Cow-Calf Industry Expansion on the Horizon? Market Signals vs. Outside Factors

John Michael Riley
Mississippi State University
riley@agecon.msstate.edu

Brian R. Williams
Mississippi State University
williams@agecon.msstate.edu

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Introduction

The cow-calf industry has been in a contraction state since 2008 and, in reality, this length is much longer given that expansion only occurred for three years from 2005 to 2007. The last year of a growing beef cow herd prior to 2005 was 1996. Since the summer of 2010, prices for calves have improved and many expected the market to signal expansion of the beef herd. Instead, contraction has continued as the beef herd has declined 2% and 3%, respectively, during 2010 and 2011. Furthermore, 2012 and 2013 appear to be headed to two more years of contraction.

Prior research has shown that heifers are both a capital good and a consumptive good. When producers perceive a price increase to be long-term, they typically increase herd size through retention of heifers (Aadland and Bailey 2001). The expectation that herd expansion is on the horizon typically indicates an increase in the price of heifers relative to steers given that the demand for heifer calves or yearlings should increase while supply would remain relatively constant. However, these signals have yet to materialize. Figure 1 shows the price relationship of heifers compared to steers for various weight groups of calves and yearlings. These four charts indicate that, from a relative standpoint, heifer prices have remained at a consistent discount as compared to prior years. The purpose of this paper is to determine the factors impacting the heifer discount relative to steers.

A number of factors can be pointed to as reasons for continued contraction. Since 2007, cow-calf producers' input prices have increased 2.5% collectively (source: ERS cost of production estimates). These higher prices have caused some fringe producers to exit the industry. These fringe producers include older individuals that "retired" from cow-calf production, hobby-type producers that chose to exit, and other small producers whose average cost are typically higher than larger cow-calf producers. A second factor is the high price of cull type cows. The economic environment since 2008 has been fragile with weak domestic production, high unemployment, and nervous consumers. This has, in turn, increased the popularity of low value beef cuts (Mintert 2009). Older cattle are a great supply of low value beef cuts and therefore, the prices of these animals have increased. Cull females entering the supply chain for beef are unavailable for reproductive purposes, decreasing the beef herd inventory. A third factor over the past two summers has been extreme drought in the United States. In 2011, drought conditions were severe in the southwestern U.S. and in 2012 these conditions have become more widespread, encompassing roughly 80% of the contiguous United States at its peak. These conditions have led to an increase in the overall liquidation of the beef herd due to the lack of resources available to maintain inventory numbers.

Numerous authors have looked at cow-calf producers retaining ownership past weaning. One common practice among cow-calf producers is preconditioning. Roeber and Umberger (2002), Avent et al. (2004), King and Seeger (2004), Zimmerman et al (2012), and Williams et al. (2012) estimate premiums associated with preconditioning calves while Dhuyvetter (2004) estimates the profitability of preconditioning. Others such as Lambert (1989), Schroeder and Featherstone (1990), VanTassell et al. (1997), and Reisenauer et al. (2001) look at optimal sellign points using stochastic programming. However, the literature on retained ownership generally assumes that calves are either sold or slaughtered and does not look at retention of heifers for breeding stock.

Other research has looked at the cattle industry's supply response to price changes. Jarvis (1974) was among the first to show that a negative supply response is a rational behavior. Jarvis explains that theoretically, a negative supply response may not only be found in heifers and cull cows, but also in steers that are kept longer to add more weight. But in reality, Jarvis finds that a negative supply response exists in only heifers and culls. Rucker, Burt, and LaFrance (1984) use econometric modeling to estimate breeding herd inventories for the United States and Montana using dynamic regression equations. Rucker, Burt, and LaFrance (1984) suggest that increases in cattle prices encourage producers to retain heifers and build herd size. Further, they explain that low-grade beef prices, a substitute for cull cow values, had no effect on herd inventories.

While Jarvis (1974) and Rucker, Burt, and LaFrance (1984) use theoretical and econometric models to look at the supply response to cattle price changes, others use simulation and rational expectation models to examine inventory response. Schmitz (1997) uses simulation techniques to understand the cattle inventory response to changes in prices. He finds that changes in economic conditions have the greatest impact on younger animals in the herd than on older animals. Contrary to other studies, Schmitz (1997) finds that in the short run, a greater number of heifers go into feedlots as prices increase. Rather, herd size is increased by culling fewer cows. Aaland and Bailey (2001) look at the supply response of the U.S. beef industry to price changes by first estimating price elasticities for fed and feeder cattle and then graphing the responses of cull rates, beef consumption, and prices to shocks in retail demand. Aaland and Bailey (2001) find both positive and negative supply responses to increases in cattle prices. Zhao and Hennessy (2009) look at the returns and their relationships at different points in the beef supply chain. They find that profits are positively correlated between cow-calf operators and feedlots and that when returns increase, heifer retention increases. But, they do not include cull cow prices and their impact on producer decisions.

Other researchers have looked at the cattle supply response and its relationship with the cattle cycle. Rosen, Murphy, and Scheinkman (1994) examine the cyclical nature of the U.S.

cattle inventory and its response to exogenous shocks in demand and production costs. They use a dynamic simulation of producer responses and compare it to actual data, finding a close fit. Within their model, they assume that producers will respond to price increases by retaining heifers as breeding stock. Similarly, Mundlak and Huang (1996) compare the cattle cycle in the United States, Argentina, and Uruguay. In their comparison, they find a negative supply response to price increases in all three countries.

Previous research has examined inventory numbers using econometric, simulation, and programming methods. Much of the previous literature looks at decisions across all stages of production rather than focus on one stage. But, decisions by cow-calf producers have a greater influence on future cattle inventories than decisions made in any other portion of the supply chain. While steers are destined to go to a feedlot and ultimately end as finished beef, the same is not true for heifers. Heifers can go the same route as steers, but cow-calf producers also have the option of adding heifers to the breeding herd. Ultimately a cow-calf producer's decision to place a heifer on feed or adding her to the breeding stock will have a chain effect that impacts inventories in both the short-run and long-run. We examine factors that impact a cow-calf producer's decision on heifer retention each year. A better understanding of a producer's decision will help to explain the continued decrease in the U.S. herd size despite price signals that appear to favor an increase in cattle numbers.

Data and Methods

Monthly data from January 1992 through November 2012 are used for the analysis. Slaughter cattle by class (steer, heifer, and beef cow) are from the Livestock Dairy and Poultry Outlook by USDA's Economic Research Service. Fed cattle prices for steers and heifers from the 5 Area

Monthly Weighted Average Direct Slaughter Cattle report by the Agricultural Marketing Service are used. Feeder cattle prices for 700 to 800 pound steers and heifers from AMS's Oklahoma National Stockyards Feeder Cattle Weighted Average report are used. Prices are deflated using the Consumer Price Index from the Bureau of Labor Statistics. Drought impact is proxied by using the Palmer Hydrological Drought Index measure from the National Oceanic and Atmospheric Administration. Summary statistics of the data are located in table 1.

Figure 1 shows the individual volume of heifer, steer and cow slaughter over the time period used in this analysis. Of note from figure 1 is that while steer slaughter has maintained a fairly consistent level, heifer slaughter has slowed since about 2005, while beef cow slaughter has picked up. Figure 2 plots the deflated prices of feeder steers and heifers as well as deflated corn prices[1].

The following general equation is estimated:

$$\frac{SSL}{HSL} = \beta_0 + \sum_{i=0}^{z} \lambda_i DrHefP_{t-i} + \sum_{j=1}^{y} \delta_j \frac{SSL}{HSL_{t-j}} + \sum_{k=1}^{x} \gamma_k FdrHefP_{t-k} + \sum_{l=1}^{w} \alpha_l CullP_{t-l} + \sum_{m=1}^{v} \rho_m DDrought_{t-m} + \sum_{n=1}^{11} \tau_n MONTH_n + \beta_1 Trend \quad (1)$$

This model determines the impact of the price of heifers already in the feedlot stage, *DrHefP*, the price heifers ready to enter the feedlot (or be held for herd expansion), *FdrHefP*, and the price of culled females, *CullP*, and drought on the steer-to-heifer slaughter ratio. Independent variables included in the model are lagged and the appropriate lag length is determined using an F-test where the full general model is the unrestricted model including all lags and the restricted model

[1] We used corn price (with lags) but specification tests indicated they were not needed.

removes lags. Based on this, the following lags are included: z=0,1,2; y=1; x=4,5,6; w=6,7,8,9,10; v=1,2,3,4. Initial models are estimated using OLS, however autocorrelation was found. Autocorrelation was corrected for and the final model is estimated using GLS.

Results

The parameter estimates for the steer to heifer slaughter ratio (SHSR) are shown in table 2. Results suggest that the current and one month lagged dressed heifer price does not have an impact on the SHSR. However, the price two months prior to slaughter does have an impact and as this price increases by $1 per hundredweight the ratio of steers to heifers being slaughtered decreases by 0.0033 percent. While the market indicates increased demand for heifers through increased current dressed heifer prices, the short-term supply of heifers for slaughter is fixed. As a result, we find no significant response in the SHSR to changes stemming from current dressed heifer price. On the other hand, the two month lagged dressed heifer price did result in an increase to the SHSR indicating that heifer marketings are most likely increased in the following month (t-1) thus decreasing the market ready supply at *t*-0. As expected, the prior month's SHSR is positively correlated with the current SHSR. A one percent increase in the lagged SHSR is associated with a 0.7735 percent increase in the current SHSR

Lagged heifer prices from *t*-4, *t*-5, and *t-6* have no effect on the SHSR, contrary to what previous literature suggests. Prior research suggests that heifer retention is negatively correlated with feeder prices. The correlation between feeder heifer and steer prices was high, NNN (see figure 3), which suggests an increase in both steer and heifer placements into feedlots. Thus the insignificant coefficients here are reasonable. Similarly, six to nine month lagged cull cow price does not impact SHSR. However, the ten month lagged cull cow price was positive and significant at the 1% level. A $1/cwt increase in cull prices causes a 0.0122 percent increase in the SHSR. In other words, as cull prices increase, heifer retention is expected to increase to replace older cows culled from the herd. This drives up the SHSR. While expectations suggest that drought conditions negatively impact the SHSR due to producers cutting back on herd size, results suggest no statistically significant relationship. There was, however, a strong seasonal cycle in the SHSR with the ratio peaking in April and May.

Implications

Previous research related to retention of animals in a beef cattle operation has focused on terminal markets. This paper determines the impact of various prices along the beef cattle production chain on heifer slaughter rates as compared to steer slaughter volume. Prices of culls, feeder heifers and dressed fed heifers are used in this analysis. The first two of these prices are important when making decisions related to herd expansion. While the price of feeder heifer prices does not show a statistically significant impact on the steer-to-heifer slaughter ratio, this in itself is an interesting finding. The constant struggle that cow-calf operators face when it comes to herd expansion and heifer retention is apparent in these results. As feeder heifer prices increase there is an immediate signal to sell these animals in the terminal market. On the other hand, there is an indication for producers to expand their herds to take advantage of the higher prices across a larger number of available animals. Thus, our finding of no significance follows this push-pull scenario. The recent market events that have led to increased culls of beef cows have pushed inventories further into contraction. The results here indicate that in there have likely been more heifers retained to offset the volume of culls, albeit at a slow pace.

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Table 1. Summary Statistics of Variables Used

	Mean	Standard Deviation	Minimum	Maximum
Steer Slaughter	1,449.07	133.54	1,121.43	1,778.61
Heifer Slaughter	878.00	88.49	690.01	1,099.80
Beef Cow Slaughter	270.77	42.11	191.87	422.44
Steer Sltr/Heifer Sltr	165.99%	16.57%	131.44%	207.57%
Real Dressed Steer Price	$70.24	$8.59	$54.91	$93.27
Real Dressed Heifer Price	$70.22	$8.55	$54.85	$93.12
Real Feeder Steer Price	$51.44	$6.85	$34.03	$68.87
Real Feeder Heifer Price	$47.77	$6.47	$31.22	$62.92
Real Cull Cow Price	$25.49	$4.21	$17.83	$36.49
Palmer Hydrological Drought Index	0.735	2.757	-5.370	5.350

Table 2. Regression Results for Monthly Steer to Heifer Price Ratio from 1992 to 2012

	Value	Standard Error	t-value	p-value
Intercept	0.2438	0.0466	5.2275	0.0000
Dressed Heifer Price	0.0000	0.0019	-0.0135	0.9892
Dressed Heifer Price (t-1)	0.0030	0.0032	0.9114	0.3631
Dressed Heifer Price (t-2)	-0.0033	0.0021	-1.5963	0.1119
Steer Sltr./Heifer Sltr. (t-1)	0.7735	0.0409	18.8901	0.0000
Heifer Price (t-4)	0.0007	0.0028	0.2572	0.7973
Heifer Price (t-5)	-0.0015	0.0043	-0.3584	0.7204
Heifer Price (t-6)	0.0021	0.0030	0.6986	0.4855
Cull Price (t-6)	0.0037	0.0052	0.7228	0.4706
Cull Price (t-7)	-0.0022	0.0070	-0.3151	0.7530
Cull Price (t-8)	0.0005	0.0068	0.0749	0.9404
Cull Price (t-9)	-0.0089	0.0068	-1.2962	0.1963
Cull Price (t-10)	0.0122	0.0047	2.6312	0.0091
Trend	0.0001	0.0001	1.7239	0.0862
Drought Index (t-1)	0.0026	0.0069	0.3742	0.7086
Drought Index (t-2)	-0.0003	0.0115	-0.0284	0.9774
Drought Index (t-3)	-0.0040	0.0116	-0.3469	0.7290
Drought Index (t-4)	0.0048	0.0070	0.6871	0.4928
January	-0.1134	0.0250	-4.5357	0.0000
February	-0.1380	0.0218	-6.3390	0.0000
March	-0.0446	0.0240	-1.8590	0.0644
April	0.0353	0.0234	1.5111	0.1323
May	0.0450	0.0250	1.8014	0.0731
June	-0.0455	0.0271	-1.6758	0.0953
July	-0.0137	0.0259	-0.5295	0.5970
August	-0.0729	0.0268	-2.7197	0.0071
September	-0.1243	0.0243	-5.1065	0.0000
October	-0.1639	0.0237	-6.9017	0.0000
November	-0.0629	0.0251	-2.5111	0.0128

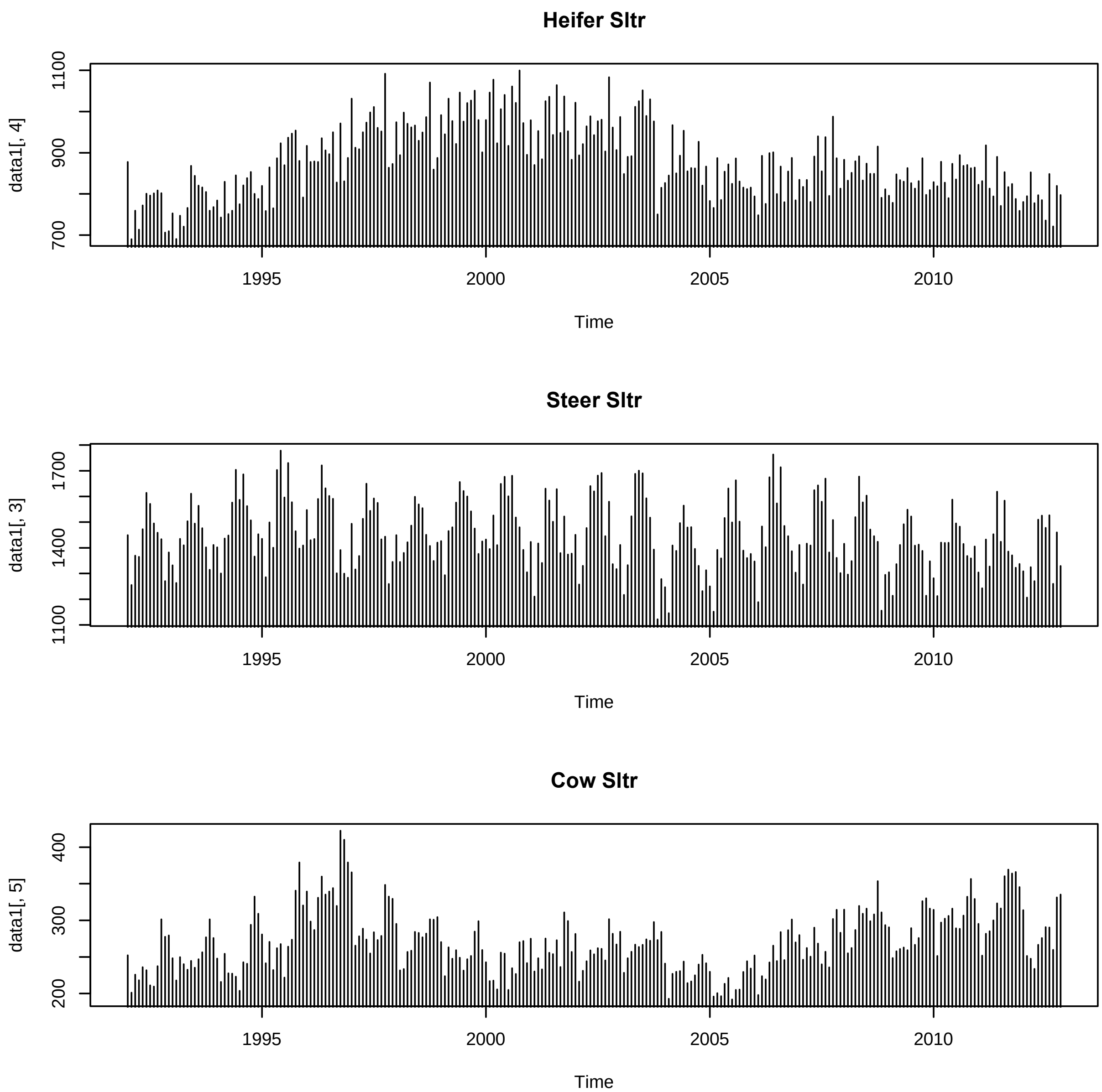

Figure 1. Slaughter Volume of Heifers, Steers, and Beef Cows.

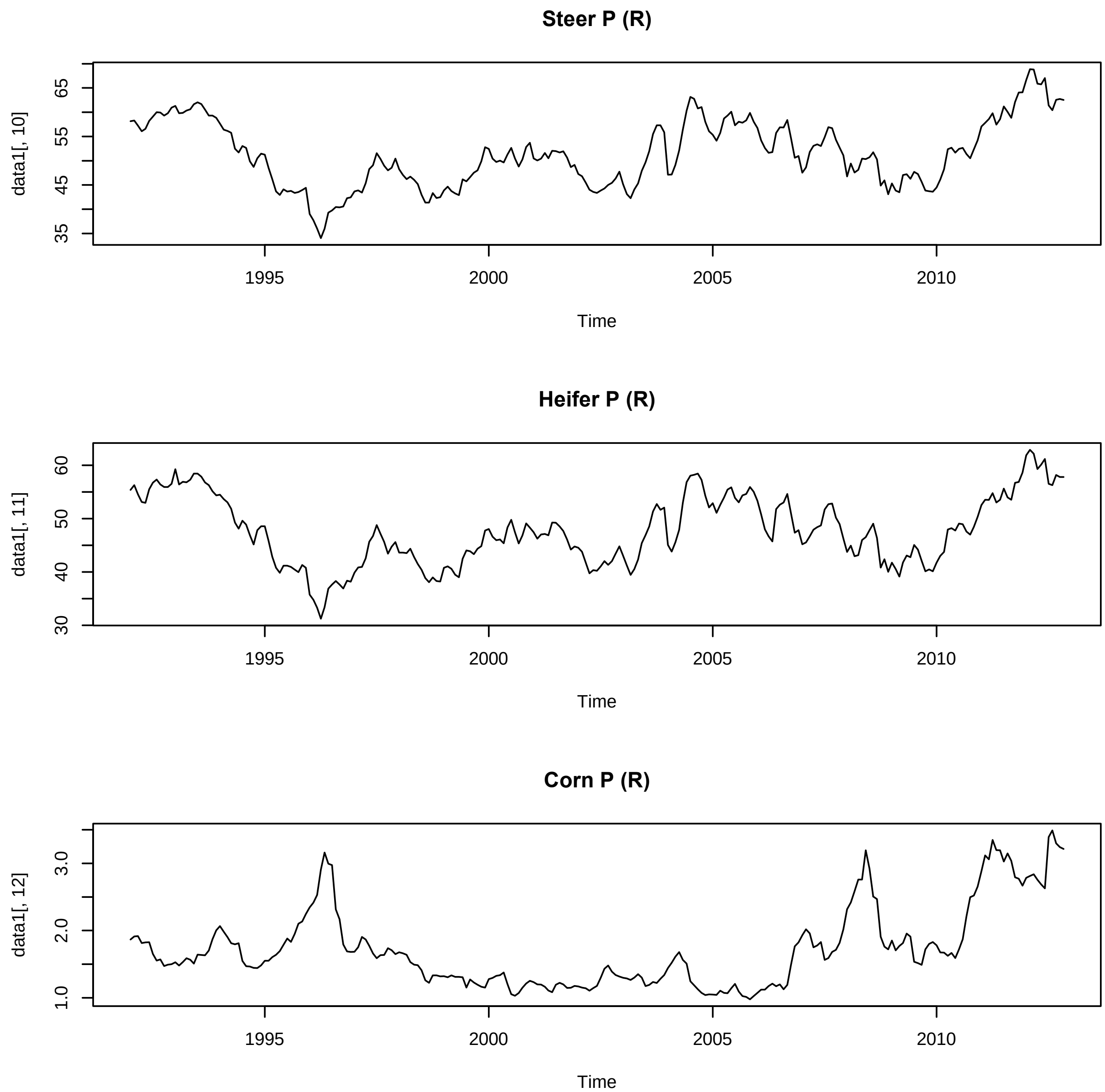

Figure 2. Deflated Prices for Feeder Steers, Feeder Heifers, and Nearby Corn Futures.

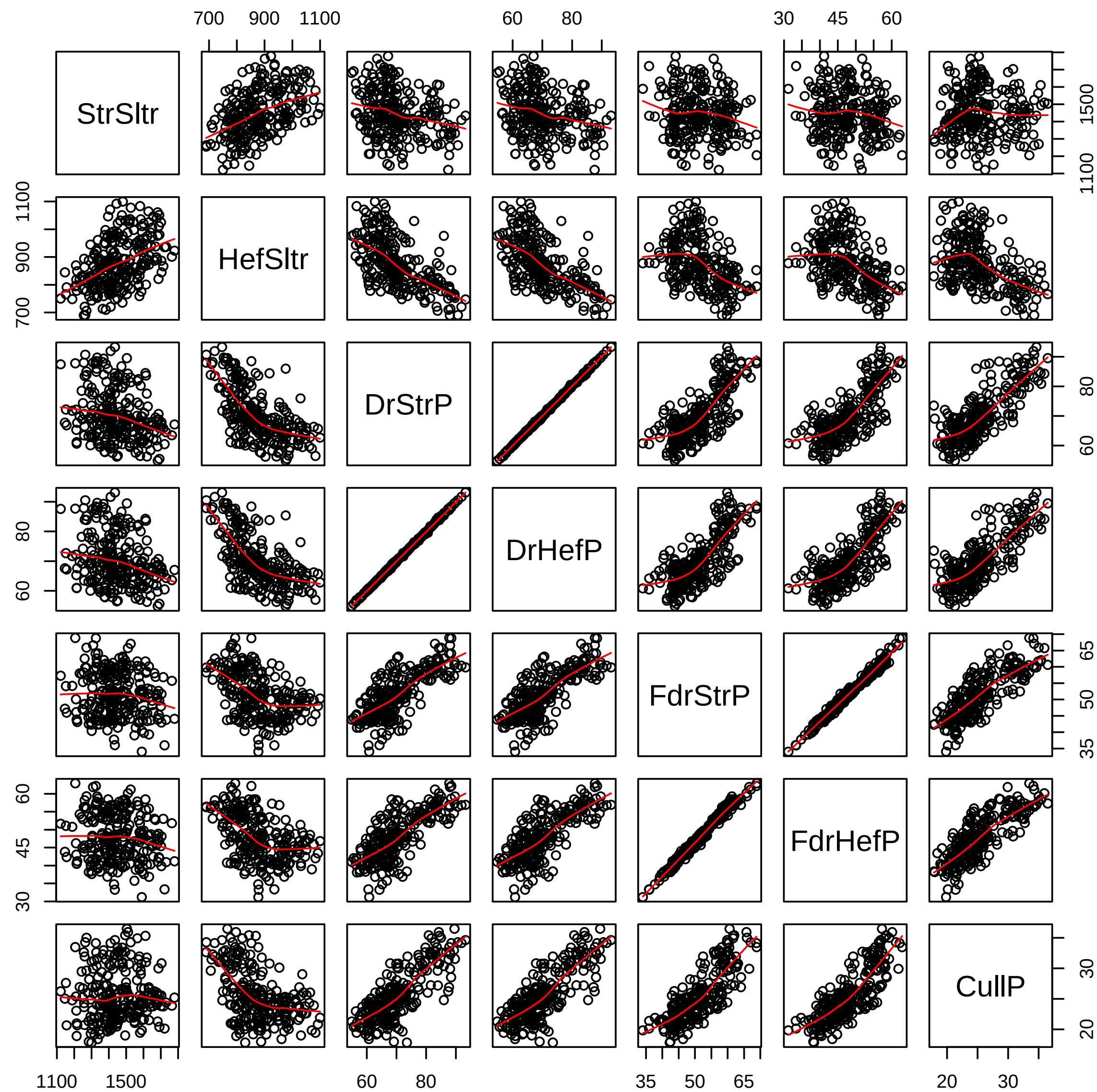

Figure 3. Scatter Plots of Primary Variables Included in Estimation