International Journal of Scientific Research Updates

Journal homepage: https://orionjournals.com/ijsru/

ISSN: 2783-0160 (Online)

ORION SCHOLAR JOURNALS

(REVIEW ARTICLE)

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Supply responsiveness of potatoes under risk in Jambi Province

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International Journal of Scientific Research Updates, 2024, 07(01), 067–073

Publication history: Received on 24 December 2023; revised on 07 February 2024; accepted on 10 February 2024

Article DOI: https://doi.org/10.53430/ijsru.2024.7.1.0027

Abstract

The supply responsiveness of potatoes under risk in Jambi province is evaluated by applying an analysis of the lagged acreage function. The characteristics of crop production can explain sustainable decision-making allocations between realized inputs and outputs, taking time lags into account. The objective of the study is to analyze the supply responsiveness of potatoes under risk. Firstly, a production function in lag is estimated from empirically expected variables. Evaluating parameters found that risky variables explained the crucial role of farmers' strategies in decision-making. The findings explain that potato farmers appear to be risk-averse. Hence, the point of government policies has to take a look at risk management, and also the dynamic point of view. In the end, to test the effectual or not of government policy such as the potato farming program, risky variables are going to explain the effect and also impact the latter result. For example, minimizing the effect of the risk variable will increase the acreage, which implies a shift in the supply curve.

Keywords: Supply response; Potato; Acreage function; Farm program

1. Introduction

The development of high-efficiency potato production today may not improve in the future. In fact, because of financial difficulties and economic crisis, the program's subsidies have been reduced [1]. With this situation in mind, agricultural policy experts across multiple fields are eager to explore the case for crop response as well as demand response for resource use in potato planting. The supply response, estimated in the case of changes in usage inputs, has been explained in many studies [2-4].

As elsewhere, much of Jambi's agricultural output and decision-making investments are made with risks and uncertainties in price commodity, production, and crop program government policies [1]. These policies have been implementing price policies that subsidize inputs such as fertilization and support the development of crop production. These government policies remain questionable. To evaluate that kind of policy, it has to know farmer responses to economic stimuli like part prices sector and not the price sector.

The supply response to dynamic prices is very important in policy construction. Potato supply will be affected by higher prices when supply responds positively to price changes. The horizontal effectiveness and substitution costs of price policies depend on the characteristics and importance of supply response estimates [5]. The main point of other variables affecting the supply response is a strategic component in policy formulation.

Strategical components include technological changes, price input, risks and financial constraints, and farm management which is going to be involved in constructing supply response, as this study is useful and more realistic [6-7].

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Knowing dynamic supply response to change price on certain products conducted in various situations are in terms of resource applications such as labor and land acreage, crop selection and methods, component opportunities, product prices, and also the existing income risk as well as attitudes of farmers towards risk. Furthermore, [8] asserts that it is also required for certain economic activities in the agricultural or agribusiness sector, where businesses are mostly exposed to uncertainty and risk.

If most input is applied, most of the farmers can't explore how to manage yields. Yield levels can then be affected by factors exogenous like infestation pesticides, rain, drying, crop diseases, and other factors that can affect crop production. Since there is no control over the supply function, it is difficult to estimate the supply function ex-ante because farmers can only investigate the output ex-post as a supply evaluation function. From information before, then, it may be expressed the subject phenomena: "Could supply responsiveness of potato to production factor prices, yield price, governmental policy in potato cultivation, pesticide price, fertilizer price, harvested area, and other external sectors be analyzed?". Hence, based on information and issue before, the objectives of study could explain: "Evaluating supply responsiveness of potato farming to production factors prices, yield price, government policy in potato farming, the fertilizer price, pesticide price, area harvest, and other external components."

Models of Supply responsiveness in crop production play an important role in structuring today's research experience. Neoclassical theory of supply production characteristics models relies on profit maximization, which has been evaluated and explored in many references [9]. Theoretically, increased uncertainty leads to a decrease in producing optimal yield prices in farming for competition [10].

Despite very much problems in evaluation, the supply response is a better meaning for policymakers to consider when examining the impact of the Jambi Agricultural Basic Plan on efficiency, production, and distribution improvements. Points to consider in assessing production response are (a) decision-making on production with ex-ante conditions and (b) excluding the risk of small, limited revenues for many manufacturers.

When risk variables are applied to input prices and output or production processes, the process appears as if it is profitable in terms of expected utility. Based on this risk information, it appears that marginal input expectations will fluctuate due to price factors. When the variables are risk aversion and uncertain returns, a disproportionate portion will explain the risk variable to the production equation, and the risk will be amplified or proportionally reduced by the input variable [11].

Crop production depends primarily on the characteristics of sustainable decision variables and the time lag between input allocation and output realization. In potato production cases in the Province of Jambi, farmers knowledge eager to know which plants to cultivate by knowing information prices and climate and input insecticide development in research areas. Farmers therefore publish levels of input variables such as fertilization and labor use. When the components of the constraints cannot be used, farmers will revise these decisions at each level based on any changes to the information [12].

Lagged production models have been a long-standing tradition of framing supply response problems at farm risk and cumulative levels [13]. On the other hand, the assessment of expected return components under risk and supply response issues is the modeler's problem when building the recipe. Constructing the optimal solution point of the best model is of great significance to policy analysis and formulation.

In addition to an appropriate collection of models, this section explains the theoretical framework used to determine the acreage response and its application to government agricultural programs. Risk production analysis in this base model is used in the acreage response model and its application to support the effectiveness of price and input subsidy programs through lagged production analysis [14]. Although crop production is studied as one or more decisions of productive production [15], those models didn't include components of risk. Thus, the formulation of production decision theory applying a one-product (as it concerns only potato) model under risk is explored.

For estimating and exploring of problem, a model of acreage decision is used, and it is explained as follows:

$$A = f(X_1, \pi, X_2, X_3), \quad \text{..........} \quad (1)$$

where X_1 means gross revenue for every hectare; π means profits; X_2 means component of risk; X_3 means policy sector; then, to explore the model, the farmer's objective under risk is applied that it means to increase the utility function of expected value explained as follows:

$$\text{Max } E\{U(\pi)\} = E\{U[I, X_3, T). A – X_4. I. A – F]\} \text{ .... } (2)$$

where π means profit; I means input each hectare usage; X_3 means farm program policy; T means *proxy* for technological change; A means acreage harvest; X_4 means production factor prices; F means the fixed production cost.

The value of gross revenue for each hectare could be expressed such as $X_1 = (I, X_3, X_5)$ A. If the case of that f'(.) = 0 is applied in terms of the first order condition for a maximum, a solution would become as next expressions :

$$A^* = A(X_1, X_2, X_3, T) \text{ .... } (3)$$

$$X_1^* = X(X_1, X_2, X_3, T) \text{ .... } (4)$$

$$\text{Let stochastic gross revenue is : } X_1 = X_1^* + X_2 \text{ .... } (5)$$

where X_1^* means farmers' expected revenue for each hectare, and X_2 means risk associated with the crop.

After that, the equations of acreage response and input demand equations can be expressed as follows:

$$A^* = A\ (X_1^*, X_2, X_3, X_4, T) \text{ .... } (6)$$

$$I^* = I\ (X_1^*, X_2, X_3, X_4, T) \text{ .... } (7)$$

Upon the substitution of (3 – 4) back to (2), the indirect expected utility function can be derived as follows:

$$V(X_1^*, X_2, X_3, X_4, T) = E\{U[I^*, X_4, T). A^* - X_2. I^*. A – F]\} \text{ .... } (8)$$

From equation (8), it can find the indirect utility function $V(X_1^*, X_2, X_3, X_4, T)$ that is continuous and differentiable (X_1^*, X_2, X_3). Meanwhile, based on [16], this equation in which homogeneity and symmetry conditions are violated under risk and risk aversion.

2. Research Methods

The study was done in Jambi Province since that locality has become Indonesia's potato-producing area. And research carried out in 2022. The study was conducted using study methods and data extracted from secondary data. The data applied in this research is from 1991-2021 in the Jambi province. The data from 1991 to 2021 is explored to explain the period of crisis economic and is divided into high, medium, and small according to the degree of economic crisis.

2.1. The Acreage Response Functional Form

Because production appears to be highly variable, supply response studies rely on measurements to estimate and guide acreage response models. Because the model of acreage response can usually be explored into production response or supply response [17-18]. The acreage response could be very large if the significant likelihood for acreage and new varieties were applied. Meanwhile, the problems of the actual level of production express the effect of independent variables like plant disease, weather, and infrastructure, in terms of supply responsiveness on the level of production is still available.

Then, to explain the main supply response, the equation of acreage response is applied as follows:

$$A_t = \alpha_0 + \alpha_1 X_{1t} + \alpha_2 X_{2t} + \alpha_3 X_{3t} + \alpha_4 X_{4t} + \varepsilon_t \text{ .... } (9)$$

where A_t means acreage variable each hectare on year t; X_{1t} means expected gross revenue on year t; X_{2t} means expected risk on year t; X_{3t} means government farm program on year t.; X_{4t} means input price on year t. Therefore, to explain that such kind of model, variables in equation (9) are expressed as follows :

2.2. The Gross Revenue Variables (X_{1t})

$$X_{1t} = \Sigma P_t. Y_t. X_{6t} \text{ .... } (10)$$

where X_{2t} means expected gross revenue in the i^{th} year; P_t means output price in the i^{th} year; Y_t means yield each hectare on the t^{th} year and X_{6t} is acreage each hectare on the i^{th} year.

2.2.1 *Farmers' Expected Gross Revenue [E(X_{1t})]*

$$E(X_{2t}) = \alpha_1 X_{2\,(t-1)} + \ldots + \alpha_p X_{2\,(t-p)} + \beta_1 \varepsilon_{(t-1)} + \ldots + \beta_q \varepsilon_{(t-q)} \ldots\ldots\ldots \quad (11)$$

where $X_{2(t-1)}$ means gross revenue for hectare on the $(t-p)^{th}$ year (t-p), which means an auto-regressive (AR) component; $\varepsilon_{(t-q)}$ means error term of lagged the q^{th} year, which means a moving average (MA) component.

2.2.2 *Risk Variable (X_{3t})*

$$\lambda_t = [X_{3t} - E(X_{3t})]^2 \ldots\ldots\ldots \quad (12)$$

2.2.3 *Farmers' Expected Risk Variable [E(X_{3t})]*

$$E(X_{3t}) = \alpha_1 X_{3\,(t-1)} + \ldots + \alpha_r X_{3\,(t-r)} + \beta_1 U_{(t-1)} + \ldots + \beta_s \varepsilon_{(t-s)} \ldots\ldots\ldots \quad (13)$$

where $X_{3(t-r)}$ means the risk variable on $(t-r)^{th}$ year, which means an AR component; $\varepsilon_{(t-s)}$ means *error term* of risk associated with production lagged s^{th} years, which means MA component.

In the analysis of time series, it seems beneficial to check data stationarity. The terms of data non-stationary of the time series have a high effect on the last result estimation. Based on [19], when a data time series is not stationary, some shock, or unexpected shock policy, is going to cause a final response, and also On the other hand, a data stationary time series includes just a transitory supply response.

In terms of null hypothesis in which the agricultural acreage process was a unit root process was estimated against the other hypothesis that the acreage process is stationary around a linear trend. To check this hypothesis, the equation was expressed as follows :

$$\delta(X_{6t}) = \beta_0 + \beta_1 X_5 + \beta_2 A_{t-1} + \beta_3 \delta(X_{6t-1}) + \varepsilon_t \ldots\ldots\ldots \quad (14)$$

where $\delta(X_{6t})$ means the difference acreage between t^{th} year and $(t-1)^{th}$ year; X_5 means linear time trend; A_{t-1} means acreage on $(t-1)^{th}$ year.

To evaluate the equation coefficient, a null hypothesis could be applied like the following expression $H_0 : \beta_1 = \beta_2 = \beta_3 = 0$. When H_0 is accepted, the potato acreage process is the process of a unit root. Then, supply response means production and acreage equations on potatoes. That equation is specified linear and also evaluated by a method of seemingly unrelated regression. Considering partial adjustment is applied and then lagged acreage is included in the equation. Therefore potato acreage equation is :

$$A_t = f(X_8{}^*_{t-1}, X_{6t-1}, X_{4t}, X_5, X_{2t}) \ldots\ldots\ldots \quad (15)$$

where A_t means harvested acreage; $X_8{}^*_{t-1}$ means the effectiveness of price farming deflated by the index of variable production cost; X_{4t} means variable expressing the impact of subsidy input and support price program; T means linear time trend; X_{2t} means variable risk.

Then at-risk estimated area equation is estimated using the method of ordinary least squares (OLS). The value of Durbin-Watson is applied to check the hypothesis. The results could be explained by looking at the extent to which risk affects planted areas and the structural resilience of the planted areas relative to risk.

3. Results and Discussion

The research objective is to estimate supply responsiveness of potato crops in dealing with farmers' decision rules on uncertainty and also programs of government policy. The function of expected profit utility was applied to explore the hypothetical parameters. The function is influenced by risk variables and plans government policies to find the best conclusions and risk-effective strategy. Main functions applied to risk analysis are the lagging production function.

3.1. The Lagged Production Function Estimation

The research used acreage supply response to explore the existence of risk production function in lag. The variables of agricultural acreage in uncertainty are explored by the method of ordinary least squares (OLS). Based on the significance of each variable testing, the null hypothesis could be explained as $H_0 : \beta_1 = \beta_2 = \ldots = \beta n = 0$. The estimation of cropping acreage response parameters under uncertainty are found in Table 2. Value of Durbin Watson analysis found that the hypothesis that $\beta 1 = \beta 2 = \ldots = \beta n = 0$ couldn't be accepted. It means that at least one of the parameters wasn't equal to zero.

In specifying acreage response it is seemingly linear and evaluated two times. Firstly, it identified supply expected gross revenue per hectare and risk variable. Secondly, it was results estimation used to estimate risk and expected gross revenue per hectare. Then it specified expected gross revenue variables as an autoregressive-moving average process of X_{2t}. The finding of ARMA (3,3) was explained as follows:

$$E(X_{2t}) = X_{2t}^* = 63{,}7 + 0{,}4\ X_{2t-1} + 0.05\ X_{2t-2} + 0.4\ X_{2t-3} - 0.3\epsilon_{t-1} - 0.04\epsilon_{t-2} - 0.5\epsilon_{t-3} \quad \ldots\ldots(16)$$

The expected risk variables (λ) were explained as an autoregressive-moving average process of $(X_{2t} - X_{2t}^*)^2$. The value of ARMA (3,3) could be expressed as follows:

$$X_2 = 72{,}8 - 0{,}3\ X_{2t-1} + 0.4\ X_{2t-2} + 0.6\ X_{2t-3} - 0.07\ U_{t-1} + 0.6\ U_{t-2} - 2.3U_{t-3} \quad \ldots\ldots(17)$$

Then, this could be explained by finding the result that economic value from time series data wasn't always stationary therefore it wasn't reasonable that its bias link could be stationary. Based on the value of unit root estimation on acreage response processing, the value of Dickey-Fuller statistics is applied in evaluating the hypothesis study in which $H_0 : \beta_1 = \beta_2 = \ldots = \beta_n = 0$. Research findings could be shown in the following Table 1.

Table 1 Dickey-Fuller Test for Acreage Response

	Results
F-test	19,472
Critical Value	5,12
Decision	accept H_1
Statement of Implication	no unit root

This finding suggested that the potato data didn't have a unit root. Hence, data on model variables didn't differ before estimating planted acreage response. After acreage response parameters were estimated, parameter estimation was shown in Table 2. As can be expressed in the following Table 2, positive value of parameter X_1t^* from expected total income is significant at a 5% level significance. It meant that when the value of expected revenue for potatoes increased, the value of potato acreage response was going to increase.

Table 2 Acreage Response In Lags Estimations

	Parameters	**Std. Error**
Intercept	**52,183**	
X_3	-0.0091*	0.0044
X_{2t}^*	0.0037**	0.0008
X_{41}	0.0062	0.0057
X_{42}	0.0034	0.0029
X_9	0.0683**	0.0224
X_5	0.0054	0.0672
R^2	0.8613	
D.W.	2.5713	

where X_3 means risk expectation; X_{2t}* means gross revenue expectation; X_{41} means fertilizer price; X_{42} means pesticide price; X_9 means subsidies input; X_5 means linear time trend; R^2 means value of adjusted R^2; D.W. means value of Durbin-Watson.

The research result got that variable risk coefficient (X_3) showed less than zero, even though it was just significant at a 10% level significance. This finding showed that farmers behaved risk-averse, variable risk had linked with increasing total income, and also the acreage response curve is going to move to the left.

3.2. Potato Production Impact of Fertilizer and Pesticide Usage

Considering trade check distortion is going to impact of pesticide and fertilizer program of government subsidy, that was seeming to investigate the impact of pesticide and fertilizers usage in potato production because that program had shown best influence on high production then stimulate in variety high production usage in which use much pesticide and fertilizer usage each hectare in time trend and last year, and also assume likely linearity in equations:

$$Y_t = \beta_0 + \beta_{14}X_{t-1} + \beta_2 X_{2t-1} + \beta_3 X_5 + e_t \quad (18)$$

where Y_t means potato production in year t; ${}_4X_{t-1}$ means input fertilizer usage per hectare in year t-1; X_{2t-1} means input pesticide usage per hectare in year t-1; X_5 means time trend.

The method OLS was applied to investigate potato production estimations. The investigated equation could be explained as follows:

$$\delta(X_{5t}) = 73{,}9 + 0{,}0572\ X_5 + 0.327\ A_{t-1} + 1.109\ X_4\ (A_{t-1}) \quad (19)$$

$$(32{,}7)\ (0{,}091)\ (0{,}157)\ (0{,}694)$$

$$D.W. = 0{,}6274 \qquad R^2 = 0{,}8073$$

The study found that the use of fertilizer inputs and pesticide inputs per hectare showed the best effect on potato production, as the signs of these parameters were significant at the 5% significance level and positive. Its finding explained that additional fertilizer input and pesticide input use could increase potato production. Then, the coefficient variable of the trend of the time showed a difference significantly from zero in the level significance of 5 %. This shows technological effect has had an impact on potato yields significantly. The program on input subsidy encouraged farmers to use more input fertilizers and input pesticides to increase yields. Hence, through the use of chemical fertilizers, the yield of potatoes is a product of the acreage. Hence, program input subsidy impact could help farmers in extend production and also shifting curve of supply response to the right. Thus, planned input subsidies cause trade off problems by moving curve of supply-response to the right.

4. Conclusion

The risk considerations of the potato crop outline are calculated by simulating different levels of potato price through a model of acreage. The model of simulation is explored in assessing the effectiveness of government programs. Hence, that looks at the risk impact on the supply responsiveness of potatoes. Empirical variables are then estimated from the important variables of the risk production function. Parameters assessment found that the risk component played a strategic role in farmers' decision-making. The finding also explained that farmers were risk averse. Hence, the programs of government policies had to rely on management risk and dynamic considerations. Finally, to explain policy effectiveness mainly in government agricultural programs, a component of risk could again have an impact and also influence the conclusion. Like, decreasing the risk level is going to increase land acreage, which means meaning potato curve of supply is going to move to the right.

Compliance with ethical standards

Acknowledgments

The University of Jambi Fund Grand supported this research. Gratitude acknowledgments to the team of research who contributed very much along the data collection. Also researcher said very much appreciation to the respondents for their support in this research.

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Anonymous. Jambi in Number. Jambi Province Planning and Development Board. Jambi, 2022; 1-147.

[2] David, C.C. and Barker. Modern Rice Varieties and Fertilizer Consumption in IRRI Economic Consequaences of New Rice Technology. Philippines. 1988; 175-212

[3] Bapna, S.L. Binswanger, H.P. and Quizon, J.B. Systems of Output Supply and Factor Demand for Semiarid Tropical India. Economic Growth Centre, Yale University USA. 1991; 1-22.

[4] Guyomard, H.; Baudry, M. and Carpenter, A. Estimating Crop Supply Response in the Presence of Farm Programmes: Application to the CAP. European Review of Agricultural Economics. 199;. 23:401-420.

[5] Smith, R.; Duffy, P.; Novak, J.; and Wilson, N. Supply Response of Crops in the Southeast. Paper in Southern Agricultural Economics Association Annual Meeting, Atlanta, Georgia USA. 2009; 1-20.

[6] Keeney, R. and Hertel T.W. Yield Response to Prices: Implications for Policy Modelling. Working Paper Dept. of Agricultural Economics Purdue University. 2008; 1-36.

[7] Edison. Rice Supply Responsiveness Analysis under Risk in Jambi Province. Disertasi. Graduate Program, University of Sriwijaya, Palembang. 2011; 1-176.

[8] Darmawi, H. Risk Management. Penerbit Bumi Aksara. Jakarta. 2005; 1-89.

[9] Brennan, J.P. The Representation of Risk in Econometric Models of Supply : Some Observations. Australian Journal of Agricultural Economics. 1982; 151-156.

[10] Choi, J.S. and Helmerger P.G. How Sensitive are Crop Yield to Price Changes and Farm Programs ? Journal Agr. And Applied Economics. 1993: 25:237-244.

[11] Villano, R.; Donnell, C.J. and Battese, G.E. An Investigation of Production Risk, Risk Preferences and Technical Efficiency: Evidence from Rainfed Lowland Rice Farms in the Phillippines. Working Paper in Agricultural and Resource Economics. University of New England. 2005; 1-24.

[12] Chavas, J.P. and Hold, M.T. Acreage Decisions Under Risk : The Case of Corn and Soybeans. American Journal of Agricultural Economics. 1990; 72:529-538.

[13] McSweeny, W.T. Kenyon, D.E. and Kramer, R.A. Toward an Appropriate Measure of Uncertainty in a Risk Programming Model. American Journal of Agricultural Economics. 1987; 61:87-96.

[14] Lu, W., Xi, A., and Ye, J. Modelling Risk Behavior of Agricultural Production in Chinese Small Households. Poster paper prepared for presentation at International Association of Agricultural Economists Conference, Gold Coast Australia. 2006; 1-17.

[15] Just, R.E. Risk Response Models and Their Use in Agricultural Policy Evaluation, American Journal of Agricultural Economics. 1975; 75:836-843

[16] Pope, R.D. The Expected Utility Hypothesis and Demand-Supply Restrictions. American Journal of Agricultural Economics. 1978; 60:619-627.

[17] Olwande, J.; Ngigi, M, and Nguyo, W. Supply Responsiveness of Maize Farmers in Kenya: A Farm-Level Analysis. Paper in International Association of Agricultural Economists Conference, Beijing, China. 2009; 1-17.

[18] Polome, P.; Harmigne, O. and Frahan B.H. Farm-level Acreage Allocation under Risk. Paper in American Agricultural Economics Association Annual Meeting, Long Beach. California USA. 2006; 1-26.

[19] Clark, J.S. and Spriggs, J. Policy Implications of Unit Root Non-stationarity in Multiproduct Acreage Response Systems, Department of Agricultural Economics, University of Saskatchewan, Canada. 1989; 583-598.