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Research Paper

The Role of Aggregate Cost Stickiness in Unemployment Rate Prediction

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ABSTRACT

Predicting macroeconomic indicators is very important for policymakers and economists. Unemployment is one of the key indicators of macroeconomics that has adverse economic and social consequences. So far, many models have been proposed to predict this variable, but models in which accounting information was used to predict unemployment rate were ignored. The purpose of this paper is to investigate the relationship between aggregate cost stickiness, as one of the known variables in accounting, and unemployment rate. To this end, seasonal macro level time series data of Tehran Stock Exchange (TSE) and macroeconomic data are analysed in two stages from 2008:2 to 2018:1. In the first stage, the relationship between these two variables is determined by specifying a linear regression model that is estimated using the OLS method. To investigate the predictive power of this model, the RMSE criterion was estimated in two scenarios with and without aggregate cost stickiness. Secondly, the reaction of the unemployment rate in response to a shock from aggregate cost stickiness is estimated by a Vector Autoregressive (VAR) model and the share of this variable is measured in the fluctuations of unemployment rate. The results show that aggregate cost stickiness improves the forecast of unemployment rate in the horizon previous. Also, the shock of aggregate cost stickiness explains about 6.5 percent of unemployment rate fluctuations.

1 Introduction

The labor market is always subject to constant change, even when the economy is in equilibrium. Despite the 23 million workers in Iran, the unemployment rate is still high. According to the statistics presented in 2018, the unemployment rate in the whole country is about 12%. However, more than one million people are actively being added to job seekers each year, leaving a limited number of employees

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[24]. Employment is one of the key variables of the economy that has always been discussed by economists and policymakers. This variable has many economic and social effects and is affected by various factors. Thus, predicting the unemployment rate in macro planning is very important. In economics, many models have been proposed to predict this variable. The Phillips Curve Theory is a well-known example of an inverse relationship between unemployment rate and inflation. According to this theory, it is challenging for economic policymakers to choose the optimal rate of unemployment and inflation. Okun's law is another example of an inverse relationship between economic growth and unemployment rate. Despite presenting economic models of forecasting unemployment rates, there are still many challenges in predicting this variable. Despite presenting economic models of forecasting unemployment rates, there are still many challenges in predicting this variable. More recently, Roxelin et al. [29], Nalardi and Ognova [27], Shivakomar and Okay [32], Abdullah and Carbias [1], and Kanchicheki and Patatokas [20], provide evidence of the relationship between corporate accounting information and macroeconomic variables and they have inferred in particular economic growth and unemployment. However, models that use corporate accounting information to predict unemployment rate in the Iranian economy have received less attention. One factor that can reduce many of the uncertainties surrounding unemployment rate forecasts is the aggregate cost stickiness (Roxelin et al. [29]). Evidence shows that corporate spending increases as sales revenue increases, while it does not decrease symmetrically when sales revenue decrease, so that cost stickiness can be in line with inflation and with unemployment rates have the opposite relationship and improve their forecasts. Thus, the purpose of this study is to investigate the role of aggregate cost stickiness of companies in TSE in forecasting unemployment rate in the framework of time series data analysis. The rest of this article is organized as follows: The second section describes the theoretical foundations of the relationship between cost stickiness and unemployment rates; the third section presents the research background. In the fourth section, research hypotheses and models corresponding to them are introduced. Section 5 presents data and sampling methods. In the sixth section, the results of the research are analyzed, and in the last section, while testing the hypotheses, several suggestions are made to policymakers.

2 Literature Review

In traditional models of cost behavior in management accounting, variable costs increase or decrease proportionally to changes in activity volume. That is, the rate of change in costs depends only on the rate of change in activity volume (Hilton [15] and Horngren et al. [16]). But new research, such as the studies by Kalijah et al. [10] and Roxelin et al. [29], suggests that the rate of increase in costs when increasing activity levels is greater than the decrease in costs when decreasing activity volume. They define this asymmetric cost behavior by the cost stickiness. The concept of cost stickiness can be illustrated by Fig. 1, which is new to the accounting literature. The horizontal axis of this graph is the sales and the vertical axis are the costs, which comprise the sum of the costs of sales and administer expenses and selling and the cost of goods sold (SG&A). The black graph shows the company's cost curve, which is a function of the company's sales level. Following the increase in sales, there is a bullish trend on this chart. Similarly, in the absence of cost stickiness, costs are reduced on the black curve by decreasing sales levels. The cost stickiness states that when reducing sales from Q1 to Q2, the cost reduction will not be dependent on the sales level. In this case, the cost on the red curve will rise from C1 to C2. Therefore, cost stickiness suggests that costs reduction is reduced at a slower rate than the firm's sales revenue stickiness. In the present study this type of stickiness is called incomplete cost stickiness. Also,

the cost curve will shift horizontally if the cost level is completely inelastic by the stickiness in sales. This is referred to as full cost stickiness.

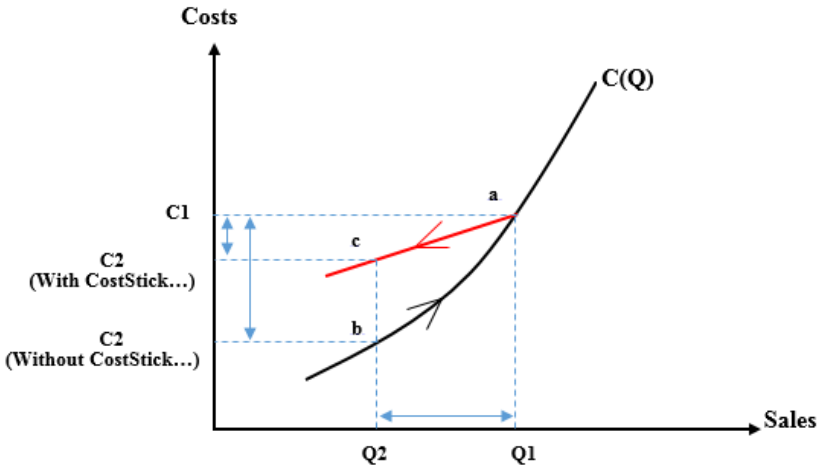


Fig. 1: Graph of costs with and without stickiness

There are many reasons for cost stickiness. Agent theory, manager forecasting, and earnings forecasting are the most important reasons for the existence of cost stickiness in accounting literature (Sepasi and Kazempour, [30]). One of the most important costs associated with the level of activity of the company is labor costs. So, the cost stickiness is related to unemployment in this way. According to agency theory, which points to contrary of interests between managers and shareholders, management tends to over-optimize the company and maintain resources to promote individual status, including power and credibility (Chen et al., [11]). According to this theory, managers do not immediately reduce their workforce as part of resources by reducing activity levels. As such, wages and salaries and other labor costs are not reduced by decreasing activity levels and decreasing sales. As a result, firstly, costs will not go down one-on-one with sales, they will be sticky, and secondly, there is a reverse relationship between cost stickiness and workers' unemployment. Long-term trends in corporate sales are usually positive. Therefore, managers prefer the optimistic view to the pessimistic view of future earnings. In other words, managers evaluate short-term earnings reduction on a temporary basis so that managers can predict future earnings more than current earnings and prefer to retain the resources used at the time of earnings reduction to maximize earnings over time.

Next, make up for their costs. If managers adjust their workforce as one of the most important resources related to operational activities during the sales downturn, education and retraining of the workforce through the hiring and training process takes time. This way, if the resources and thus costs are reduced in proportion to the decrease in sales, the company loses the opportunities for sales development. As such, managers' optimism about future earnings leads to cost stickiness, although upward adjustment and downward adjustment are not symmetric (Banker et al. [7]). The existence of contracts between workers and managers is another source of cost-stick formation (especially wage costs). If managers see higher net benefits of retaining workers when compared to lower sales revenue, compared to the cost of paying insurance and the costs of hiring and training new workers in the long-term plan of the firm, they would rather retain workers (Branson, [9]). Information asymmetry is another case that can be a reason for cost stickiness and its relation to unemployment. In economists' terms, it can be said that information is transmitted slowly in the labor market, resulting in a slow adjustment. As a result, the company's expenses are not adjusted immediately as sales revenue declines. According to Anderson

et al. [2], the relationship between cost stickiness and unemployment is related to the costs of matching resources such as costs of hiring and firing workers or costs of installing and removing equipment. The greater magnitude of matching costs leads to greater cost stickiness, as firms' behavior with regard to voluntary decision making is asymmetric (Banker et al., [7]). For example, managers are reluctant to fire employees because of the significant training costs faced by sales reductions, the maintenance of unused resources can prevent staff dismissal costs and new training costs when hired. In contrast, when an activity increases, although managers are reluctant to hire more staff because of the matching costs, the current sales increase will only occur if more employees are hired, thereby neglecting the impact of greater reluctance. (Bunker and Baizalov, [8]).

3 Research Background

Naghdi et al. [25] examined the impact of accounting information on economic variables using data from 88 stock companies over the period from 2006 to 2016. Their results show that accounting information fluctuations are considered as a predictor of fluctuations in economic variables. In another study, Naghdi et al. [26] designed and explained an economic growth forecasting model with an accounting approach using a neural network hybrid model and artificial intelligence. According to their results, the effectiveness of operating activities, especially aggregate accounting earnings, in predicting GDP is greater than in financing and investment activities, and this relationship is greater in the mining and industrial sectors. Anderson and Khamovich [3] examined the asymmetric behavior of spending versus sales revenue changes. The results of the study indicate the existence of cost sticky behavior by incorporating variables and macroeconomic variables such as inflation and interest rates. Kanchitacheki and Patatokas [21] examined the role of aggregate accounting earnings in predicting GDP growth. They show that aggregate earnings are an important factor in predicting GDP growth over the next three or four periods. In another study, Kanchitacheki and Patatokas [22] show that portfolios consisting of 100 companies in the US stock exchange are a good way to extract the data needed to predict GDP growth. Also, they show that the earnings data of one hundred companies has good explanatory power in predicting GDP growth rate. Kim and Wang [19] examined the risk of workers' unemployment and cost-stick behavior. They believe that companies take the risk of joblessness into account when adjusting resource adjustment policies. Their results also show that costs increase more in response to increased sales than the same decrease in response to reduced sales. The results of this study show that an increase in the benefits of unemployment insurance leads to a decrease in the stickiness of administrative, public and sales costs.

Shiva Kumar and Okay [32] study the impact of total accounting earnings on inflation. He used both consumer price index (CPI) and producer price index (PPI) to measure inflation. The results suggest that total accounting benefits do not include information content related to CPI, while they have the necessary explanatory power to predict and explain PPI. They also believe that total accounting earnings can explain PPI forecasting error and thereby mitigate inefficiencies in predicting economic experts. Gallo et al. [12] show that accounting variables, especially aggregate accounting earnings, are able to predict and explain future changes in inflation, unemployment, and GDP growth rates. Gear et al. [13] showed that negative changes in total accounting earnings, compared to positive changes, are a more accurate way of predicting GDP growth, thereby reducing forecast error. Shulin et al. [31] have examined the impact of corporate tax avoidance on macroeconomic variables. Their results using the OLS method show that the relationship between tax avoidance and macroeconomic variables is statistically significant for the next four periods. Alon Kailey et al. [17] examined the relationship between the dispersion of aggregate earnings and unemployment as well as industrial production. According to their

results, earnings dispersion can reduce the error of forecasting unemployment and industrial production. Saeedi and Ghajar [14] examined the relationship between accounting earnings and GDP in Companies Listed in TSE from 2009 to 2013. Results show a significant relationship between accounting earnings and GDP growth rate, and control variables including inflation rate and unemployment rate have a significant relationship with GDP growth rate and GDP forecast. Roxelin et al. [29] examined the relationship between aggregate cost stickiness and unemployment rates in the US using time series data. Their results show that, firstly, cost stickiness improves unemployment rate forecasts, and secondly, there is a positive shock to the cost stickiness of lowering unemployment rates. Nalari and Agnova [27] believe that, first, aggregate accounting earnings are not only capable of predicting the unemployment rate, but are also quite effective in explaining the error associated with initial estimates of the unemployment rate. Second, it is possible to predict GDP growth using accounting information. Edomilam et al. [29] examined the relationship between aggregate accounting earnings on unemployment rates among Nigerian firms between 2006 and 2017 using time series data.

The results of this study show that the growth of aggregate earnings has a negative and significant relationship with unemployment changes. Lalvani and Chucker [23] examined the relationship between aggregate accounting earnings changes and GDP growth in 8 countries like Australia, Canada, China, India, Japan, South Korea, Britain and the United States and they have found that aggregate accounting earnings leads to economic growth, and GDP growth forecasts are improved using accounting earnings information.

4 Research Methodology

This research, in terms of purpose, is an applied one and a quasi-experimental, post-event research and carry out based on historical information. To data collection of research literature review publications, books, and also available databases have been used. In order to analyze the relationship between variables of the research, econometrics methods include linear Ordinary Least Square (OLS) regression and Vector Autoregressive (VAR) model were used.

4.1 Research Methodology

Since the aim of this study is to investigate the role of aggregate cost stickiness in predicting the unemployment rate, the following three hypotheses have been developed:

Hypothesis 1: aggregate cost stickiness has a significant effect on unemployment rates in future periods.

Hypothesis 2: stickiness of aggregate costs reduces the forecast error of unemployment rates in future periods.

Hypothesis 3: The aggregate cost stickiness shock reduces the unemployment rate for future periods.

According to Roxelin et al. [29] aggregate cost stickiness is one factor that can reduce many of the uncertainties about unemployment rate forecasts. Evidence shows that corporate spending increases as sales revenue increases, while it does not decrease symmetrically when sales revenue decrease, so that cost stickiness can be in line with inflation and with unemployment rates have the opposite relationship and improve their forecasts. Agent theory, manager forecasting, and earnings forecasting are the most important reasons for the existence of cost stickiness in accounting literature (Sepasi and Kazempour, [29]). One of the most important costs associated with the level of activity of the company is labor costs. So, the cost stickiness is related to unemployment in this way.

4.2 Model

The study of the relationship between aggregate cost stickiness and unemployment rate in this research is done in two stages. In the first stage, the relationship between these two variables will be determined by a linear regression model estimated by the OLS method. In this model, the role of aggregate cost stickiness in estimating and predicting unemployment rate is examined. Secondly, by specifying a VAR model, the unemployment rate in response to a shock from aggregate cost stickiness is estimated and its dynamics are plotted against time and the contribution of cost stickiness to the volatility of this variable is measured. Thus, in the first step, the following equation has been explicitly modified following Roxelin et al. [29], Aruba [4], Kanchitscheki and Patatokas [20] and Nalardi and Ognova [27] for the next four periods:

$$\mathrm{UR_{t+k}} = \alpha_{1k} + \alpha_{2k}\mathrm{AggCostStickiness_t} + \alpha_{3k}\mathrm{Controls_t} + \varepsilon_{t+k} \quad (1)$$

Where t represents the period of time and is equivalent to one season and UR_t is the unemployment rate. $AggCostStickiness_t$ shows cost stickiness and is measured by the following relationship:

$$\log\left(\frac{(\mathrm{COGS+SG\&A})_{i,t}}{(\mathrm{COGS+SG\&A})_{i,t-4}}\right) = \beta_0 + \beta_1 \log\left(\frac{\mathrm{SALES_{i,t}}}{\mathrm{SALES_{i,t-4}}}\right) + \beta_2 D_1 + \beta_3\left(D_1 \times \log\left(\frac{\mathrm{SALES_{i,t}}}{\mathrm{SALES_{i,t-4}}}\right)\right) + \varepsilon_t \quad (2)$$

Where "COGS" is the cost of goods sold, "SG&A" is the sum of the costs of sales and administer expenses and selling and the cost of goods sold and "SALES" is the sales revenue. "D_1" is a livestock variable that takes the number one and otherwise zero if company sales decline. The coefficient "β_3" in the above relation shows the cost stickiness. The above relationship is estimated to be cross-sectional for sample firms. The first change in the model of this study is related to the uncertainty variable of the Roxelin et al. [29] model, while in this study the uncertainty of oil exports is used with respect to the structure of the Iranian economy. The oil export uncertainty variable is derived from the conditional variance in the following generalized autoregressive conditional heteroscedasticity (GARCH) model:

$$VAR(\varepsilon_t) = H_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i {\varepsilon^2}_{t-i} + \sum_{j=1}^{q} \beta_j H_{t-j} \quad (3)$$

The significance of α_i in relation (3) means that the conditional variance (H_t) is sensitive to fluctuations of previous periods and responds rapidly to market stimuli. Also, positive and significant value of β_j coefficient indicates export uncertainty. That is, oil export uncertainty persists over time and shifts from one period to the next. In other words, it takes a relatively long time for change. The second change in the model relates to the two variables Employment Growth Dispersion (Emp-gr-Disp) and Stock Return Dispersion (Ret-disp). In this study, instead of using the residuals of a second-order autoregressive model or AR (2) to measure the dispersion of the aforementioned variables, the residuals of the autoregressive moving average (ARMA) models were optimized based on the Schwartz information criterion (SIC) and Akaike (AIC) are used. This change is consistent with time series econometric theories. The ARMA model (p, q) is generally stated as follows:

$$Y_t = \beta_0 + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{j=0}^{q} \gamma_j \varepsilon_{t-j}, \gamma_0 = 1 \quad (4)$$

In the above relation Y_t refers to each of the variables of employment growth and stock returns. Also p and q are the number of self-regressive component (AR) and moving average (MA) breaks, respectively, which are calculated by Schwartz and Akaike criteria based on the relations (5) and (6), respectively:

$$\text{SBIC} = ln(\hat{\sigma}^2) + \frac{k}{T}(lnT) \tag{5}$$

$$\text{AIC} = ln(\hat{\sigma}^2) + \frac{2k}{T} \tag{6}$$

Where $\hat{\sigma}^2$ is the variance of the residuals obtained from each regression (with hypothetical degrees p and q), k is the degree of freedom and T is the number of observations. If α_{2k} is significant in estimating relation (1), the first hypothesis of the research is that the effect of aggregate cost stickiness on unemployment rate will be significant in future periods. The Controls symbol in Equation (1) also shows the vector from the control variables of the research as in Table 1:

Table 1: Vector of control variables

Variable	Explanation
Adv-GDP	Forecast of real GDP growth by ARIMA model (the data of GDP is collected of the Central Bank of the Islamic Republic of Iran).
Earn	Aggregate Earning (following Roxelin et al. [28] Aggregate Earning is equal weighted average earnings (scaled by contemporaneous sales) available in quarter t).
D(Earn)	Change in Aggregate Earning
MKT-Ret	Market Return (Equal-weighted average return for our sample stocks available in quarter t).
Uncer	Uncertainty (Oil Export Uncertainty of Iran in the equation (3)).
Emp-gr-Disp	Employment Growth Dispersion (Residual of Growth Employment by ARIMA model in the equation (4)).
Ret-disp	Stock Return Dispersion (Residual of Market Return by ARIMA model in the equation (4)).
IR	Interest Rate (One-year deposit interest rate based on the time series data reported by the Central Bank of the Islamic Republic of Iran).
INF	Inflation Rate (Percentage growth of consumer price index (CPI) based on the time series data reported by the Central Bank of the Islamic Republic of Iran).

To investigate the predictive power of relation (1), the RMSE criterion is used in two scenarios. In the first scenario, there is aggregate cost stickiness in the model and the relationship prediction error (1) is measured. In the second scenario the aggregate cost stickiness is not present in relation (1).

$$RMSE = \sqrt{\sum_{t=T+1}^{T+n} \left(UR_t - \widehat{UR}_t\right)^2} \tag{7}$$

In relation (7) the symbols UR_t and $\widehat{UR}_t$ represent real and predicted unemployment rates, respectively. In the second step, a VAR model is based on Stoke and Watson's [34] and Roxelin et al. [29]. The VAR system under investigation consists of four endogenous variables that will be estimated based on Taylor's rule. Taylor's rule states how much the central bank changes its nominal interest rate in response to changes in inflation, output, and other economic conditions. Following Stoke and Watson [34], firstly, unemployment growth in this system will be replaced by product growth under Okun's law.

Secondly, the total cost is added to this stickiness system. As such, the relationship between unemployment growth and aggregate cost stickiness as an additional component of the VAR model is outlined below:

$$AZ_t = \emptyset Z_{t-k} + \varepsilon_t \quad (8)$$

Where Z_t is a vector of the endogenous variables of the VAR model including $AggCostStickiness_t$, IR_t, UR_t and INF_t, which refers to aggregate cost stickiness, interest rate, unemployment growth rate and inflation rate, respectively. The results of this VAR model are interpreted based on the impulse response functions (IRFs). The dynamics depicted by the IRFs of the VAR model test the third hypothesis of the study, where the dynamics of unemployment growth rates are obtained by responding to shocks to inflation, interest rates and total cost stickiness. Finally, as an implied analysis of the variance decomposition of the forecast error of unemployment growth rate in response to the shock inflicted by inflation, interest rate and aggregate cost stickiness are measured in the framework of the introduced VAR model. This tool expresses the share of aggregate cost stickiness from the fluctuations of unemployment rate growth.

5 Data and Findings

5.1 Data set

The data in this study is time series and covers a period of 10 years from 2008:1 to 2017: 4 seasonally. Accounting data are elicited from the financial statements and explanatory notes of the listed firms via TSE websites and Rahavard Novin software. In addition, the economic data have been obtained from the Central Bank of the Islamic Republic of Iran. The final data are analyzed using Eviews software. Elimination method was used to select the population of micro level data (companies). For this purpose, the following criteria are considered and if one company meets all the criteria, it is selected as one of the available statistical society companies. Companies listed on the TSE constitute the statistical community of the micro level data of this research. Sample selection conditions were as follows:

A. To be admitted to TSE by the beginning of 2008.

B. Their financial statements are available for each season from 2008 to 2017.

C. Their financial year ends March of each year.

D. The available statistical community does not include investment firms, financial intermediaries, banks, financial and credit institutions, and insurance and leasing.

E. Companies should not have more than one month of trading interruption during the period under review.

Table 2: Unit root test by ADF method

Variable	ADF Statistic	Prob
CH_UR	-2.586164	0.0113
ADV_GDP	-2.721910	0.0808
EARN	-18.01482	0.0001
D(EARN)	-5.320664	0.0001
MKT_RET	-7.369367	0.0000
UNCER	-2.159187	0.0002
EMP_GR_DISP	-6.008390	0.0000
RET_DISP	-6.430571	0.0000
IR	-2.080579	0.0005
INF	-2.866378	0.0586

Accordingly, 121 companies were selected as the sample of micro level data. This part of the research is devoted to the estimation of models specified in the previous section. Since the research data are of time series type, a unit root test was performed before any estimation.

5.2 Unit root test

Each time series is the product of a random process. When a random process is stationary, the mean and variance are constant over time, and the covariance between two time periods depends only on the interval or interruption between the two time periods and has no relation to the real time covariance calculation. If the time series variables are not stationary, there may be a problem called spurious regression. In this study, the Augmented Dickey-Fuller (ADF) method was used to test unit root or stationary data. In this test the following regression equation is estimated:

$$\Delta y_t = \alpha + \delta y_{t-1} + \sum_{i=1}^{k} \theta_i \Delta y_{t-i} + \varepsilon_t \quad (9)$$

In this regression, if the null hypothesis, $\delta = 0$, is not rejected, it means that the y_t series follows a random step process and is nonstationary. The results of this test at first level and difference are presented in Table 2. Based on the ADF test results in Table 2, all the research variables are static. Therefore, the regressions made in the following sections are not spurious regressions.

5.3 Estimation of OLS model

In this part of the research the Equation (1) in two scenarios, with the aggregate cost stickiness and without the aggregate cost stickiness, are estimated for 4 periods ahead and the results are shown in Tables 3 and 4, respectively. According to the results in Table 3, the effect of aggregate cost stickiness on unemployment rate in two and three periods ahead is statistically significant. The effect of real GDP growth on the unemployment rate for the two and three periods was negative significant in both models with and without aggregate cost stickiness. The impact of real GDP growth on the unemployment rate of the one leading periods is significant only in model without aggregate cost stickiness. The impact of aggregate earnings on the unemployment rate in both models in the second and third periods was negative and significant. The prediction power of relation (1) is then compared using the RMSE criterion in the two scenarios. In the first scenario, there is aggregate cost stickiness in the model and the relationship prediction error (1) is measured. In the second scenario the aggregate cost stickiness is not present in relation (1). The results are as Table 5. The results in Table 5 show that in models where there is no cost stickiness, the RMSE criterion in all four periods is higher than the cost stickiness in the present model. Thus, the existence of aggregate cost stickiness improves the unemployment rate forecast and reduces the unemployment rate forecast error. In the model, despite the aggregate cost stickiness, the lowest RMSE belongs to the previous two periods. This means that incorporating aggregate cost stickiness to the model improves the forecast of the next two seasons of unemployment.

5.4 Estimation of VAR model

This section presents a VAR model for observing the forecast and dynamics of the unemployment rate in response to the shock of inflation rate, interest rate and aggregate cost stickiness shocks. Two efficient IRFs and variance analysis tools are employed for this purpose.

Table 3: Estimation of unemployment rate using the OLS Method (Model with aggregate cost stickiness)

Variable	K=1	K=2	K=3	K=4
C	15.0662 (14.6660) [0.0000]	16.4932 (20.2421) [0.0000]	16.1647 (10.0666) [0.0000]	15.2217 (8.5370) [0.0000]
AGG-CostStick	-0.3523 (-0.3167) [0.7539]	-0.9784 (-1.7680) [0.0600]	-0.6414 (-2.1053) [0.0370]	-0.1888 (-0.1007) [0.9206]
Adv-GDP	-0.0212 (-0.9434) [0.3538]	-0.0102 (-1.6739) [0.0909]	-0.0308 (2.1048) [0.0455]	-0.0306 (1.1815) [0.2489]
Earn	-1.5477 (-1.0949) [0.2832]	-5.1906 (-2.6524) [0.0134]	-6.2371 (-2.2756) [0.0317]	-4.1260 (-1.3890) [0.1776]
D(Earn)	2.0180 (1.5333) [0.1368]	3.9481 (2.2327) [0.0343]	1.9388 (1.5322) [0.1380]	1.2398 (0.5502) [0.5872]
Mkt-Ret	0.8953 (-0.9689) [0.3411]	0.3371 (0.4576) [0.6510]	1.4263 (2.3124) [0.0293]	1.2921 (1.4980) [0.1472]
Uncer	4.48E-06 (0.6041) [0.5508]	-1.76E-05 (-2.1513) [0.0409]	-2.604E-05 (-1.6677) [0.1078]	-2.67E-05 (-1.7158) [0.0991]
Emp-gr-Disp	-5.2514 (-1.2230) [0.2319]	1.9528 (0.5202) [0.6073]	0.1475 (0.0268) [0.9788]	-6.6888 (-0.9355) [0.3588]
Ret-Disp	1.2356 (1.1947) [0.2426]	-0.1097 (-0.1340) [0.8944]	-1.6335 (-2.3733) [0.0256]	-1.4044 (-1.3074) [0.2035]
Ir	-0.2465 (-3.8423) [0.0007]	-0.2807 (-6.0292) [0.0000]	-0.2803 (-3.6178) [0.0013]	-0.2251 (-2.1455) [0.0422]
Inf	-0.0749 (-1.5570) [0.1311]	-0.1215 (-4.3408) [0.0002]	-0.0727 (-1.6719) [0.1070]	-0.0468 (-0.5044) [0.6185]
R-squared	0.4652	0.6709	0.6129	0.3422
F-statistic [Prob]	2.1669 [0.0537]	3.4600 [0.0052]	2.6325 [0.0241]	1.2485 [0.3120]
Durbin-Watson	1.6871	1.8405	1.6116	1.6403

Note: The numbers inside the parenthesis represent the t statistic, and the numbers in the bracket indicate the probability.

The model stipulated in the Taylor rule is based on the fact that the unemployment rate is replaced by Okun's law of economic growth and the aggregate cost stickiness is introduced as a new component.

Before performing any operation, it is noted that the prerequisite for the implementation of the VAR model is that all variables in the model are stationary.

Table 4: Estimation of unemployment rate using the OLS Method (Model without aggregate cost stickiness)

Variable	K=1	K=2	K=3	K=4
C	15.1172 (14.6637) [0.0000]	16.4304 (21.0469) [0.0000]	16.1765 (10.7265) [0.0000]	15.2217 (8.5370) [0.0000]
Adv-gdp	-0.0205 (-1.8029) [0.0742]	-0.0127 (-3.0637) [0.0125]	-0.0312 (-2.0135) [0.0545]	-0.1888 (-0.1007) [0.9206]
Earn	-1.5280 (-1.1130) [0.2752]	-5.5016 (-2.8575) [0.0081]	-6.2037 (-2.1839) [0.0382]	-4.1260 (-1.3890) [0.1776]
D(Earn)	1.8546 (1.6954) [0.1011]	4.7101 (3.1171) [0.0043]	1.8317 (1.2991) [0.2053]	1.2398 (0.5502) [0.5872]
Mkt-Ret	-0.8932 (-0.9724) [0.3391]	0.2638 (0.3612) [0.7207]	1.4379 (2.2999) [0.0297]	1.2921 (1.4980) [0.1472]
Uncer	-4.28E-06 (0.5879) [0.5613]	-1.77E-05 (-2.2037) [0.0363]	-2.60E-05 (-1.7051) [0.1001]	-2.67E-05 (-1.7158) [0.0991]
Emp-gr-Disp	-4.4829 (-1.0420) [0.3063]	0.1769 (0.0509) [0.9597]	0.3903 (0.0764) [0.9397]	-6.6888 (-0.9355) [0.3588]
Ret-disp	1.2129 (1.1538) [0.2583]	0.0350 (0.0425) [0.9664]	-1.6552 (-2.3371) [0.0274]	-1.4044 (-1.3071) 0.2035
Ir	-0.2451 (-4.0131) [0.0004]	-0.2861 (-6.8464) [0.0000]	-0.2796 (-3.5010) [0.0017]	0.2251 (-2.1455) [0.0422]
Inf	-0.0739 (-1.5647) [0.1289]	-0.1242 (-4.4836) [0.0001]	-0.0723 (-1.6131) [0.1188]	-0.0468 (-0.5044) [0.6185]
R-squared	0.4443	0.5645	0.5127	0.3422
F-statistic Prob	2.4883 [0.0313]	3.8891 [0.0028]	3.0404 [0.0127]	1.2485 [0.3120]
Durbin-Watson	1.6928	1.8533	1.6111	1.6403

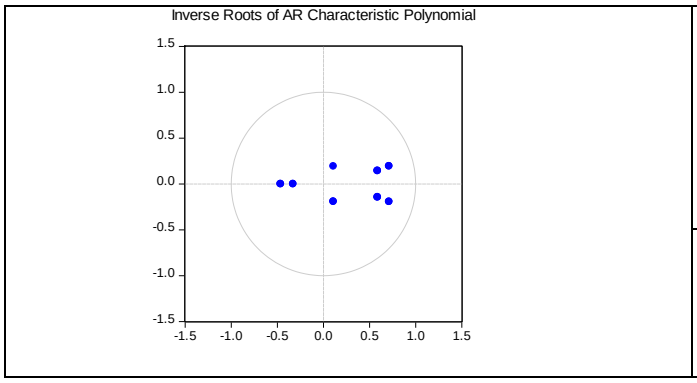
Note: The numbers inside the parenthesis represent the t statistic, and the numbers in the bracket indicate the probability.

If this condition is not met, the variable will not return to equilibrium and steady state in the event of a shock. Since all model variables under investigation are stationary (as shown in Table 2), therefore, there is no problem in this regard. In addition, the VAR model under investigation has to be estimated at the optimum lag and eventually stability, meaning that none of the roots of the VAR model are outside the unit circle. Fig. 2 shows the optimal lag and stability for the VAR model.

Table 5: Models' forecast performance evaluation results by RMSE criterion

Model	K=1	K=2	K=3	K=4
With Agg-CostStick …	0.8204	0.5625	0.6201	0.9612
Without Agg-CostStick …	0.9011	0.7682	0.8203	0.9614

Source: Research findings



Optimal lag based on AIC criteria

Absolute magnitude of largest model root: 0.73

Fig. 2: Prosperities of the VAR model

According to the results of the VAR model shown in Fig. 2, the optimal lag of this model is based on the AIC criterion of lag 2 and the largest root of the model is 0.73. Despite the necessary preconditions, the forecast and dynamics of the unemployment rate in response to the shock as much as a standard deviation to the inflation rate, the interest rate and the aggregate cost stickiness by the IRFs derived from the VAR model (2) in the form of (3). The horizontal axis in this form is time (each period equals one season) and the vertical axis is the percentage of the variable change from equilibrium state.

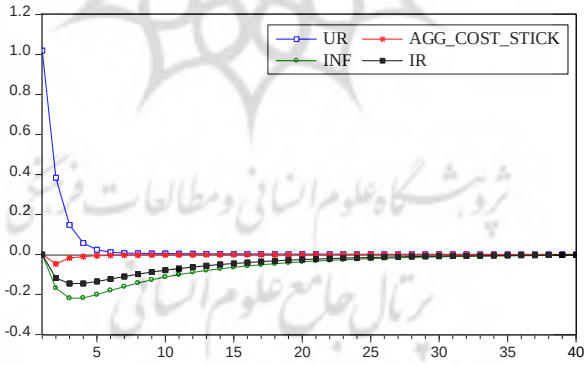


Fig. 3: Response of unemployment rate to one standard deviation shock from the variables of the model

Table 6: Variance decomposition of unemployment rate relative to shocks from the model variables

Period	UR	INF	IR	Agg-CostStick …
5	55.3262	24.7876	12.2857	7.6003
10	49.3618	32.7882	11.2006	6.6493

Source: Research findings

Fig. 3 shows the response of the unemployment rate to the shock from each of the variables of aggregate cost stickiness, inflation rate and interest rate. The results show that a positive impulse to the aggregate cost stickiness of firms by one standard deviation reduces the unemployment rate in the Iranian economy after two periods (less than one year) and then moderates its effect. While a positive impulse to inflation and interest rates also reduce the unemployment rate over time, and their fluctuation in the unemployment rate is much more than the aggregate cost stickiness. The duration of the unemployment rate adjustment and the return to steady state in response to these two shocks will be about five years. Variance decomposition of Predictive Error is another useful tool in the VAR model that is widely used in predicting the dynamics of variables. This tool measures the variance of the prediction error of a variable in each period as a result of a shock. In other words, variance decomposition is a tool that measures the contribution of shock to one variable in generating fluctuations in other variables. As such, the purpose of this section is to measure the share of aggregate cost stickiness in fluctuating macroeconomic variables. The results of the decomposition of variance of unemployment rate in the framework of Taylor's rule and the VAR model will be in Table 6, which respectively measure the contribution of other variables to the unemployment rate fluctuation. The results of this section are reported for periods 5 and 10. The results of variance decomposition of the unemployment rate forecast error within the VAR model show that the share of aggregate cost stickiness of unemployment rate fluctuations is about 8% in the fifth forecast period and less than 7% in the tenth period. While in the fifth and tenth periods, about one-fourth and one-third of the unemployment rate fluctuations, respectively, are explained by the inflation rate. The results of the variance decomposition of the VAR model were in line with the results of the IRFs.

6 Conclusions and Suggestions

Until now, many models have been proposed to predict unemployment rates, but models that have used accounting information to predict unemployment rates have not been addressed. This paper examines the relationship between aggregate cost stickiness, as one of the variables recognized in accounting, and unemployment rate. For this purpose, seasonal time series data of macroeconomic level of TSE and macroeconomic firms during 2008 – 2017 were analyzed in two stages. In the first step, the relationship between these two variables was determined by specifying a linear regression model that was estimated using OLS method. Based on the results, the effect of aggregate cost stickiness on unemployment rate in two and three periods ahead is statistically significant. Accordingly, the first hypothesis of the research on the significant effect of aggregate cost stickiness on the unemployment rate in future periods was accepted. This result is consistent with the results of research by Roxelin et al. [29]. Also, in periods when aggregate cost stickiness has a significant relationship with the unemployment rate, the relationship between GDP and the unemployment rate is negative and significant, which refers to the establishment of the Okan law in the Iranian economy. This result is consistent with the results of Maddah and Farhadi [24]. Based on the results of the OLS models, the effect of interest rate and inflation rate on unemployment rate are negative and significant, which is consistent with Phillips curve in economic literature.

To investigate the predictive power of this model, the RMSE criterion was used in two scenarios with aggregate cost stickiness and no aggregate cost stickiness. The results show that in models where there is no aggregate cost stickiness, the RMSE criterion in all four periods (forecast horizons) is higher than when the aggregate cost stickiness is present in the model. Therefore, the existence of aggregate cost stickiness improves the unemployment rate forecasting and reduces the unemployment rate forecast

error. So, the second research hypothesis is accepted. This result is consistent with the results of research by Roxelin et al. [29]. In the model with aggregate cost stickiness, the RMSE criterion in the second forward period is lower than in other periods. This means that the inclusion of aggregate cost stickiness in the model improves the forecast for the next two quarters of the unemployment rate compared to other periods. Finally, the unemployment rate in response to a shock from aggregate cost stickiness was estimated by a VAR model and the contribution of this variable to unemployment rate fluctuations was measured. The results show that a positive impulse to the aggregate cost stickiness of firms reduces the unemployment rate in the Iranian economy after two periods (less than one year) and then moderates its effect. This result implies acceptance of the third research hypothesis that the negative effect of aggregate cost stickiness on unemployment rate. This result is in line with the results of research by Roxelin et al. [29] and Nalardi and Ognova [27]. The share of aggregate cost stickiness of unemployment rate fluctuations is about 8%, while about one-third of unemployment rate fluctuations are explained by inflation. However, part of the unexplained residual of the unemployment rate in economic literature can be described through aggregate cost stickiness. Compared to the intensity of the effect of this impulse compared to the results of Roxelin et al. [29], it can be said that a smaller part of the Iranian economy is the stock market, and the existence of contracts and a large government sector in the Iranian economy prevents the unemployment rate from reacting more strongly. Also, the lower share of aggregate cost stickiness compared to the inflation rate is consistent with the Phillips curve theory in macroeconomic literature. But part of the unexplained waste of the unemployment rate can be explained by economic models. Based on the results, the following suggestions are made:

1. Consider the role of inflation and adjusting financial statements based on price indexes.

2. Using accounting information such as aggregate cost stickiness to improve unemployment rate forecasts.

3. The way in which organizational managers can anticipate the positive or negative trends of key economic variables will be crucial; therefore, managers of organizations will be better able to think about the success of their programs. Introducing some of the basic accounting variables that are effective in predicting major economic variables can help managers of these firms.

4. It is suggested to accounting and economic researchers that they can look at accounting information from a macroeconomic perspective and can use this information to predict macroeconomic indicators such as inflation and unemployment.

5. The conventional view of accounting information is retrospective. While the results of the present study, the macro accounting literature has a strong belief in the future impact of corporate accounting information on the economy. Therefore, it is suggested that economic analysts in economic forecasts pay attention to the future nature of corporate accounting information, especially large corporations in the country. This issue can also be covered in future accounting studies.

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