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Impact of Exchange Rates, Price, and Interest Rates on

Farm Capital Investment for Intermediate Livestock Farms

Dr. Timothy Baker, Advisor

Acknowledgements

I would like to thank my advisor, Prof. Timothy Baker, for all the help, and advice he has given me regarding this project for the past few semesters. I would also like to thank Prof. Michael Wetzstein, who was the head for the AGEC undergraduate research program, for all the help he has given as well. Furthermore, I am especially grateful for Dr. Sarah Stutzman's assistance with both access and advice regarding the ARMS data that she collated. For everyone who offered feedback, and support, I would like to thank them as well, as they helped make this research study possible.

Introduction

In the United States, there are very few industries, as significant to both the country, and the world's development, but at the same time as controversial as the agricultural industry. With many recent developments or trends like the Great Recession, and the ongoing pattern wherein farms are getting a smaller share of the entire food bill, it raises questions of how farm capital investment will be affected in the coming future.

In this paper, there will be a strong focus in the farm capital investment in the agriculture industry, but specifically smaller livestock farms. With this in mind, there are some very important reasons to why investment in livestock farms should still be supported. A major trend that may be significant is the continued demand for meat products. In recent years, the demand for products like beef, pork, and chicken have continued to see an increase. Another major reason is that the improvement of technology, and the recently lower prices of some inputs like corn as compared to that of the past have made it possible for farms to cut costs, and improve the overall efficiency of farms.

Even with these benefits, there may be problems in the coming future. For the past few years, the dollar was relatively weak as compared to that of the past. However, the dollar has become stronger as of late due to many factors like expectations as a result of the political scene in the United States, and the continued improvement of the United States' economic performance. Although some may see this in a positive note, this may actually be problematic for farm owners. If the dollar continues to appreciate or remain strong as compared to other currencies, this may affect overall expectations for the future, which may cause a decrease in the amount of farm capital investment. Aside from this, the Federal Reserve has set interest rates relatively low for the past couple of years due to the Great Recession to combat the previous Recession and financial crisis. Due to the improvement of the United States economic situation, interest rates have started seeing an increase, which should cause a negative effect on farm capital investment.

Another important trend to look at is the trends for the prices of the products. According the USDA Economic Research Service (2017), prices are

expected to increase for both dairy and poultry products, while beef and pork may see a decrease in 2017 due to increases in supply. These price changes are significant because increases in price will add more benefits for producers to increase their farm capital investment.

Literature Review

For this analysis, there are multiple sources that were relevant for this study. Many of these studies looked into the effects that certain determinants will have on investment. Studies of Chisholm (1974), Feder, Lau, Lin and Luo (1992), and Hall and Jorgenson (1969) look at the impacts that changes in tax policies, and credit will have on investment behavior in different environments. These studies generally showcased that increases in taxes due to policy led to more conservative behavior with investment, and a decrease in overall investment, while an increase in available farm credit led to increases in the farm capital investment for these regions.

Other studies focused on multiple other factors that affected farm capital investment. One factor that is significant for this study is the exchange rate. There are studies conducted by Darby, Hallet, Ireland, and Piscitelli (1999), and Nucci, and Pozzolo (1999) that look at the impact of this factor on investment. Based on the study of Nucci and Pozzolo (1999), their results show that exchange rates do have an impact for both the demand of products, and prices of inputs, but the strength of the impact changes depending on the market. Markets with lower monopoly power will see a stronger impact. For the case of Darby, Hallet, Ireland, and Piscitelli (1999), their study focuses more on how exchange rate certainty will have an impact on the level of investment. Based on their results, exchange rate stability has the ability to lead to increases investment for some markets, but there are some other markets that will not see permanent gains.

Another important study looks at the impacts that farm income, and depreciation has on the farm capital investment. This study was done by Ariyarante, and Featherstone (2009). Based on their results, increases in depreciation, and farm income leads to an increase in the farm capital investment. Besides these two factors, other studies conducted by Ferdousi (2009), and the Heerman (2016) state that lower interest rates increases the incentives to invest.

A very key study is the one conducted by Stutzman (2016). For that study, it looked at the impacts of multiple factors for different farm typologies, which are residential, intermediate and commercial. In the study, Stutzman (2016) uses a fixed effects model was used to analyze the effects of these factors from ARMS data. The

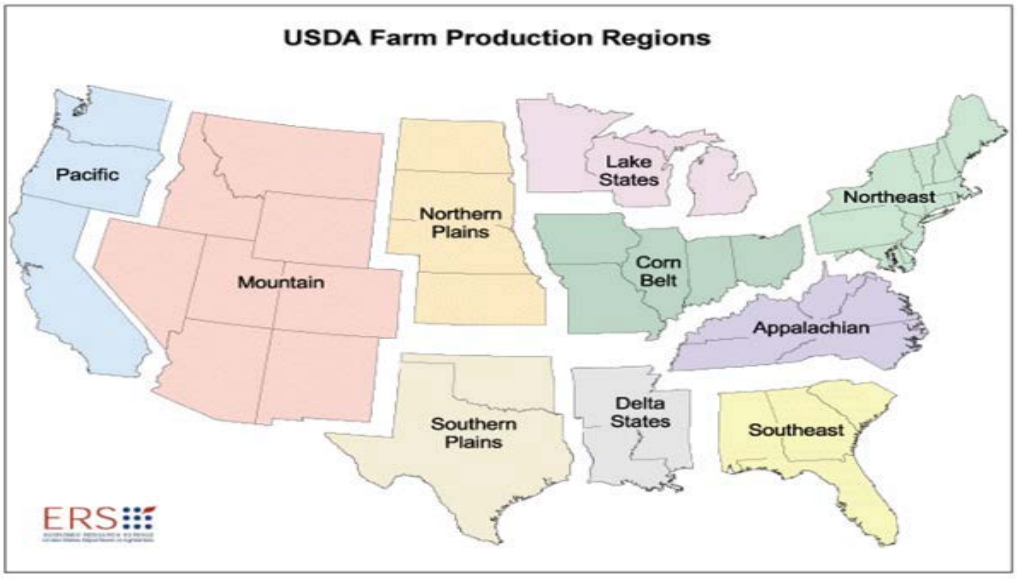
main focus was the difference between groups regarding the impacts of farm income, tax reductions, and working capital. For both this study, and the study of Ariyarante and Featherstone (2009), they both normalize some factors like investment to reduce heteroscedasticity.

For this paper's analysis, it will also make use of the ARMS data to study the impacts of factors like interest rates on investment, while having focus purely on the livestock intermediate group. It will also see the normalization of certain factors by the farm capital assets.

Data and Variables

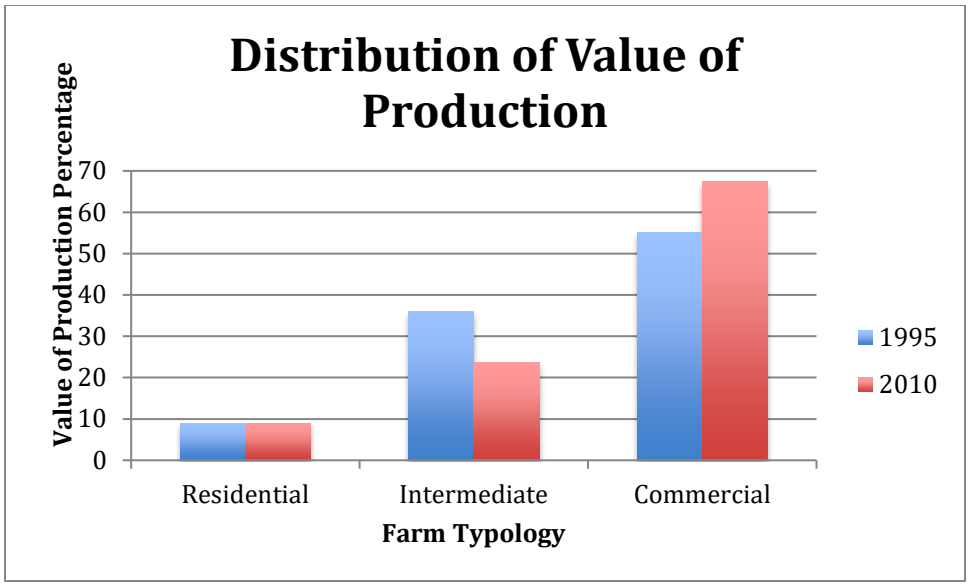
Product Type and Region

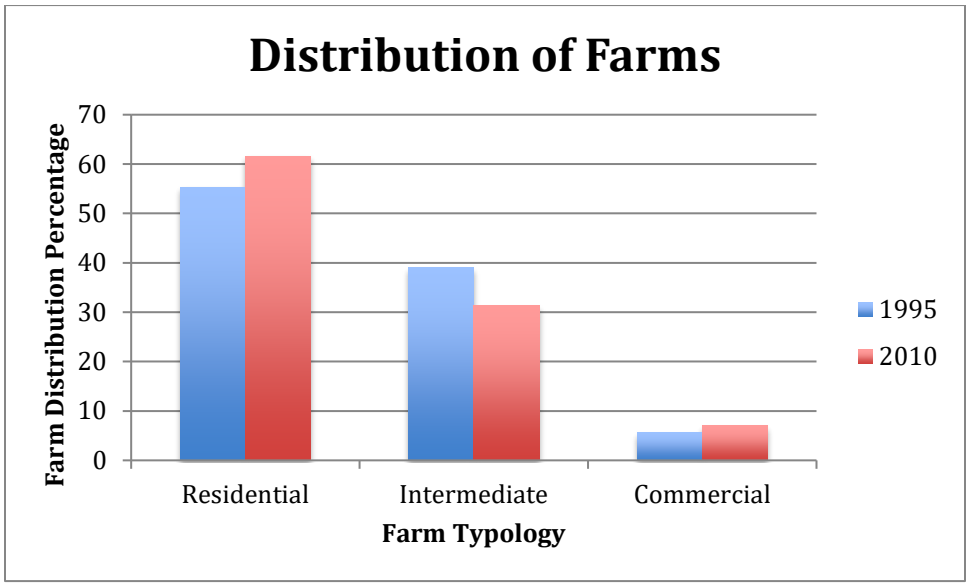
In this paper, the observations found are split into four main groups of livestock, which are beef, pork, chicken and dairy. They are then split into ten different regions as shown below. Aside from this, the observations used in this paper, are from the years 1996 to 2013. Also, a map from the USDA for the different regions will be shown below.



Type of Farm

Unlike the study conducted by Sarah Stutzman (2016), this paper will focus on only one group based on farm typology. This group only includes intermediate farms, which are farms where the annual gross income is less than 350,000 and the main focus of the operator is farming. Looking at this group is significant because the current trend is that this type of farm is seeing a decrease over time, which is quite different from the situation of other types of farms where the operator's main occupation is not farming or the gross income of the farm is greater than 350,000. According to Stutzman (2016), there has been a decrease in both the number of farms and the value of production for this farm group. As a result, they are the most vulnerable group to the changing trends occurring at present, and in the coming future. Two graphs showcasing the decreasing trend for both value of production and distribution of intermediate farms can be seen below.



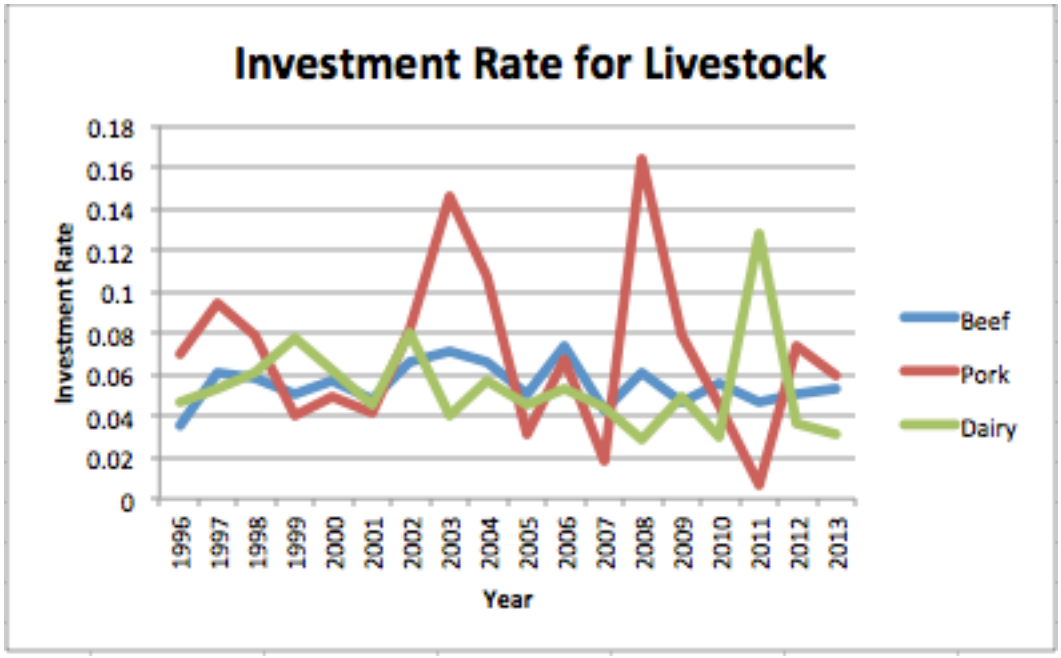


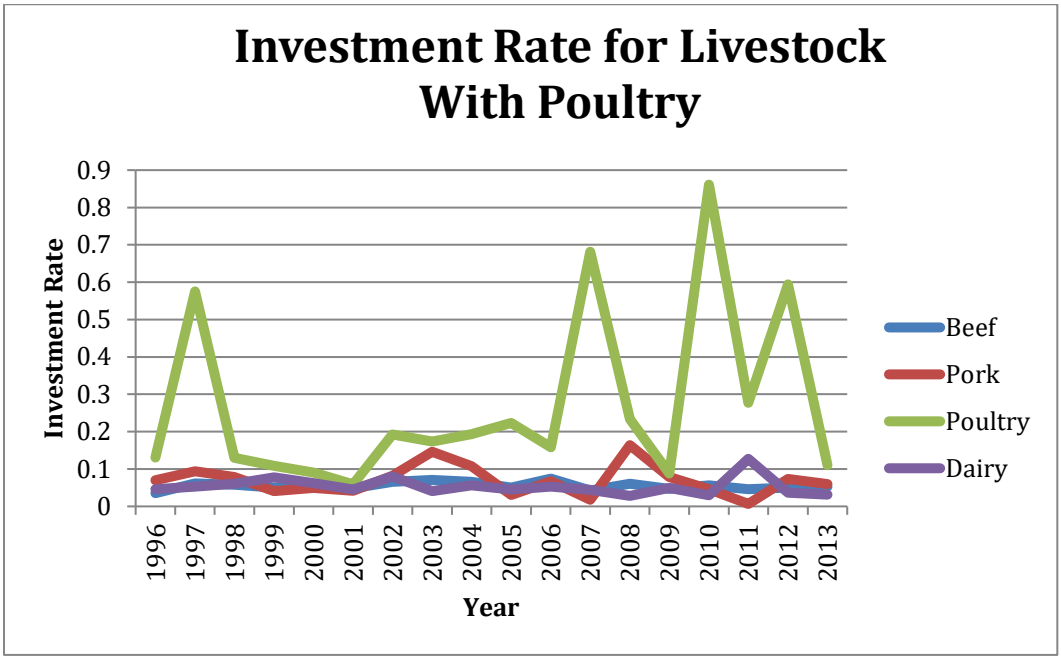
Variables included in Model

Investment

The dependent variable of the model used for this analysis is investment. The dependent variable is the sum of the total investment made by farms during a given year for buildings, equipment, machinery, and breeding livestock. For this variable, it does not take into account investment into land. This is because land investment was only added in 2004, and there was no information regarding this in previous years. Below, there are two graphs showcasing the investment rates by each livestock group. The graph using data that includes poultry shows that this specific

livestock group seems to have a larger amount of volatility for its investment rate. This is likely due to the different production types of poultry. This issue will be tackled in further depth in the latter parts of this analysis.





Product Prices

According to Dwivedi (2012), the increase in output of a product will lead to an increase in the amount of investment made to meet the new level of output.

Product prices will affect investment because of its direct relationship with quantity of output supplied.

Farm Income

The farm income used in this model is the net cash farm income. An increase in the profits and the income of farm will have a positive impact on the total amount of investment made for the business.

Interest Rate

Interest rates have an inverse relationship with farm capital investment. As a result, increased interest rates should lead to a decrease in the total amount of investment made by farms.

Tax Rate

The tax rate will have a negative impact on the investment rate. As the marginal tax rate increases, this should lead to a decrease in the farm capital investment.

Depreciation

According to Sarah Stutzman (2016), the cost of capital will see a decrease if a tax sees a deduction. This can be due to factors like an increase in the depreciation tax deductible. As a result, an increase in the depreciation should lead to the cost of investment to become cheaper. Therefore, this should lead to an increase in the overall farm capital investment.

Exchange Rates

This exchange rate is from the USDA. This is the trade-weighted exchange rate per livestock type. These are generally weighted based on the amount of trade that a country has with the United States for a specific product. These take into account currencies used during the time including those that are no longer used at present. The trade-weighted data is an index with a base year of 2010. An increase in the exchange rates should lead to an overall decrease in foreign demand of this product. Because of this, expectations of the future will be affected, so the supply will see a decrease, which would make investment into fixed assets less likely.

Acres

An increase in the acreage size of the farms should lead to an increase in the amount of investment in fixed assets like machinery since it becomes more efficient to use this over time due to economies of scale.

Working Capital

Working capital was acquired by decreasing current assets by the current debt. An increase in working capital should lead to more funds to use on investment.

Models

Linear Regression Model

$$\frac{Invest_{i,t}}{a_{i,t}} = B_0 + B_1 PriceIndex_{i,t} + B_2 \frac{NCFI_{i,t}}{a_{i,t}} + B_3 Interest_{i,t} + B_4 \frac{WC_{i,t}}{a_{i,t}} + B_5 Exchangerate_{i,t} + B_6 \frac{Acres_{i,t}}{a_{i,t}} + B_7 \frac{Depr_{i,t}}{a_{i,t}} + Year_t + C_i + e_{i,t}$$

The linear regression model is shown above. The fixed capital assets or total assets for machinery, buildings and others will normalize these factors, and they are represented by the symbol, $a_{i,t}$. This is following the studies of Stuzman (2016), and Ariyarante and Featherstone (2009). Factors like net cash farm income, acres, working capital, investment depreciation will be divided by these capital assets. According to Stutzman (2016), this should help reduce heteroscedasticity for the data. Following the model of Stutzman (2016), $Year_t$ and C_i are the individual year dummy variables, and the time invariant differences between cohorts or groups. The subscript, i, is cohort mean for the specific observation.

For the model type used, there are some possible issues with using the simple linear regression for panel data. The chief concern is that this method will lead to biased estimates when using this type of data. As a result, there are three possible options that can be used. These are the pooled regression, fixed effects model, and the random effects model.

Pooled, Fixed Effects or Random Effects Model

The pooled regression can only be used under certain conditions. There has to be a lack of presence of fixed or random effects. For the case of the fixed effects, there will have to be a presence of fixed effects, while lacking random effects. The

opposite will be seen for the case of the random effects model. Although using these models may depend on other factors like the scope or goal of the experiment, or analysis, using the method that does not fit the data may lead to biased estimates, which will cause problems with the results of the analysis.

To test this, I checked for Random effects and Fixed effects. Using the Hausman test for random effects, I was able to test for the presence for random effects. Below, there is a table showcasing the results of these tests. Based on the results shown, there is a presence of random effects for all cases. As a result, I will be making use of the random effects model.

Hausman Test for Random Effects	
Livestock Type	**Pr>m**
Beef	**0.7254**
Pork	**0.95**
Poultry	**0.998**
Dairy	**0.9521**

Hypotheses

For this study, there will be three different hypotheses of note that will revolve on three different factors. These are interest rates, the exchange rates, and prices of the products. The first hypothesis is that a change in the interest rates will have an impact on the farm capital investment. The second, and third hypotheses are that changes in the exchange rates, and the prices of products will lead to an impact on farm capital investment for intermediate farms.

Results

Random Effects Model Results			
Livestock	Interest Rate Coefficient (P-value)	Exchange Rate Coefficient (P-value)	Price Index Coefficient (P-value)
Beef	-0.000222 (0.9985)	0.000825 (0.0130)	0.025851 (0.0251)
Pork	-0.59226 (0.2255)	-0.00017 (0.9370)	-0.01356 (0.8809)
Poultry	4.13937 (0.4468)	-0.01383 (0.4044)	0.187843 (0.8607)
Dairy	-0.19731 (0.4478)	0.000307 (0.6586)	0.010418 (0.8065)

Goodness of fit

Livestock Type	Goodness of Fit
Beef	0.1204
Pork	0.2301
Poultry	0.0801
Dairy	0.0683

The goodness of fit for all 4 livestock groups is shown above. Based on the results, there are some issues with the goodness of fit for this model. Overall, this can be attributed to many factors being non-significant. A major reason why this is

the case was that it is likely that there was not much variation in the data. There may also be some issues with multiple types of production types for livestock. Due to the larger variation for this case, it may have led to problems with the estimates, which would have contributed to the non-significance of some of these factors.

1st Hypothesis

Even though farm capital investment should be impacted by the change in interest rates, the result for all four cases says otherwise. Based on this, it seems that the interest rate was not significantly different from zero. Because of this result, I cannot reject the null hypothesis. There are some potential reasons why there was no significance for this period. There may be a lack of variation for the data for interest rates in general. To counter this, it may be useful to include more years in the next study, and increase the number of farms included in the data.

2nd Hypothesis

Unlike the previous case, there was significance, but for only one main livestock group, which was beef. Based on the result, a positive change in the price of beef will lead to an increase in farm capital investment. This follows what is expected for the price of beef. Because of the result, I can accept this hypothesis for beef. This is significant due to the events seen in the near future. With prices set to see a decrease for beef, it may lead a negative impact in the farm capital invested for beef intermediate farms.

For all the other cases, the results showed that they were not significantly different from zero. As a result, I will have to reject the hypothesis for the other three cases. It is possible that this occurred because there was not much variation in the data for the other livestock types. Furthermore, another possible issue is that there may be a problem with different production types for other groups like poultry. With groups like poultry having different product types, it is likely that there may be different costs, and practices used by these firms, which should lead to estimates that may prevent significant results.

3rd Hypothesis

For the case of beef, the results show that is statistically significant. However, the results also show a different result from what I anticipated. Based on the data

acquired, it shows that a positive increase in the exchange rate will lead to an increase in the farm capital investment. As a result of this, I can accept the hypothesis because the exchange rate did have an impact on farm capital investment. However, the fact that it led a positive result is an issue that may be useful to address to gain a better understanding of the relationship between farm capital investment, and the exchange rate. For the other three cases, the same scenario for hypothesis two was seen here as well. With a lack of statistical significance, I have to reject the hypothesis for the other three choices. It is likely that the same problems that plagued the other hypotheses affected this case as well.

Conclusions and Recommendations

With certain issues like lack of variation for terms like the interest rate, it may be beneficial to increase the number of years, and observations to increase the variation of the data for future studies. Furthermore, the effect of differences caused by the production types may have also negatively affected the results making them not significantly different from zero. As a result, it may be useful to separate these groups from each other to prevent issues with the estimates. From the different livestock groups, beef was the only one to see significance for the price and exchange rate factors. . For the case of beef prices, the trend for 2017 is that beef prices are set to see a decrease, which will result in a negative impact for beef farm capital investment. On the other hand, the direct relationship of both the exchange rates and farm capital investment means that the current situation may actually benefit farm capital investment. It may prove useful to study this factor even further, and analyze the changes occurring over time to see whether or not intervention is needed to boost intermediate farm capital investment.

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