-run relationship between the time series variables (Engle and Granger, 1987). Moreover, the test measures the cointegration relation within nonstationary time series variables. Basically when a one-time series variable follows the other then it is considered that they form a cointegration relationship.

The generalized formula stands as follows

$$x_v = B_1 x_{v-1} + e_v \quad (6)$$

where

$$\Delta x_v = B_1 x_{v-1} - x_{v-1} + e_v \quad (7)$$

$$= (B_1 - I) x_{v-1} + e_v \quad (8)$$

The x_v and e_v are considered vectors.

4. Results

4.1. OLS findings

The results from the ordinary least square (OLS) indicate that unemployment positively affects the inflation rate which stands against the theoretical paradigms. The Phillips curve claims that the relationship is negative since reducing the unemployment rate (generated from higher growth) is followed by a higher inflation rate. According to Table 2 the p-value < 0.05 indicates that unemployment was significantly influencing the inflation rate in Yugoslavia. Adjusted R2 and R2 stand at low levels since the model use only one independent variable. However, the explanatory power of unemployment in this model according to Adjusted R2 is 36.8%.

Table 2. OLS results

Dependent Variable: Inflation			
Unemployment	2.188***	Observations	25
	(0.565)	R2	0.394
Constant	0.028	Adjusted R2	0.368
	(0.040)	Residual Std. Error	0.198 (df = 23)
		F Statistic	14.985*** (df = 1; 23)

Coefficients:

	Estimate	**Std. Error**	**t-value**	**Pr (>|t|)**
(Intercept)	0.02815	0.03961	0.711	0.484391
Unemployment	2.18777	0.56517	3.871	0.000775 ***

Note: *p<0.1; **p<0.05; ***p<0.01

Source: Authors elaborations based on the World Bank database [prepared in R Studio]

Since the data collection covers the period from 1965 to 1990, the number of observations for each variable is 25. The estimated coefficient for unemployment is 2.18, so basically a 2.18% increase in unemployment increase the inflation rate by 1%.

4.2. VAR estimation results

The VAR model is an additional test used to verify the relationship between unemployment and inflation in Former Yugoslavia. The first process in the VAR model requires determining the optimal lags based on the information criteria. To specify the univariate VAR involving two series, the order *p* is specified based on Akaike

Information Criterion (AIC), Hannan-Quin (HQ), Schwarz (SC), and Akaike Final Prediction Error (FPE). According to R studio outcomes, all the selection criteria (AIC, HQ, SC, and FPE) suggest using one lag in the model. The higher the number of lags, the lower the degrees of freedoms and number of observations. The results from Table 3 show in both models M(1) and M(2) inflation holds negative estimated coefficients while unemployment is a positive one. The variables inflation and unemployment appeared to be insignificant with a p-value > 0.05. However, all of the roots stand within the unit circle which we can conclude that the system is stable.

Table 3. VAR estimation results based on two models M(1) and M(2).

	M(1)	**M(2)**		**M(1)**	**M(2)**
Inflation.l1	-0.098	-0.037	Observations	24	24
	(0.187)	(0.029)	R2	0.013	0.101
Unemployment.l1	0.251	0.147	Adjusted R2	-0.081	0.016
	(0.657)	(0.100)	Residual Std. Error (df = 21)	0.177	0.027
const	0.073*	0.017***	F Statistic (df = 2; 21)	0.139	1.183
	(0.037)	(0.006)			
Note:	*p<0.1; **p<0.05; ***p<0.01				

Source: Authors elaborations based on the World Bank database [prepared in R Studio]

Several tests have been performed to diagnose our VAR model, such as serial correlation, heteroscedasticity, normality tests. The Portmanteau Test (asymptotic) measures the serial correlation for our VAR model. Since the p-value > 0.05 in the Portmanteau Test, our model does not suffer from the serial correlation issue. Moreover, the model does have a heteroscedasticity issue where based on the ARCH (multivariate) the p-value > 0.05. An additional test conducted for our VAR model (named "ModelPhillip2") was to test the normal distribution of the residuals. Standing on the JB-Test, Skewness, and Kurtosis our model passes the normality test. In this context, the p-value in each of the tests is higher than 5% and our data are normally distributed. The 6th and 7th test indicates the Granger causality test for the variables unemployment and inflation. The first H0 (6th Test) claims that inflation does not Granger cause unemployment and we cannot reject this hypothesis since p-value > 0.05. The second H0 (7th Test) reports that unemployment does not Granger cause inflation and again we cannot reject the H0 since p-value > 0.05. Based on the sample that we have for the Yugoslavia from 1965 to 1990 the unemployment does not Granger cause inflation and the other way around.

Table 4. Diagnostic tests for the VAR model.

1st Test	Portmanteau Test (asymptotic) – Serial correlation test. Data: Residuals of VAR object ModelPhillip2 Chi-squared = 34.816, df = 44, p-value = 0.8375
2nd Test	ARCH (multivariate) -Heteroscedasticity data: Residuals of VAR object ModelPhillip2 Chi-squared = 36, df = 108, p-value = 1
3rd Test	JB-Test (multivariate) – Normality Test data: Residuals of VAR object ModelPhillip2 Chi-squared = 3.9305, df = 4, p-value = 0.4155
4th Test	Skewness only (multivariate) – Normality Test data: Residuals of VAR object ModelPhillip2 Chi-squared = 2.5578, df = 2, p-value = 0.2783
5th Test	Kurtosis only (multivariate) – Normality Test

	data: Residuals of VAR object ModelPhillip2 Chi-squared = 1.3727, df = 2, p-value = 0.5034
6th Test	Granger causality H0: Inflation do not Granger-cause Unemployment data: VAR object ModelPhillip2 F-Test = 1.6483, df1 = 1, df2 = 42, p-value = 0.2062
7th Test	Granger causality H0: Unemployment do not Granger-cause Inflation data: VAR object ModelPhillip2 F-Test = 0.14624, df1 = 1, df2 = 42, p-value = 0.7041

Source: Authors elaborations based on the World Bank database [prepared in R Studio]

Figure 5 and 6 show the impulse response function *(irf)* for inflation and unemployment in the case of Yugoslavia. The *(irf)* function check both shocks caused by inflation and unemployment for the 20 periods ahead. In the short-run (three periods ahead) shock from inflation cause a negative effect on unemployment. In the long run, the shocks from inflation to unemployment are smoothed and the effect is zero. To this end, we can conclude that there is a short-run effect of inflation on the unemployment rate considering the error term. The second figure indicates the positive shocks of unemployment on the inflation rate. Still, the reaction is almost identical where the short-run effect is observed while no long-run influence is observed. Considering the error term, the positive shock of unemployment cause a positive effect on inflation in the short run.

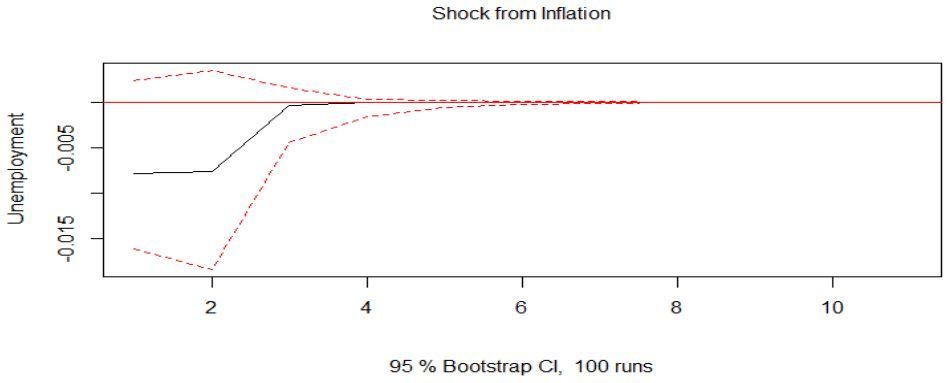

Fig. 5. Represents impulse response function *(irf)* for inflation
Source: Authors elaborations based on the World Bank database [prepared in R Studio]

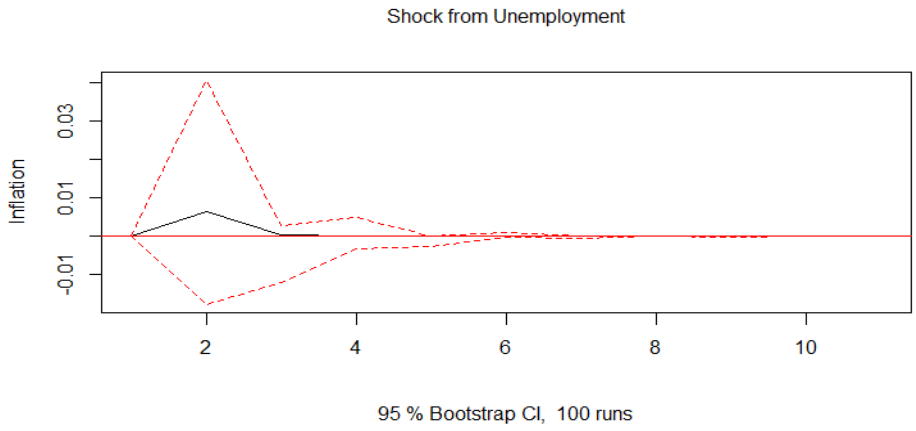

Fig. 6. Represents impulse response function *(irf)* for unemployment
Source: Authors elaborations based on the World Bank database [prepared in R Studio]

An additional function of the VAR model is forecasting the variables which are displayed in Figure 6 in the appendix. Forecasting was applied 4 years ahead using a 95% confidence interval (ci = 95%) in the context of unemployment and inflation in Yugoslavia.

4.3. Johansen Co-integration tests

The Johansen test stands as an important statistical technique for testing cointegration among time series variables. After imposing log transformation and differencing our data are normally distributed and do not suffer from stationary issues. There are two types of Johansen cointegration tests such as trace statistics and maximal eigenvalue where the inference might be different. Since the Johansen test is derived from the VAR model, determining the number of lags is important. The lag selection criteria provide these information where AIC = 7, HQ = 7 , SC = 1 and FPE = 2. The minimum number of lags allowed in the R program is 2. Based on this fact, we were constrained to use the AIC and HQ number of lags which is 7. Since we have chosen 7 lags in the model we are constrained to use 6 lags *(n-1)*.

Table 5. Testing for short-run cointegration between inflation and unemployment.

Trace Statistic					**Maximal Eigenvalue Statistic**				
	test	10pct	5pct	1pct		test	10pct	5pct	1pct
r <= 1 |	3.83	7.52	9.24	12.97	r <= 1 |	3.83	7.52	9.24	12.97
r = 0 |	16.64	17.85	19.96	24.60	r = 0 |	12.81	13.75	15.67	20.20

Source: Authors elaborations based on the World Bank database [prepared in R Studio]

Table 5 displays the Johansen cointegration results for Trace Statistics and Maximal Eigenvalue. In our case, we are using only two variables such as unemployment and inflation and we might have only one cointegration. As we can see both tests (Trace Statistics and Maximal Eigenvalue) indicate results at 1% significance level, at 5% and 10% significance level. Generally in social science, it is used the significance level at 5%.

Trace statistics indicate that when r=0, test statistics are lower than the 5% significance level (16.64<19.96). The identical situation occurs when r<=1, the test statistics is again lower than the 5% significance level (3.83 < 9.24). The Trace Statistics shows that there exists one cointegration relation between unemployment and inflation. The results from the Maximal Eigenvalue show the same wherein the case of r=0, test statistics are lower than the 5% significance

level (12.81 < 15.67). In the same line went the outcomes for r<=1, where 5% significance level is higher than the test statistics (3.83 < 9.24). To this end, Eigenvalue tests indicate that there exists one cointegration relation between two variables.

5. Conclusion

Reducing the unemployment rate and keeping inflation under control remains the goal of any economic policy. The SFRY, which was neither part of Eastern nor of the Western one, applied a unique economic system known as self-management socialism. It allowed the private initiative to a limited extent and a considerable part of the economic activities made SFRY a mixed economy, combining indicative planning at the national level with the market needs. The economy suffered persistently from high unemployment rates where the oil crisis of the 1970s exacerbated the problem. Inflation was another chronic problem, reaching double-digit levels in the mid-1980s while tripled during 1988-89. In this respect, we analyzed this relationship by recognizing the data limitations in a one-party political system and with a specific economic model. The OLS results indicate a positive relationship between unemployment and inflation, which conflicts with the Philips curve outcomes. An increase in the inflation rate by 1% caused unemployment in Yugoslavia to increase by 2.18%. The causality test indicates the unemployment does not Granger cause inflation and the other way around. Another test used to measure the short-run and long-run relationship between unemployment and inflation is the impulse response function (IRF). The results from the IRF suggest that in the short-run positive shock of inflation caused a positive effect on the unemployment rate and vice versa. Since the IRF is created for the 20 periods ahead, in the long run, shock from unemployment to inflation and the other way around is mitigated. The deterioration of monetary policy and fiscal discipline by the end of the 1980s has made the Philips curve steeper upwards. The money supply increased significantly to write off the debts of SOEs while the output was dropping and unemployment rising. The Johansen test, a widely used statistical technique for measuring a co-integration level among time series variables has also been applied in our case study. Standing on the Trace Statistics and Maximal Eigenvalue, the significance level is always higher than trace statistics that indicates a co-integration between unemployment and inflation rate.

The early Yugoslav communists and theorists were right when they maintained that socialism is an evolutionary system to justify their model of self-management. In reality, it proved to be revolutionary in many ways until it collapsed with enormous consequences through the civil wars that followed. The limitation of this research is in its historical aspect as it takes into consideration an economic system that has gone together with the country in which it was implemented. Another limitation is that the Yugoslav model allowed a greater scope of private ownership than in any other socialist country, thus many unofficially unemployed people such as the peasants managed to make their living and generate incomes from subsistence activities such as agriculture. This accounted for a sort of allowed informal sectors, thus the national unemployment data included them desp-ite being engaged in some kind of economic activities. The third limitation was linked with the regional development disparities (developed north and underdeveloped south) where the unemployment rate varied considerably. Therefore, future research of particular relevance and importance would be to investigate the regional development disparities in former SFRY, to learn the lessons about current development disparities in the Eurozone that operate under common currency and the market mechanism.

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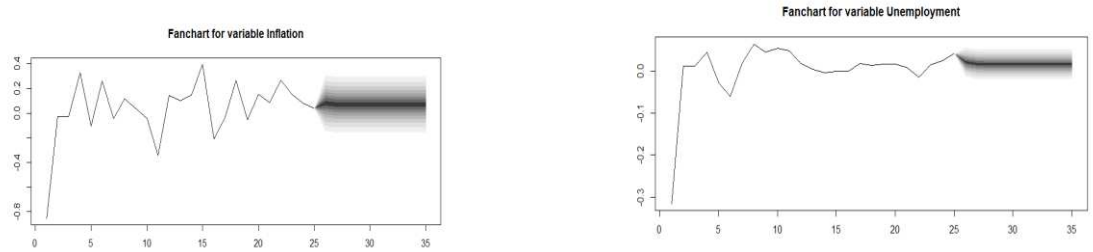
Appendix

Fig. 7. Forecasting the Yugoslavian unemployment and inflation rate four years ahead**.**



Source: Authors elaborations based on the World Bank database [prepared in R Studio]