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DIFFERENCES BETWEEN FOR-PROFIT, NON-PROFIT, AND PUBLIC HOSPITALS IN MEDICAL AND NON-MEDICAL CATEGORIES: COSTS AND OUTSOURCING DECISIONS

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ABSTRACT

The purpose of this study is to measure and compare several potential differences between for-profit, non-profit, and public hospitals in medical and non-medical cost categories. To do this, costs associated with two medical and two non-medical categories for California short-term general care hospitals were broken down into several subsets in order to better understand exactly how and why each category behaves as it does. The results show significant differences for total costs between for-profits and the other hospital types across the board and a difference for outsourcing decisions between for-profits and the other hospital types for the medical categories but not for the non-medical categories.

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INTRODUCTION

Over the past several decades, economists have been examining for-profit, non-profit, and public hospitals in an attempt to determine whether there are any differences between them and, if there are, what causes these differences. The results of these studies have been mixed, as some studies show for-profits to have higher costs, some show the opposite, and some show no significant difference between the two. Despite this apparent confusion, meta-analysis shows that the differences in results are at least in part due to differences in methodology rather than actual differences in the groups of hospitals examined. Furthermore, studies with stronger methodologies tend to find smaller differences between for-profits and non-profits regarding a hospital's total costs (Shen, Eggleston, Lau, and Schmid 2005).

However, a point to note is that the above results come from looking at a hospital's total costs instead of breaking costs down into smaller categories, such as medical costs and non-medical costs, which may tell a more complete story of any potential differences between different hospital types. In fact, studies that have broken costs down into discrete categories have found that results on differences between hospital types are not necessarily the same across the chosen categories. For example, administrative costs for for-profit hospitals seem to be significantly higher than for non-profits or public hospitals, but salary and wage costs showed the opposite pattern, with employee benefits for clinical personnel being much lower in for-profits (Woolhandler

and Himmelstein 1997). This would seem to suggest that inconclusive results when measuring total costs may actually be hiding differing results between cost categories. The above study suggests that medical costs would likely be lower in for-profits than in non-profits or public hospitals but leaves open how non-medical costs besides administrative costs would behave, as the driving forces behind administrative costs are different from other non-medical costs such as maintenance and grounds keeping.

If for-profits do in fact have lower medical costs, one of the possible explanations of these differences is that for-profits selectively locate in higher profit areas or choose to perform only higher profit procedures (Norton and Staiger 1994), and as a result appear to be more profitable and have lower costs. In comparison, non-profit hospitals would be more likely to offer procedures that were not profitable and public hospitals would be even more likely to offer such procedures. Evidence exists for this theory (Horwitz 2005), but it is not clear from this study whether this explanation is the main reason for observed cost differences between hospital types or whether other important reasons also exist. Another hypothesis is that for-profits cut corners in ways that are not easily observable in order to improve easily-measurable metrics such as costs, resulting in lower costs but also a lower quality of care. However, previous studies have not shown support for this idea, as quality of care does not appear significantly different between for-profits and non-profits (Sloan, Picone, Taylor, and Chou 2001). Nonetheless, this still remains a possibility. Thirdly, it may be that for-profits tend to

perform certain tasks more efficiently than non-profit or public hospitals due to the difference in their structure, thus resulting in lower costs for for-profits.

A point to note about some of the above explanations is that they focus their efforts to explain any differences in total costs between for-profit, non-profit, and public hospitals as a result of differences in medical costs. However, as the example with administrative costs shows, differences in medical costs are not the only possible explanation for differences in total hospital costs. It is possible that other non-medical costs may show different patterns between these three hospital types. Similarities or differences in their patterns could shed light on whether overall results are driven by medical factors, non-medical factors, or some combination of the two.

Additionally, other studies have shown that there are good reasons to believe that outsourcing decisions are handled differently by for-profit hospitals. Specifically, outsourcing becomes more attractive to for-profits than non-profit or public hospitals when an outside source can provide a service that is relatively lower in both quality and cost, especially if the quality of the service in question is important to the hospitals (Marsh and Warren 2013). However, if true, we would expect to see different results depending on which hospital activities we observe. For medical procedures, where quality is very important, we would expect a stronger difference in outsourcing between for-profit hospitals and non-profit or public hospitals if such outsourcing options exist.

By contrast, many non-medical operations would likely show little to no differences because the quality of the results would be much less important.

DATA AND METHODS

The data used was taken from the complete 2011-2012 data set of annual hospital financial data and the 2012 pivot profile collected by California's Office of Statewide Health Planning and Development. This annual financial data contained, among other statistics, data on general measures of hospital size, staff, location, caseload, revenues, costs, and inventories. For the purposes of this paper, only the cost data, categorical data, and other potentially related data were necessary. In order to focus in on the necessary categories, the original 446 hospitals in the data set were reduced so that only the for-profit, non-profit, and public hospitals that performed general short-term care remained, which reduced the number of hospitals in the data set to 275. Religious hospitals were left out of the new data set so as to allow a focus on just the for-profits, non-profits, and public hospitals. Additionally, a handful of otherwise eligible hospitals were dropped because of miniscule numbers or comparability issues, likely because the hospitals in question were not open or had not been recording data for the entirety of the year.

In order to measure potential differences between the three hospital types, a few different types of variables were created from the new data set for four separate categories, two medical and two non-medical. To examine the effects on total costs, the

total adjusted direct expenses for a given hospital were divided by the number of units of service for the category being examined. For the medical categories the units were the total number of procedures for the chosen category and for the non-medical category the units were either the size of the grounds in square feet or the amount of gross patient revenue in thousands of dollars. Total costs per unit were also split up into several different subsets in order to observe whether these exhibited different behavior from total costs.

These subset variables were: employee compensation costs, capital costs, outsourcing costs, and other costs. To examine the effects on employee compensation costs, salary, wage, and employee benefits costs were totaled and then divided by the number of units of service for the category being examined. For capital costs, leases, rentals, and depreciation were totaled and then divided by the number of units of service for the category being examined. For outsourcing costs, professional fees and purchased services were totaled and then divided by the number of units of service for the category being examined. For other costs, all other costs were divided by the number of units of service for the category being examined.

Of note is the fact that the cost category subsets do not necessarily add up to the total costs for any given hospital. This is because the individual cost categories are not adjusted the way that total expenses are. Though this may at first seem to be a problem, as it calls into question the comparability of the variables, there is no real

difference in the coefficients, statistical significance, or other important results for the total adjusted expenses and the unadjusted expenses. So, because the adjusted expenses are technically more accurate and because there is no practical problem with comparability using the adjusted expenses, the total costs figure is calculated using the adjusted expenses data.

In addition to the cost per unit variables, one other variable was examined: percent of total costs outsourced. Percent of total costs outsourced was measured by dividing outsourcing costs by total unadjusted costs. This variable was created to better compare outsourcing decisions between the three hospital types.

The percent of total costs outsourced variable was calculated using the unadjusted expenses because of direct comparability problems not present in the general total cost variable. Because outsourcing costs were not adjusted, if the total costs for a given hospital were adjusted by a large amount, this could greatly skew the percent of total costs outsourced variable, possibly even giving the result that certain hospitals outsource more than 100% of its costs. So, even though adjusted costs are a more accurate measure of total costs, they are not suitable for the percent of total costs outsourced variable.

For each of the above variables, four categories were looked at, two medical and two non-medical. The categories of financial data that were tested were the cardiac catheterization data, the electroencephalography data, the grounds keeping and

maintenance data, and the credit and collection data. These four sets of data were good candidates for a number of reasons.

Cardiac catheterization is a relatively uniform procedure and the data available for it is broken down by procedure rather than by operating hours or some other measure, making the data easily comparable between hospitals and avoiding some potential complicating factors. Using the cardiac catheterization data rather than overall medical data also avoids the potential concern that the results reflect a different mix of procedures between for-profits and non-profits rather than an actual cost difference.

The same argument applies for the electroencephalography data, as it too is relatively uniform and the data for it is broken down by procedure. However, there is an additional wrinkle with the electroencephalography data that is not present in the cardiac catheterization data. On occasion, an electroencephalography procedure is done for days or even weeks at a time for diagnostic purposes instead of the typical twenty to thirty minute procedure. Although this is likely randomly distributed among hospitals, this problem may call into question the comparability of the results between hospitals, especially if the number of hospitals being looked at is especially small, as is the case with public hospitals. However, as public hospitals have fewer data points across the board, this problem would still crop up with any other procedure examined and thus does not render electroencephalography data unsuitable.

Grounds keeping and maintenance data is measured in terms of the size of the grounds in square feet which, like cardiac catheterization, makes the data uniform and easily comparable between hospitals. In addition to meeting the requirement of being a non-medical cost category, grounds keeping also avoids potential complications that administrative data would bring to the table. However, the choice of grounds keeping does still have a few potential problems. Due to the nature of the services, it is likely that many of the hospitals chose to outsource large portions of their grounds keeping expenses, which could cause problems with the regression and interpretation of other categories, such as wage and capital costs. This is likely true of many non-medical cost categories, though, so it does not make grounds keeping a poor candidate for this purpose. Another shortcoming of the grounds keeping data is that fewer hospitals submit records for grounds keeping than for cardiac catheterization. Again, though, this problem holds for many non-medical categories, and enough hospitals submit their grounds keeping data to prevent significance problems for total costs and outsourcing costs.

Credit and collection data is measured in terms of the amount of gross patient revenue in thousands of dollars, which potentially creates a comparability issue, as patient revenue would differ depending on a hospital's patient mix. To try to control for this, variables for the percent of Medicare patients, the percent of Medi-Cal (the California version of Medicaid) patients, and rural hospitals have been included in the models. While credit and collection data still has the same outsourcing problem as the

grounds keeping data, it has significantly more data points in general which should give results that are more statistically significant.

The model used for each variable used the same basic structure. Each variable examined was tested for eight possible effects: changes as the amount of output for the given category increased, a difference between for-profits and non-profits, any interaction between output and for-profits vs. non-profits, a difference between for-profit and public hospitals, any interaction between output and for-profit hospitals vs. public hospitals, a difference between rural hospitals and other hospitals, the percent of Medicare patient hours, and the percent of Medi-Cal patient hours. The model used for each variable was:

$$\textit{Cost Variable in Hospital}_i = \alpha \textit{Output}_i + \beta_1 \textit{Non-profit}_i + \beta_2 \textit{Output}_i * \textit{Non-profit}_i + \gamma_1 \textit{Public}_i + \gamma_2 \textit{Output}_i * \textit{Public}_i + \delta \textit{Rural}_i + \vartheta \textit{Medicare}_i + \lambda \textit{Medi-Cal}_i + \varepsilon_i$$

Output was measured simply as the units of service for a given category. This would measure any changes in costs as the size of the given category grew. Non-profit and public were simply dummy variables that would measure any initial difference between the for-profits and non-profits or for-profit and public hospitals, respectively. The interaction terms would measure any change in the relationship between either for-profits and non-profits or for-profit and public hospitals as the amount of output increased. Rural was a dummy variable denoting that a given hospital was a small and rural hospital. Medicare and Medi-Cal were measures of patient mix in the hospitals,

giving the percent of patient days for the hospital that were either Medicare or Medi-Cal patient days.

The rural variable was included in each model because there are strong reasons to think that urban and rural settings tend to have different effects on for-profit, non-profit and public hospitals, and represent an otherwise potentially confounding factor in the results (Plante 2009). The Medicare and Medi-Cal variables were included to control for patient mix at the hospitals, as this too is a potentially confounding factor.

It was quickly determined that most of the variables would need to be in logs in order to draw proper conclusions from the models. Thus, in the final models used, all of the cost variables, as well as the output variable, are logs. However, this raised a problem, as a number of the hospitals reported zero costs in a given category. While this represented only a minor problem for cardiac catheterization and electroencephalography, more than half of the hospitals reported zero wage costs or capital costs for grounds keeping and credit and collection. Unfortunately, these zeros existed not because of a lack of reporting but because such a large percentage of total costs were outsourced for grounds keeping and credit and collection, so it was not possible to blithely discard the zeros from the data set. However, because these zeros represented such a large portion of the data, any attempt to insert a plug figure would give results that were more the result of the chosen plug figure rather than any variance in the data. In the end, the zeros were simply dropped from the data set, and as a result

only a handful of for-profit and public data points remain for wage costs and capital costs for grounds keeping and credit and collection.

RESULTS

Cardiac Catheterization Results

	log(Total Costs/Unit)	log(Wage Costs/Unit)	log(Capital Costs/Unit)	log(Outsourced Costs/Unit)	Percent Outsourced	log(Other Costs/Unit)
log(Output)	-0.49	-0.45	-0.56	-0.74	-0.15	-0.45
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.02)
Non-Profit	0.54	0.94	0.38	-0.17	-0.53	0.86
	(0.16)	(0.02)	(0.63)	(0.83)	(0.00)	(0.29)
Non-Profit	-0.11	-0.25	-0.06	0.06	0.15	-0.08
Interaction	(0.32)	(0.04)	(0.81)	(0.79)	(0.00)	(0.72)
Public	0.50	0.29	-2.08	-1.13	-0.62	1.93
	(0.51)	(0.70)	(0.17)	(0.45)	(0.01)	(0.22)
Public	-0.10	-0.04	0.68	0.32	0.18	-0.43
Interaction	(0.66)	(0.87)	(0.15)	(0.48)	(0.02)	(0.37)
Rural	-0.54	-0.50	-0.64	-0.75	-0.08	-0.67
	(0.00)	(0.00)	(0.07)	(0.02)	(0.14)	(0.05)
% Medicare	-0.73	-0.30	-1.85	-0.75	0.15	-1.96
	(0.00)	(0.32)	(0.00)	(0.20)	(0.05)	(0.00)
% Medi-Cal	-1.23	-0.99	-3.09	-1.81	0.01	-1.54
	(0.00)	(0.01)	(0.00)	(0.01)	(0.93)	(0.02)
Observations	126	117	114	118	126	126
R Squared	0.59	0.57	0.30	0.31	0.30	0.36

(p values)

The results for total costs per unit and employment costs per unit show the same basic patterns. As the number of cardiac catheterization procedures a hospital performs increases, the costs per unit associated with the procedures decrease, as expected from gains in efficiency. Additionally, at low levels of output, non-profits have higher costs per procedure, but as the number of procedures the hospital performs increases, the difference between them and for-profits seems to disappear. However, this secondary effect is not statistically significant for total costs. Public hospitals show a similar pattern

as non-profits, but none of the results are statistically significantly different from for-profits. The chosen variables seem to explain more than half of the observed variation in total costs per unit and employment costs per unit.

Capital costs show the same pattern as total costs and employment costs with one important exception: public hospital capital costs initially seem to start significantly lower than do for-profits, with the difference disappearing as hospital size increases. However, as public hospitals mostly have similar amounts of output, this actually means that, over the observed range, public hospital capital costs per unit are fairly flat as output increases, in contrast to for-profit and non-profit hospitals. The variables appear to explain about a third of the observed variation.

The results for outsourcing costs per unit also showed that as the number of procedures a hospital performs increases, the costs attributed to outsourcing per procedure decreased. However, unlike the previous cost categories, it is for-profits that seem to have higher spending, though as before this effect seems to disappear as the amount of procedures increase. The variables seem to explain about a third of the observed variation. Despite this, any difference in total outsourcing costs per unit between hospital types is not statistically significant.

The percent of cardiac catheterization spending that is outsourced behaves very differently for non-profits and public hospitals compared to for-profits. For non-profit and public hospitals, the percentage of spending that is outsourced stays about the

same regardless of the amount of output, but the percentage of for-profit spending that is outsourced seems to drop about 15% each time the amount of output is doubled. Furthermore, smaller non-profit and public hospitals outsource a much smaller percent of their costs than do similarly sized for-profits, though as before, this difference seems to disappear as the amount of output increases.

Other expenses per unit drop as the number of procedures a hospital performs increases, and any difference between the hospital types is not statistically significant, though the general trend for them is in line with total costs per unit.

Electroencephalography Results

	log(Total Costs/Unit)	log(Wage Costs/Unit)	log(Capital Costs/Unit)	log(Outsourced Costs/Unit)	Percent Outsourced	log(Other Costs/Unit)
log(Output)	-0.03	-0.14	-0.30	-0.43	-0.20	0.14
	(0.75)	(0.45)	(0.24)	(0.18)	(0.10)	(0.68)
Non-Profit	0.40	0.39	0.25	-0.95	-0.69	0.50
	(0.22)	(0.48)	(0.77)	(0.35)	(0.07)	(0.63)
Non-Profit	-0.09	-0.06	0.01	0.28	0.19	-0.02
Interaction	(0.44)	(0.76)	(0.99)	(0.45)	(0.17)	(0.96)
Public	0.67	0.40	1.12	-1.61	-0.68	1.35
	(0.11)	(0.54)	(0.27)	(0.24)	(0.16)	(0.30)
Public	-0.27	-0.14	-0.35	0.34	0.15	-0.33
Interaction	(0.07)	(0.52)	(0.29)	(0.47)	(0.36)	(0.45)
Rural	-0.34	-0.46	-0.27	-0.24	-0.01	0.26
	(0.02)	(0.02)	(0.53)	(0.60)	(0.99)	(0.60)
% Medicare	0.02	-0.08	0.08	2.10	0.29	-0.45
	(0.93)	(0.82)	(0.88)	(0.01)	(0.30)	(0.51)
% Medi-Cal	-0.07	-0.01	-0.08	0.92	0.32	0.86
	(0.76)	(0.98)	(0.90)	(0.23)	(0.24)	(0.24)
Observations	139	108	100	109	139	108
R Squared	0.21	0.20	0.20	0.19	0.12	0.11

(p values)

The second medical category examined, electroencephalography, mostly shared the same general trend of results for total costs per unit and employment costs per unit with cardiac catheterization. The main difference is that public hospital costs did not appear to converge with for-profits and non-profits at higher outputs. If anything, the difference seems to widen as output increases. However, none of the output or non-profit results were statistically significant, and the public results for employment costs were also not statistically significant. Additionally, the variables explained only a fifth of the observed variation.

Capital costs per unit are, again, mostly similar to the cardiac catheterization results with one difference: instead of remaining flat, public hospital capital costs per unit appear to drop much faster than for-profit or non-profit costs per unit. However, the differences between the hospital types were not statistically significant. Again, the variables only explained a fifth of the observed variation.

Outsourced costs per unit are effectively the same for both electroencephalography and cardiac catheterization, as only the general trend in output is statistically significant. Only a fifth of the observed variation is explained by the variables.

Percent outsourced also gives the same general trend in the results for both electroencephalography and cardiac catheterization. However, the variables only explain about twelve percent of the observed variation in electroencephalography.

With the exception that other costs per unit for electroencephalography remain largely flat while they fall precipitously for cardiac catheterization, there are no important differences between the two medical categories. The variables explain only about ten percent of the observed variation.

Grounds Keeping and Maintenance Results

	log(Total Costs/Unit)	log(Wage Costs/Unit)	log(Capital Costs/Unit)	log(Outsourced Costs/Unit)	Percent Outsourced	log(Other Costs/Unit)
log(Output)	-0.75	-0.58	-1.33	-0.55	0.05	-0.47
	(0.00)	(0.28)	(0.09)	(0.12)	(0.80)	(0.60)
Non-Profit	-0.49	-2.62	-4.32	1.68	1.08	-1.92
	(0.62)	(0.42)	(0.35)	(0.43)	(0.34)	(0.71)
Non-Profit Interaction	0.12	0.45	0.77	-0.25	-0.20	0.32
	(0.50)	(0.46)	(0.35)	(0.53)	(0.33)	(0.74)
Public	-1.51	-0.96	-5.46	0.52	1.50	-0.05
	(0.19)	(0.77)	(0.30)	(0.84)	(0.26)	(0.99)
Public Interaction	0.32	0.22	1.01	-0.06	-0.31	0.09
	(0.13)	(0.72)	(0.29)	(0.90)	(0.20)	(0.93)
Rural	-0.21	0.02	0.13	-0.25	0.00	0.01
	(0.07)	(0.95)	(0.82)	(0.33)	(1.00)	(0.98)
% Medicare	0.01	0.80	0.56	-0.49	-0.44	-0.17
	(0.99)	(0.39)	(0.65)	(0.45)	(0.20)	(0.89)
% Medi-Cal	0.13	0.14	0.69	-1.31	-0.59	-1.06
	(0.57)	(0.84)	(0.56)	(0.01)	(0.03)	(0.26)
Observations	110	43	56	109	112	72
R Squared	0.49	0.21	0.18	0.25	0.13	0.07

(p values)

The total costs per unit for grounds keeping fall as the size of the grounds increases, as expected. Non-profit hospitals are not significantly different from for-profits, but public hospitals appear to have initially lower costs, but then higher costs, than the other hospital types. However, this difference is slight at best. The variables seem to explain about fifty percent of the observed variance.

For employment costs per unit and capital costs per unit, none of the variables comparing the hospital types are statistically significant. However, this is largely because both of these measurements have the same basic problem: grounds keeping costs are outsourced to such an extent that between half and two thirds of hospitals in the data set report no wage or capital costs. Moreover, for employment costs per unit, there are just six non-zero for-profit data points, and the situation is only marginally better for capital costs per unit, with just nine available for-profit data points. As a result, it is very difficult to draw any conclusions from the lack of statistical significance comparing hospital types for these measurements.

Despite this major problem, the results for employment costs per unit and capital costs per unit may still be somewhat useful. All three measurements show the same pattern of falling costs per unit as exhibited by total costs per unit. However, this result is not statistically significant for employment costs per unit.

The results for outsourced costs per unit also show a general pattern of falling costs per unit as the size of the grounds increases. While the non-profit and public hospital results are the opposite of their results for total costs per unit, the results are all not statistically significant. The variables explain about twenty five percent of the observed variation.

The percent of total expenses that have been outsourced follows the same pattern as the outsourced costs per unit with the exception of the general output

variable, which is no longer statistically significant. In fact, none of the results for this measurement (except the Medi-Cal results) are statistically significant, and only thirteen percent of the observed variation is explained by the variables.

Finally, in regards to other expenses per unit, none of the variables were statistically significant and very little of the observed variation was explained by the variables.

Credit and Collection Results

	log(Total Costs/Unit)	log(Wage Costs/Unit)	log(Capital Costs/Unit)	log(Outsourced Costs/Unit)	Percent Outsourced	log(Other Costs/Unit)
log(Output)	-0.60	-0.57	-1.05	-0.60	0.06	-0.93
	(0.10)	(0.03)	(0.07)	(0.02)	(0.60)	(0.03)
Non-Profit	-2.40	-3.10	-5.16	-2.82	0.62	0.04
	(0.13)	(0.09)	(0.22)	(0.12)	(0.45)	(0.99)
Non-Profit Interaction	0.48	0.57	0.95	0.54	-0.11	0.10
	(0.09)	(0.07)	(0.18)	(0.09)	(0.43)	(0.86)
Public	-2.54	-1.18	2.04	-1.76	1.02	-3.43
	(0.15)	(0.56)	(0.72)	(0.38)	(0.26)	(0.39)
Public Interaction	0.53	0.25	-0.36	0.41	-0.18	0.69
	(0.08)	(0.47)	(0.71)	(0.24)	(0.26)	(0.32)
Rural	-0.04	0.09	-0.11	-0.17	-0.04	-0.23
	(0.82)	(0.69)	(0.86)	(0.45)	(0.68)	(0.65)
% Medicare	0.03	-0.18	-1.31	0.17	-0.15	1.08
	(0.94)	(0.68)	(0.25)	(0.71)	(0.45)	(0.23)
% Medi-Cal	0.05	-0.14	-1.85	-0.09	-0.23	0.14
	(0.89)	(0.72)	(0.12)	(0.82)	(0.18)	(0.86)
Observations	186	73	56	186	192	79
R Squared	0.10	0.15	0.24	0.08	0.02	0.17

(p values)

For the second non-medical category, credit and collection costs, the total costs per unit results showed the same trend of falling costs for for-profits, but both non-profit and public costs stayed largely flat, and both showed a statistically significant

difference from for-profit hospitals. Only ten percent of the observed variation was explained by the variables.

Like grounds keeping, wage and capital costs have numerous dropped data points, and once again between half and two thirds of hospitals in the data set report no wage or capital costs due to the extent of outsourcing. While public hospitals report no statistically significant difference from for-profits, non-profit hospital do, as their costs remain flat while the other hospital types' costs fall. However, it is worth noting that for-profit hospitals only have fourteen data points for wage costs and eleven for capital costs, so this result is not particularly robust. For employment costs, the variables explain about fifteen percent of the observed variation, and for capital costs, the variables explain about a quarter of the observed variation.

Both non-profit and public hospital outsourced costs remain fairly flat as for-profits outsourced costs fall, but the difference is not statistically significant for public hospitals. Only eight percent of the observed variation was explained by the variables.

The three hospital types showed no statistically significant differences for percent outsourced, and all three showed no significant changes as output increased. Only two percent of the observed variation was explained by the variables.

Other costs per unit generally fell as the amount of patient revenue increased, and the three hospital types showed no statistically significant differences. The variables explained seventeen percent of the observed variation.

DISCUSSION

By focusing in on cardiac catheterization and electroencephalography, two procedures that are relatively uniform, we can largely discount the possibility that the differences found are due to for-profits choosing to only perform more profitable procedures, which is a possible concern when looking at medical costs as a whole (Horwitz 2005). The results for total cardiac catheterization costs per unit show that for-profit hospitals tend to have lower costs per unit than non-profits, but that the two seem to converge as more procedures are performed. In fact, by the mean level of output, the difference between the two has largely disappeared. While the public hospital total cost per unit results are not significantly different from the for-profit results for cardiac catheterization, this is due to a lack of data for public hospitals. Ignoring the significance problem, public hospitals seem to behave much like non-profit hospitals with regards to their total costs per unit. The electroencephalography results show a similar pattern when comparing for-profits and non-profits, but the difference between them is not significant. Public hospitals have slightly more data points for electroencephalography, but there is likely a skewness problem in the data.

On the surface, it may seem plausible that the tendency for for-profit hospitals to have a lower cost per unit may be the result of them cutting corners in health care to improve easy to observe metrics (such as expenses) at the cost of more difficult to observe ones (such as longer-term mortality differences). However, previous studies

(Sloan, Picone, Taylor, and Chou 2001) have failed to show a difference in quality between hospital ownership types, even in difficult to observe categories.

Another plausible story is that for-profits keep costs down by either locating in different areas than other hospitals (Norton and Staiger 1994) or serving a different mixture of patients (Plante 2009). However, these explanations have been largely separated out by controlling for hospital location and patient mix.

It is also possible that for-profits simply tend to be more efficient than non-profit or public hospitals, at least when the hospitals are small, due to the difference in their structure. This would not only explain the difference between for-profits and non-profits, but may also explain why the difference disappears as more procedures are performed, as for-profits would be more responsive initially, but could lose this advantage as more procedures are done. However, there is limited evidence in the literature to support such a conclusion.

While the above lines of thinking also hold for employment costs per unit and capital costs per unit, as the anomalies in the public data can be explained by a lack of data, the results for outsourcing decisions must be looked at a little closer. For both medical categories, it is fairly clear that for-profits tend to outsource a much larger percent of their costs than the other hospital types do, thought as before, this difference seems to disappear for hospitals that perform a large amount of these procedures. The difference for cardiac catheterization seems to disappear by the mean

level of output while the difference for electroencephalography seems to extend to hospitals with output somewhat higher than the mean. This result fits the story that for-profits tend to outsource more than non-profit and public hospitals when an outside source can provide a service that is relatively lower in both quality and cost, especially if the quality of the service in question is important to the hospitals, as medical costs would be. So, this result appears to concur with what other research has previously found regarding outsourcing (Marsh and Warren 2013).

Interesting to note is that non-profit and public hospitals, as well as for-profit hospitals to a lesser extent, seem to outsource much more of their electroencephalography costs than their cardiac catheterization costs, and as a result the measured differences between them were less significant. This may reflect the fact that cardiac catheterization is an invasive procedure with a potential risk of complications while electroencephalography is rarely invasive and has essentially no risk of complications in most procedures. So, quality differences would likely be more important for cardiac catheterization procedures, and as stated above this would lead to less outsourcing, which is what we see in the data.

A close look at the difference in percent outsourced between the hospital types shows that all hospital types seem to outsource a similar percent of their costs as more cardiac catheterizations are performed. It is possible that these results indicate that for-profits change their outsourcing decisions to be more like non-profit and public

hospitals as the number of procedures performed increases. This may be because as more procedures are performed, it makes an increasing amount of sense for for-profits to keep more of their medical spending in-house, eventually falling in line with how non-profit and public hospitals outsource. Again, though, further research is necessary to properly determine if this is actually the case.

Total costs per unit for both cardiac catheterization and electroencephalography appear to be primarily driven by employment costs per unit, which on average account for more than half of a hospital's total costs per unit. For cardiac catheterization, capital costs per unit and outsourcing costs per unit each make up on average about ten percent of a hospital's total costs per unit, and other costs per unit make up the remainder. For electroencephalography, capital costs per unit make up about thirty percent, outsourcing costs per unit make up about ten percent, and other costs per unit make up the remainder.

The purpose of looking at grounds keeping costs per unit and credit and collection costs per unit was to look at two purely non-medical cost categories to determine if there is a difference in how medical and non-medical costs are handled. The results for total costs per unit showed that for-profits tend to have lower costs than the other two hospital types, though this result was not statistically significant for non-profits in regards to grounds keeping.

Though the medical data also shows a difference between for-profits and the other hospital types, it is interesting to note that for grounds keeping, as well as for credit and collection, the difference between the hospital types appears to grow, not shrink, as the amount of output increases, and that this difference begins to appear before the mean level of output. This seems to suggest that while for medical costs for-profits slowly behave more like the other hospital types as output increases, for-profits slowly behave less and less like their counterparts for non-medical costs. It is possible that this difference develops because non-medical categories do not share the same concerns with quality as medical categories do, but again, further research is necessary to determine the cause of this difference.

The total cost per unit figures do seem to suggest that the general efficiency difference between for-profits and other hospital types extends to non-medical categories as well. However, the difference that exists is less clear in the non-medical categories for two important reasons. One is that employment and capital costs are much smaller as a percentage of total costs for these non-medical categories, which not only lessens their impact but makes it impossible to draw firm conclusions from the results. The second reason has to do with differences in outsourcing decisions.

Like medical outsourced costs per unit, non-medical outsourced costs per unit are essentially a wash, with the exception of non-profits for credit and collection. More importantly, the percent outsourced results for both grounds keeping and credit and

collection show no real difference between the hospital types, whereas the percent outsourced results for the medical categories showed a very strong difference between for-profits the other two hospital types. Thus, for non-medical costs, the type of ownership of the hospital appears to have essentially no relationship with how costs are outsourced.

This seems to imply that all three hospital types handle their outsourcing decisions the same way for non-medical categories, unlike cardiac catheterization and electroencephalography where for-profits outsource a larger percent of their costs. This result is also in keeping with previous research results because quality differences in non-medical categories are nowhere near as important to a hospital as quality differences in medical procedures, and so we would expect grounds keeping and credit and collection results to show either much less of a difference or no difference at all in outsourcing decisions between hospital types (Marsh and Warren 2013).

Finally, it is also possible that some of the differences between the medical and non-medical results for total costs per unit and outsourced costs per unit may be due in part to differences in the make-up of total costs per unit. For both grounds keeping and credit and collection, outsourced costs account for nearly three quarters of total costs whereas for cardiac catheterization and electroencephalography outsourced costs only make up about ten percent of total costs.

APPENDICES

Appendix A

For-Profit Summary Statistics

	# Observations	Mean	Std. Dev.	Minimum	Maximum
Cardiac Catheterization log(Output)	31	3.10	0.67	1.49	4.13
Cardiac Catheterization log(Total Costs/Unit)	31	3.05	0.39	2.29	4.17
Cardiac Catheterization log(Wage Costs/Unit)	30	2.82	0.39	2.16	3.99
Cardiac Catheterization log(Capital Costs/Unit)	29	1.72	0.73	-0.16	3.39
Cardiac Catheterization log(Outsourced Costs/Unit)	31	1.85	0.87	-0.68	3.44
Cardiac Catheterization Percent Outsourced	31	0.15	0.21	0.01	0.97
Cardiac Catheterization log(Other Costs/Unit)	31	1.83	0.74	0.36	3.35
Electroencephalography log(Output)	39	2.61	0.50	1.71	3.69
Electroencephalography log(Total Costs/Unit)	39	2.12	0.30	1.54	2.74
Electroencephalography log(Wage Costs/Unit)	22	1.88	0.56	0.06	2.55
Electroencephalography log(Capital Costs/Unit)	24	0.84	0.54	0.10	2.10
Electroencephalography log(Outsourced Costs/Unit)	30	1.56	0.95	-1.63	2.62
Electroencephalography Percent Outsourced	40	0.47	0.45	0	1
Electroencephalography log(Other Costs/Unit)	22	0.10	1.05	-2.46	2.74
Grounds Keeping log(Output)	21	5.29	0.49	4.44	6.08
Grounds Keeping log(Total Costs/Unit)	21	-0.45	0.46	-1.27	0.29
Grounds Keeping log(Wage Costs/Unit)	6	-0.47	0.44	-1.24	0.07
Grounds Keeping log(Capital Costs/Unit)	9	-2.28	1.05	-3.94	-0.38
Grounds Keeping log(Outsourced Costs/Unit)	20	-0.89	0.89	-3.02	0.26
Grounds Keeping Percent Outsourced	21	0.73	0.41	0	1
Grounds Keeping log(Other Costs/Unit)	10	-1.95	0.88	-3.63	-1.02

Credit and Collection log(Output)	50	5.59	0.44	4.56	6.47
Credit and Collection log(Total Costs/Unit)	50	-0.42	0.84	-2.96	0.73
Credit and Collection log(Wage Costs/Unit)	14	-0.42	0.65	-2.16	0.64
Credit and Collection log(Capital Costs/Unit)	11	-2.57	1.03	-4.08	-1.07
Credit and Collection log(Outsourced Costs/Unit)	46	-0.59	0.88	-2.96	0.73
Credit and Collection Percent Outsourced	50	0.77	0.38	0	1
Credit and Collection log(Other Costs/Unit)	15	-2.28	1.05	-4.00	-0.45
Percent Medicare	70	0.41	0.18	0.05	0.91
Percent Medi-Cal	70	0.18	0.16	0	0.68

Appendix B

Non-Profit Summary Statistics

	# Observations	Mean	Std. Dev.	Minimum	Maximum
Cardiac Catheterization log(Output)	82	3.60	0.62	2.00	5.44
Cardiac Catheterization log(Total Costs/Unit)	82	3.00	0.57	0.88	4.20
Cardiac Catheterization log(Wage Costs/Unit)	74	2.59	0.53	0.62	3.57
Cardiac Catheterization log(Capital Costs/Unit)	73	1.67	0.76	-0.64	3.10
Cardiac Catheterization log(Outsourced Costs/Unit)	74	1.51	0.72	-0.70	2.70
Cardiac Catheterization Percent Outsourced	87	0.06	0.06	0	0.25
Cardiac Catheterization log(Other Costs/Unit)	82	2.31	0.90	-0.10	4.20
Electroencephalography log(Output)	75	2.85	0.65	1.18	4.51
Electroencephalography log(Total Costs/Unit)	75	2.24	0.30	1.37	3.12
Electroencephalography log(Wage Costs/Unit)	63	2.10	0.35	1.25	3.08
Electroencephalography log(Capital Costs/Unit)	56	1.06	0.60	-0.45	2.48
Electroencephalography log(Outsourced Costs/Unit)	59	1.28	0.84	-0.83	2.48
Electroencephalography Percent Outsourced	77	0.26	0.34	0	1
Electroencephalography log(Other Costs/Unit)	63	0.57	0.70	-0.94	2.36
Grounds Keeping log(Output)	66	5.64	0.53	3.93	6.79
Grounds Keeping log(Total Costs/Unit)	66	-0.49	0.44	-1.17	1.24
Grounds Keeping log(Wage Costs/Unit)	24	-0.81	0.64	-2.83	0.01
Grounds Keeping log(Capital Costs/Unit)	36	-2.37	0.98	-4.37	0.07
Grounds Keeping log(Outsourced Costs/Unit)	64	-0.80	0.77	-4.19	1.23
Grounds Keeping Percent Outsourced	66	0.70	0.37	0	1
Grounds Keeping log(Other Costs/Unit)	41	-2.22	1.15	-5.73	-0.44

Credit and Collection log(Output)	96	5.87	0.53	4.46	6.95
Credit and Collection log(Total Costs/Unit)	96	-0.19	0.64	-3.27	0.72
Credit and Collection log(Wage Costs/Unit)	37	-0.33	0.40	-1.51	0.34
Credit and Collection log(Capital Costs/Unit)	30	-2.19	0.88	-3.56	-0.62
Credit and Collection log(Outsourced Costs/Unit)	94	-0.45	0.83	-3.27	0.56
Credit and Collection Percent Outsourced	96	0.75	0.35	0	1
Credit and Collection log(Other Costs/Unit)	42	-2.03	1.00	-4.80	0.47
Percent Medicare	151	0.32	0.19	0.01	0.73
Percent Medi-Cal	151	0.13	0.14	0	0.72

Appendix C

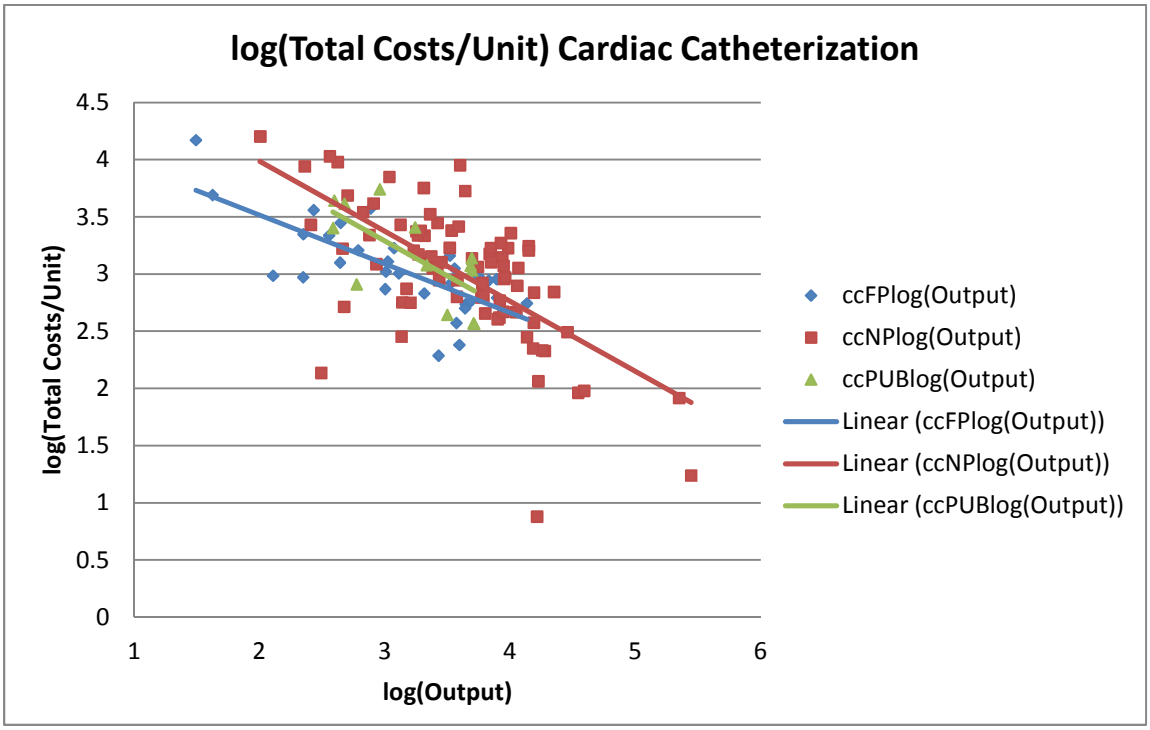
Public Summary Statistics

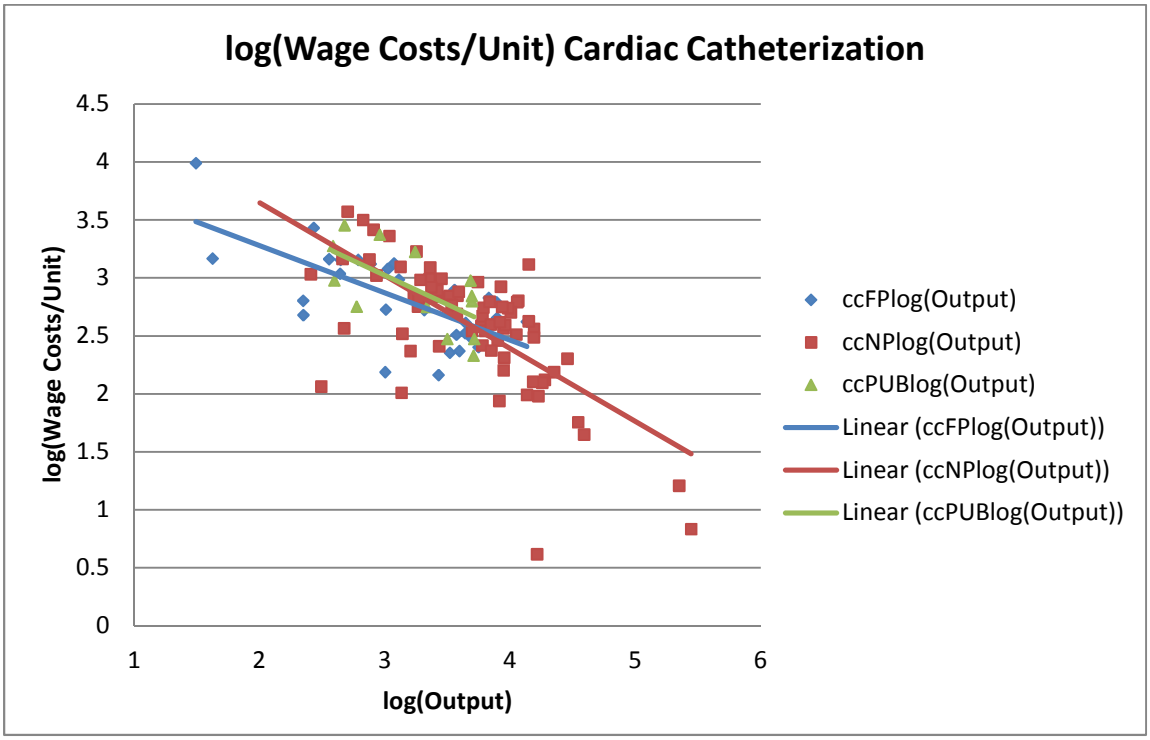
	# Observations	Mean	Std. Dev.	Minimum	Maximum
Cardiac Catheterization log(Output)	13	3.24	0.46	2.59	3.71
Cardiac Catheterization log(Total Costs/Unit)	13	3.14	0.40	2.57	3.74
Cardiac Catheterization log(Wage Costs/Unit)	13	2.90	0.36	2.33	3.45
Cardiac Catheterization log(Capital Costs/Unit)	12	1.74	0.87	-0.06	2.84
Cardiac Catheterization log(Outsourced Costs/Unit)	13	1.62	0.78	-0.48	2.47
Cardiac Catheterization Percent Outsourced	13	0.07	0.07	0.01	0.23
Cardiac Catheterization log(Other Costs/Unit)	13	2.41	0.65	1.46	3.46
Electroencephalography log(Output)	26	3.04	0.63	1.77	4.20
Electroencephalography log(Total Costs/Unit)	26	1.93	0.44	0.78	2.46
Electroencephalography log(Wage Costs/Unit)	23	1.80	0.40	0.78	2.40
Electroencephalography log(Capital Costs/Unit)	20	0.73	0.70	-0.57	1.84
Electroencephalography log(Outsourced Costs/Unit)	20	0.68	1.19	-2.70	2.39
Electroencephalography Percent Outsourced	26	0.17	0.27	0	0.99
Electroencephalography log(Other Costs/Unit)	23	0.63	0.64	-0.94	2.06
Grounds Keeping log(Output)	25	5.50	0.54	4.51	6.48
Grounds Keeping log(Total Costs/Unit)	25	-0.36	0.41	-0.99	0.30
Grounds Keeping log(Wage Costs/Unit)	13	-0.47	0.44	-1.15	0.26
Grounds Keeping log(Capital Costs/Unit)	11	-2.04	0.70	-3.18	-1.16
Grounds Keeping log(Outsourced Costs/Unit)	25	-1.00	0.76	-2.49	0.27
Grounds Keeping Percent Outsourced	25	0.50	0.43	0.01	1
Grounds Keeping log(Other Costs/Unit)	21	-1.78	0.93	-3.78	-0.08

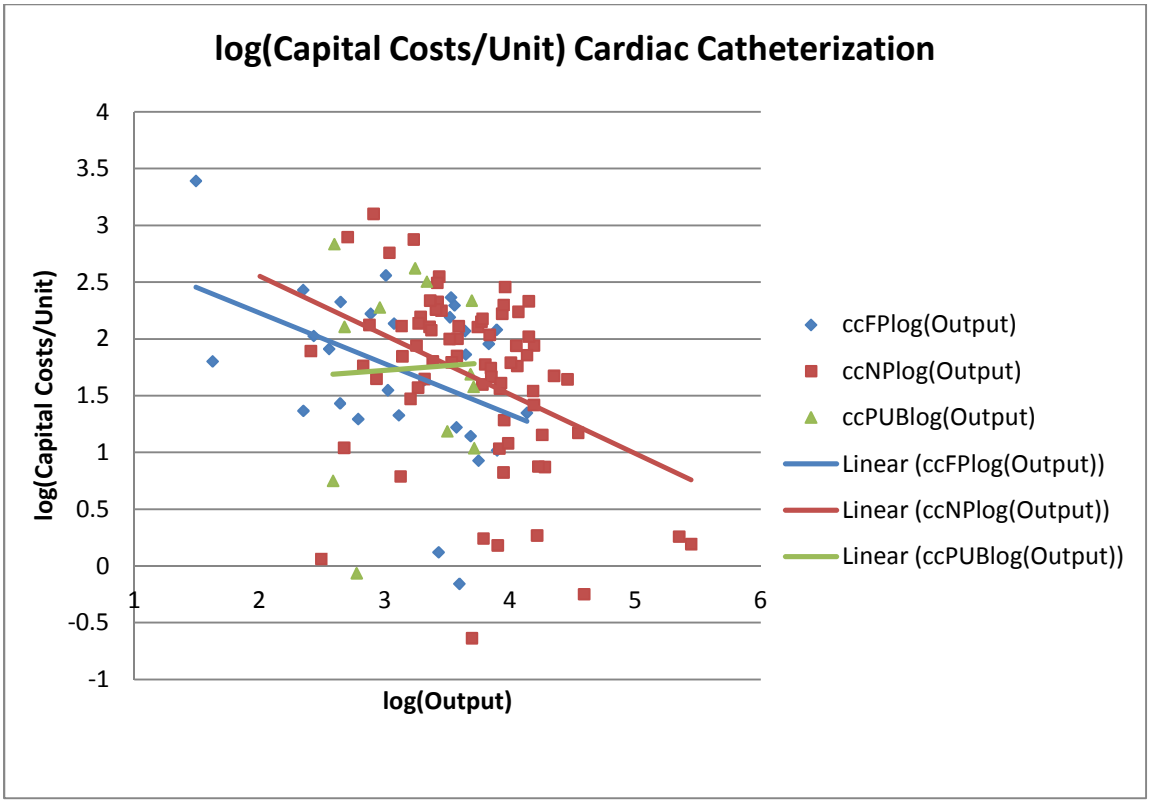
Credit and Collection log(Output)	46	5.47	0.61	4.36	6.44
Credit and Collection log(Total Costs/Unit)	46	0.04	0.36	-0.66	0.81
Credit and Collection log(Wage Costs/Unit)	22	-0.18	0.43	-0.92	0.75
Credit and Collection log(Capital Costs/Unit)	15	-2.73	0.99	-5.22	-1.42
Credit and Collection log(Outsourced Costs/Unit)	46	-0.14	0.36	-0.87	0.47
Credit and Collection Percent Outsourced	46	0.75	0.29	0.14	1
Credit and Collection log(Other Costs/Unit)	22	-2.04	0.99	-4.10	-0.23
Percent Medicare	54	0.26	0.17	0.03	0.68
Percent Medi-Cal	54	0.37	0.28	0.01	0.90

Appendix D

Scatter Plots and Regressions



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log(Capital Costs/Unit)
log(Output)
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3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
1
2
3
4
5
6
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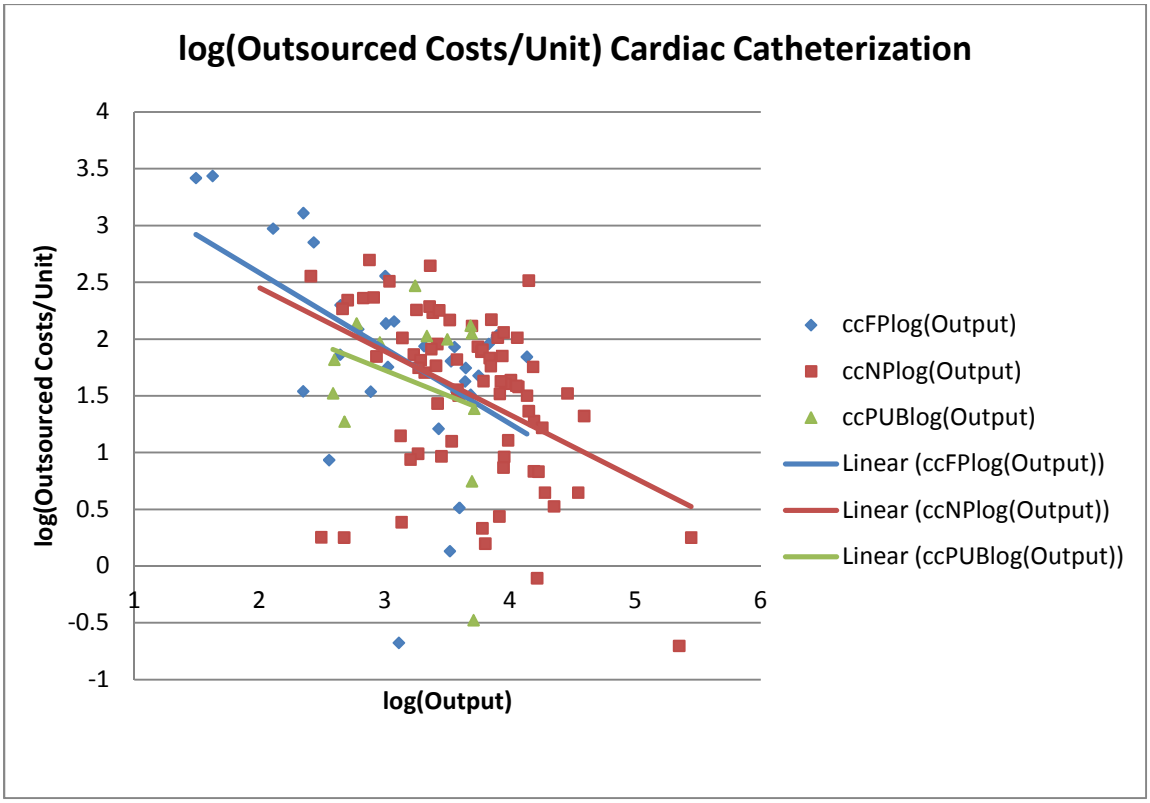
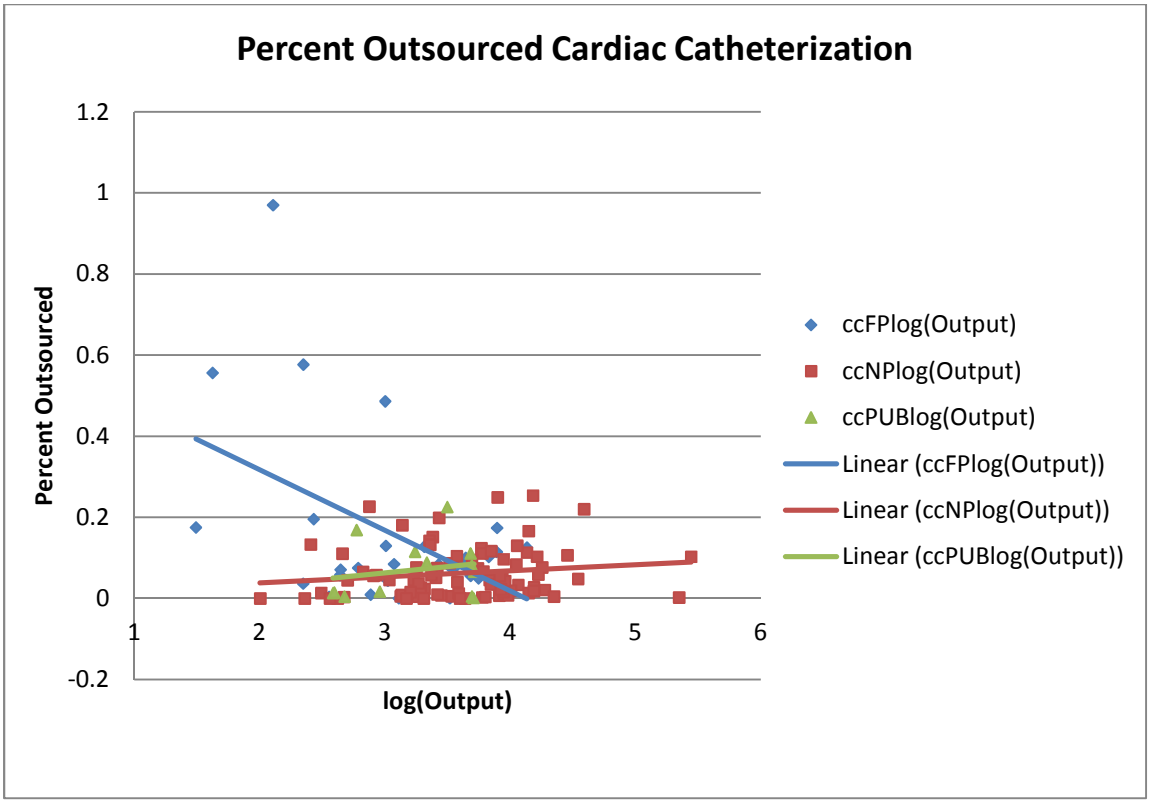
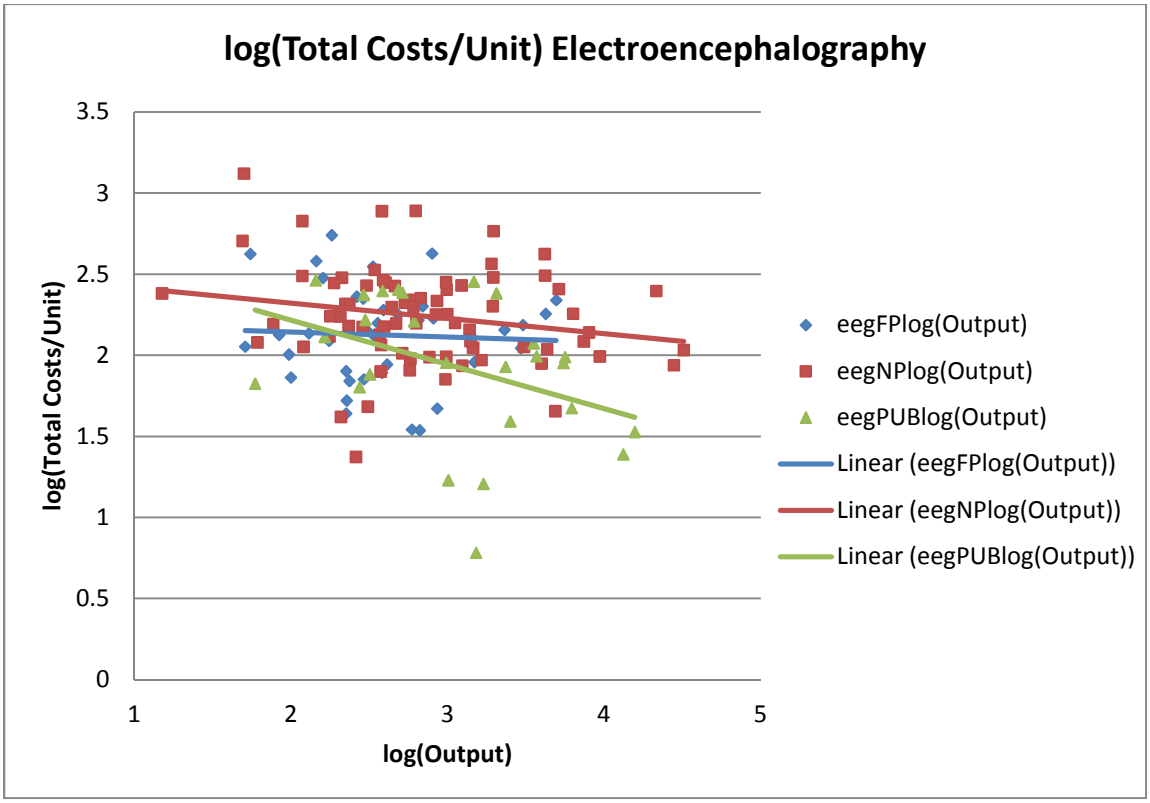
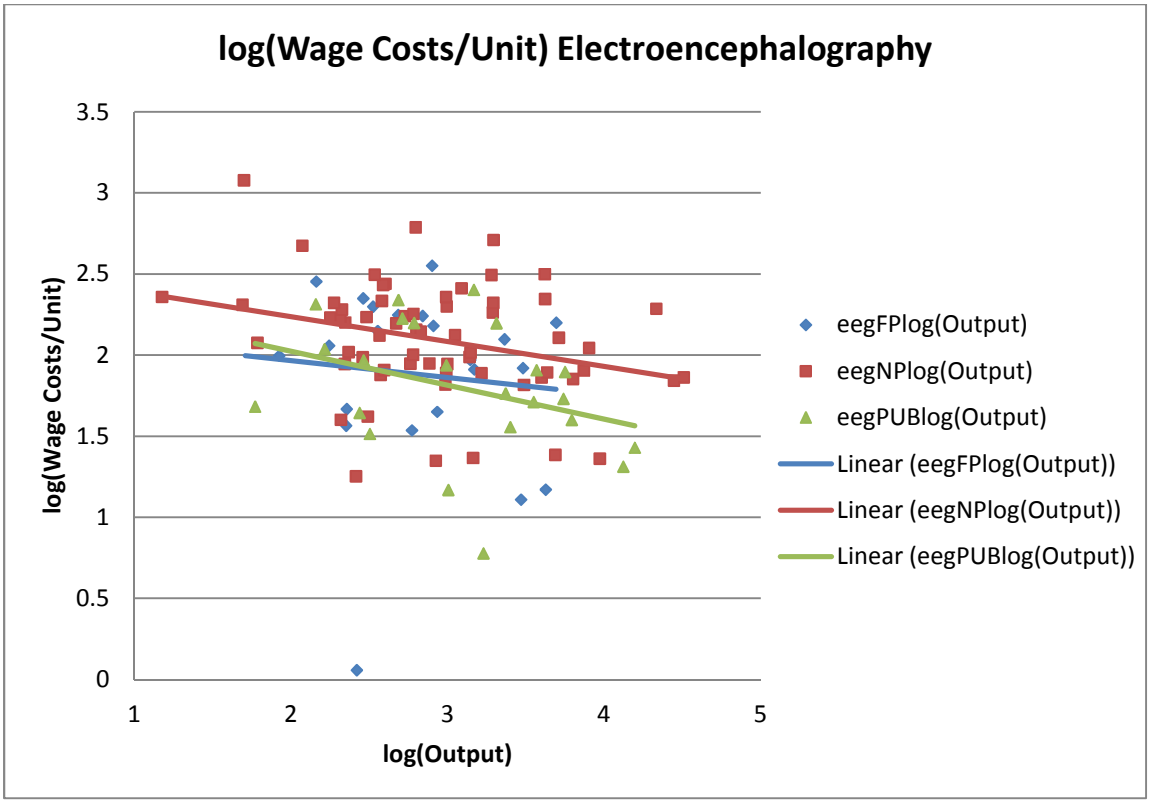
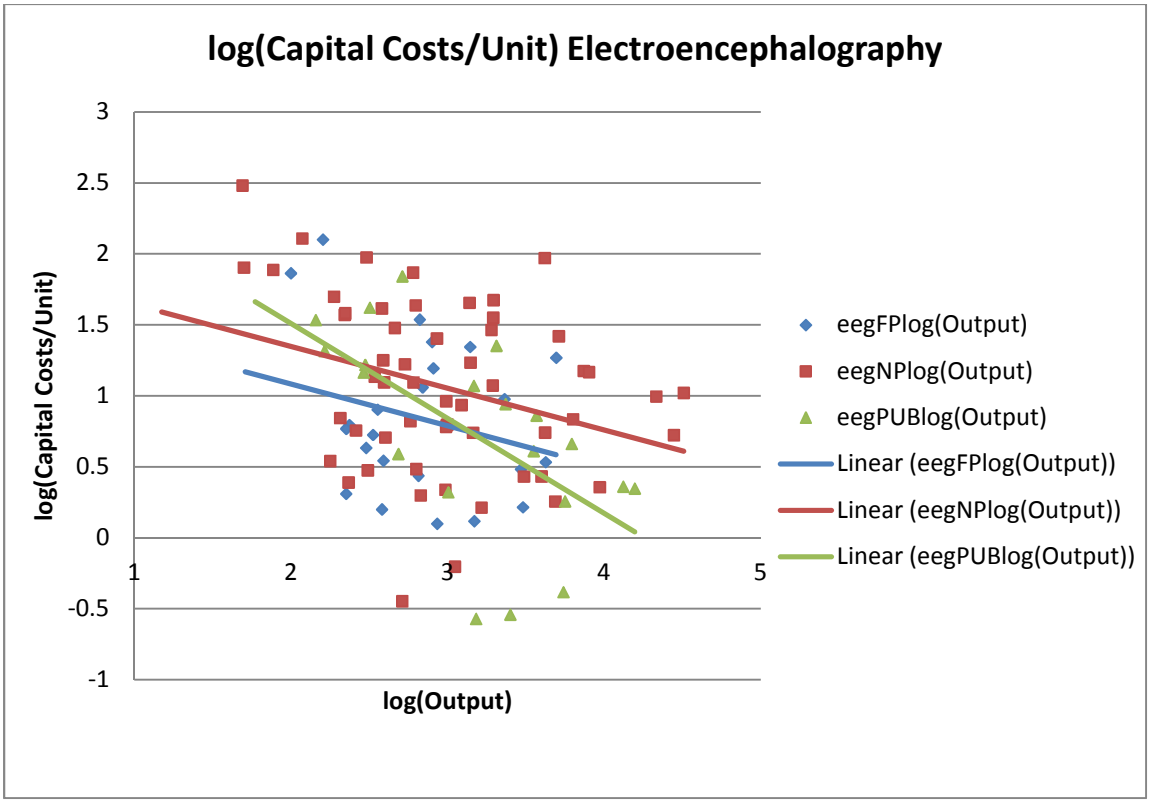
ccNPlog(Output)
ccPUBlog(Output)
Linear (ccFPlog(Output))
Linear (ccNPlog(Output))
Linear (ccPUBlog(Output))

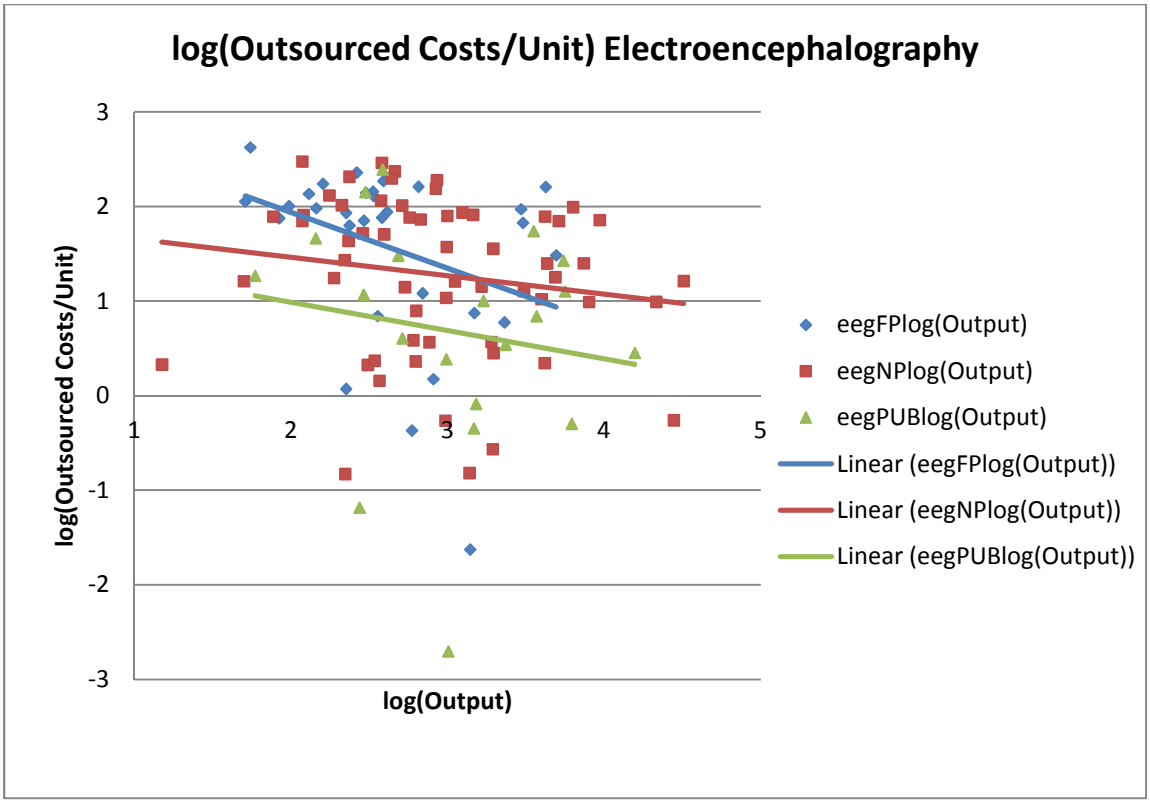

log(Outsourced Costs/Unit) Cardiac Catheterization
log(Outsourced Costs/Unit)
log(Output)
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
-1
1
2
3
4
5
6
ccFPlog(Output)
ccNPlog(Output)
ccPUBlog(Output)
Linear (ccFPlog(Output))
Linear (ccNPlog(Output))
Linear (ccPUBlog(Output))

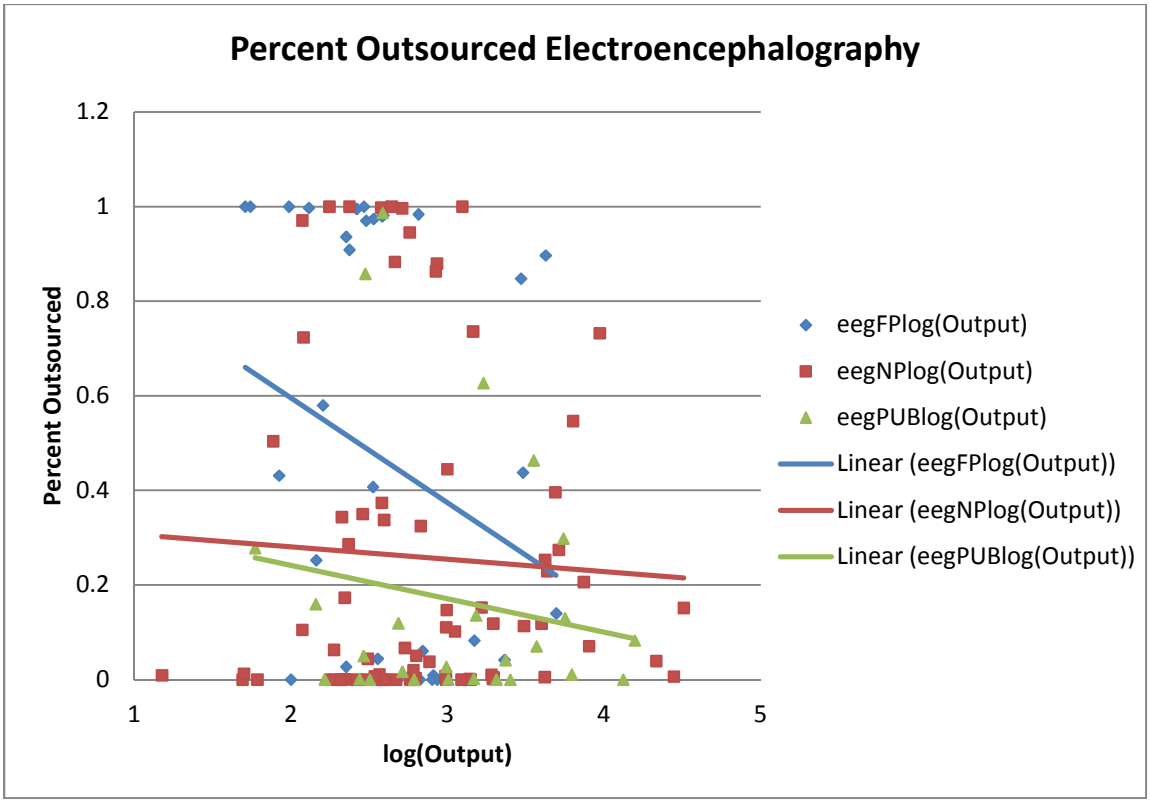

Percent Outsourced Cardiac Catheterization
Percent Outsourced
log(Output)
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
1
2
3
4
5
6
ccFPlog(Output)
ccNPlog(Output)
ccPUBlog(Output)
Linear (ccFPlog(Output))
Linear (ccNPlog(Output))
Linear (ccPUBlog(Output))

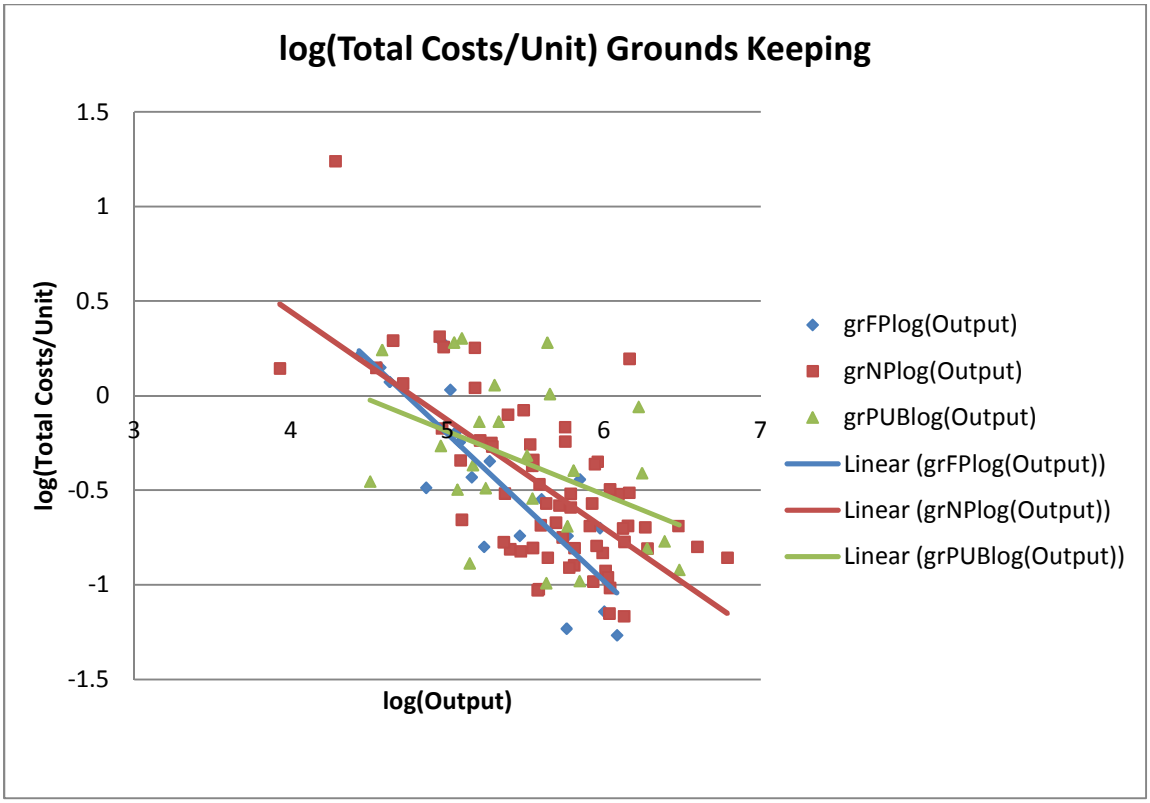

log(Total Costs/Unit) Electroencephalography
log(Total Costs/Unit)
log(Output)
3.5
3
2.5
2
1.5
1
0.5
0
1
2
3
4
5
eegFPlog(Output)
eegNPlog(Output)
eegPUBlog(Output)
Linear (eegFPlog(Output))
Linear (eegNPlog(Output))
Linear (eegPUBlog(Output))

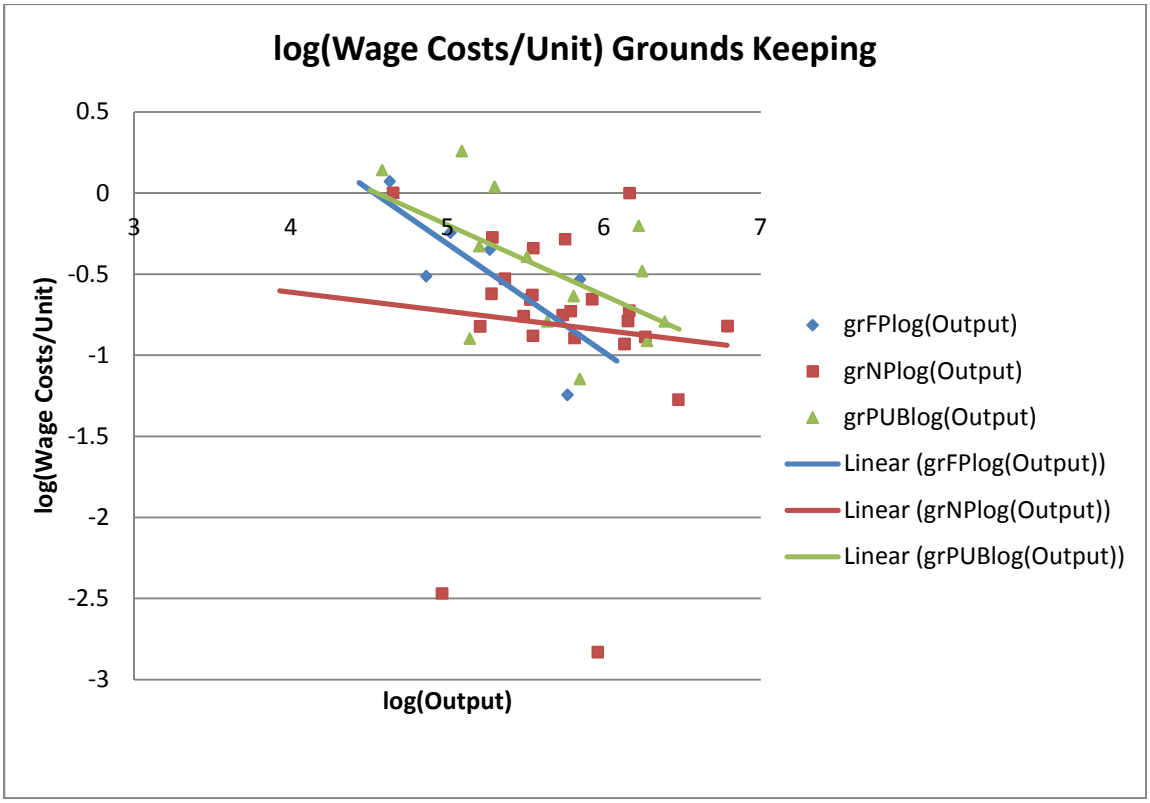

log(Wage Costs/Unit) Electroencephalography
log(Wage Costs/Unit)
log(Output)
3.5
3
2.5
2
1.5
1
0.5
0
1
2
3
4
5
eegFPlog(Output)
eegNPlog(Output)
eegPUBlog(Output)
Linear (eegFPlog(Output))
Linear (eegNPlog(Output))
Linear (eegPUBlog(Output))

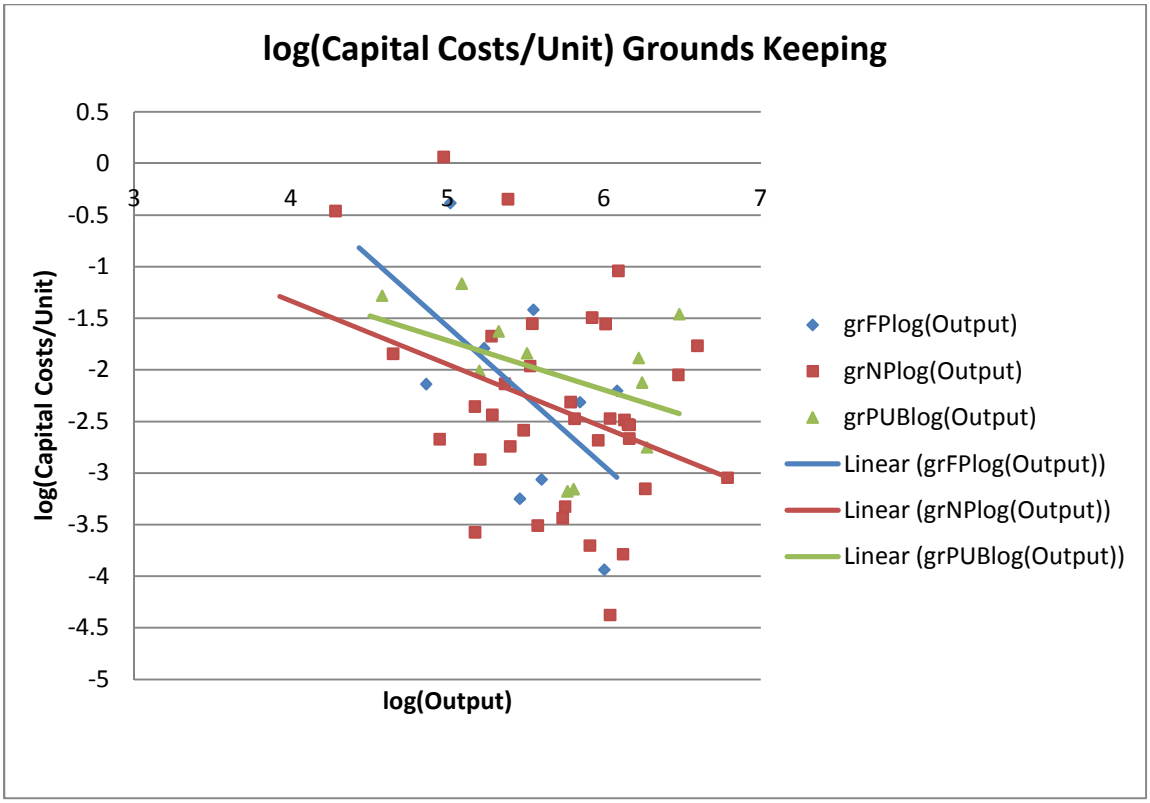

log(Capital Costs/Unit) Electroencephalography
log(Capital Costs/Unit)
log(Output)
3
2.5
2
1.5
1
0.5
0
-0.5
-1
1
2
3
4
5
eegFPlog(Output)
eegNPlog(Output)
eegPUBlog(Output)
Linear (eegFPlog(Output))
Linear (eegNPlog(Output))
Linear (eegPUBlog(Output))


log(Outsourced Costs/Unit) Electroencephalography
log(Outsourced Costs/Unit)
log(Output)
3
2
1
0
-1
-2
-3
1
2
3
4
5
eegFPlog(Output)
eegNPlog(Output)
eegPUBlog(Output)
Linear (eegFPlog(Output))
Linear (eegNPlog(Output))
Linear (eegPUBlog(Output))


Percent Outsourced Electroencephalography
Percent Outsourced
log(Output)
1.2
1
0.8
0.6
0.4
0.2
0
1
2
3
4
5
eegFPlog(Output)
eegNPlog(Output)
eegPUBlog(Output)
Linear (eegFPlog(Output))
Linear (eegNPlog(Output))
Linear (eegPUBlog(Output))


log(Total Costs/Unit) Grounds Keeping
1.5
1
0.5
0
-0.5
-1
-1.5
3
4
5
6
7
log(Total Costs/Unit)
log(Output)
grFPlog(Output)
grNPlog(Output)
grPUBlog(Output)
Linear (grFPlog(Output))
Linear (grNPlog(Output))
Linear (grPUBlog(Output))


log(Wage Costs/Unit) Grounds Keeping
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
3
4
5
6
7
log(Wage Costs/Unit)
log(Output)
grFPlog(Output)
grNPlog(Output)
grPUBlog(Output)
Linear (grFPlog(Output))
Linear (grNPlog(Output))
Linear (grPUBlog(Output))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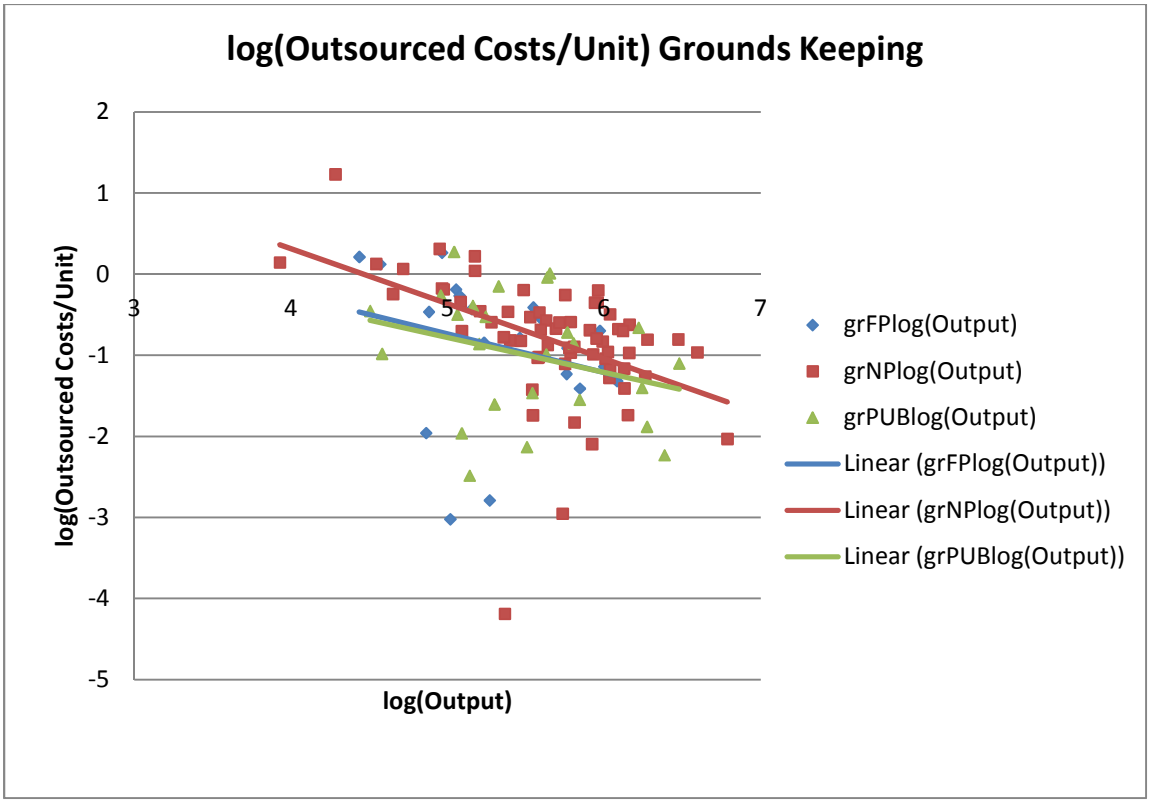
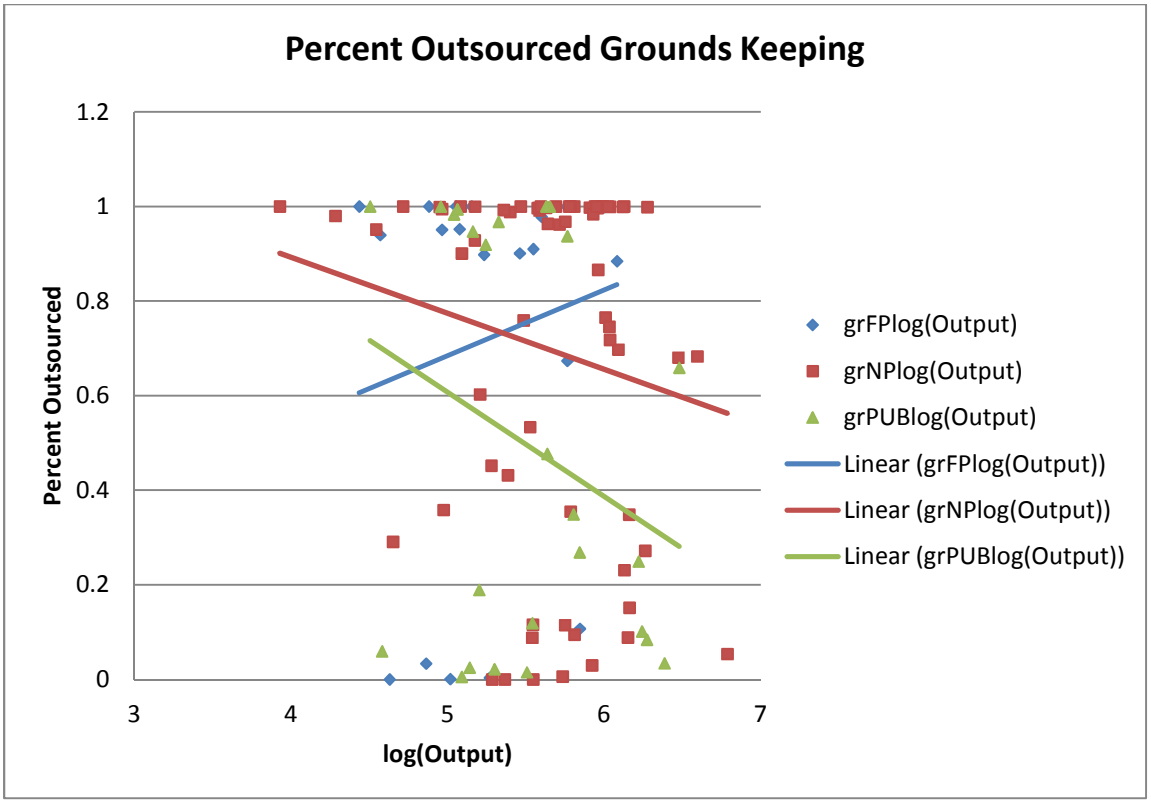
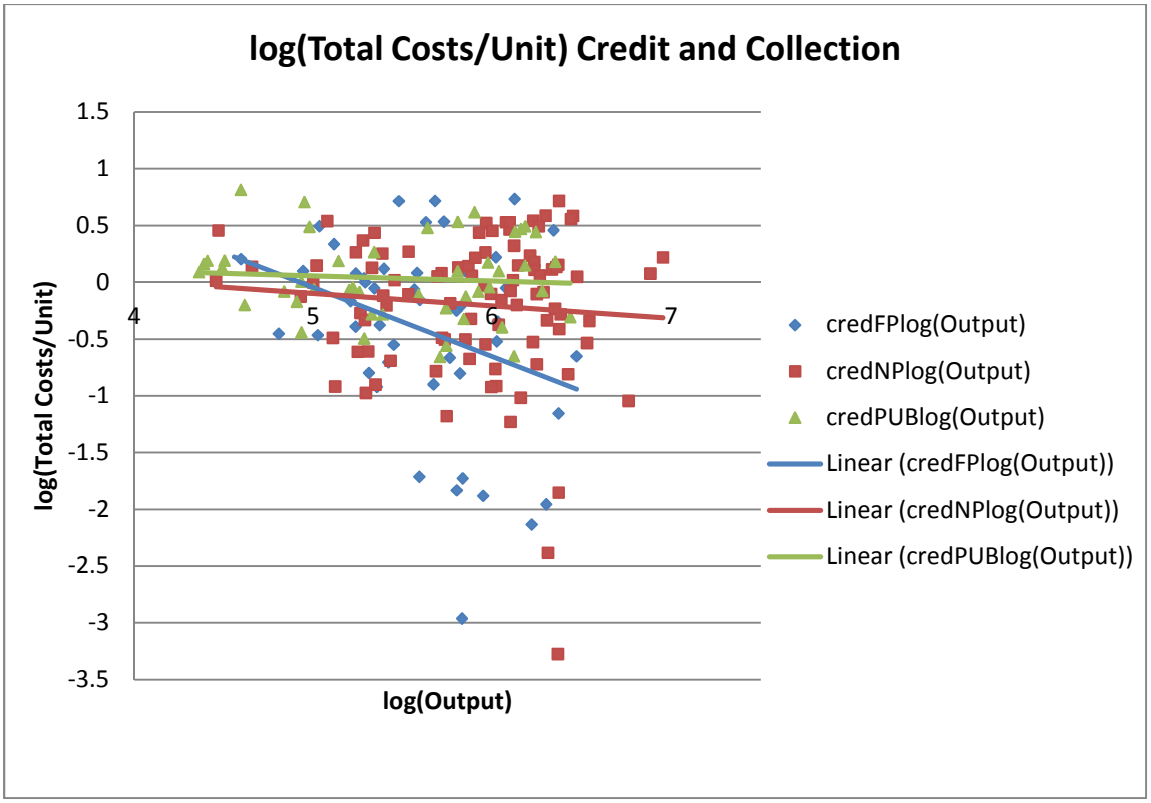
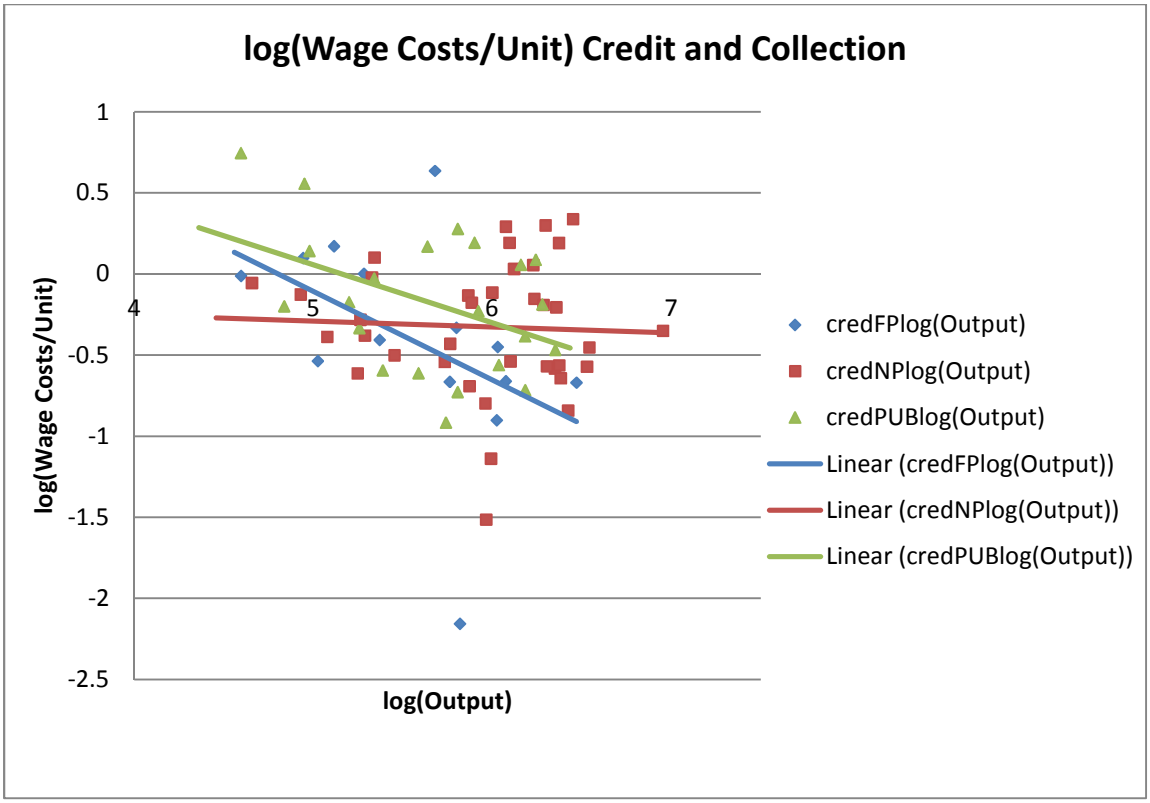
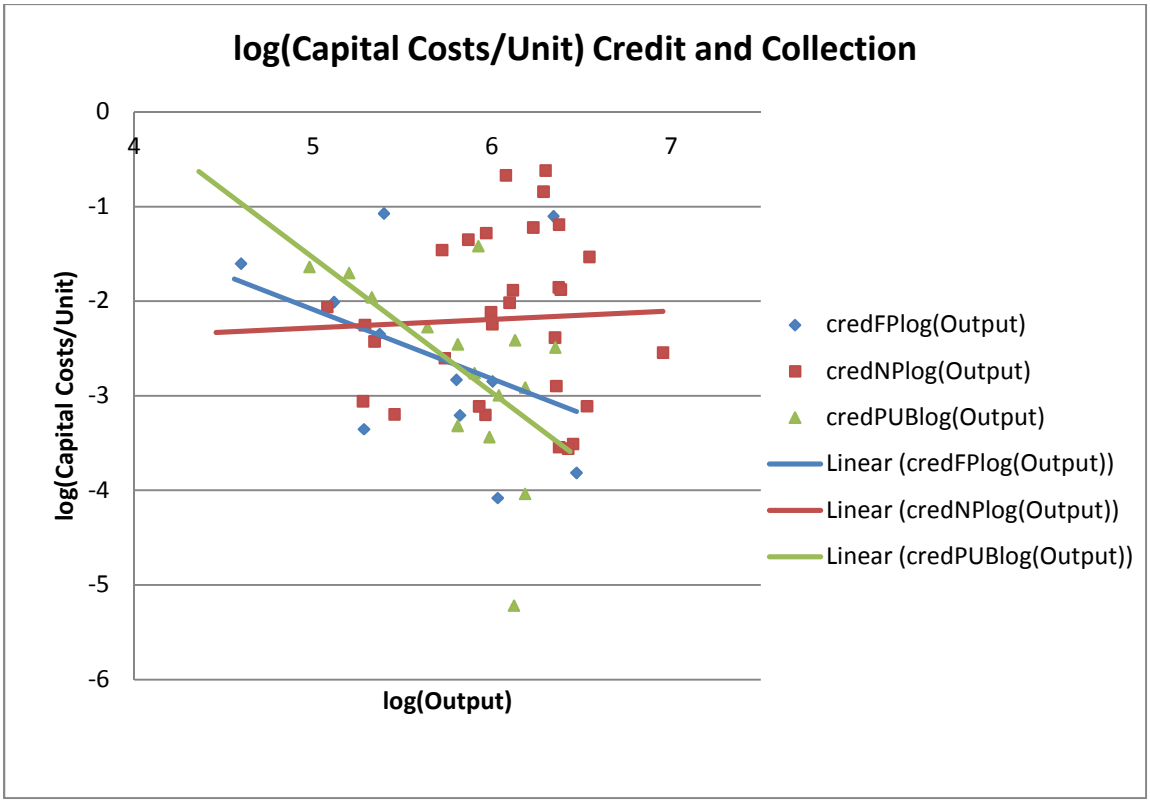
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
3
4
5
6
7
log(Capital Costs/Unit)
log(Output)
grFPlog(Output)
grNPlog(Output)
grPUBlog(Output)
Linear (grFPlog(Output))
Linear (grNPlog(Output))
Linear (grPUBlog(Output))

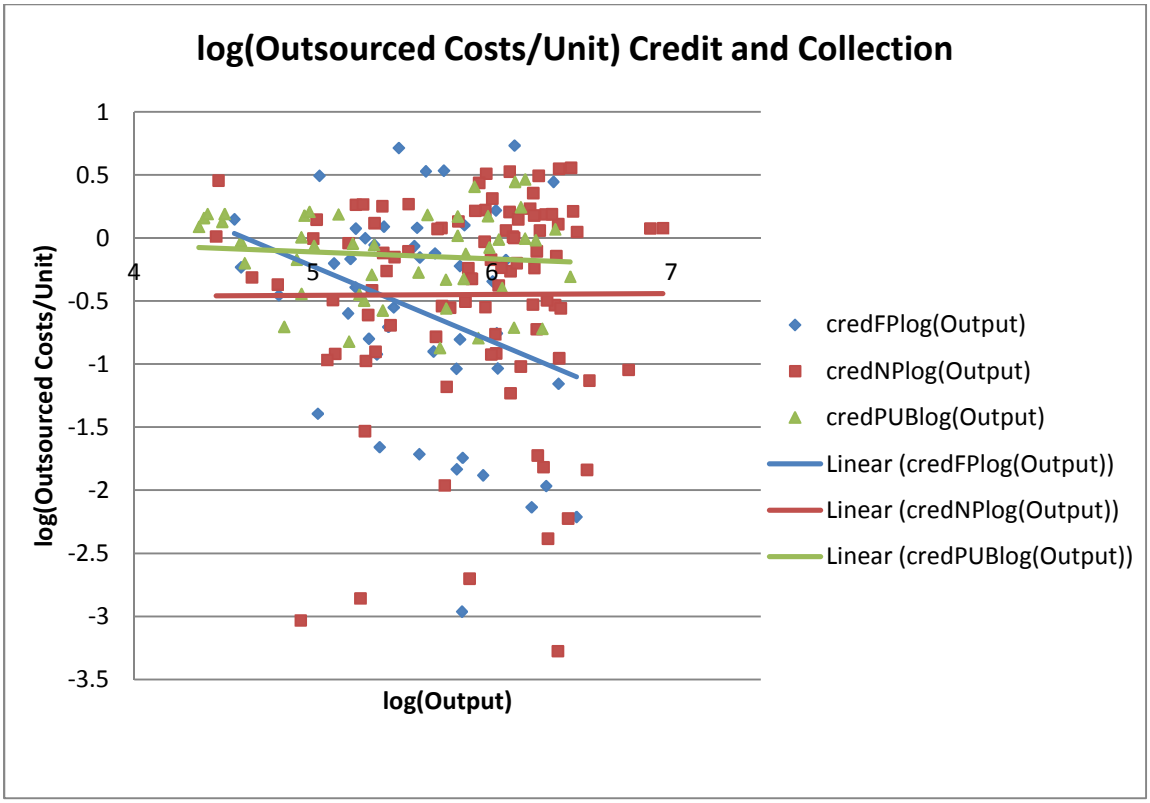

log(Outsourced Costs/Unit) Grounds Keeping
2
1
0
-1
-2
-3
-4
-5
3
4
5
6
7
log(Outsourced Costs/Unit)
log(Output)
grFPlog(Output)
grNPlog(Output)
grPUBlog(Output)
Linear (grFPlog(Output))
Linear (grNPlog(Output))
Linear (grPUBlog(Output))

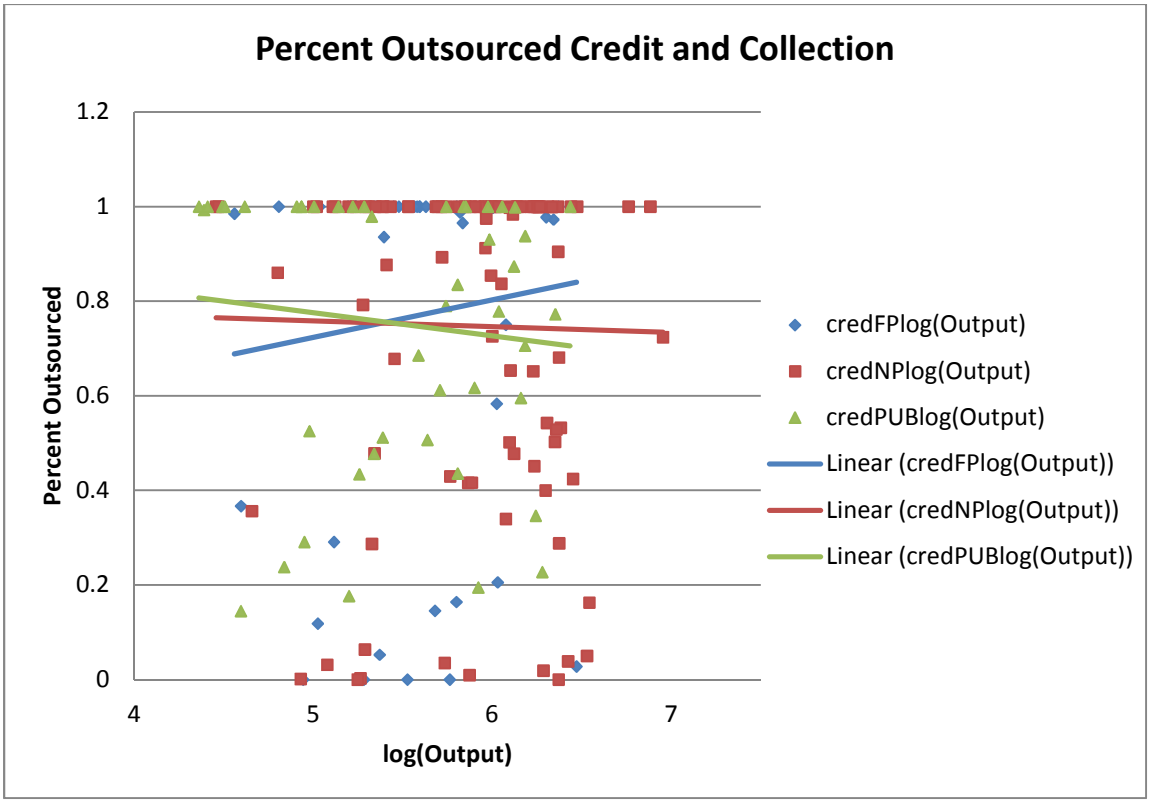

Percent Outsourced Grounds Keeping
Percent Outsourced
1.2
1
0.8
0.6
0.4
0.2
0
3
4
5
6
7
log(Output)
grFPlog(Output)
grNPlog(Output)
grPUBlog(Output)
Linear (grFPlog(Output))
Linear (grNPlog(Output))
Linear (grPUBlog(Output))


log(Total Costs/Unit) Credit and Collection
log(Total Costs/Unit)
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
4
5
6
7
log(Output)
credFPlog(Output)
credNPlog(Output)
credPUBlog(Output)
Linear (credFPlog(Output))
Linear (credNPlog(Output))
Linear (credPUBlog(Output))


log(Wage Costs/Unit) Credit and Collection
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
4
5
6
7
log(Wage Costs/Unit)
log(Output)
credFPlog(Output)
credNPlog(Output)
credPUBlog(Output)
Linear (credFPlog(Output))
Linear (credNPlog(Output))
Linear (credPUBlog(Output))


log(Capital Costs/Unit) Credit and Collection
0
-1
-2
-3
-4
-5
-6
4
5
6
7
log(Capital Costs/Unit)
log(Output)
credFPlog(Output)
credNPlog(Output)
credPUBlog(Output)
Linear (credFPlog(Output))
Linear (credNPlog(Output))
Linear (credPUBlog(Output))


log(Outsourced Costs/Unit) Credit and Collection
log(Outsourced Costs/Unit)
log(Output)
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
4
5
6
7
credFPlog(Output)
credNPlog(Output)
credPUBlog(Output)
Linear (credFPlog(Output))
Linear (credNPlog(Output))
Linear (credPUBlog(Output))


Percent Outsourced Credit and Collection
Percent Outsourced
log(Output)
1.2
1
0.8
0.6
0.4
0.2
0
4
5
6
7
credFPlog(Output)
credNPlog(Output)
credPUBlog(Output)
Linear (credFPlog(Output))
Linear (credNPlog(Output))
Linear (credPUBlog(Output))

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