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Property Rights Entitlements and Production: The Case of California Animal Trespass Law*

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Introduction

Our theoretical concern with the possible effects of property rights and liability rules on externality and production dates to Coase's "The Problem of Social Cost"[1]. As Polinsky[2] has characterized the problem, there are three approaches to controlling externalities while protecting entitlements: 1. property right approach; 2. liability rule approach and 3. tax — subsidy approach. He concludes that when the zero transaction costs assumption is not met and the government does not have full information about the externality problem, none of the approaches can achieve both the government's goals. Yet he continues:

> ... the government can determine that the tax approach with marginal compensation is inferior to the liability rule approach in a wide range of circumstances, and that the property right and liability rule approaches are equivalent in many other circumstances. Moreover with some additional information ... [i]n terms of entitlement protection, there is a clear preference for the property right approach.[3]

Our practical concern with this problem predates Coase by many centuries. This paper is concerned with one particularly rich example of attempts by the State to meet both of Polinsky's goals. California, from 1850, when it became a State, to 1890, experimented with various legal forms of control of the most basic of externalities: the trespass of grazing animals[4] onto land not under the legal dominion of the animal owner.[5] This experiment and its effects on the production of the competing industries should give us some indication of the efficacy of the

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[1] R. H. *Coase*, The Problem of Social Cost, 4 J. Law & Econ. 1 (1960).

[2] A. M. *Polinsky*, Controlling Externalities and Protecting Entitlements: Property Right, Liability Rule, and Tax-Subsidy Approaches 8 J. Legal Stud 1 (1979).

[3] Id at 5.

[4] Grazing animals includes horses, mules, jacks, jennies, hogs sheep, goats and cattle.

[5] Clearly both ownership of the fee title to the land as well as leasehold estates, licenses and easements are included in the meaning of land under the legal dominion.

various legal forms of control affecting levels of production, and should be generalizable to other externalities.

When California entered the union in 1850, it passed the Trespass Act which defined a lawful fence and gave an owner of land who had enclosed his premises with such a fence, the right to collect damages which grazing animals caused, but not under other circumstances[6]. By giving owners of animals the privilege to allow their animals to invade the land of another, unless he had taken sufficient precautions to physically prevent the invasion, the legislature gave us a law which is essentially Coase's case of the pricing system with no liability for damages. Fencing was generally not a practical alternative: Wood was scarce in much of the inhabited part of the state; barbed wire was invented in 1868, and not marketed until 1874; the land was semi-arid and hedges required greater rainfall. In 1865 it was estimated that *interest* on the cost of fencing all the cultivated land exceeded the *value* of the cattle in the state by $3 million.[7]

This Act was the chief grievance of the farmers in California. They and their allies in the San Francisco Chamber of Commerce fought for its repeal[8] during the 1850's and 1860's. It was therefore hotly debated and a constant issue of legislation. From 1855 to 1878, well over 150 separate acts changing the law were enacted by the California legislature. The acts can be categorized in three ways: 1. by county (usually the changes were done for a small group of counties at one time); 2. by animal (separate statutes were passed for each of the grazing animals, although they typically fall into the groups of hogs, sheep and cattle), and 3. by enforcement mechanism.

There were five principal categories of enforcement mechanisms:

1. Fence Law — the 1850 Trespass act requiring landowners to fence-out trespassing animals, otherwise there would be *no liability.*

2. Trespass Laws — the finder of an estrayed animal may "take — up" animals found on his land and receive *expenses* for caring for animal until the owner is found or the animal is sold at public auction.

3. Estray Laws — the finder of estray may also recover for the *damages* the animal may cause to their land or crops.

[6] „Trespass Act", [1850] California Statutes p 131.

[7] California State Agricultural Society, Transactions 1864 - 65 at 150 - 151 (1865).

[8] Robert Glass *Cleland,* The Cattle on a Thousand Hills: Southern California 1850 - 1870 (1941) at 85.
See also Letter from Chamber of Commerce of San Francisco to California State Agricultural Society, January 29, 1868 reprinted in Transactions of the State Agricultural Society, Appendix to the Journal of the Senate and Assembly of the State of California, 18th Session at 114 (1868).

4. Pound Laws — the impounding function is under the control of the county or the municipality and the owner of trespassed land does not collect the expenses.

5. Criminal Laws — the *fine* for allowing animals to run at large or to trespass on the land of another; enforced by the municipal constable.

In a previous work[9], I have shown that, contrary to Coase's Theory that any complete system of property rights entitlements will yield the same level of production; non-convexities due to externalities imply that only if the entitlement is given to the externality receptor, can we be sure to be able to achieve optimal production. This finding suggests that the changes in the trespass law will have significant effects on the production of crops and of animals in those areas where there are interaction effects between the animals and the crops.[10]

This paper is an empirical test of that theory. If complete, consistent systems of property rights, that give the owners of land the right to exclude all others, are more efficient than inconsistent systems where some industries have privileges against that right to exclude,[11] then we expect, *cet. par.,* different allocations of the resource in question as between the industries in question and different levels of production. With regard to differences in animal trespass law, we should expect that the 1850 Trespass Act would yield suboptimal production and changes which give landowners a property right allocation (a right to exclude) should yield optimal production. On the other hand, if the Coase Theorem can be used to predict how resources are allocated, then we should have the correct mix of uses under either system and production levels should not be effected by changes in the law.

[9] K. R. *Vogel,* Non-Convexities and Property Rights Entitlements, Dept. of Economics, SUNY at Buffalo, 1981. (Presented at WEA International meeting, San Francisco July 1981).

[10] An example of the interaction would be:
> [t]he ... stock raiser['s] cattle by hundreds or thousands ... roam over thousand of acres, and often hundreds of miles in extent, of unfenced lands of the public domain, or property of private individuals ... frequently pasturing on lands or committing deprevations on the fields, orchards, vine yards and other crops of the practical agriculturalist ... „Committee on Agriculture 17th Session, California Senate, Report in Relation to Fencing Agricultural Lands, 1868.

[11] The Trespass act of 1850 is an excellent example of a system of property rights where one industry, stock-raising has a privilege to use the land of another, by using it for pasturing against the wishes of the owner.

Methodology

A. Data

Assessors of the several counties of California collected annual taxes on land, improvements, personal property and production. They reported this as yearly assessments to the State Agricultural Society, and it was published in an appendix to the proceedings of the legislature. This study is a report on the two principal crops of the nineteenth century: Wheat and Barley; and the two principal livestock: Cattle and Sheep.

Annual data by county was collected on the thousands of bushels harvested, by crop, and the number of acres of land cultivated for each crop. Also annual data on the number of head of cattle and sheep was collected by the county. Unfortunately no data was found on the annual climatological characteristics of the counties, or on prices so to adjust for the possibility of unexplained changes in production due to changes in wheather or to changes in prices, all production data is reported as five year moving averages.[12] Also as annual population statistics were not reported, density is measured only by the assessed value of land and improvements per acre.

All changes in the law are reported either as dummy variables with a value of 0 if such a law had not been enacted for that county or a value of 1 while such a type of law was in effect in that county; or for the criminal laws by the value of the fine.

As price data was unavailable for this time period, an equilibrium model cannot be used. Rather the changes in the law are used to try to explain production of the competing products.

B. Model

There is perhaps no real world example which will come closer to the idealized no transaction costs world envisioned by Coase than the trespass of animals on farmland. If the models derived from that analysis are accurate changes from 1. the Trespass Act, (Fence Laws) which gave the privilege of use to the rancher, to 2. Estray Laws, which gave the right to exclude the landowner, would have no significant effect on the relative production of crops and animals.

On the other hand, if it is more efficient to have the legal right to exclude, then changes from the fence-out laws (like the Trespass Act

[12] Moving averages were calculated by the formula:
$XMA_{(T)} = .1X_{(T-2)} + .2X_{(T-1)} + .4X_{(T)} + 2.X_{(T+1)} + .1X_{(T+2)}$

of 1850) to fence-in laws (like the trespass and estray laws) should increase production of crops, while the effect on the production of animals is not specified by the model.

The explanation for these effects is quite straight-forward. If stock-raisers have the privilege to use land without considering the full value of the land[13, 14], then they will make inefficient use of the land in in production of stock and less land than optimal will be used in the production of crops Therefore changes giving more private rights and remedies to the farmer will increase the production of crops.

The direction of the change for the production of stock in not as certain. If all land which could reasonably be used for agricultural purposes was in use at the time the law changed, then less land would be available for stock-raising and if the technology of raising animals did not change there would be fewer animals after a change in the law. If however, all the available land was not used for agriculture or if a new technology of stock-raising was available which made more efficient use of the land, then the changes in the law, by forcing the rancher to take account of the full marginal opportunity cost of the land, would encourage more efficient use of the land and might actually increase the production of animals.[15]

In addition to changes in the property and liability rules, the legislature also enacted criminal statutes, which can be considered a primitive form of tax-subsidy approach to the problem of trespass. Given the

[13] Instances can be cited where the rancher who owns cattle by the thousands has purchased of the public domain from eighty to one hundred sixty acres... Surrounded by thousands of acres of good agricultural land... which... he uses and enjoys as absolutely as if he had obtained a patent for the whole tract. . . The herding of large bands of cattle on the unenclosed lands has a tendency to prevent its settlement by permanent farmers.
Committee on Agriculture, supra note 9.

[14] In spite of the analysis of Coase, the rancher need not consider the full opportunity cost of land when he has the privilege of use, but no right to exclude. When the farmer has the right to exclude, we are assured that only if both the marginal and total conditions are satisfied will any allocation of the land be the equilibrium. However, if the rancher has the privilege to use the land, his private optimal use of the land may be in a nonconvex part of the production space and it may be impossible for the farmer to pay (without making a pure lump-sum transfer) the rancher to stop the use of the farmer's land. See *Vogel* supra note 8.

[15] As it turns out the early ranchers did make very inefficient use of the land. The Spanish cattle raising technology drove the cattle from pasturage to pasturage, using up all the grass in each season. The American method fed the cattle with hay, grown on the most fertile lands, and prevented the weight loss which occured during the season Wm. Flint, „The Fence Question" Transactions of the California State Agricultural Society, 2 Appendix to the Journals of the Senate and Assembly of the State of California, 15th Session. (1864).

probability that the legislature did not, or could not, estimate the optimal amount of the tax, this approach is the least efficacious in achieving the optimal mix of farming and ranching. Also this approach is enforced by the government, which implies that not every violation of the norm will have a fine imposed.[16] This should reinforce the conclusion that criminal laws should be less effective in the control of the externality and therefore in increasing production of crops.

The formal model used to test these propositions is unfortunately a very simple one due to the constraints of working with 100 year old limited data. The effects of changes in the laws on the production of the agricultural products was estimated using a simple linear model with this relationship:

Production = f (Legal Variables, Time, Fertility, Weather, Probability of Interaction).

The estimated model[17] was:

$$XMA = b_1 + b_2\,LH3 + b_3\,LH4 + b_4\,LH5 + b_5\,LS2 + b_6\,LS5 + b_7\,LC2 + b_8\,LC3 + b_9\,LC5 + b_{10}\,LA3 + b_{11}\,YEAR + b_{12}\,VPAC + b_{13}\,WPAC + b_{14}\,BPAC.$$

Where X is the various products.

Year is included to account for the possibility of a secular growth trend. The three density variables, assessed value per acre, bushels of wheat per acre and bushels of barley per acre, are included for two reasons. First, it is readily apparent that some places are more fertile and therefore better for growing crops. Rangeland need not receive the rainfall or irrigation or be easily tillable to be satisfactory for cattle or sheep to graze. Wheat per acre and barley per acre are intended as proxies for the variable fertility, including weather, factors. If more grain can be produced, it is assumed that the land is more fertile. Second, the effects of the possible externality of animals trespassing on crop land depends upon stock raising and crop growing being neighboring activities. The probability of interaction should therefore be greater if the density of use is higher. Population density would be a good measure if agricultural uses were consistently the primary uses. However in nineteenth century California mining was still a very major source of employment well past the gold rush.[18] Therefore assessed value per assessed acre was used as a proxy for the possibility of interaction effects.

[16] There are no reported appellate cases, which might suggest that there was no significant enforcement.

[17] A number of the possible legal variables were dropped from the equation due to the high degree of collenearity with other variables:
$R_{LH2.LH3} = .712$ $R_{LS3.LC3} = .680$ $R_{LA2.LA3} = .748$:
Also there were separate acts for horses but they were almost coterminous with the laws relating to cattle:
$R_{LHORSE2.LC2} = 1.0$
$R_{LHORSE3.LC3} = .973$
$R_{LHORSE5.LC5} = 1.0$

Table 1

List of Variables

WHMA	Wheat in thousands of bushels, moving averaged.
BAMA	Barley in thousands of bushels, moving averaged.
CATMA	Cattle in thousands of heads, moving averaged.
SHMA	Sheep in thousands of heads, moving averaged.
WPAC	Wheat per Acre, moving averaged.
BPAC	Barley per Acre, moving averaged.
VPAC	Assessed Value per Acre, moving averaged.
YEAR	Calendar Year, 1854 to 1890.
LH2	Hog Trespass Law.
LH3	Hog Estray Law.
LH4	Hog Pound Law.
LH5	Hog Animal Law.
LS2	Sheep Trespass Law.
LS3	Sheep Estray Law.
LS5	Sheep Criminal Law.
LC2	Cattle Trespass Law.
LC3	Cattle Estray Law.
LC5	Cattle Criminal Law.
LA2	All Animal Trespass Law.
LA3	All Animal Estray Law.

Estimation Results

The results of estimating the above equation are presented in Tables 2-7. There were 1820 observations for the 54 counties in California for up to 37 years. Not every county existed for the whole time period and therefore those counties will have less than the full 37 observations.

[18] Other than San Francisco, in 1870 the most dense counties were all in the mountains and foothills where the gold rush occured: Nevada, Trinity, El Dorado and Klamath. U. S. Bureau of the Census, Census of Population, 1870.

Also any observation with a missing value for any of the included variables was dropped, which will account for about two thirds of the sample.

Table 2 gives the results for the estimation of the complete model for the above described sample. Table 3 gives the results when only those variables which are significant at the 5 % level are included. This is presented principally to simplify the task of discerning the effects of those variables which are significant.

The results for the effects of the changes in the law on the production of crops are as expected. Uniformly, the significant coefficients are positive, implying that changes from fence-out to fence-in laws encourages the growth of the farming industry. The strong effect of the law on production appears to be a reasonable refutation of that part of the Coase Theorem which implies that changes in the legal position of the parties in a property rights dispute should have no effect on the equilibrium (production) position of the parties. It is also consistent with the hypothesis that it should increase the efficiency in joint production when the property rights to exclude are strengthened.

The results for the effects on the production of stock are not as clear, which again is consistent with the view that an improvement in the property right of the landowner to exclude should increase the joint product of the competing industries. For cattle, most of the legal variables have no effect on production, but the criminal laws relating to sheep and cattle, and the estray law relating to cattle, all tend to increase production of cattle. Note that it appears to be the criminal laws which have the greatest effect here (they had no significant effect on the production of crops).

For sheep, the split in the effect on the legal variables is more evenly balanced. The hog estray and pound laws seem to decrease the amount of sheep production; the cattle trespass and criminal laws and the all inclusive estray laws seem to increase the production of sheep; while the rest have no significant effect. One possible explanation for the effect of cattle laws might be in decreased competition by cattle raisers. Only LC 3 (which is highly correlated with LS 3) of the laws relating to cattle has no significant effect on the production of sheep. However these laws pertaining to cattle do not have any negative effect on cattle (in fact LC 5 has a positive effect on both), which does not lend much credence to intra-stock competition being an important factor. Not knowing enough about the possibilities of joint production, I also have no satisfactory explanation for the reasons why it should be hog estray and pound laws which would have negative effects on sheep production[19].

Another part of the theory involves the belief that the interaction effects, and therefore the efficacy of laws in limiting the interaction, should be greater, where there is more probability of the interaction in dense counties. This was tested in two ways. The first way is in the equations presented as Table 2. Value per acre was entered as a proxy for the interaction, effect and it was insignificant in all cases.[20] The second way was by separating the sample into dense and not dense counties to see if the effects of the law would be different in the separate groups of counties. The results for the partitioned sample are presented in Tables 4 - 7.

Tables 4 and 5 are the estimates for the dense counties. Dense counties are defined as having at least one-fifth of their observations at greater than $10,000 assessed value par acre; which was the mean of the sample.[21] Table 4 is, like Table 2, an estimate of the full model; Table 5 is, like Table 3, the presentation when only significant variables are included. Tables 6 and 7 present the comparable results for the non-dense counties.

The results for crops is, once again, extremely consistent. There are no significant and negative coefficients and approximately one-half the total legal variables have positive and significant coefficients. This reconfirms the hypothesis that fence-out laws encourage crop growing. The difference between the sub-samples presents itself in the coefficients for the animals. The non-dense counties have only positive (or non-) significant coefficients, implying that ranchers were either able to move, or to produce more efficiently after the change. However, for the dense counties, between one-quarter and one-half of the significant coefficients[22] were negative. The Hog Estray (and Trespass) Law, and the Cattle Trespass Law in its effect upon Cattle, tended to decrease the production of the animals.

These laws, are the laws which come closest to giving private property rights to the farmers. They give the farmers the power to enforce their own right to exclude and are, therefore, likely to be more efficacious

[19] See the discussion of the differences between Tables (4 & 5) and Tables (6 & 7) below for a possible explanation of the anamoly of the negative coefficient only for Hog Estray Laws.

[20] Note that wheat per acre was significant and negative in its effect on cattle. This supports the hypothesis that counties with higher fertilitiy tend to have less production of animals, as the land there is more efficiently used for crop growing.

[21] The dense counties are: Alameda, Alpine, Fresno, Kern, Los Angeles, Monterey, Plumas, Sacramento, San Benito, San Bernadino, San Francisco, San Mateo, Solano, Sonoma, Ventura and Yolo.

[22] Or between one sixth and one third of all coefficients. There were no non-zero observations in his sample for LH4 and LH5.

than pound or criminal laws. As all we can estimate is a reduced form production model it is not possible to discern the reasons for the negative effect of these laws in a more specific manner. However, we can say that, as expected, the effect of the change in the law is more pronounced in those areas where the interaction effect is likely to be higher, giving additional confirmation to the underlying model.

Conclusions

The Coase Theorem itself is tautological and therefore excludes the possibility of empirical testing, as it is clear that any time there are truly *zero* transaction costs the parties will agree to produce at the joint optimum. However with a very small departure from that assumption, we find differences between property and liability rights systems in production equilibrium. I have shown elsewhere that, due to the nonconvexity of the farmer's production function in the presence of the rancher's externality, if the rancher has the privilege to trespass, there may be no price at which the two can trade to reach the joint optimum, if the rancher's private optimum is in the nonconvex part of the farmer's production space. However, if the farmer has the right to exclude, there does exist a feasible price, which will result in trade to reach the joint optimum.

This study is an attempt to empirically test that hypothesis. It has been shown that changes in the animal trespass laws from laws giving a privilege to trespass to owners of livestock to those giving a right to exclude to ranchers results in increases in the production of crops and, in those areas with high probability of interaction between the uses, some possible decreases in the production of livestock. The result is consistent with the above stated hypothesis that only when farmers are given the right to exclude can we be relatively certain of being able to reach a joint optimum. These results are inconsistent with the application of the Coase hypothesis, which would imply no, or random, effects from changes in the law.

Table 2

Regression Results		**Full Sample**		**Full Model**
Explanatory	Dependent Variables			
Variables	WHMA	BAMA	CATMA	SHMA
LH3	170.49 (3.72)**	82.31 (5.25)**	—1.19 (—1.32)	—15.97 (—2.86)**
LH4	—296.99 (—0.95)	—45.59 (—0.43)	—4.77 (—0.78)	—81.34 (—2.14)**
LH5	81.01 (2.66)**	22.28 (2.14)*	—0.79 (—1.32)	4.74 (—1.28)
LS2	—1.49 (—0.05)	—1.77 (—0.19)	—0.34 (—0.78)	—1.16 (—0.35)
LS5	2.53 (1.60)	1.20 (2.22)*	0.08 2.48)*	—0.17 (—0.88)
LC2	580.26 (4.19)**	97.17 (2.05)*	—0.88 (—.0.32)	35.62 (2.11)*
LC3	140.02 (1.98)*	35.12 (1.47)	2.77 (1.99)*	—0.27 (—0.03)
LC5	—2.20 (—0.98)	3.71 (4.85)**	0.35 (7.96)**	2.13 (7.81)**
LA3	303.02 (5.54)**	68.00 (3.63)**	—1.11 (—1.04)	23.92 (3.59)**
Year	—4.30 (1.11)	—2.96 (—2.27)*	—0.12 (—1.55)	1.47 (3.11)**
VPAC	—0.00009 (—0.63)	—0.00003 (—0.50)	—0.000003 (—1.17)	.000008 (0.45)
WPAC	0.86 (1.44)		—0.03 (—2.40)*	—0.08 (—1.05)
BAPC		0.002 (1.63)	0.00004 (0.52)	0.0002 (0.46)
Constant	7930.51 (1.10)	5545.54 (2.27)*	234.05 (1.65)*	—2682.18 (—3.05)**
R^2	.154	.164	.131	.168
F	10.388**	11.120**	8.175**	10.594**
d. f.	(12,606)	(12,606)	(13,605)	(13,605)

The numbers in parantheses are the T-Ratios

\+ — Significant at 10 % * — Significant at 5 % ** Significant at 1 %

Table 3

Regression Results	**Full Sample**		**Significant Variables**	
Explanatory	Dependent Variables			
Variables	WHMA	BAMA	CATMA	SHMA
LH3	176.73 (4.02)**	85.77 (5.63)**		—11.85 (—2.25)*
LH5	67.63 (2.31)*			
LS5		1.24 (2.33)*	0.07 (2.58)**	
LC2	561.94 (4.20)**			
LC3	148.55 (2.21)*	50.61 (2.19)*		
LC5		3.50 (4.58)**	0.35 (8.18)**	2.08 (7.71)**
LA3	274.76 (5.96)**	51.98 (3.35)**		29.35 (4.64)**
Year			—0.21 (—3.42)**	1.30 (3.01)**
WPAC			—0.03 (—2.83)**	
Constant	—74.30 (—1.15)	5.91 (0.26)	402.44 (3.55)**	—2374.77 (—2.95)**
R^2	.151	.154	.132	.163
F	22.963**	23.567**	24.589	31.181
d. f.	(5,613)	(5,613)	(4,614)	(4,614)

Table 4

Regression Results	**Dense Counties**			**Full Model**
Explanatory	Dependent Variables			
Variables	WHMA	BAMA	CATMA	SHMA
LH3	—119.27 (—1.23)	80.66 (1.82)	—13.08 (—5.22)**	—85.27 (—5.62)**
LS2	477.71 (1.20)	18.66 (0.11)	0.79 (0.08)	84.05 (1.35)
LS5	8.96 (2.61)**	3.61 (2.32)*	—0.04 (—0.40)	0.008 (0.02)
LC2	1858.66 (4.24)**	128.93 (1.40)	—10.98 (—2.10)*	58.57 (1.85)
LC3	175.15 (1.18)	—16.31 (—0.24)	10.62 (2.71)**	15.53 (0.65)
LC5	—0.06 (—0.02)	2.66 (2.21)*	0.31 (4.58)**	2.54 (6.14)**
LA3	365.05 (4.16)**	129.13 (3.23)**	—2.75 (—1.21)	25.94 (1.88)
Year	—18.09 (2.28)*	—6.96 (2.05)*	—0.47 (—2.30)*	—0.45 (—0.36)
VPAC	—0.0001 (—0.99)	—0.00007 (—1.06)	—0.000005 (—1.04)	0.000002 (0.10)
WPAC	3.89 (1.58)		—0.18 (2.81)**	—0.03 (—0.07)
BPAC		0.008 (1.07)	—0.0004 (—0.82)	—0.00004 (—0.15)
Constant	33631.95 (2.28)*	13077.83 (2.07)*	916.60 (2.40)*	920.93 (0.40)
R^2	.224	.182	.240	.271
F	6.181**	4.98**	6.14**	7.05**
d. f.	(10,169)	(10,169)	(11,168)	(11,168)

Table 5

Regression Results	**Dense Counties**	**Significant Variables**		
Explanatory Variables	Dependent Variables WHMA	BAMA	CATMA	SHMA
LH3		90.85 (2.42)*	—13.36 (—5.42)**	—78.55 (—6.41)**
LS5	8.51 (4.35)**	3.29 (2.34)*		
LC2	920.37 (4.75)**		—10.39 (—2.01)*	68.44 (2.26)*
LC3			10.13 (2.79)**	
LC5		2.59 (2.17)*	0.30 (4.47)**	2.62 (6.51)**
LA3	374.08 (4.35)**	134.69 (3.42)**		26.14 (2.36)*
Year	—18.25 (—2.88)**	—7.12 (—2.42)*	—0.61 (—4.14)**	
WPAC			—0.18 (—2.91)**	
Constant	34213.32 (2.88)**	13373.47 (2.43)*	1166.65 (4.23)**	126.41 (8.45)**
R^2	.215	.184	.246	.288
F	13.266**	9.065**	10.723**	19.127**
d. f.	(4,175)	(5,174)	(6,173)	(4,175)

Table 6

Regression Results	**Non-Dense Counties**			**Full Model**
Explanatory Variables	Dependent Variables WHMA	BAMA	CATMA	SHMA
LH3	188.53 (3.53)**	64.36 (4.52)*	1.24 (1.57)	6.55 (1.14)
LH4	—268.39 (—0.84)	—54.04 (—0.64)	—1.56 (—0.33)	—41.51 (—1.21)
LH5	82.01 (2.66)**	25.40 (3.10)**	—0.10 (—0.21)	—3.50 (—1.06)
LS2	—0.97 (—0.04)	0.11 (0.02)	—0.02 (—0.04)	—0.26 (—0.09)
LS5	0.69 (0.39)	0.65 (1.39)	0.10 (3.84)**	—0.11 (—0.58)
LC2	446.26 (2.43)*	73.84 (1.51)	5.47 (2.03)*	9.22 (0.47)
LC3	133.21 (1.64)	50.95 (2.41)*	3.86 (3.23)**	12.88 (1.47)
LC5	—6.63 (—1.65)	2.62 (2.45)*	0.54 (9.21)**	1.53 (3.56)**
LA3	304.04 (4.34)**	52.84 (2.83)**	—0.11 (—0.11)	28.90 (3.84)**
Year	—0.76 (—0.16)	—1.88 (—1.52)	—0.14 (—2.02)*	1.25 (2.48)*
VPAC	—0.0007 (—0.48)	—0.00009 (—0.21)	0.00003 (1.30)	0.0002 (1.51)
WPAC	0.69 (1.12)		—0.01 (—1.33)	—0.06 (—0.88)
BPAC		0.002 (1.83)	0.00007 (1.26)	0.0002 (0.59)
Constant	1295.68 (0.15)	3506.15 (1.51)	269.48 (2.08)*	—2321.40 (—2.46)*
R^2	.148	.142	.260	.145
F	7.087**	6.805**	12.426**	6.510**
d. f.	(12,410)	(12,410)	(13,409)	(13,409)

Table 7

Regression Results	Non-Dense Counties		Significant Variables	
Explanatory	Dependent Variables			
Variables	WHMA	BAMA	CATMA	SHMA
LH3	189.61 (3.72)**	68.80 (5.02)**		
LH5	81.31 (2.82)**	19.28 (2.49)*		
LS5		0.11 (4.38)**		
LC2	472.14 (2.76)**			
LC3		60.63 (2.96)**	4.60 (4.06)**	
LC5		2.46 (2.31)*	0.54 (9.33)**	0.95 (4.00)**
LA3	306.69 (5.27)**	50.88 (3.46)**		35.08 (5.22)**
Year				0.95 (2.11)*
Constant	—31.12 (—0.52)	—7.17 (—0.34)	7.78 (7.69)**	—1738.21 (—2.07)*
R^2	.149	.134	.247	.143
F	19.418**	14.054**	47.262**	24.484**
d. f.	(4,418)	(5,417)	(3,419)	(3,419)