Uncovering the Elasticity of Supply of Barley Production

A simple model estimation :

$$LogProduction_{\,i} = \beta_1 Price_i + \beta_o + \varepsilon_i$$

Where β_i represents the intercepts of the model
$LogProduction_i$ is the dependent variable where i = 1..n (number of observations)
$Price_i$ repesents the independent variable
β_1 is the coefficient of estimate (elasticity of supply)
$\varepsilon_i$is the error term

Including state fixed and time fixed effects will provide a clearer representation of the elasticity of supply. In this case state fixed effects would explore the relationship between the predictor (Quantity produced) and outcome(price) variables within a state. We assume that there is correlation between the state's error term and quantity produced by that state, thus by removing these time invariant factors, we can assess the net effect of quantity produced on price.

The fixed effects model :

$$LogProduction_{it} = \beta_1 Price_{it} + \beta_i + \varepsilon_{it}$$

Where β_i represents the intercepts for each state (i= 1,2...25)
$LogProduction_{it}$ is the dependent variable where i = state id and t - time
$Price_{it}$ repesents the independent variable
β_1 is the coefficient of estimate (elasticity of supply)
ε_{it} is the error term

The regression output is as following :

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Oneway (individual) effect Within Model

Call:
plm(formula = logproduction ~ Price, data = data.panel, model = "within",
    index = c("Year"))

Unbalanced Panel: n = 25, T = 9-28, N = 527

Residuals:
       Min.     1st Qu.      Median     3rd Qu.        Max.
-2.13162906 -0.27163752  0.00076478  0.28256470  1.53716638

Coefficients:
       Estimate Std. Error t-value  Pr(>|t|)
Price -0.144337   0.020975 -6.8814 1.777e-11 ***
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    127.96
Residual Sum of Squares: 116.91
R-Squared:      0.086355
Adj. R-Squared: 0.040764
F-statistic: 47.3531 on 1 and 501 DF, p-value: 1.7771e-11
```

The fixed effects constants for each state is :

```
       1        2        3        4        5        6        7        8        9       10       11       12
13.69071 16.95011 12.62517 12.86302 13.79983 11.94238 14.61625 16.19575 11.41544 12.14609 11.72690 11.62168
      13       14       15       16       17       18       19       20       21       22       23       24
12.34771 16.37500 10.79744 14.14167 13.55464 11.29349 13.53238 11.14862 14.16817 13.55120 15.33065 12.82943
      25
14.83861
```

Here, the production variable was logged so that the distribution appears more symmetric. The coefficient of estimate is -0.144337 and the standard error is 0.020975. This shows that production (dependent variable) decreases by 14% overtime on average per state when price (independent variable) increases by 1 dollar. This is not what I expected. According to the law of supply an increase in quantity supplied would lead to an increase in price (graph of quantity supplied is upward sloping). However the data states the opposite, as the quantity produced of barley is highly responsive to changes in price. The data indicates that the barley has a price elastic supply. I thought that barley would be a pretty inelastic good because it is a necessity (food product). The price variable is significant at all levels (this is what was expected).

In conclusion, hard to determine the price elasticity of supply because there are factors which affect the price of barley which we could not control for in our model. These factors include the ease of storage, factor mobility, substitutability of barley with crops. Even though we controlled for state fixed and time fixed effects, the other factors could be production (independent) variable, which clouds the results.