

The Effects of Currently Reported Data on Data Quality: An Analysis of the Agricultural Labor Survey

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Abstract

The Agricultural Labor Survey (Ag Labor) is a bi-annual survey administered for the purpose of collecting data on the number of hired workers, average hours worked, and wage rates. The Ag Labor survey has a panel design, which means that for each data collection session, respondents are asked to provide the same information for two different reference periods. This request may place unnecessary burden on respondents and can also lead to false rates of change due to variation in question interpretation, recall errors, and variation in open-ended response coding. The current study uses mixed methods to explore the impact of interviewer behavior on data quality by assessing respondents' response process when presented with currently reported data (CRD). In addition to the effects of CRD on data quality, the results of panel surveys are also prone to seam effects. This effect can produce fabricated changes that could lead to misinterpretation of the study results. The study also explores the impact of seam effects on data quality by assessing the magnitude of difference for various variables.

Key Words: Currently Reported Data, Previously Reported Data, Seam Effects, Panel Survey, Data Quality, Farm Labor

1. Introduction

Panel surveys are beneficial because they can give insight into patterns of change over time. More specifically, using panel survey data, researchers can distinguish between permanent and transitory characteristics (Duncan et al 1993), identify gross patterns of change over time and establish causality (Duncan and Kalton, 1987; Trivellato 1999). However, a number of the disadvantages to panel surveys, can impact data quality. Panel surveys are often prone to attrition, and even more concerning, subsequent attrition bias due to particular subgroups opting out of the panel. Another issue is measurement error, which can be attributed to a number of things, such as item nonresponse, memory decay, question interpretation issues, panel conditioning (Ruspini, 2002) and constant wave response (Young 1989; Martini 1989). These types of errors can lead to spurious change, often referred to as seam effects (Rips, Conrad and Fricker 2003). In this paper, the focus is attention on seam effects.

Seam effects occur when between-study variation (transition months) tends to be higher than within-study variation (month-to-month difference). Transition months also referred to as "on seam" months are adjacent months where data are collected from different interviews. "Off seam" months are adjacent months where data are collected during the same interview. Seam effects are often attributed to respondent behavior. In panel surveys, it is common to ask respondents the same question using different references periods both within and across data collections.

When asked to provide a response, respondents may give the same response to two identical questions with different reference periods in the same interview – a phenomenon commonly referred to as constant wave response. This behavior is often attributed to respondents' low motivation or satisficing (Krosnick, Narayan and Smith 1996). Others argue that memory decay may occur leading respondents to report the same information in a single interview (Rips, Conrad and Fricker 2003).

Substantial research has been devoted to studying how question wording and interviewers can help alleviate seam effects (for examples see Conrad, Rips, and Fricker 2009; Jackle 2008, Mathiowetz and McGonagle 2000). However, with the exception of a few studies that found seam effects to be the product of keying errors and data editing (Burkhead and Coder 1985; Lynn et al 2005), little research has focused on how interviewers themselves might be attributing to seam effects when administering the survey questions. At the National Agricultural Statistics Service (NASS), recently observed interviewer behavior in the Agricultural Labor Survey (Ag Labor), led to the question of whether interviewer behavior was affecting data quality, and possibly producing seam effects.

NASS administers the Ag Labor bi-annually on behalf of the U.S. Department of Labor. Data from this survey are used to establish wage rates for agricultural workers. The Ag Labor survey has a panel design in which respondents are asked to provide the same information for different reference periods during each data collection.. Farm and ranch operators are asked to provide data for reference weeks in January and April during data collection in April and data for reference weeks in July and October during data collection in October. Information such as the number of hired workers, average hours worked, and wage rates are collected.

During the past several years, substantial changes have been made to the Ag Labor survey. Prior to 2012, Ag Labor was administered four times per year in January, April, July, and October. Only 25 percent of the data was collected during each data collection session. Starting in 2012, the survey was administered twice per year. The impact of this change on data quality has never been evaluated.

Another recent modification to the Ag Labor survey was the change in worker groups. In the past, respondents were asked to categorize paid workers into four major categories - Fieldworkers, Livestock workers, Supervisor/Manager, and Other workers (see Figure 1 below). Starting in 2014, the Standard Occupational Classification system (SOC) was used to categorize workers (Cosca and Emmel, 2010). Respondents were asked to report workers in subcategories within each major category (see Figure 2 below).

2. For the paid workers, record the number of workers, hours worked, and the gross wages paid the week of October 6th through the 12th. Please separate the workers by the main type of work they were hired to do based on the following groups:

Code	Work Hired to Do
1	FIELD WORKERS: Jack-of-all-trades and machinery operators on crop farms, fruit or vegetable pickers, greenhouse or nursery workers, hay balers and haulers, etc.
2	LIVESTOCK WORKERS: Jack-of-all-trades and machinery operators on livestock or poultry operations, workers hired to fix fences, tend animals, milk cows, gather eggs, etc.
3	SUPERVISOR/MANAGER: Hired managers, range foremen, crew leaders, etc. Exclude individuals not directly involved in day-to-day decisions on the farm.
4	OTHER WORKERS: Office workers, bookkeepers, pilots, pesticide applicators, etc.

Work Hired to Do	Worker Code (shown above)	Number of Paid Workers	Total Hours Worked	Total Gross Wages That Week (Dollars)
	411	412	413	414
	421	422	423	424
	431	432	433	434

Figure 1: 2013 Agricultural Labor Survey Worker Groups

2. For the paid workers, record the number of workers, hours worked, and the gross wages paid the week of October 11th through the 17th.
****Record each worker only once.**
****Separate the workers by the main type of work they were hired to do based on the groups outlined on page 5:**

Work Hired to Do	Worker Code (shown on page 5)	Number of Paid Workers	Total Hours Worked	Total Gross Wages That Week (Dollars)
	611	612	613	614

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Worker codes for Sections 1 and 2

Code	Work Hired to Do
FIELD WORKERS	
11	Agricultural Equipment Operators - Crop, Nursery and Greenhouse: Drive and control farm equipment to till soil and to plant, cultivate, and harvest crops.
12	Farmworkers - Crop, Nursery and Greenhouse: Manually plant, cultivate, and harvest vegetables, fruits, nuts, horticultural specialties, field crops, Christmas trees and short rotation woody crops. Use hand tools, such as shovels, trowels, hoes, tampers, pruning hooks, shears, and knives. Duties may include tilling soil and applying fertilizers; transplanting, weeding, thinning, or pruning crops; applying pesticides; or cleaning, grading, sorting, packing, and loading harvested products. May construct trellises, repair fences and farm buildings, or participate in irrigation activities.
13	Graders And Sorters - Crop, Nursery and Greenhouse Products: Grade, sort, or classify agricultural crops by size, weight, color or condition.
14	Hand Packers And Packagers - Crop, Nursery and Greenhouse Products: Pack or package by hand a wide variety of products and materials.
15	All Other Field Workers: All agricultural workers working with crops, nursery or greenhouse products not included in codes 11-14.
LIVESTOCK WORKERS	
21	Farmworkers - Farm, Ranch, and Aquacultural Animals: Attend to live farm, ranch, or aquacultural animals that may include cattle, sheep, swine, goats, horses and other equines, poultry, finfish, shellfish, and bees. Attend to animals produced for animal products, such as meat, fur, skins, feathers, eggs, milk, and honey. Duties may include feeding, watering, herding, grazing, castrating, branding, de-beaking, weighing, catching, and loading animals. May maintain records on animals; examine animals to detect diseases and injuries; assist in birth deliveries; and administer medications, vaccinations, or insecticides as appropriate. May clean and maintain animal housing areas. Includes workers who drive and control equipment to accomplish the tasks described.
22	Graders And Sorters - Farm, Ranch, and Aquacultural Animal Products: Grade, sort, or classify unprocessed food and other agricultural products by size, weight, color, or condition.
23	Hand Packers And Packagers - Farm, Ranch and Aquacultural Animal Products: Pack or package by hand a wide variety of products and materials.
24	All Other Livestock Workers: All agricultural workers working with farm, ranch and aquacultural animals or products not included in codes 21 – 23.
SUPERVISORS	
31	Farmers, Ranchers and Other Agricultural Managers: Plan, direct, or coordinate the management or operation of farms, ranches, greenhouses, aquacultural operations, nurseries, tree farms, or other agricultural establishments.
32	First-Line Supervisors of Farm Workers: Directly supervise and coordinate the activities of agricultural, aquacultural, and related workers.
OTHER WORKERS	
41	Agricultural Inspectors: Inspect agricultural commodities, processing equipment and facilities, and aquacultural operations, to ensure compliance with regulations and laws governing health, quality, and safety.
42	Animal Breeders: Select and breed animals according to their genealogy, characteristics, and offspring.
43	Pesticide Handlers and Sprayers: Mix or apply pesticides, herbicides, fungicides, or insecticides through sprays, dusts, vapors, soil incorporation, or chemical application to all crops including nursery and greenhouse products and facilities, and livestock, and livestock facilities. Usually requires specific training and state or federal certification. Excludes pilots who dust or spray crops from aircraft.
44	Any Other Worker Not Listed Above: Including, but not limited to, mechanics, shop workers, truck drivers, accountants, bookkeepers, office workers. Excluding contract & custom workers, retail workers, and "value-added" workers.

Figure 2: 2014 Agricultural Labor Worker Groups

When significant changes to survey questionnaires and procedures occur, it is imperative that comprehensive evaluation be conducted to determine whether these changes have an impact on data quality. The changes to the worker groups were evaluated using cognitive interviewing and behavior coding. Cognitive testing was conducted before and after these changes were implemented. The purpose of these studies was to determine whether operators understood the categories and were able to accurately place workers in the correct labor category (Ott 2013; Sloan 2017). Both of these studies found that respondents had difficulty assigning workers to a single category as workers tended to have a broad range of duties on the operation and were not always hired to perform a single type of work. Both studies also found that it was difficult for respondents to report workers' wages due to the incompatibility between format of the question and record format across operations.

In a separate study, Ridolfo and Edgar (2015) performed behavior coding of the October 2013 Ag Labor telephone interviews. Two important findings emerged from this study. First, Ridolfo and Edgar (2015) found the questions asked in this survey were difficult for respondents to answer and asking respondents to report this information for two different quarters on one survey was burdensome. Second, enumerators often changed question wording and/or used respondents' currently reported data (CRD) when administering the second quarter questions. That is, they inserted respondents' answers to the October questions into the July labor questions and reworded the July questions to be more similar to verification questions. Interviewers were likely modifying their behavior to alleviate burden placed on respondents. When respondents were presented with CRD, 50 percent of the time they replied yes with no further elaboration or discussion; 25 percent of the time they did not reply at all and the interviewers accepted their silence as confirmation. Although it is difficult to determine from behavior coding alone whether or not these simple confirmations are valid responses, this type of behavior (and nonresponse), could be an indication that respondents are satisficing to complete the survey faster.

The interviewers' behavior was similar to dependent interviewing, a method commonly used to address seam effects. Using this method, interviewers present respondents with their prior survey responses during the administration of subsequent survey questions. The prior information also known as previously reported data (PRD) can be used retrospectively, as an edit check, or proactively, as a reminder of previous answers. Although this type of survey administration can be beneficial in reducing measurement error, improving efficiency of data collection and reducing respondent burden (Jackle, 2008), it can also mask true changes in status if respondents have low motivation.

With the Ag Labor survey, the concern was that interviewers' behavior may be leading to seam effects. For certain questions, changes in status across quarters are expected. For example, due to the seasonality of farm work, we would expect to see changes in the number of workers and hours worked across quarters and to a lesser extent changes in worker types and wages paid are anticipated. Variation in changes in labor across farm types is also expected. Farms, such as dairies, cattle ranches, and egg production, are likely to have roughly the same amount and type of workers on hand given the nature of the work. But, for crop farms, we expect to see more variation in labor given the different tasks required each season (e.g., planting, harvesting,,)

In the current study, changes to the questionnaire administration of the Ag Labor survey affected data quality is examined. First, interviewers' behavior on data quality is

evaluated using cognitive interviews. Second, whether seam effects are present in the survey data following the change in questionnaire administration is examined.

2. Methods

2.1 Cognitive Interviews

Respondents were recruited using the NASS list frame and all participation was voluntary. Interviews were scheduled in advance and respondents were given the option of an in-person interview or a telephone interview. Seventeen cognitive interviews were conducted in Pennsylvania, Virginia, and Maryland, of the 17, nine interviews were conducted in-person and eight over the phone. Interviewers were given a guide and scripted probes for the interview, which took approximately one hour to conduct. The first quarter questions were administered as written while currently reported data were used in the administration of the second quarter questions. Respondents were then probed retrospectively on their question response process. Written notes from the interviews were used for the qualitative analysis. The constant comparative method (Strauss and Corbin, 1990) was used to analyze the cognitive interview data.

2.2 Seam Effects

Ag Labor was administered quarterly before 2012 and biannually after 2012 so the data from these two time periods were compared to determine whether the change in the administration of the survey affected the data quality. Data quality was gauged by evaluating the seam effects for the on-seam and off-seam month pairs. As stated above, transition months also referred to as “on-seam” months are adjacent months where data are collected from different interviews. “Off-seam” months are adjacent months where data are collected during the same interview. In the Ag Labor survey, January and April would be “off-seam” months, April and July “on-seam” months and July and October “off-seam” months.

The data from the two time periods (quarterly administration and biannual administration) were concatenated and analyzed. Three separate GLIMMIX models were fit using the following dependent variables: paid workers, hours worked, and wages paid. The independent variables were farm type and month-year (this variable is the month and year in which the data were collected for example July 2015 which accounted for the seasonal effect).

The survey separates farm operations into 16 types. In order to simplify the analysis, farms were combined by similarity of production and labor. The combination of operations was based on results from prior cognitive interviews, leading to an expectation of change in reporting of production and labor for some operations and not for other operations. The collapse resulted in five major farm types labeled as 1) Crops, 2) Specialty crops, 3) Nursery and Christmas Trees, 4) Livestock and 5) Specialty livestock. The consolidated farm operations can be seen in Table 1.

Crops	Grains, oilseeds, dry beans, and dry peas; Tobacco; Cotton and cottonseed; Other crops and hay, CRP and pasture
Specialty Crops	Vegetables, melons, potatoes and sweet potatoes; Fruit, tree nuts, and berries
Nursery and Christmas Trees	Nursery, greenhouse, floriculture, and sod; Cut Christmas trees and short rotation woody crops
Livestock	Hogs and pigs; Milk and dairy products from cows; Cattle and calves; Sheep, goats, and their products; Poultry and eggs
Specialty Livestock	Horses, ponies, and mules; Aquaculture; Other animals and other animal products

Seam effects were examined in three of the survey questions: hours worked, total gross wages that week, and number of paid workers.

3. Results

3.1 Cognitive Interview Results

As seen in Table 2, interviewers administered CRD the most for field questions. was administered for the majority of interviews with the highest number for the field questions. Due to the nature of different operations and answers to the first quarter questions, interviewers were not able to administer CRD for the second quarter questions for some of the interviews. Reasons for not administering CRD included (but were not limited to) 1) the respondent providing all of the information in the initial question, 2) the respondent being adamant about no change between quarters, and 3) respondents not reporting workers in the first quarter.

	Question 3	Field	Livestock	Supervisor	Other	Total
Total CRD Administrations	11	38	20	16	17	102
Had to revert to original question			2	1	4	7
Original and CRD not asked		2	2	3	4	11

As anticipated, the cognitive testing confirmed that, for many farms, the amount and type of labor changed substantially across quarters due to the seasonality of farm work. For example, crop farms tend to have more work spring through fall when they are planting and harvesting. The variability in farm employment is particularly pronounced for nurseries, whose labor can vary drastically month to month. One nursery reported their busiest months are April and May when they have about 30 employees on the payroll. Sales drop dramatically after Memorial Day and their labor decreases each month until mid-December when they close and lay off all workers. They reopen in February and may hire about 6 employees to help with planting and remain at that level until April. In contrast, livestock farms have more stagnant labor across each quarters. Although, livestock farms that produce their own feed, do report some variability in the amount and type of labor on hand across each quarter.

A second finding that emerged from the cognitive testing was that respondents needed to access their records to report accurately. But, when they did access their records, it increased their response burden. This is because respondents often do not keep information in their records in the same format as it is asked on the survey. Respondents had to do a lot of record transformation, sometimes accessing multiple sets of records, to provide response in the format requested. Furthermore, respondents who were adamant about using records during the in-person cognitive interviews, freely admitted that if they responded to the Ag Labor survey over the phone, they likely would not use their records and instead provide rough estimates from memory.

When presented with CRD during the cognitive interview, respondents had a number of reactions similar to those found in the behavior coding study. Some respondents provided a simple confirmation with no further discussion (e.g., “yes”), others would confirm the CRD but elaborated on that response (e.g., “Yes, I had the same workers in July”), others would ask for clarification and some would correct the CRD. Table 3 presents respondents’ reaction to the CRD in the cognitive interviews categorized by whether or not a change in labor across the two quarters was anticipated. Although there appears to be a slight difference in the percentages for the two types of operations, the difference was not statistically significant using Fisher’s exact test (p-value = 0.54), which is likely due to the small sample size.

	Simple	Elaborated	Clarification	Corrected
Expect change in reporting	52%	22%	8%	18%
Do not expect change in reporting	64%	20%	3%	13%

3.2 Seam Effects Results

First, descriptive analyses for the variables: number of paid workers, wages paid, and hours worked are presented. Table 4 shows the percentage of operations that reported change or no change in the three variables during quarterly administration of the survey. Zero represents no change in the reported value and one represents a change in the reported value. Operations appeared to be consistent with reporting the change in workers (86.69%) from October to January when compared to change reported (86.65%) from January to April. The percentage of change reported was also consistent for the variables hours worked and wages paid during quarterly administration. Table 5 shows the percentage of operations that reported change or no change in the three variables during biannual administration of the survey. As noted previously, two quarters of data were collected during each interview session when the survey changed to biannual administration. For this reason excessive change on the seam may be present. The months October 2014 to January 2015 are on-seam months because the data were collected during different interviews. The months January 2015 to April 15 are off-seam months because the data were collected during the same interview. More change (89.23%) occurred in the reporting of workers during off-seam months (October 2014 to January 2015) when compared to the change in reporting (59.86%) of workers during on-seam months (January 2015 to April 2015). There was also more change reported for the variables hours worked and wages paid during off-seam months compared to on-seam months. This suggests respondents may report the same information for both quarters during one interview session.

Table 4: Percent of Change for workers, hours, and wages for quarterly administration of Ag Labor				
Workers from October 2009 to January 2010			Workers from January 2010 to April 2010	
No Change	13.31		No Change	13.35
Change	86.69		Change	86.65
Hours from October 2009 to January 2010			Hours from January 2010 to April 2010	
No Change	4.36		No Change	3.44
Change	95.64		Change	96.56
Wages from October 2009 to January 2010			Wages from January 2010 to April 2010	
No Change	3.33		No Change	2.52
Change	96.67		Change	97.48

Table 5: Percent of Change for workers, hours, and wages for biannual administration of Ag Labor				
Workers from October 2014 to January 2015			Workers from January 2015 to April 2015	
No Change	10.77			40.14
Change	89.23			59.86
Hours from October 2014 to January 2015			Hours from January 2015 to April 2015	
No Change	3.37		No Change	28.35
Change	96.63		Change	71.65
Wages from October 2014 to January 2015			Wages from January 2015 to April 2015	
No Change	2.01		No Change	28.42
Change	97.99		Change	71.58

Additional descriptive statistics can be seen in Appendix A and Appendix B. Appendix A shows the trend for these three statistics from July 2008 to April 2010 and from July 2014 to April 2016 for each of the operation types as defined above in Table 1. Ag Labor was administered quarterly during the time period of 2008-2010 and biannually for the time period of 2014-2016 so the data from these two time periods were compared. The graphs for the number of workers showed more dramatic changes from one quarter to the next when compared to the graphs for the number of hours worked and paid wages. The tables in Appendix B summarize the percentage of change for the same three statistics for each operation type. Overall the percentage of change was greater for all three variables when the survey was administered quarterly. This suggests respondents may have reported true change when respondents reported one quarter of data per interview but report the same information for both quarters since respondents now report two quarters per interview.

Next, three GLIMMIX models were fit for the data. The results for each analysis can be seen in Table 6, Table 7, and Table 8. The variables farm type and month-year were significant for all three models. This suggests that the season and type of operation affects the number of workers, hours worked, and wages paid. In the future, the period (a variable represented the quarterly and biannual administration of the survey) along with an interaction between month-year and period will be evaluated to determine if they also have an effect on these three variables.

Table 6: Generalized Linear Mixed Model 1 - Paid Workers				
Effect	Num DF	Den DF	F Value	Pr > F
Farmtype	4	8710	98.06	<.0001
mnyr	5	8710	125.37	<.0001

Table 7: Generalized Linear Mixed Model 2 – Hours Worked				
Effect	Num DF	Den DF	F Value	Pr > F
Farmtype	4	8710	70.64	<.0001
mnyr	4	8710	3650.27	<.0001

Table 8: Generalized Linear Mixed Model 3: Wages Paid				
Effect	Num DF	Den DF	F Value	Pr > F
Farmtype	4	8710	69.92	<.0001
mnyr	4	8710	2395.26	<.0001

4. Conclusion

The cognitive interviews, highlighted the fact that for some farms, there is an expectation of change in farm labor across each quarter. However, when reviewing the survey data, this expectation is not always met, especially when CRD is presented to respondents. From the seam analysis, seam bias was detected for crop, specialty crops, and nursery/Christmas tree operations during biannual administration of the survey. However, the pattern of seam bias was slightly different for the three variables of interest across operations. The results from both the cognitive interviews and seam analysis suggest that CRD tends to be difficult to administer uniformly in an agricultural setting. One reason is the natural operation of a farm. For example, some operations have consistent staff throughout the year so verification of CRD could be beneficial. However, some operations do not have consistent staff throughout the year so changing the CRD throughout the interview could be burdensome for respondents. For panel surveys like Ag Labor, proxy reporting is common when the initial respondent is not available. The interaction of proxy reporting, CRD, and satisficing gives rise to incomparable data. CRD also tends to be difficult to administer because of the type of question being asked of the respondents.

The results seen in this paper, though significant, also exhibit limitations. Due to time constraints and costs, cognitive interviews were restricted to a small sample of local operations in Pennsylvania, Maryland, and Virginia. More time and funds would have permitted a larger sample with more diverse operation types in various geographic locations. Also, a representative sample for cognitive interviews would align more with the sample of survey data.

To save costs, the administration of Ag Labor was changed from quarterly to biannual. However, this change in survey administration was not fully evaluated prior to the fielding of the survey. As evidenced in this research, this change in survey administration is likely impacting data quality. For many federal surveys, it is not always possible to conduct extensive pre-testing prior to fielding a survey given tight production schedules and budgets. However, it is never too late to evaluate survey questionnaires. For ongoing surveys, such as Ag Labor, it is a good idea to continuously evaluate the methodology, even if the survey has been pretested in the past. Methods such as respondent debriefings, behavior coding, paradata analysis, IRT and multilevel modeling allow for continued evaluation post data collection using existing data. Recent work has shown the benefit of using data mining and multilevel modeling techniques to identify questions and respondent characteristics that are associated with poor data quality (e.g., high item nonresponse, response timing) in ongoing surveys (McCarthy, 2013; Maitland et al 2016). We would argue that this approach can be used as well to examine the impact of changes in survey methodology (e.g., questionnaire administration) on data quality. Along with continued evaluation of survey methodology, Ag Labor would also benefit from utilizing a record check study to assess data quality. As noted by Moore and Marquis (1989), record checks can detect measurement errors. In turn, these detections could allow for further improvement of Ag Labor through adjustment of survey estimates and the survey design.

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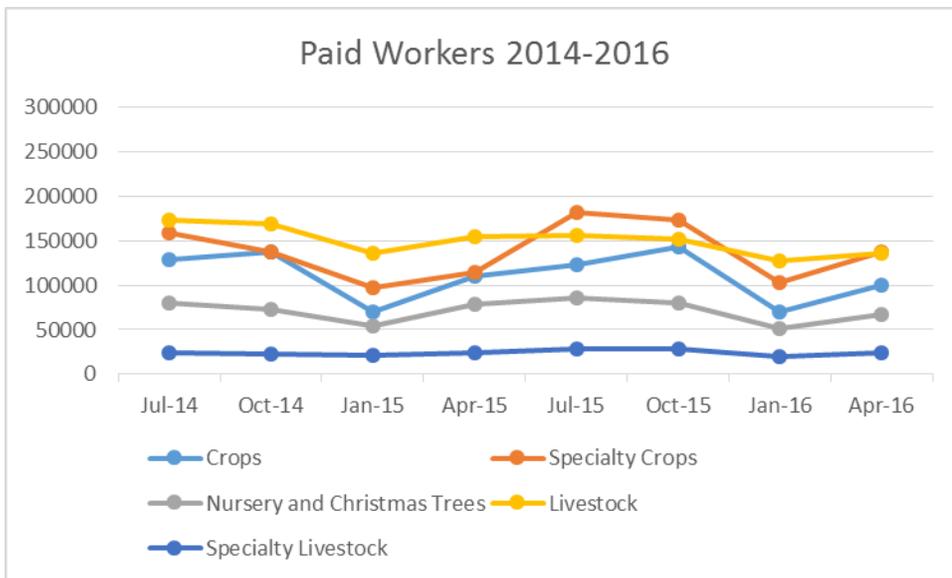
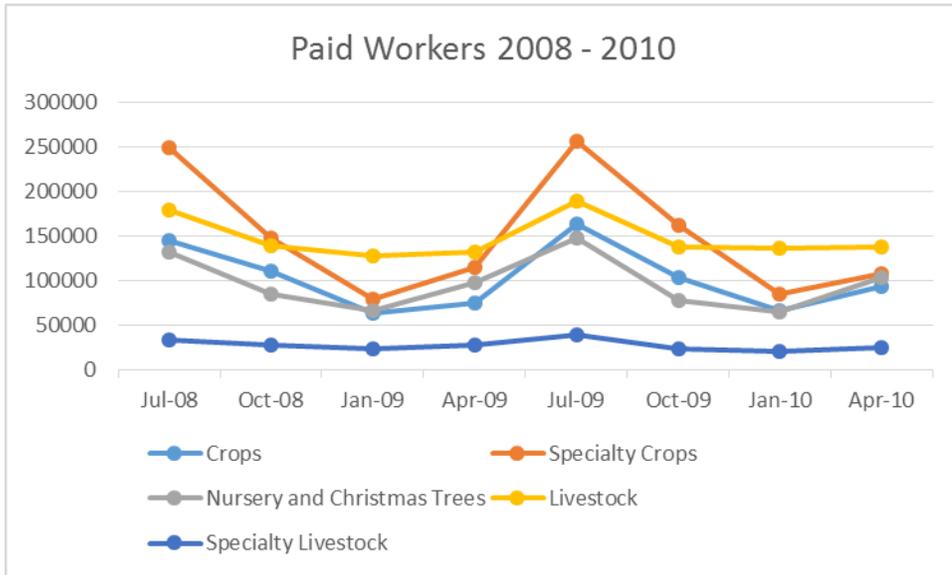
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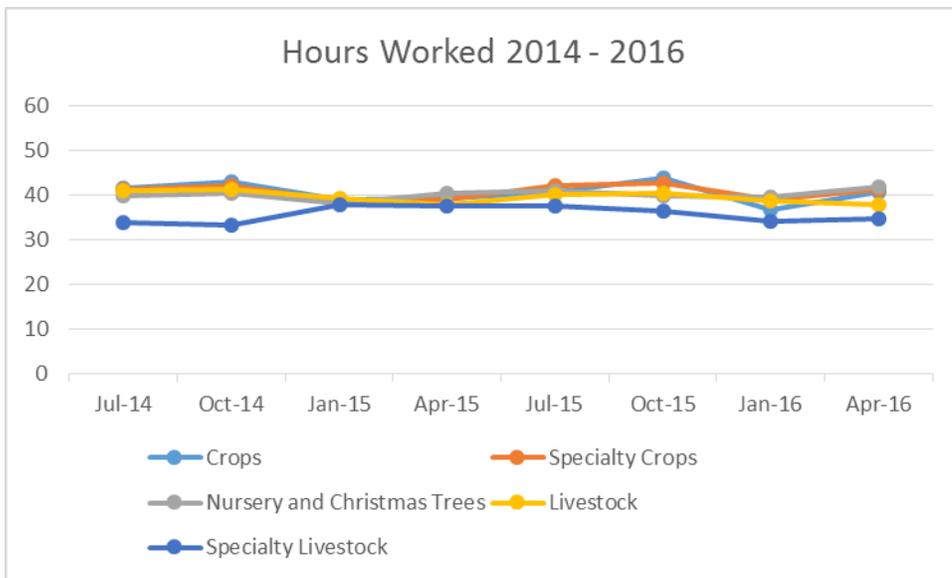
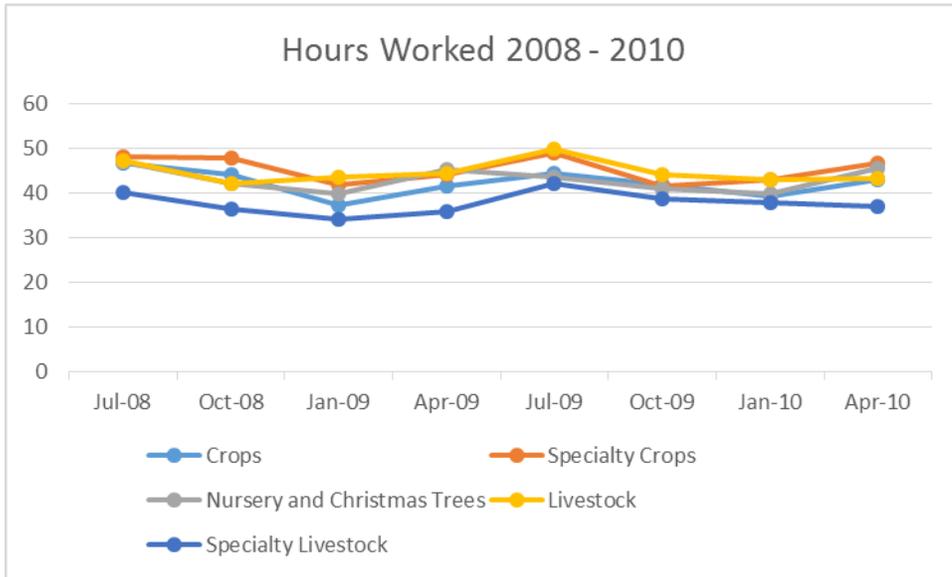
Appendix

A: Graphs for the number of paid workers, hours worked, and wages paid for the years 2008-2010 compared to 2014-2016

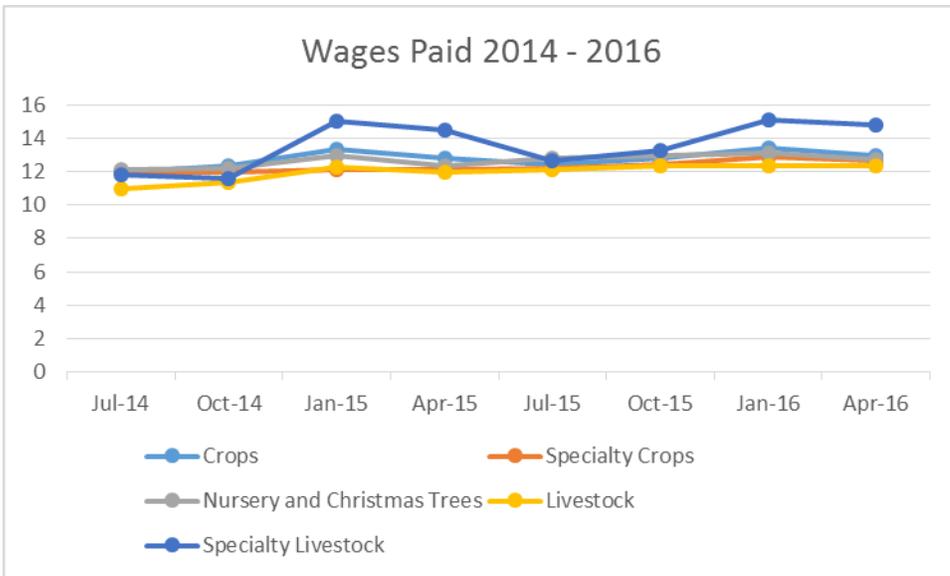
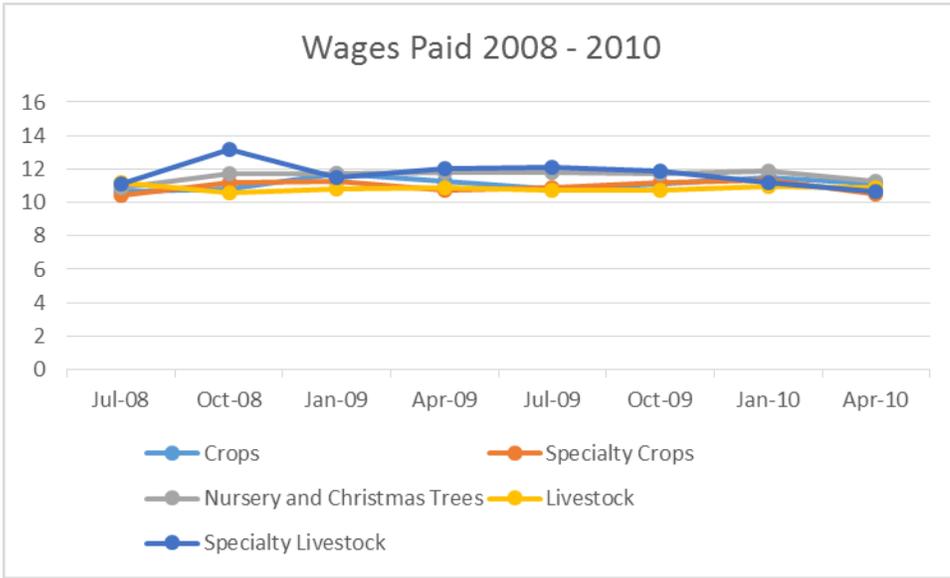
Number of Paid Workers



Hours Worked



Wages Paid (in Dollars)



B: Tables for the percentage of change for the number of paid workers, hours worked, and wages paid for the years 2008-2010 compared to 2014-2016

Table 7: Percentage of Change for Number of Paid Workers		
Crops	2008 - 2010	2014 - 2016
July to October	-23.07%	6.25%
October to January	-42.81%	-48.53%
January to April	18.48%	55.08%
April to July	116.04%	11.93%
July to October	-36.08%	16.47%
October to January	-36.03%	-51.23%
January to April	41.03%	43.51%
Specialty Crops	2008-2010	2014-2016
July to October	-40.40%	-13.23%
October to January	-47.05%	-29.59%
January to April	46.45%	18.64%
April to July	122.44%	58.42%
July to October	-36.97%	-4.67%
October to January	-47.57%	-41.11%
January to April	27.32%	34.32%
Nursery and Christmas Trees	2008-2010	2014-2016
July to October	-35.24%	-9.79%
October to January	-22.77%	-25.60%
January to April	48.20%	46.84%
April to July	50.80%	7.92%
July to October	-47.36%	-6.00%
October to January	-16.18%	-35.79%
January to April	59.65%	29.50%
Livestock	2008-2010	2014-2016
July to October	-22.52%	-3.22%
October to January	-8.70%	-19.59%
January to April	3.37%	14.20%
April to July	44.10%	0.92%
July to October	-27.56%	-3.04%
October to January	-0.97%	-16.20%
January to April	1.17%	7.25%
Specialty Livestock	2008-2010	2014-2016
July to October	-18.33%	-5.48%
October to January	-13.67%	-5.90%
January to April	13.77%	8.40%
April to July	45.84%	22.62%
July to October	-39.98%	-2.93%
October to January	-12.18%	-27.16%
January to April	16.49%	15.41%

Table 8: Percentage of Change for Hours Worked		
Crops	2008 - 2010	2014 - 2016
July to October	-5.33%	3.89%
October to January	-15.60%	-9.34%
January to April	11.27%	0.69%
April to July	7.43%	3.08%
July to October	-6.18%	7.84%
October to January	-5.80%	-15.94%
January to April	9.26%	10.64%
Specialty Crops	2008-2010	2014-2016
July to October	-0.71%	2.09%
October to January	-12.60%	-8.24%
January to April	5.96%	1.11%
April to July	10.78%	8.16%
July to October	-15.28%	1.02%
October to January	3.83%	-8.32%
January to April	8.54%	5.35%
Nursery and Christmas Trees	2008-2010	2014-2016
July to October	-10.07%	1.42%
October to January	-5.52%	-5.15%
January to April	14.00%	5.68%
April to July	-4.31%	1.62%
July to October	-5.84%	-2.67%
October to January	-2.76%	-1.04%
January to April	14.88%	5.56%
Livestock	2008-2010	2014-2016
July to October	-10.73%	0.53%
October to January	3.23%	-4.38%
January to April	2.25%	-3.55%
April to July	11.99%	5.72%
July to October	-11.12%	0.44%
October to January	-2.66%	-3.72%
January to April	0.17%	-2.11%
Specialty Livestock	2008-2010	2014-2016
July to October	-9.42%	-1.38%
October to January	-5.59%	13.80%
January to April	4.83%	-0.75%
April to July	17.57%	-0.09%
July to October	-8.32%	-3.24%
October to January	-2.31%	-5.93%
January to April	-1.81%	1.61%

Table 9: Percentage of Change for Wages Paid		
Crops	2008 - 2010	2014 - 2016
July to October	1.60%	3.29%
October to January	8.74%	7.72%
January to April	-3.93%	-3.78%
April to July	-4.29%	-2.75%
July to October	3.28%	2.91%
October to January	3.12%	4.79%
January to April	-3.43%	-3.50%
Specialty Crops	2008-2010	2014-2016
July to October	7.22%	0.11%
October to January	0.79%	1.26%
January to April	-4.45%	-0.19%
April to July	0.81%	0.43%
July to October	3.40%	2.16%
October to January	0.98%	3.43%
January to April	-7.10%	-1.64%
Nursery and Christmas Trees	2008-2010	2014-2016
July to October	8.31%	0.60%
October to January	-0.43%	5.89%
January to April	0.71%	-4.35%
April to July	0.16%	3.28%
July to October	-0.91%	1.18%
October to January	1.39%	1.64%
January to April	-4.98%	-3.13%
Livestock	2008-2010	2014-2016
July to October	-5.56%	3.39%
October to January	2.31%	8.16%
January to April	0.90%	-2.23%
April to July	-1.56%	0.78%
July to October	-0.09%	2.17%
October to January	2.46%	-0.29%
January to April	-0.76%	0.12%
Specialty Livestock	2008-2010	2014-2016
July to October	18.07%	-1.66%
October to January	-12.53%	29.78%
January to April	4.20%	-3.69%
April to July	1.12%	-12.58%
July to October	-2.05%	4.92%
October to January	-5.93%	13.77%
January to April	-4.94%	-1.99%