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The Impacts of Renewable Energy, Exchange Rate, and Inflation on Agricultural Sector Employment in Turkey

Türkiye'de Yenilenebilir Enerji, Döviz Kuru ve Enflasyonun Tarım Sektörü İstihdamına Etkileri

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ABSTRACT

The Autoregressive Distributed Lag (ARDL) bounds test approach is used in this study to provide empirical evidence about the impact of renewable energy usage, exchange rate, and inflation rate on agricultural sector employment in Turkey from 1990 to 2019. According to the study's findings, a 1% increase in renewable energy usage will raise agricultural sector employment by 1.06% in the short run, a 1% inflation will reduce agricultural sector employment by 0.12%, and a 1% Turkish Lira appreciation will raise agricultural sector employment by 0.4%. The long-run ARDL model results show a 1.06% decrease in agricultural sector employment for every 1% increase in renewable energy use, whereas inflation shows a 0.09% decrease in agricultural employment for every 1% inflation rate, while every 1% Turkish Lira appreciation increases agricultural employment by 0.08%. Based on these study findings, renewable energy promotes agricultural employment in the short run. In the meantime, long-term renewable energy development cannot accommodate agricultural sector employment. As a result, Turkey must devise a long-term renewable energy development strategy that will increase employment while keeping inflation and exchange rates stable and not harming agricultural employment.

Keywords: Agricultural employment, ARDL bounds test approach, exchange rate, inflation, renewable energy

ÖZ

Bu araştırma, 1990–2019 döneminde yenilenebilir enerji kullanımı, döviz kuru ve enflasyonun Türkiye'de tarım sektörü istihdamı üzerindeki etkisi hakkında Autoregressive Distributed Lag (ARDL) sınır testi yaklaşımı kullanılarak ampirik kanıtlar sağlamak amacıyla yapılmıştır. Çalışmanın sonuçları, kısa dönemde yenilenebilir enerji kullanımında %1'lik bir artış için tarım sektörü istihdamının %1,06 oranında artacağını, enflasyon oranındaki %1'lik bir artışın tarım sektörü istihdamını %0,12'sini azaltacağını, %1 Türk lirasını değerlenmesinin ise tarım sektörü istihdamını %0,4 artırdığını göstermektedir. Uzun dönem ARDL modeli sonuçları, yenilenebilir enerji kullanımı ile tarım sektörü istihdamı arasında negatif bir ilişki olduğunu ve tarım sektörü istihdamında %1,06'lık bir düşüş ve yenilenebilir enerji kullanımında %1'lik bir artış olduğunu gösterirken, tarım sektörü istihdamında yüzde 0,09'luk bir azalma enflasyon oranındaki %1'lik bir artışa karşılık gelirken, her %1 Türk lirası değerlenmesi tarım sektörü istihdamını %0,08 oranında artırıyor. Bu araştırmanın sonuçları, kısa vadede yenilenebilir enerjinin tarımsal istihdamı teşvik eden itici güç olarak tanımlandığını göstermektedir. Bu arada, uzun vadede yenilenebilir enerji gelişimi, tarım sektörü istihdamını karşılayamıyor. Bu nedenle Türkiye, tarım sektöründe istihdamı artırabilecek yenilenebilir enerjiyi uzun vadede geliştirmeyi planlamalıdır. Türkiye'nin de tarım sektöründe istihdamı olumsuz etkilememesi için enflasyonu ve döviz kurunu düşük tutması gerekiyor.

Anahtar Kelimeler: Tarımsal istihdam, ARDL sınır testi yaklaşımı, döviz kuru, enflasyon, yenilenebilir enerji

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Introduction

The effects of energy consumption on economic indicators have received a great deal of interest in the studies. Earlier research has mostly established that energy consumption is significantly related to economic growth, inflation, trade terms, and stock markets. Contrary to popular belief, the relationship between energy and employment has received insufficient attention in the economic literature. High levels of unemployment observed in several developed and developing countries in recent years have focused attention on the factors that may affect the labor market (Arouri et al., 2021).

Turkey's participation in the Paris Agreement, which was signed in 2016, had implications for Turkey's efforts to keep the increase in global temperature well below 2°C above preindustrial levels and to implement attempts to maintain the temperature rise to 1.5°C. To accomplish this goal, Turkey has set a net-zero carbon target for 2053, which will necessitate significant improvements in the energy system. Renewable energy sources have been identified as one of the least expensive decarbonization mitigation strategies.

The global transition from nonrenewable to renewable energy has contributed to many benefits, such as reduced global warming and climate change. Applying renewable energy not just results in a lower carbon future but also improves social and economic development by creating jobs and increasing growth in the economy. One of the United Nations' long-term objectives is to accomplish zero carbon emissions by empowering nations to transform from carbon-emitting fossil fuels to renewable energy. Renewable energy sources include, to name a few, solar energy, wind and solar, tidal energy, hydropower, and wave power. Such sources of energy are not harmful to the environment and cannot be eliminated.

Parallel to Turkey's recent economic growth, the country has one of the world's biggest energy markets. Increasing energy consumption in tandem with development and growth raises the issue of energy sustainability and supply security. Many studies in the economics literature confirm the positive relationship between energy consumption and the level of development. Between 2009 and 2023, Turkey's electricity demand is expected to rise by 6% per year (Erdal, 2012). It is stated that in countries with high dependence on imported energy such as Turkey, using domestic and renewable energy sources alternatives will not only ensure energy supply security but also contribute to solving the widespread unemployment problem, especially in the agricultural sector.

In addition to its economic involvement by developing renewable energy alternative solutions, improving energy efficiency, and thus mitigating the severity of energy usage on climate change and growing energy supply security, its positive influence on employment has recently been studied. Investing in the environment, energy efficiency, and renewable energy generates thousands of employment opportunities across the world. Environmental consciousness, the Kyoto Protocol, a carbon tax, renewable energy investments and energy security, international agreements, and energy trade cooperation all result in the rise of new job opportunities known as green professions.

Based on Table 1, the total employment in the Turkish agricultural sector has decreased in the 2015–2019 period, while the inflation rate has increased from 2015 to 2018 and decreased in 2019. In addition, the Turkish lira exchange rate is depreciating through the years. Even though, on the other hand, renewable energy usage in Turkey in the same period was growing. This condition shows the potential for using renewable energy to increase employment and potential solution to solve employment problems in the agricultural sector while keeping the exchange rate and inflation stable.

Environmentalists prefer renewable energy sources because they are less harmful to the environment and reduce greenhouse gas emissions. However, it is more expensive than fossil fuels. As a result, it is critical to investigate the impact of renewable energy, the Turkish lira exchange rate, and inflation on agricultural employment. Renewable energy research will result in the rapid proliferation of renewable energy resources required for sustainable energy, as well as the development of new technologies, economic growth, and the creation of new jobs over the next decade (Moreno & López, 2008; Paska et al., 2009). Numerous studies have been carried out to examine the impact of renewable energy on economic growth and job creation in understanding the link between renewable energy and economic practices. Renewable energy has a significant effect on economic growth, according to (Chica-Olmo et al., 2020). Raised consumption of renewable energy has been shown to boost the economic growth of the country, which is beneficial to the country and must be encouraged. These results are supported by Rahman and Velayutham (2020), who predicted that increased renewable energy would boost economic growth. According to Proença and Fortes (2020), renewable energy has a positive impact on job creation.

Nevertheless, there is no research conducted to examine both the short- and long-run impacts of renewable energy usage, exchange rate, and inflation rate on employment in Turkey's agricultural sector. As a result, the existing literature contains a gap. In order to close the gap, this study's focus is investigating how renewable energy use, inflation, and exchange rate impact Turkish agricultural sector employment. The study is beneficial to academics, economists, politicians, and policymakers alike. This

Table 1.
Agricultural Sector Employment, Exchange Rate, and Inflation Rate in Turkey (OECD, 2019; World Bank, 2021)

Year	Employment in Agriculture (1000 Persons)	Renewable Energy (Thousand Tons of Oil Equivalent)	Exchange Rate of Turkish Lira	Inflation Rate (%)
2015	5292	15,657.33	2.72	7.67
2016	4976	17,135.58	3.02	7.78
2017	4810	17,738.48	3.64	11.14
2018	4441	19,146.50	4.82	16.33
2019	4091	23,382.16	5.67	15.18

study draws on data from Turkey's agricultural sector, inflation rate, exchange rate, and renewable energy use. This research is beneficial, academics, economists, politicians, and policymakers can all benefit from it.

Literature Review

Becker and Fischer (2013) claim that renewable energy is desirable in the long run because of its cost advantages. Several studies have been conducted to examine the impact of renewable energy use on economic growth. Ge and Zhi (2016) have also investigated the relationship between employment and renewable energy. The relationship between employment and renewable energy has also been investigated.

Proença and Fortes (2020) found that renewable energy and employment have positive relationship. According to Deka and Dube (2021), there is long-run bidirectional causality between inflation and the exchange rate. Renewable energy use in Mexico influences both inflation and the exchange rate, but neither has a long-term impact on renewable energy. Based on the short-run ARDL findings, increasing the use of renewable energy in Mexico has the effect of increasing currency exchange appreciation. According to Arouri et al. (2021), employment and energy consumption are strongly intertwined in Africa. There is unidirectional causality from employment to energy use in Tunisia, Cameroon, Zambia, and Ethiopia. There is a unidirectional causality from energy use to employment in the Democratic Republic of the Congo and Egypt. Algeria, Benin, Kenya, Mozambique, and Tanzania also have revealed bidirectional causality. However, these studies have not been specifically addressed the impact of renewable energy in a particular country and economic sector. Moreno and López (2008) forecasted that the potential of renewable energy energies will have a significant impact on employment, compensating for the gradual loss of employment in traditional mining industries. Furthermore, renewable energies are estimated to produce more jobs in construction and installation than in operation and maintenance, posing the risk of a shortage of available construction professionals in the coming years.

Meyer and Sommer (2016) discovered that the positive relationship between renewable energy deployment and job creation is not simplistic because of different assumptions, scope definition, and simulated connections such as crowding out of innovative energy production or impacts from price levels, income, and international trade all affect the outcome. More study is required. Algül and Kaya (2021) compared the employment effects of renewable and fossil energy-based energy industries in Turkey. According to their findings, renewable energy industries surpass fossil-based electricity industries in terms of job creation. As a result, in addition to the claimed environmental benefits, the renewable energy industry could be a powerful factor in Turkey's attempts to improve sustainable development, particularly given the employment benefits. Fuinhas and Marques (2012) investigate the relationship between primary electricity consumption and economic growth in Portugal, Italy, Greece, Spain, and Turkey. They are resistant to the panel framework, according to the results. As one additional unit of product requires less than one unit of energy, an energy-saving policy decreases GDP growth while observing an investing occurrence.

From the perspective of renewable energy application and policy, Uruguay designed an energy policy to create and promote the use of renewable energy in electric power generation as well as the use of biomass for energy purposes (Resquin et al., 2018). Swarooprani (2023) indicated that renewable energy could help to undertake poverty in rural communities by by providing steady incomes, skill growth, and education to inexpert and semi-skilled workers. . Hadjilambrinos (2019) implied that for the environmental benefits of renewable energy development, a variety of reasons are also offered as justifications for government policies to promote these energy resources. These reasons include the creation of new jobs, often in geographic regions that face adverse employment conditions, such as remote and rural areas. It is important, therefore, that in order to assess the societal impact of renewable energy development, the impact of such development on employment be studied. Based on these studies, the impact of using renewable energy on agricultural sector employment has not been discussed. Therefore, researching renewable energy, the Turkish lira exchange rate and inflation's impact on agricultural employment is important.

Methods

This study draws on data from annual Turkey's agricultural sector employment, inflation rate, exchange rate, and renewable energy use of the 1990–2019 period retrieved from the official websites of the OECD and World Bank. Renewable energy refers to a variety of energy sources that are environmentally friendly and can be utilized repeatedly because they cannot be destroyed. In Turkey, agricultural sector employment data is displayed as 1000 people employed. Inflation refers to the rate at which a country's consumer prices rise across a predetermined amount of time. The currency exchange rate is the value of 1 USD in Turkish lira.

The ARDL bounds test is used in this study to examine the relationships between renewable energy, exchange rate, and inflation and their impact on agricultural sector employment. The Augmented Dickey-Fuller (ADF) (Cheung & Lai, 1995) and Phillips and Peron (PP) (Phillips & Perron, 1988) tests are used to ensure that no variable is stationary on the second difference. If the bounds test model's *F*- and *t* statistics are bigger than the lower and upper bounds, then both short and long-run ARDL model can be specified (Pesaran et al., 2001). In this study, agricultural sector employment is defined as the dependent variable, while renewable energy, exchange rate, and inflation are specified as independent variables. The ARDL model was then estimated, with the optimal number of lags chosen, the significance of parameters considered, and the residuals carefully examined. Following the completion of the diagnostic tests, the optimal model is obtained. The bounds test is then used to determine the presence of cointegration. Finally, the short and long-run elasticities are computed, as well as the estimated long-run cointegrating equations.

A variety of techniques have been used in numerous studies to identify cointegration between macroeconomic variables. However, these methods require that all variables in the system be stationary and have an equal order of integration. As a result, the regression equation is as follows:

$$InEmp_{it} = \alpha_i + \beta_1 InRen_{it} + \beta_2 InExc_{it} + \beta_3 InInf_{it} + \varepsilon_{it} \quad (1)$$

Eq. (1) shows the statistical representation of the ARDL model used in this study to investigate the relationship between renewable energy usage, inflation rate, and exchange rate impact on agricultural sector employment in Turkey. The logarithm of employment is used to articulate the dependent variable ($lnEmp_{it}$). Renewable energy, as determined by the logarithm of thousand tons of oil equivalent (TOE), is of particular interest among the variables. $lnRen_{it}$; $lnExc_{it}$; and $lnInf_{it}$ represent the logs of renewable energy, exchange rate, and inflation at time t. α_i is the and constant and ε_{it} denotes the error term. β_1, β_2 , and β_3 are the coefficients of all independent variables for the ARDL model.

The standard ARDL model is given by the equation below:

$$\Delta lnEmp_t = \alpha_0 + \sum_{i=1}^{p} \beta_1 \Delta lnEmp_{t-i} + \sum_{i=1}^{p} \beta_2 \Delta lnRen1_{t-i} + \sum_{i=1}^{p} \beta_3 \Delta lnExc_{t-i} + \sum_{i=1}^{p} \beta_4 \Delta lnInf_{t-i} + \delta_1 lnEmp_{t-1} + \delta_2 lnRen_{t-1} + \delta_3 lnExc_{t-1} + \delta_4 lnInf_{t-1} + \varepsilon_t \quad (2)$$

The preceding equation is defined as the unrestricted error correction model where the expected sign of parameters are: $\alpha_0 \neq 0$; $\beta_1 \neq 0$; $\beta_2 \neq 0$; $\beta_3 \neq 0; \beta_4 \neq 0$; $\delta_1 \neq 0$; $\delta_2 \neq 0$; $\delta_3 \neq 0$; $\delta_4 \neq 0$. The parameters β_1, β_2, β_3, and β_4 represent short-run dynamic coefficients, while δ_1, δ_2, δ_3, and δ_4 explain the long-run multipliers of the equations. The null and alternative hypotheses for cointegration test among variables in equation (2) are: $H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$ means there is no long-run relationship. Meanwhile, $H_a : \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0$ demonstrate the existence of a long-run relationship. Similarly, to test the existence of the short-term relationship identified in Eq. (1), we can construct the null and alternative hypotheses as follows: $H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ shows no short-run relationship is existing. Furthermore, $H_a : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$ denotes the short-run relationship.

The following long-run model (equation 3) is estimated if there is evidence of a long-run relationship between the variables:

$$\Delta lnEmp_t = \alpha_0 + \sum_{i=1}^{p} \delta_1 lnEmp_{t-i} + \sum_{i=1}^{p} \delta_2 lnRen_{t-i} + \sum_{i=1}^{p} \delta_3 lnExc_{t-i} + \sum_{i=1}^{p} \delta_4 lnInf_{t-i} \quad (3)$$

Finally, if a long-run relationship exists, the error correction model (ECM) is used to obtain the short-run dynamic coefficient, which ECM (t − 1) suggests the correction mechanism in stabilizing the model's disequilibrium, known as the speed of adjustment or feedback effect. Consequently, the following ARDL short-run dynamics specification can be obtained:

$$\Delta lnEmp_t = \alpha_0 + \sum_{i=1}^{p} \beta_1 \Delta lnEmp_{t-i} + \sum_{i=1}^{p} \beta_2 \Delta lnRen1_{t-i} + \sum_{i=1}^{p} \beta_3 \Delta lnExc_{t-i} + \sum_{i=1}^{p} \beta_4 \Delta lnInf_{t-i} + \gamma ECM_{t-1} + \varepsilon_t \quad (4)$$

The Breusch–Godfrey serial correlation test, Breusch–Pagan–Godfrey heteroskedasticity test, and Jarque–Bera normality, cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests are used to assess the model's validity, robustness, reliability, and stability.

Results

Descriptive Statistics and Unit Root Test Results

Table 2 and 3 provides descriptive statistics for Turkey's agricultural sector employment and all dependent variables from 1990 to 2019. The total sample size for each variable used in this study is 30. During 1990 and 2019, the mean values of agricultural sector employment, renewable energy, and inflation rate in Turkey were 5583.067 thousand persons, 11,952.23 thousand TOEs, and 36.62%, respectively. Turkey's average inflation rate has been quite high during this period. Furthermore, the standard deviations for Turkey's agricultural sector employment are 784.322%, exchange rate is 1.42%, and inflation is 32.82%.

Results of the ARDL Bound Test

This section of the study presents the results of the ARDL bound test, short-run and long-run ECM results. According to Akaike Information Criterion, the best model for Eq. (1) is ARDL (4, 3, 3, 4).

The next process is to determine whether the variables have a long-run relationship. The core premise of the ARDL model is that the variables in the model should be integrated to order zero [*I*(0)], order one [*I*(1)], or both. This helps with the application of bound testing. As a result, the long-run relationship's ARDL F statistics value for the bound test is 8.017.

Table 4 shows that the *F* statistics (8.017) is obviously bigger than the 4.66 upper bound critical value at a 1% significance level. This means that the dependent and independent variables have been cointegrated. This implies that the dependent and independent variables are cointegrated. Therefore, the null hypothesis $H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$ is rejected, and the alternative hypothesis $H_1 : \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0$ is accepted.

Table 2.
Descriptive Statistics Results

Variable	Agricultural Sector Employment	Renewable Energy	Exchange Rate	Inflation Rate
Mean	5583.067	11,952.23	1.44	36.62
Median	5811.500	10,738.68	1.38	15.75
Maximum	6942	23,382.17	5.68	105.22
Minimum	4091	9311.890	0.00	6.25
Std. Dev.	784.322	3335.5	1.42	32.82
Sum	167,492	358,566.9	43.22	1098.46
Observations	30	30	30	30

Table 3.
Unit Root Test Results

Variable	ADF Test			PP Test		
	t-Statistic	*p*	Integration	*t*-Statistic	*p*	Integration
lnEmp	−4.5126	.0013*	*I*(1)	−4.5138	.0013*	*I*(1)
lnRen	−4.7379	.0007*	*I*(1)	−4.8553	.0006*	*I*(1)
lnExc	−4.7379	.0007*	*I*(1)	−4.8553	.0006*	*I*(1)
lnInf	−4.5975	.0011*	*I*(1)	−4.6251	.0010*	*I*(1)

Note: *Significance at 1% level.
ADF = Augmented Dickey-Fuller; PP = Phillips and Peron; ARDL = Autoregressive Ditributed Lag; Ren = Renewable Energy; Exc = Exchange Rate; Inf = Inflation

Table 4.
ARDL Bound Test Results

Significance (%)	*I*[0] Bound	*I*[1] Bound	Inference
10	2.37	3.2	Cointegrated
5	2.79	3.67	Cointegrated
2.5	3.15	4.08	Cointegrated
1	3.65	4.66	Cointegrated

ARDL = Autoregressive Distributed Lag

Estimated Long-Run Model

The long-run model is estimated after establishing the validity of cointegration between variables. Table 5 displays the estimation evidence of the long-run model.

As shown in Table 5, renewable energy consumption has a negative and significant relationship with agricultural sector employment in the long run. If renewable energy consumption increases by 1%, it will reduce agricultural sector employment by 1.05%. This result is in accordance with (Pestel, 2019), which stated that investment-induced renewable energy impact on job creation may fade in the long run as infrastructure expansion reaches its saturation point. Zhang et al. (2017) also concluded that the declining trend in the ratio of jobs/solar photovoltaic (PV) from 2009 to 2015 indicates that, in tandem with the constant evolution and accomplishment of the economy of scale and industrial innovation of the solar PV sector in China, mechanization and automation are replacing physical labors.

In addition, the exchange rate has a positive and significant long-run impact on agricultural sector employment. Holding all other variables constant, the estimated result shows that a 1% Turkish lira appreciation causes a 0.08% increase in employment. Furthermore, the inflation rate is a statistically significant and negative relationship with agricultural sector employment, showing a 1% increase in the inflation rate would decrease 0.09% from agricultural sector employment. The inflation output is consistent with Vermeulen's (2015) research, which stated that job creation, in the long run, will be implicitly disturbed by rising inflation; therefore, lower inflation is thus preferable. The ECM is used to show the short-term relationship between variables, while the short-run model (ECM-1) can be estimated to capture the adjustment toward the long run.

Short-Run Error Correction Model

The ECM is used to indicate the short-run relationship between variables. To capture the adjustment toward the long run and the model, the short-run model (ECM-1) can be estimated (Table 6).

According to the ARDL short-run estimation results, the renewable energy variable has the highest coefficient value, indicating that the use of renewable energy becomes the most important factor influencing agricultural employment in the short run. For instance, every time renewable energy consumption increases by 1%, it will result in a 1.06% increase in agricultural employment. This result is consistent with research conducted by Proença and Fortes (2020), which states that a positive impact on increasing employment opportunities could be achieved by increasing the capacity of renewable energy usage. Furthermore, the Turkish lira exchange rate factor against the US dollar plays a positive role compared to the inflation factor, where the exchange rate variable coefficient is positive when compared to the negative inflation variable coefficient. If the Turkish lira appreciates by 1% it can increase employment in the agricultural sector by 0.4%. This condition could be happened because the agricultural sector employment from year to year showed declining trend, while at the same time frame the Turkish lira continued to depreciate. Therefore, it is important to make Turkish lira exchange rate to be stable or even appreciated. Meanwhile, if inflation in Turkey increases by 1%, it will have an impact on reducing 0.1% of employment in the agricultural sector.

The presence of a long run correlation between variables is confirmed by the existence of a negative and significant lagged error term ECM(−1) at the 1% level of significance. The error correction coefficient is −0.89. This implies that long-run deviation

Table 5.
ARDL (4, 3, 3, 4) Model Results

Dependent Variable: Agricultural Sector Employment (Emp)	Coefficients	Standard Error	*t*-Statistic	*p*
Ren	−1.06	0.56	−1.87	.09*
Exc	0.08	0.06	1.45	.08*
Inf	−0.09	0.13	−0.68	.05*
C	18.45	5.03	3.67	.01

Note: *Significant at 1% level.ARDL = Autoregressive Ditributed Lag; Ren = Renewable Energy; Exc = Exchange Rate; Inf = Inflation

Table 6.
Estimated Short-Run Model Result

Variables	Coefficients	Standard Error	*t*-Statistic	*p*
D(Emp(−1))	0.50	0.15	3.44	.009
D(Emp(−2))	−0.03	0.15	−0.21	.835
D(Emp(−3))	0.54	0.13	−0.68	.006
D(Exc)	0.28	0.10	2.66	.029
D(Exc(−1))	0.42	0.09	4.59	.002
D(Exc(−2))	0.23	0.09	2.70	.027
D(Inf)	0.04	0.06	0.67	.522
D(Inf(−1))	−0.12	0.05	−2.69	.028
D(Inf(−2))	0.11	0.05	2.43	.041
D(Ren)	0.21	0.15	1.42	.193
D(Ren(−1))	1.03	0.26	3.91	.005
D(Ren(−2))	1.06	0.34	3.15	.014
D(Ren(−3))	0.49	0.23	2.09	.070
ECT(−1)	−0.89	0.16	−5.49	.000

ARDL = Autoregressive Ditributed Lag; Ren = Renewable Energy; Exc = Exchange Rate; Inf = Inflation

equilibrium is corrected at a rate of 89% annually, implying that there is "an over correction" toward long-run equilibrium following a short-run shock. To confirm the absence of spurious regression and results, several diagnostic tests are run on the ARDL estimations.

Diagnostics Test Result

Several diagnostic tests are performed on the ARDL estimations to confirm the absence of spurious regression and results. Table 7 results support the accepted null hypothesis of no serial correlation, no heteroscedasticity, and normal distribution. Moreover, the CUSUM and CUSUMSQ stability tests in Figure 1a and b indicate the model's stability. The test confirmed that the selected model of the ARDL bound testing approach is reliable for analyzing the impact of renewable energy, exchange rate, and inflation rate on agricultural sector employment in Turkey.

Table 7.
Residual Diagnostic Test Results

Test series	*p*
Breusch–Godfrey LM (Lagrange-Multiplier) test	.2936
Jarque–Bera Normality test	.4359
Breusch–Pagan–Godfrey heteroskedasticity	.4163

The serial correlation of the estimated ARDL model is tested using the Breusch–Godfrey test. The test returns a *p*-value of .2936, denoting that the null hypothesis of no serial correlation is not rejected at all levels of significance. The Jarque–Bera statistic confirms the estimated residuals' normality behavior. The Breusch–Pagan–Godfrey test yielded a *p*-value of .4163 when used to test the heteroskedasticity assumption. These findings indicate that the *p*-value is greater than the 95% CI. That is, because the null hypothesis of constant variance is not rejected, the model's homoskedasticity assumption is correct.

The plots of the parameter stability test: CUSUM and CUSUMSQ are shown in Figure 1. When the CUSUM plot is well within the 5% critical bound, the null hypothesis of parameter stability cannot be rejected. The CUSUMQ plot is also within the 5% critical bound. It means that the estimated parameters do not exhibit structural instability throughout the study, so they are constant or stable within the sample considered.

Generally speaking, the diagnostic tests indicate that the estimated equation possesses the suitable statistical characteristics.

The study shows that employment in the agricultural sector and the use of renewable energy have a statistically significant and positive relationship. These findings indicate that the short-term renewable energy implementation program could positively impact Turkish people, especially by supporting to create job opportunities. The study's result is in accordance with the government's claim that investments in renewable energy could generate job opportunities, resulting in socioeconomic benefits that go beyond environmental concerns. Renewable energy has a positive impact on employment in the short-term, as it creates new job opportunities. Renewable energy technologies require more labor than traditional fossil-fuel technologies, which explains why the expected positive impact prevails. The direct gross short-run employment effect of renewable energy sources is positive, implying that expansions in renewable technology facilities create extra labor supply in agricultural sectors along its value chain. This raises the supply of workers in fields such as research and development, manufacturing, construction, and preservation of green energy systems.

The use of renewable energy sources, such as plant biomass, could represent an important source of employment (Resquin et al., 2018). The development of renewable energy projects in rural regions can be a valuable avenue for income creation and can have a positive impact on the economy, employment, and growth in rural regions (Swarooprani, 2023). However, some studies have shown that the impact of policies promoting renewable energy development on labor markets can be more complicated (Hadjilambrinos, 2019).

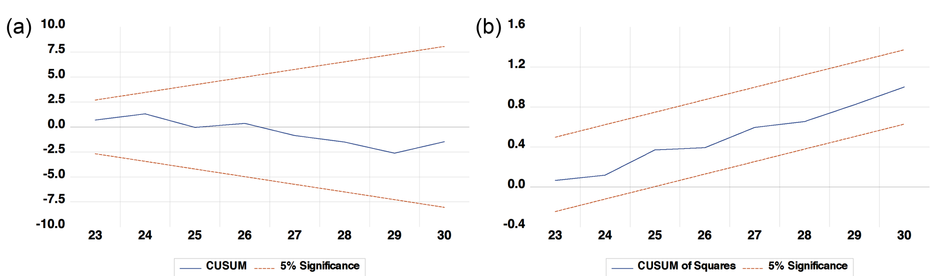

Figure 1.
The Plot of (a) CUSUM and (b) CUSUMQ. CUSUM = Cumulative sum; CUSUMQ = Cumulative sum of squares.

Meanwhile, renewable energy has a negative long-term impact on agricultural sector employment. It follows that the short-run effects of renewable energy on job creation in the supply and installation of renewable energy infrastructure may diminish in the long run as infrastructure expansion reaches its saturation point. After this point, only the preservation and reconstruction of renewable technologies would necessitate labor demand. Only the maintenance and replacement of renewable energy plants would require labor demand after this point. Overall, when the demand consequence of renewable energy production will be more prominent in the short run, the contractive cost impulse will be stronger in the long run. This trend can be seen in the employment balance, which means that a favorable employment situation in the early years will eventually even out. The agricultural sector would also reduce the negative impact of rising energy prices by implementing a saver energy manufacturing system based on this condition. Nevertheless, if these savings are insufficient, there is a possibility when energy-intensive just like big agricultural companies relocate their manufacturing operations overseas. If companies depart or close their operation in the country, it may have a bad long-term impact on labor demand. The interdependence of energy and labor as components in manufacturing systems defines the amount that could decrease work opportunities. As a result, supporting evidence on the magnitude of optimistic and pessimistic employment growth is obligated to enable policy concerning cumulative gross consequences of a change in energy strategy on labor supply.

It was determined that an increase in inflation would indeed damage employment generation and that lower inflation is thus desirable. The undeniable negative impact should discourage decision-makers from seeking to manipulate any potential short-run trade-off. A higher agricultural workforce in Turkey cannot be achieved by taking greater levels of inflation. Therefore, while the decline in agricultural sector employment in Turkey is a real issue, it cannot be solved by allowing inflation to rise.

In both the short and long run, the exchange rate has a positive impact on agricultural sector employment in Turkey. Given that agriculture employs many workers in Turkey, in the case of agricultural companies, it may be increasingly employing workers for labor-intensive operations and opening additional employment opportunities as the Turkish lira is appreciated. These findings point to an important requirement for Turkey's policy tools to reduce excessive volatility in the exchange rate to maintain agricultural sector employment. Key policy recommendations included the use of capital controls, stimulating Foreign Direct Investment (FDI) rather than based on speculation short-term inflow of foreign, countercyclical fiscal and monetary policies, enhancing the domestic financial system, protecting formal and informal debt currencies, accumulating reserve funds for self-insurance, restricting fiscal deficits, and trying to manage current account imbalances.

The foundation of future agricultural employment creation will be a systemic dedication to the stability of exchange rate and inflation and the utilization of renewable energy. The results of this study can be extended to advanced economies with comparable economic circumstances to Turkey. The upcoming investigation could be carried out to compare the impact of renewable energy use on different economic factors or particular economic. This study can also be conducted using more recent data from Turkey, both monthly and annually.

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