Consumers' Willingness to Pay for Locally Sourced Meat

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Introduction

Covid brought confusion to most markets and the meat market was no exception. As meat demand and meat processing availability shifted, federal and state-level government interest became focused on supporting small to medium meat processors throughout the country as an option to stabilize the level of meat processing available as covid caused many of the major processors to shut down at different occasions (US Government 2022). The main issue with focusing on these smaller plants as a solution for the shortage of meat processing supply is their cost disadvantages over larger processors which requires them to charge premiums. This is why researching consumers' willingness to pay (WTP) for meat from these small to medium processors is important. This paper is part of a larger study into the meat supply chain, consumers' willingness to pay for beef, pork, poultry, and lamb, and later will be added to the research of the minimum premiums that these small processors need to be able to cover their cost disadvantages compared to larger processors. The research at this time has explored what processors see as their main constraints to expansion of processing capacity and now exploring what factors impact WTP with a special interest in the regional effects and additional researched WTP for local products and would provide significant evidence for there being positive WTP for local products. This paper introduces an interest in differences in WTP across regions of the USA.

Literature Review and Related Research

WTP for locally processed meat has been of interest for a while now but as Covid has brought new interest into local meat processing there has been additional research conducted to understand these processors and their needs to have larger impacts on the supply chain and what is the viability with is increased role. Currently, the following universities are conducting

research on the state level of small to medium meat processors the University of California Davis with research in the state of California led by Michael Dimock, and Cornell University with research in the state of New York led by Mike Baker by and Purdue University conducting research using USDA NASS Quick Stats data looking at the national level lead by Meilin Ma. Unlike UC Davis and Cornell researchers that focused on the state level needs of meat processors the research in partnership with the United State Department of Agriculture is focused on the needs of meat processors on the national level with initial research through phone surveys with meat processors across eighteen states. Unfortunately, after reaching out to processors, and only getting responses from ten processors across eight states. As the second stage of the research into consumers' WTP begins, a national approach with a hypothetical consumer choice experiment through an online survey will be employed that was launched in April 2022. On the WTP side of the related research are the following studies: Centro de Investigación y Tecnología Agroalimentaria de Aragón's research on WTP on local lamb led by Azucena Gracia, Pennsylvania State University on WTP for locally produced beef led by Xiaogu Li, and Kansas State University's research on WTP on meat origin labels led by Dr. Glynn Tonsor.

Research Connected with First Part of Project

As stated earlier, the role of local meat processors in the meat supply chain as a method to create a more resilient supply chain and what would keep them from doing so has mainly caught attention in the last couple of years as covid saw the shutdown of some of the largest processing plants which greatly disrupted the supply chain. This is the background for the following research from UC Davis, Cornell, and Purdue.

UC Davis' study examined the California meat supply chain focusing on its resilience to disruptions such as COVID-19 and the ransomware attack on JBS in June. Twenty-

seven interviews were conducted with individuals across various parts of the meat supply chain focusing on California but also a few in surrounding states (Dimock et al., 2021). The first research objective was to examine if the meat supply chain is less resilient due to the concentration of the industry around a few larger processors. Secondly, the research examined what could be done to support smaller processors to increase the resilience of the state's supply chain to various supply shocks. The study provided five main recommendations. First, as the supply chain recovers from the pandemic, there is an opportunity for supporting small and medium meat processing, as California has a budget surplus and CDFA (California Department of Food and Agriculture) is considering new approaches to support the meat supply chain. These opportunities are increased by funds being made available at the Federal level. Secondly, there are concerns among the processors participating in this study over the concentration in the processing industry: the authors noted that 80% of the meat processing in the United States occurs at four processors. Thirdly, the complexity of inspection requirements and the resources needed to meet the requirements merits further study. California's MPI (Meat and Poultry Inspection) program does not have a USDA CIS (Cooperative Interstate Shipment), so a Californian processor can sell across state lines only with a full USDA inspection. Fourth, there is a growing demand for what the authors label as "high-value meat" with descriptors such as local, organic, grass-fed, etc. (Dimock et al., 2021). Finally, the results are supportive of a "collaborative supply chain", with coordination from producer to end-user to level the playing field for smaller actors in the supply chain.

Cornell's study examined the effects of the COVID-19 pandemic on the livestock supply chain in New York State (NYS) (Baker et al., 2021). The authors conducted 112 surveys with USDA, Custom Exempt, and 5A processors throughout New York from October 2020 to

February 2021. Custom Exempt processors only process meat for personal use and do not sell to retail or wholesale outlets. 5A is a classification for poultry processors in the state of New York, with wholesale licensing only within the state (NMPAN, 2012). The focus of Baker et al. was whether the pandemic created interest in expanding processing capacity, the barriers processors face in expansion, and how best to support interest in an expanded capacity. The survey assessed processors' desire to transition from Custom Exempt to USDA inspected processors that would allow them to sell meat wholesale and across state lines. This would allow New York processors to market their products to those residing outside of New York. Without grant funding, 20% indicated they were interested in expanding their operations to USDA inspected to allow for out-of-state demand. If funding were to be made available, the percentage of interested processors would increase to 32% (Baker et al., 2021).

Purdue's study differs from the interview approach of the UC Davies and Cornell studies, in that they instead used USDA data and estimated models to test the resilience of different types of market structures. Purdue's study examined the bottleneck that can occur in the meat processing stage creating disruptions in the flow of products from farmers to consumers. The researchers argue that this supply chain has an hourglass shape where there are many farmers, few processors, and many consumers. This raises potential supply chain issues if the processor link in the supply chain is disrupted. They focused their research on the beef supply chain and the effect of differing levels of the risk of processor shut down on the resilience of the beef supply chain. They use an economic model to conduct counter factual simulations to compare disruptions across different levels of processor concentration. Data from USDA's NASS Quick Stats website were used to estimate their models and define three processor sizes: small 1-49,000 head a year, medium 50,000-499,000 head a year, and large over 500,000 a year (Ma & Lusk,

2021). The researchers estimated these models with the risk of shutdown ranging from 5% to 50%. They found that aggregate economic welfare is typically lower under a more diffuse packing sector because of the loss of economies of scale (Ma & Lusk, 2021). They conclude that more comprehensive policy designs to account for this may be needed to improve short-term resiliency in the beef supply chain.

Research Connected to Current Section of Project

Willingness to pay for meat and its effects has been a topic of interest for many researchers for several years. Some of the research with closer interest to the research is the following research from Centro de Investigación y Tecnología Agroalimentaria de Aragón, Pennsylvania State University, and Kansas State University. While I was able to find research connected to WTP for individual cuts of meat I was unable to find any research connected to WTP for a proportion of animals' carcasses.

Research in the town of Zaragoza, Spain with Centro de Investigación y Tecnología Agroalimentaria de Aragón (CITA) (Gracia et al., 2012). The main interest of their research was the difference in WTP between males and females for local meat focusing on lamb based on social influences. They used a nonphotochemical choice experiment through an experimental auction with an actual exchange of funds and products in the form of lamb ribs. Their research only included 77 participants and 61% of their participants were female (Gracia et al., 2012). Their results saw women have a positive WTP for locally raised lamb at € 0.188, but men had a negative WTP for locally raised lamb at € -0.281 (Gracia et al., 2012). While both of these results were statistically significant and provide something to compare the results to with such a small number of participants and then dividing them into even smaller groups of males and females, it

creates issues with the accuracy of the results. Even with this issue, this focus provides an interesting coefficient and reasoning behind it to check.

The research with Pennsylvania State University's Agricultural Economic Department (Li et al. 2018). They conducted a hypothetical choice experiment that was conducted online at a national level. Their study was focused on what attributes affect WTP for both steak and ground beef. They used a logit model to analyze their results. As opposed to CITA research with only 77 usable results they obtained 1,688 usable results being only hypothetical they did use cheap talk to manage any overstatement of WTP. For both steak and ground beef, the Angus label saw the highest WTP increase of $2.26 and $0.45 respectively with local production behind it with a WTP increase of $1.25 and $0.19 respectively (Li et al. 2018). Even with the cheap talk effort of the researchers with no real exchange of funds and goods, it is difficult to get a completely accurate WTP estimate due to people's tendency to overestimate their WTP if they do not have to actually buy a product. This issue does decrease some of the value of these WTPs but still allows them to estimate WTP which can be expensive and otherwise difficult. This paper provides a good estimate to compare the results too.

Research with Kansas State University's Agricultural Economic Department (Tonsor et al. 2013). They conducted a hypothetical choice experiment survey that was conducted online through Survey Sampling International, with a focus on WTP for meat origin labels. They had 2,001 complete results. The main test was a double-bounded dichotomous questions to test looking at labels for steak from North America, Mexico, Canada, and the US (Tonsor et al. 2013). They found WTP for US steak, chicken breast, and pork chop respectively $1.67, $1.44, and $1.53 (Tonsor et al. 2013). More interesting were the effects of demographic factors, particularly education at -$0.20 WTP which tells us that increased education decreases WTP for

meat origin labels (Tonsor et al. 2013). This study has the same issues that Li's research had as a hypothetical choice experiment and no real exchange of goods and funds which can lead to participants overstating WTP. They also attempted to address this with a cheap talk script to make consumers aware of the issue and decrease it from happening. An additional issue of the survey being online is the issue of participants rushing through the survey and possibly lowering the quality of the data. It will be interesting to test the results on how education and demographics affect the results.

Methods

The survey was designed using Qualtrics and begins with base information to make sure the participant fits the needs of the survey. As stated earlier, participants that are active in grocery purchasing for their household were wanted. With this in mind, participants were asked this as the first question but only removed them from the survey if they said that they had no involvement in the purchases. If the participants had some involvement in purchases, then they were asked their ages and removed if they were under eighteen.

These were the two main initial filters of the survey for the participants that were fit to keep answering the rest of the questions. Later, they were asked their meat consumption dynamics by type of meat and later on, they were randomly assigned questions regarding their WTP of one of the meat products they reported to consume. The random assignment of questions regarding WTP was designed in order to keep the survey as short as possible and try to capture more honest answers from the participants, and also to try to collect a decent amount of data on WTP for all meat types.

Sample

The set for this research is USA meat consumers who are involved in grocery shopping and are over the age of 18. To get a suitable sample for this group, an online survey was conducted through Dynata. The survey was launched in April 2022 and are asking for 5,000 complete surveys. In order to verify the results, the company was requested to run a round of 500 completes to catch any issues that may arise with the survey. After which point, the data will be set up and test models, so code will be prepared for the final run. Within the first five hundred, it was observed that the question to understand the amount of freezer space that consumers had which allowed them to answer more than one amount for the same size freezer.

There were similar issues with the carcass questions where participants could answer yes and no but instead of completely eliminating these questions, forcing these participants who had answered both to be removed. On top of these issues, the randomizer logic to set participants into different groups, unfortunately, had issues and did not send participants evenly to beef, pork, and chicken instead favoring beef and pork which meant that the chicken results and lamb were ignore due to lack of responses at this time and beef and pork were only looked at. The issues are currently being working on to correct these before the research is moved forward with the next step of data collection. Once data collection is completed, the data will be able to run through the models and get full results. But with the limited data currently available, allowing some preliminary tests of the carcass models for steers and hogs to be run.

Quality and Value of Data

In order to ensure the quality and value of the data, using the following are used to verifications were made. First, there is a trap question where participants are asked to answer blue and if they do not, they will be removed from the results because not answering blue will indicate that they are not reading and answering the questions carefully. Next, because the

research is focusing on willingness to pay for meat, there was a question asking about how they consider their diet. If they consider their diet vegan or vegetarian, they were additional remove from the results so the willingness to pay is not skewed by those who have no willingness to pay for any meat.

They were also ask questions about willingness to pay for portions of the whole carcass for steers, hogs, and lambs to ensure the value of these questions, they were additional asked the size and number of freezers that the participants have to guarantee that the customer could realistically purchase portions of a carcass and store it noting that it takes about fourteen cubic feet to store half of a steer (5BarBeef 2022), and six to seven cubic feet for half a hog (French, 2021).

To limit biases towards any type of meat, the participants were asked which of the following meats they have eaten beef, pork, chicken, lamb, or neither. They were allowed to answer as many as they wanted and using Qualtrics logic, they were randomly assigned to one of the meats they answered unless they answered lamb. They were assigned to lamb in this case because it is expected that there will be a lower number of consumers who have eaten lamb in the last month compared to the those who would have eaten the other types in the last month. After each participant is assigned to a group, they are given one carcass question at random and three cuts questions at random except for lamb where they will only be given one carcass question at random without any cuts questions due to the limited availability of cuts lamb. As a final attempt to improve the quality of the data before the participants were asked any price questions, the participants were exposed to a cheap talk paragraph to help reduce the skewing of the hypothetical nature of an online consumer choice survey which has been seen to be effective at limiting overstatement of WTP (Tonsor et al. 2011).

Choice Experiment

To capture WTP, two different types of hypothetical consumer choice questions were employed. The first type is for potions of carcasses of steers, hogs, lamb, and chickens were presented to the participants with a table of the cuts of each proportion of carcass of each animal and then they were provided a total price and a per pound price for a set portion of that carcass. Below are examples of each animal carcass question. The prices for steer for the ¼ were $5-7 per pound for the ½ were $5-6.50 per pound and for the whole were $4.75-5.25 per pound. The prices for the hog for the ½ were $4.29-5.95 per pound and for the whole were $3.45-4.64 per pound. The prices for the whole chicken were $2.86-5.71 per pound. The prices for lamb for the ½ were $14.50-16.50 per pound and for the whole were $15.50-16.50 per pound.

Steer 1/4 $5

Would you be willing to purchase 1/4 of a steer (125 lbs of beef) for $625 or $5.00/lbs?

Cut	Lbs of beef for ¼ steer	Lbs of beef for ½ steer	Lbs of beef for whole steer
Arm/Chuck Roast	14	29	58
Rump Roast	7	14	29
Brisket	4	7	14
Bag of Bones	24	48	96
Beef Stew	2	5	10
Ground Beef	53	106	212
Ribeye Steaks	6	12	24
NY Strips Steaks	5	10	19
Top Sirloin Steaks	6	12	24
Beef Ribs	4	7	14
Total	125	250	500

Yes   ○

No   ○

Chicken $4.29

Would you be willing to purchase a whole chicken 3.5 lbs for $15 or $4.29/lb?

Cut	LBS
Breasts	1.44
Drumstick	.60
Thighs	1.09
Wings	.39
Total	3.5

Yes   ○

No   ○

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hog 1/2 $5.48

Would you be willing to purchase 1/2 hog 105 lbs for $575 or $5.48/lb?

Cut	½ Hog in LBS	Whole Hog in LBS
Mix Sausage	30	60
Pork Chops	15	30
Spareribs	5	10
Ham or Ham steaks	25	50
Shoulder Roast	15	30
Bacon	10	20
Ham Hocks	5	10
Total	105	210

Yes   ○

No   ○

Lamb 1/2 $14.5

Would you be willing to purchase 1/2 a lamb 24.2 lbs for $350 or $14.50/lb? (Please drag and drop your answer into the box.)

Cuts	½ Lamb: Quantity	LBS	Whole Lamb: Quantity	LBS
Rack Rib	1	1.5	2	3
Loin Chops	4	.3	8	.6
Leg Shanks	2	7	4	14
Leg Roast	1	2.5	2	5
Ground Lamb	5	1	10	2
Total		24.2		48.4

Yes

No

The second consumer choice questions are the meat cut questions for beef, pork, and chicken. As stated earlier for beef, steak and ground beef were presented, for pork loins, ham, and bacon were presented and for chicken breasts, wings and thighs were presented. For each cut

question, an option to purchase from a national grocery and from a local butcher at different

prices and some questions with different volumes and some questions with the same volumes

and only varying prices and sourcing were presented. Below are examples from each of the cut

questions from each of the meat cuts sets.

loin g10$4 l30$6.25

How many of each package would you be willing to purchase at these prices? (Please enter the number of each type of package would you want to purchase or mark none.)

	10lbs package Pork Loin from a National/Regional Grocery Store at $4.00/lb	Two, 15 lbs packages or 30lbs Pork Loin from Local Butcher at $6.25/lb	None
Number Purchased			

Theory

The data used for this research was acquired from a consumer choice survey that was distributed online throughout the USA. The survey was distributed in April 2022 and focused on the WTP for the following meats: beef, pork, chicken, and lamb and how it was affected by sources and size, and if it was different for various locations. This focus was accomplished by comparing WTP for meat from a local butcher/meat processor vs meat from a national/regional grocery store presenting and about purchasing different portions of a carcass for each species, then different prices and quantity questions for cuts of beef, pork, and chicken from either a regional/national grocery store or a local butcher starting at prices from the USDA ERS (Economic Research Service) Retail prices for beef, pork, poultry cuts, eggs, and dairy products for the grocery store and then varying them by 25% to provide three prices and have a 25% premium for each price for the butcher prices. Then a set of prices was constructed for each cut had a set of questions with the same quantity required to purchase and then a set of questions where the consumer was required to purchase a large quantity at the butcher shop than at the grocery store using the same sets of prices. After these questions, they were then asked demographic questions to allow for investigation into how demographics affected WTP for meat from a butcher vs a grocery store.

Models

There were two main styles of questions to collect WTP and will use two types of models to analyze these questions. The first type of questions that were modeled was on different portions of carcasses of steers, hogs, chickens, and lambs. For the steer questions, the participants are given an option to purchase either a quarter, half, or whole and are given the cuts and portions of each they will get for each portion of carcasses. For each size question, there were three different price levels, each with a 10% variance to the next level. For the hog questions, the portions provided to the participants are half and whole and again the prices were varied by 10% providing three different possible prices for each portion. For the lamb questions, the participants were provided the following portions are half and whole and the same 10% price variances were used for three different price options for both the portions. And finally, for the chicken, whole was provided as a portion and again used the 10% variation to provide three different possible prices for the participants to see.

The second type of questions that were modeled is the cut questions for beef, pork, and chicken. For the cuts, the participants are given price and volume with two portions, one from a national grocery store and one from a local butcher, and the option to pick neither. The participants chose the number of packages they wanted to purchase of either option or both at the given prices and volume due to different sale options at local processors there were larger packages with them for one set of questions and then a second set of questions was created with the same size packages for each option. Prices from USDA ERS's Retail prices for beef, pork, poultry cuts, eggs, and dairy products (USDA ERS 2022) were employed for the cut questions given a 25% premium local butcher and varying prices by 10% to have three different prices for both national grocery and local butcher. The cuts of interest were the following for beef the two

cuts observed were steaks and ground beef, for pork the cuts observed were loin, ham, and bacon, and for chicken, the cuts observed were breasts, wings, and thighs.

Tobit Model

To run the data for the cuts questions, a Bivariate Tobit model will be employed which requires two individual models to be built that will be solved simultaneously. The first for quantity local as a function of own price cross price of P-national and any of the demographic variables that are desired to test. The second equation is needed for quantity national as a function of own price cross price of P-local and any demographic variables that are desired to test (Koul et al., 2013). R-studio will be employed to run these models.

$$QL = \beta_0 + \beta_1 PL + \beta_2 PN + \varepsilon$$
$$QN = \beta_0 + \beta_1 PN + \beta_2 PL + \varepsilon$$

Probit Model

To run the data for the carcass questions Probit models will be employed where the dependent variable is the probability of a participant choosing yes on a question with the independent variable of the given prices and proportion of carcass as dummies plus any demographic variables that are desired to test.

Prob of Yes $= \beta_0 + \beta_1 \, \boldsymbol{proportion} \, + \beta_2 \, \boldsymbol{price} + \varepsilon$

R-studio will be employed to run these models. The price for each model is expected to have negative coefficients as the price increase, it is expected for more participants to say no, and it is also expected that the dummies for the larger portions will also have negative coefficients as the portion of the carcass the participant would be purchasing increases, the participants is less likely to purchase.

Steer

Prob of Yes $= \beta_0 + \beta_1$ ***proportion steer*** $+ \beta_2$ ***price steer*** $+ \varepsilon$

Hog

Prob of Yes $= \beta_0 + \beta_1$ ***proportion hog*** $+ \beta_2$ ***price hog*** $+ \varepsilon$

Lamb

Prob of Yes $= \beta_0 + \beta_1$ ***proportion lamb*** $+ \beta_2$ ***price lamb*** $+ \varepsilon$

Chicken

Prob of Yes $= \beta_0 + \beta_1$ ***proportion chicken*** $+ \beta_2$ ***price chicken*** $+ \varepsilon$

Earlier Research Results

From the earlier research with small to medium meat processors, 187 processors across 18 states were contacted but between extremely low response rates and restrictions from the USDA side of the project ended with only 9 responses across 8 states throughout 2021. From the earlier research, it was observed that processors' key issues for increasing processing capacity are the following: available skilled employees, available animals, and freezer space.

Preliminary Results

The base Probit models for hog and steer were completed with the data from the initial survey run and the Tobit models for the beef and pork cut questions are currently being run. As stated above, here are the results from the Probit models from hogs and steers with a second table for each that is the coefficients converted into a percentage change.

Hog

$$\text{\textbf{Prob of Yes}} = \beta_0 + \beta_1 \textbf{\textit{price hog}} + \beta_2 \textbf{\textit{dummy whole}} + \varepsilon \ (1)$$

Table 1

	Dependent variable:
	Yes
Price	-0.309[*]
	(0.160)
Whole	-0.701[**]
	(0.289)
Constant	1.617[*]
	(0.864)
Observations	167
Log Likelihood	-111.424
Akaike Inf. Crit.	228.848

Note: $^*p<0.1; ^{**}p<0.05; ^{***}p<0.01$

Table 2

Intercept	Price	Whole
0.6187074	-0.1182442	-0.2682136

As stated above, a Probit model was used for hog, and with equation 1 as the base equation, the dependent variable is the probability of a participant selecting yes to purchase the portion of hog they were offered in the question with independent variables of price and a dummy for Whole with the base portion being half. Looking at the results, it is observed that the price and the dummy for whole are both negative, which is what was expected. After converting them to percentage changes using glm in r, it is observed that as the price of the hog carcass increased by one percent, the percentage change of the participant saying yes decreased by 11.8%, similarly on the whole dummy if the participant was given a whole carcass question as opposed to a half carcass questions the likelihood of the participant choosing yes was decreased by 26.8%.

Steer

$$\textbf{Prob of Yes} = \beta_0 + \beta_1 \, \textbf{\textit{proportion steer}} + \beta_2 \, \textbf{\textit{price steer}} + \varepsilon \text{ (2)}$$

Table 3

	Dependent variable:
	Yes
Price	-0.193
	(0.169)
Half	0.428*
	(0.229)
Whole	-0.324
	(0.250)
Constant	0.955
	(0.991)
Observations	202
Log Likelihood	-135.425
Akaike Inf. Crit.	278.851

Note: $^{*}p<0.1;$ $^{**}p<0.05;$ $^{***}p<0.01$

Table 4

Intercept	Price	Half	Whole
0.36763152	-0.07410025	0.16464367	-0.12465399

A similar Probit model was used for steer, with equation 2 as the base equation with the dependent variable being the probability of the participant choosing yes and with independent variables of price and dummies for half and whole carcasses with the base as a quarter. The results show that half was the only significant variable. The signs on price and whole were both negative, which matched what was expected, with price increase decreasing the probability of yes and being offered a whole versus a quarter decreasing the probability of choosing yes. With that said, it was unexpected to see that the half dummy variable had a positive sign saying that a participant was more likely to say yes when offered a half versus a quarter. After performing the conversion in r, it is seen that if the price increases by one percent, the probability of yes

decreases by 7.4 percent. And if the participant sees half instead of a quarter, they are 16.5% more likely to say yes, and if they are offered whole versus a quarter, they are 12.5% less likely to purchase the portion.

Continued Research

Data collection began in April 2022 and with the issues that had occurred in the first run of the survey, the full results have not been archived at this point and the research will continue with the cut models to capture willingness to pay for the cuts, with additional runs for the survey to test for additional issues. The expectation is that this research will be able to bring new information into the WTP for proportions of carcasses in general and more information into the demographic and regional factors of WTP for both cuts and carcasses. After this section of the research is completed, the project will be furthered with an additional survey on the processors side of the transaction to capture the premium required by these smaller processors to sustain their businesses and see if on a regional level these required premiums match consumer's WTP. Once willingness to pay and the processor's minimum required premiums is better understood, NASS quick stats will be used to see if the supply of animals available to these small processors would allow them to expand their processing and allow them to be a viable option to support a larger portion of the meat market.

Conclusion

In conclusion, there is a great deal of research and analysis to be done with current data and with the second run of data as well. With this first run of data more was learned of the process of data collection and cleaning of survey data than usable data output but with these early findings, it is believed that there is valuable information that can be gathered once the full

models have been run with a complete set of data. Using the issues from the first run to increase

the value of the data from the sequential runs. At which point, the results will be connected to the

initial research and future research.

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