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Unearthing 'dead capital': Heirs' property prediction in two U.S. southern counties

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ABSTRACT

Heirs' property is a form of tenancy in common. It is typically inherited land passed to subsequent generations as intestate property, or property inherited outside of the formal probate process, without "clear title." In economic terms, this form of property ownership can result in inefficient property uses, as owners tend to under-invest in such properties, owing to uncertainties regarding returns on investments. This, in turn, contributes to a diminution of wealth for affected families. Unclear titles also impede homeowners' ability to apply for various forms of land and home improvement aid offered by federal agencies. As well, tenancies in common have the effect of intensifying already existing vulnerabilities of place, again, because constraints on homeowners' access to equity make home improvements less likely.

The magnitude of the heirs' property phenomenon is not well-understood. Extant estimates are dated and often not verifiable; and no systematic means of identifying these parcels has been accepted. We present a methodology for assessing the accuracy of predictors typically used to identify heirs' parcels using logistic models and data from a rural Appalachian county (Leslie County, KY) and a more urban Black Belt[1] county (Macon-Bibb County, GA). This is the first attempt to empirically examine these predictors. Year property was last sold and financial caretaker are the strongest predictors in both counties. Using these indicators, the percent of correctly predicted heirs' parcels is about 67 percent in Leslie County and 48 percent in Macon-Bibb County. Applications of this methodology for national forest planning are discussed.

1. Introduction

In the U.S., the descriptor "heirs' property" references inherited, real property owned as a tenancy in common. The co-owners or heirs of the tenancy hold fractional interest in land not physically divided (Mitchell, 2001, 2005; Chandler, 2005; Craig-Taylor, 2000; Rivers, 2006). Our definition is taken from the 2010 Uniform Partition of Heirs Property Act which states: "…real property transferred from one generation to the next and held in a tenancy in common is referred to colloquially in many communities from those in the Southeast to those in Appalachia to those in Indian Country as 'heirs property' or 'heirs' property" (National Conference of Commissioners on Uniform State Laws, 2010, p.4). Heirs' property classification is essentially a titling problem, which often results from lack of estate planning. Property is classed as heirs when individuals do not create wills or else those wills are not probated in a timely manner. As a result, clear lines of ownership can be very difficult to establish as families proliferate. Consider the case of Mr. and Mrs. Smith who purchase 100 acres of land in rural, south Georgia. They have four children during the course of their marriage, in addition to Mr. Smith's two children from a previous marriage. Mr. and Mrs. Smith die in early 2017 without having established wills, and there is no other legal document specifying how ownership of the 100 acres is to be divided. If no such document exists, Georgia's intestate laws would apply to the estate. These stipulate that the adult Smith children each receive a 1/6 partial interest in the 100 acres.

Further, each Smith co-heir, regardless of the size of his or her fractional interest, amount of physical or financial contributions in the property, or living distance from the land, is entitled to the same rights to the full extent of the acreage. Yet, each co-heir can exercise his or her exclusionary right, which means that any one heir could opt out of cooperating in functions or management of the property, including those that are potentially beneficial to its ecological or economic

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[1] Historically, the southern "Black Belt" referred to rural counties comprising the antebellum plantation South, renowned for its rich, black, fertile soil. Because of the co-existence between these productive lands and high proportions of African American residents, Black Belt now references that sub-region of the U.S. South with counties containing higher than average numbers of African Americans, including both rural and urban counties.

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functioning (Deaton, 2007). Although six adults have a legal claim to the land, only the names of Mr. and Mrs. Smith are on the deed, not the names of their children and certainly not those of any subsequent grand or great grandchildren. Although latter generations have both a legal and fractional interest in the property, there is no document which substantiates this relationship; thus title to the one-hundred acres is "clouded" with respect to any heir whose name is not explicitly attached to the title.

This lack of documentation renders heirs' property incongruent with developed world political and economic systems which prioritize clearly delineated private property rights. Banks will not lend to owners unless borrowers have clear or marketable title, and reputable resource extractors (e.g., timber harvesters) are reluctant to enter into contracts with heirs' owners. Such restrictions have the effect of reducing wealth for affected families because the equity stored in these properties cannot be accessed (Geisler, 1995). This may be problematic not only for individual families but for communities as well because heirs' properties, like poverty and race, may cluster cluster, which could accentuate vulnerabilities of place.

The extent of heirs' property ownership is not clearly understood in the U.S. Estimates concentrate almost singularly on approximations of heirs' property prevalence among southern, rural, Black Belt African American landowners. These approximations range from thirty to roughly forty percent of all African American-owned land in the South (Graber, 1978; Emergency Land Fund, 1980; Johnson Gaither, 2016). But Deaton (2005, 2007) also charges that generational poverty in central Appalachia may be attributed, in part, to the proliferation of questionable land titles in that sub-region of the South. Also, Native American land titles were effectively fractionated or rendered heirs' by congressional mandate in the late 1800s. Shoemaker (2003, p.729) writes: "In Indian Country today, fractionation has reached crisis proportions. Hundreds of co-owners share small pieces of land as tenants in common." As well, lack of clear title is expected to present problems for Hispanics in southwest Texas communities called *colonias* (Way, 2009; Ward et al., 2012).

Efforts are currently underway to develop a geospatially-based, systematic approach to identify heirs' properties based on characteristics of taxed, county-level land parcels (Jones et al., forthcoming). The methodology builds on the approach taken by Dyer et al. (2009) and adapted by Georgia Appleseed Center for Law and Justice (2013). However, neither Jones et al., forthcoming, Dyer et al. (2009), nor Georgia Appleseed Center for Law and Justice (2013) modelled the efficacy of assumed predictors. These studies offer no indication of the strength or preciseness of selected variables thought to determine heirs' status.

To address this gap, we specify a logistic equation to model known heirs' parcels as a function of factors commonly used to indicate such properties. We then assess the validity of these variables in predicting heirs' parcels by comparing the distribution of true or known heirs' parcels to "predicted" heirs' parcels, the latter created from logistic model predictors, i.e., those intuitive factors assumed to indicate heirs' status. Few municipalities or U.S. counties maintain databases with heirs' status clearly delineated; so those interested in identifying heirs' property parcels for a given area have relied on indicators from tax parcels, e.g., year the property was last sold, evidence of recent improvements to property, whether owner address differs from parcel address, etc., to determine properties more likely to be heirs'. Open-ended methods are also used to determine whether a parcel is an heirs' property. One could simply ask the landowner or county tax official to classify a property; but for broader scale quantification of heirs' extent, systematic approaches using property indicators is more efficient. Again, however, no validation of a systematized approach has been offered. The aim of the present research is to assess the efficacy of such predictors. The development of both reliable and valid indicators of heirs' parcels would be of great benefit to policymakers and public/private organizations in their efforts to redress this issue.

2. Literature review

Peruvian economist Hernando de Soto's (2000) treatise concerning the potential of untitled property to build wealth in developing countries may be applied to the problem of tenancies in common in the U.S. In the non-Western context, de Soto argues that properties with vague ownership or unclear titles detract from the owner's ability to build capital (He describes such assets as "dead capital."). Deaton (2007) suggests that de Soto's ideas regarding property ownership may be applied to heirs' properties in the U.S., again owing to the inability of owners to use these properties to leverage assets. As indicated, because ownership is unclear, it is very difficult, if not impossible for heirs to access credit using property classed as heirs for collateral, for example. De Soto (2000) touts the U.S. (western) example of formal titling as an approach that could work to the advantage of Developing World landowners by facilitating wealth accumulation because formal titles provide creditors with a reasonable level of confidence in any collateral that may be presented in the loan application process.

However, a number of scholars counter that de Soto's assumptions about formal titling cannot be transferred easily to non-western contexts (Bromley, 2008; Benjaminsen et al., 2008; Meinzen-Dick and Mwangi, 2008). For instance, Unruh (2002, p.275) argues: "how the American pioneer intersected with lands and how this evolved into, or merged with formal law is much less relevant to the situation of developing countries than how the property rights systems of Native Americans intersected with formal law…." The point made is that the aspirations of 19th century white settlers in the U.S. were congruent with American mainstream ideals of Manifest Destiny, undergirded by land privatization and individualization of the same. In contrast, titling for population groups in developing world contexts has been and continues to be problematic (Ho and Spoor, 2006; Bromley, 2008; Benjaminsen et al., 2008). We argue that the seamless adoption of processes involving formalization of real property titles by certain racial and ethnic minority groups in the U.S. may also be somewhat presumptuous. As indicated, congressional acts set in motion land fractionation for Native Americans, resulting in confusion and stagnation that have yet to be properly sorted (U.S. Department of the Interior, 2012; U.S. Department of the Interior, 2014). Also, others maintain that southern, rural African Americans, in particular, have had less confidence in formalized court proceedings involving land tenure because these very institutions have acted to disenfranchise minority property owners (Mitchell, 2001, 2005; Daniel, 2013); and Larson (2002) forcefully argues that the informal modes of home purchasing that emerged in Hispanic, Texas *colonias* are natural consequences of the exclusion of these populations from formal credit channels. There is also the view that marketable title has the effect of actually increasing financial vulnerabilities for poor people because these groups are often targets of aggressive predatory lending schemes. Such creditors count on lower wealth owners not being able to repay debt, resulting in the forfeiture of collateral. While such scenarios are, unfortunately, too common we argue that low income property owners would be in a better bargaining position vis-à-vis creditors if they possessed clear, rather than clouded property title. For instance, Goldstein (1999, p.5) notes: "As more conventional lenders provide mortgage loans to lower-quality-credit borrowers…subprime borrowers will be less likely to resort to the products promoted by predatory lenders. Borrowers often turn to high-cost loans because they have a narrow set of products from which to choose." As well, Ward et al.'s (2011) south Texas case study on title clearance for low income Hispanic homeowners also supports this assertion. After title clearance, property owners reported that they had more psychological security and felt that clear titles gave them legitimacy in the eyes of creditors, resulting in a greater degree of confidence in their ability to engage with banks.

The most common concerns of heirs' property ownership have to do with wealth attenuation (i.e., lack of economic efficiency) and land loss vulnerability (Deaton, 2012). The "wealth concern," as explicated by

(Deaton, 2012, p.612) refers to the lack of optimal fiscal uses of property. Property is said to be inefficiently used or managed when appropriate returns on financial investment are not realized. Both Heller (1998) and Deaton (2007) dub such scenarios as "tragic," again because non-cooperation among co-heirs' can result in the underutilization or waste of resources. The other problem with heirs' properties relates to the possibility that heirs could be turned away from their properties, that is, displaced, because any heir, regardless of the size of his or her interest in a given piece of land, has the right to ask the court to partition the property. If a court decides the property cannot be reasonably divided in physical terms, a "forced sale" (i.e., against the wishes of other co-heirs) may result in order to satisfy the court's partition decision.

Deaton (2012) addresses the "buyout" option contained in the 2010 Uniform Partition of Heirs Property Act, legislation which ostensibly protects co-heirs from forced sales, among other things (National Conference of Commissioners on Uniform State Laws, 2010). He argues that the option of those heirs who do not wish to partition to purchase the interest of the heir(s) wishing to partition may exacerbate problems of heirs' ownership. While this course could reduce displacement worries for both non-partitioning heirs and the party or parties wishing to cash out of the heirship, the option does not address essential problems of heirs' ownership. That is, the Uniform Partition of Heirs Property Act does not address the fundamental reasons *why* properties are ultimately classed as heirs.' These reasons may have to do with more endemic factors associated with both place and persons, such as the lack of a host of personal and social capitals which act to reproduce preferences for informal systems of ownership (i.e., Larson, 2005), particularly among lower income racial and ethnic minority groups.

2.1. Heirs' property estimation

A more fundamental problem than that of the consequences of title clearing relates to heirs' property identification. Title clearing is but one means of addressing the heirs' property conundrum. For instance, there may be fundamental legal redresses such as the Uniform Partition of Heirs Property Act that alter a court's approach to the partitioning of these properties (National Conference of Commissioners on Uniform State Laws, 2010). But before these or any other remedies are suggested or acted upon, it is essential that a better inventorying of these properties be made. A question often posed to those working on heirs' property issues is: "what is the magnitude of the problem?" Indeed, the extent of heirs' property ownership is not clearly understood for any sub-region of the country, again, as most estimates are county-specific or are dated.

Several attempts have been made to estimate heirs' property extent in the U.S. South, beginning in the late 1970s. Estimates have been provided for the region as a whole, for selected counties within states and cooperatives associated with electrical cooperatives. Table 1 (from Johnson Gaither, 2016) lists a summary of findings along with areas studied. With the aid of local tax officials, Graber (1978) estimated that one-third of all rural, Black-owned land was heirs' property in ten counties in Alabama, Georgia, Mississippi, North Carolina, and South Carolina. Also in the late 1970s, Tinubu and Hite (1978) assessed heirs' property extent for three South Carolina electric cooperatives with a mailed household survey. Roughly 3.5 percent of 1067 landowners said that they had heirs' property. The low response rate (19.5 percent), however, and the small number of respondents who indicated ownership of heirs' property (n = 37) made generalization to the larger population problematic.

Probably the most cited study on heirs' property was conducted in 1980 by the Emergency Land Fund, which used a rigorous method for identifying rural African American landowners. This involved statistical techniques in concert with ground-truthing, and reviews of identified parcels by local tax and court officials to help substantiate Black ownership. Heirs' property extent for the entire South was inferred from results of a survey of 1708 African American landowners in five states. Roughly 9 million acres of African American-owned land was estimated, with approximately 3.8 million of these being designated as heirs' property. This acreage constituted 41 percent of black-owned land at that time.

The only other research we are aware of that has estimated heirs' property in Appalachia is provided by Deaton's (2005) study of Letcher County, Kentucky. Using a random sample of property owners obtained from the county's taxing authority, investigators asked (via phone) respondents to classify their property as either: simple (full ownership), partial interest (heirs'), life estate (legal title divided between owners until one owner dies), or some other arrangement. About 24 percent of respondents indicated that they owned "partial interest, undivided with others" interests which Deaton (2005, p.93) construed as heirs' property. Also, using curative reports (title information) compiled by an oil and gas well drilling concern in Letcher County, Deaton (2007) estimated that seven of 48 land tracts (14 percent) associated with the well sites were tenancies in common or heirs' property. Deaton (2007) found an average of just four heirs per tract for these parcels. The author's open-ended discussions with the company suggested that one reason for the smaller number of heirs had to do with the fact that the company avoided engaging with heirships involving larger numbers of co-heirs because of the higher transaction costs associated with numerous owners.

Dyer et al. (2009) estimated the extent and impact of heirs' property for Macon County, Alabama. Similar to the method used in our study, Dyer et al. (2009) used the notations "heirs of" or "both dec'd" (deceased) to identify heirs' parcels. Numerous visits to the local tax office were made in an effort to help validate the methods used. Given no certainties as to how complete the inventory was, Dyer et al. (2009) stressed that the notations included on the tax rolls should be taken as conservative estimates of heirs' extent, as there could have been others with no such notation. This study estimated that heirs' parcels constituted 4.1 percent of county land, with an estimated value of more than $25 million. Most recently, Georgia Appleseed (2013) used both tax assessor accounts and Superior Court records to examine heirs' property for Chatham, Chattooga, Dougherty, Evans, and McIntosh Counties in Georgia. Investigators found 1620 parcels, totaling 5215 acres. The properties have an estimated fair market value of $58,649,195.

As these studies indicate, various methods have been used to identify heirs' parcels. Tax and court records are used most consistently. Researchers often encounter problems with dated, duplicate, or incorrectly recorded records, which makes the identification task more daunting. However, these issues can be easily addressed with geospatial techniques and by ground-truthing results with appropriate officials. The urgency of heirs' property estimation is made clear by the limited number of studies conducted thus far.

3. Study areas

Analyses were conducted for a rural county in central Appalachia, Leslie County Kentucky, and for an urban county in the Black Belt Piedmont, Macon-Bibb County Georgia. These counties were selected because we were able to obtain relevant datasets with heirs' parcels clearly indicated. As well, the respective data allow us to model heirs' parcels for two very different counties, one a "completely rural" county in Kentucky, according to the Rural-Urban Beale codes with a homogeneous population with respect to race/ethnicity and the other in middle Georgia, embedded in a larger, five-county metropolitan area with considerable socio-demographic diversity (U.S. Department of Agriculture 2016; U.S. Census Bureau 2016b).

Leslie and Macon-Bibb Counties are outlined in Fig. 1. Table 2 shows key socio-demographic variables for both counties—population, race, Hispanic ethnicity, poverty, household income, and education level (U.S. Census Bureau 2016b). Leslie County covers a total land area

Table 1
Heirs' property estimation in the U.S. South (does not include Native American lands).

Source	Area examined	Parcels	Method	Heirs' acres	Average acres per parcel	Percentage of land	Total value
Multi-State							
Graber (1978)	10 counties in 5 States	–	Local auditor review of tax digests	–	–	33 percent of rural, Black-owned	–
Emergency Land Fund (1980)	5 States	101,648	Landowner survey	3,836,498	37.7	41	–
Multi-county							
Tinubu and Hite (1978)	3 South Carolina electric coops.	37	Landowner survey	–	–	–	–
Coastal Community Foundation (cited in Rivers, 2006)	2 South Carolina counties	3300 (approx.)	n/a	17,000 (1 county)		–	–
Alabama Appleseed (Baab, 2011)	2 Alabama counties	771	Review of tax records	11,000+	> 14.23	1.5	> $31 million
Center for Heirs' Property Preserv. (Personal Communication A 2014)	6 South Carolina counties	–	Review of tax and court records	41,000	–	–	–
Georgia Appleseed (2013)	5 Georgia counties	1620	Review of tax and court records	5215	6.2	–	$58.6 million
Single county							
Deaton (2005)	1 Kentucky county	–	Telephone survey	–	–	–	–
Deaton (2007)	1 Kentucky county	475	Oil and gas curative reports	–	–	–	–
Southern Coalition for Social Justice (2009)	1 North Carolina county		Local official review of tax records	5623	11.8	2	–
Dyer et al. (2009)	1 Alabama county	1516	Tax and court records	15,937	10.5	4.1	> $25 million

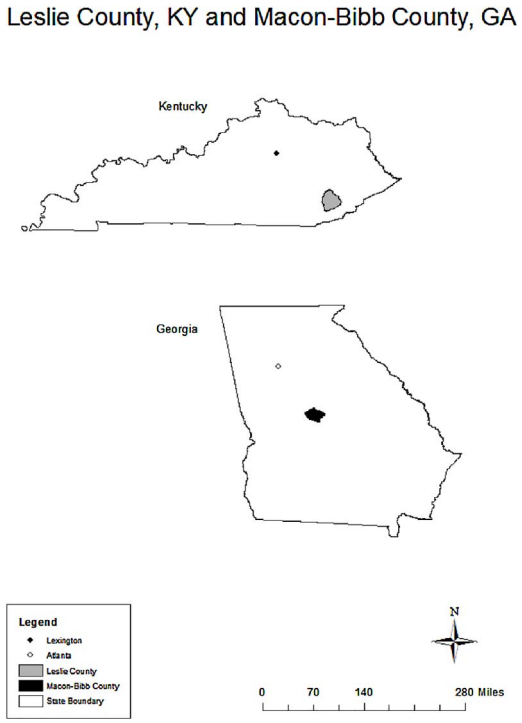

Fig. 1. Leslie and Macon-Bibb Counties.

of 400.84 square miles; Macon-Bibb has roughly two-thirds that amount at 249.76. Macon-Bibb has a much larger population than Leslie, which has a virtually all non-Hispanic white population. This contrasts sharply with Macon-Bibb's slight majority African American population. Percent of population below poverty is slightly higher in Macon-Bibb although the percent of population 25 or over with less than a high school education is about twice as much in Leslie as in Macon-Bibb. Also, median household income is higher by about $7000 in the Georgia county.

For Leslie County, a database of taxed land parcels served as our primary data source for heirs' parcel identification. These were obtained from the Property Valuation Administrator's Office (PVA) for 2015. The database for Leslie County included: property identification number, number of acres, land use category (i.e., residential and farm), property address, owner's name and mailing address, real estate value, sale price, last sale date, and property description, as well as parcel shapefiles for use with Geographic Information System software. The PVA office indicates "heirs of" in the owner's name column. We used this notation to identify heirs' parcels. The first author emailed and telephoned officials in Leslie County to ascertain how the local tax assessor's office understood or defined the term "heir." Consistent with our definition, the term indicates property in which owners have undivided, partial interests. Entries for parcel numbers that contained identical information but had more than one entry in the database were merged to avoid over counting. No other irregularities were detected in the data.

For Macon-Bibb County, taxed parcels maintained in the form of

Table 2
Socio-demographic characteristics for Leslie and Macon-Bibb Counties.
Source: U.S. Census Bureau American Community Survey 2010–2014.

	Population	% African American- not Hispanic	% White- not Hispanic	% Hispanic	% below poverty	Median Household Income	% over 25, No High School Diploma
Leslie (sq. mile = 400.84)	11,128	0.2	98.1	0.9	23.5	$29,156	35.5
Macon-Bibb (sq. mile = 249.76)	155,237	52.5	43.5	3.1	24.1	$36,614	17.3

Heirs Property Identification.

Computer Assisted Mass Appraisal (CAMA) data were used to identify heirs' parcels (McCluskey et al., 2013). CAMA data are defined by the Appraisal Standards Board[2] which sets a systematic protocol for data relevant to mass appraisals such as housing and property values. Municipal governments typically use CAMA data to derive tax revenues assessed on real property. CAMA data for our project were obtained from the University of Georgia's Carl Vinson Institute of Government Office of Information Technology Outreach Services. CAMA data are utilized by about 140 of Georgia's 159 counties in the WinGAP format.[3] CAMA data for Macon-Bibb County also included "heirs" notation next to the owner's name, which we used to identify heirs' parcels. We also verified that in Macon-Bibb County, "heir" describes parcels where owners have undivided, fractional interests in the property.

Both datasets represent the best available representation of heirs' parcels produced by the respective counties. In both instances, the "heirs" notation was recorded by tax officials using historical understandings of the property and its owners or sources that may be particular to their county concerning these properties. We acknowledge that the data may not include all of the heirs' parcels in the counties because in neither case was there an official census of heirs' parcels undertaken; but we have no reason to assume that there would be a systematic underrepresentation of heirs' notations in the data that is associated with a particular covariate. While omissions may exist, these are believed to be random rather than systematic. Our confidence in the accuracy of the noted parcels is reinforced by the positive correlations of heirs' parcels with a number of socio-demographic characteristics (see below). Again, based on communication with tax assessors in both counties, we understand that the notations indicate property owned by at least two people with undivided interests and thus are valid indications of heirs' parcel although possibly not universal in the sense that all heirs' parcels were noted.

3.1. Heirs' parcels and socio-demographic characteristics

Before presenting results evaluating the effectiveness of heirs' property indicators, we first examine the broader social context in which heirs' parcels are situated. Prior research indicates that heirs' property owners are more likely to be either African American or Native American, have lower education levels, income, and or wealth (Emergency Land Fund, 1980; Mitchell, 2001, 2005; Deaton, 2005; Deaton et al., 2009; Shoemaker, 2003; Bobroff, 2001); so we would expect to find heirs' property concentrated in places with higher than average levels of social marginalization. Also, Dyer et al. (2009) found a higher proportion of heirs' parcels in incorporated or higher density sections of Macon County, Alabama.

Given the relatively narrow variation with respect to socio-demographic and economic indicators in Leslie County, we looked at these contextual factors only for Macon-Bibb County, Georgia. The analysis was conducted at the U.S. census block group (CBG) level in ArcGIS, ArcMap 10.3.1. There are 126 CBGs in Macon-Bibb County. Variables examined were proportion: African American, below poverty, over 25 without a high school diploma (no diploma), and persons per acre (population density) (U.S. Census Bureau 2016a, 2016b, 2016c). Figs. 2–5 show spatial overlay between proportion: African American, below poverty, over 25 without high school diploma, and persons per acre, respectively, and heirs' parcels.

In Fig. 2, the highest African American concentration for Macon-Bibb CBGs is depicted in the darkest brown color. The highest African American populations in the county are within the historical city boundary of Macon (outlined in red).[4] Visually, the greatest concentration of heirs' parcels also coincide with the highest concentration of black residents. Again, in Fig. 3, CBGs showing higher proportions of the population below poverty are in the city of Macon, which again intersect spatially with a higher number of heirs' parcels. Lower education populations appear somewhat less concentrated in the city, but again, heirs' parcels tend to coincide with lower education neighborhoods (Fig. 4). Fig. 5 shows the overlay of heirs' parcels and persons per acre for each CBG. Findings support Dyer et al.'s (2009) findings from Macon County, Alabama that heirs' parcels are more

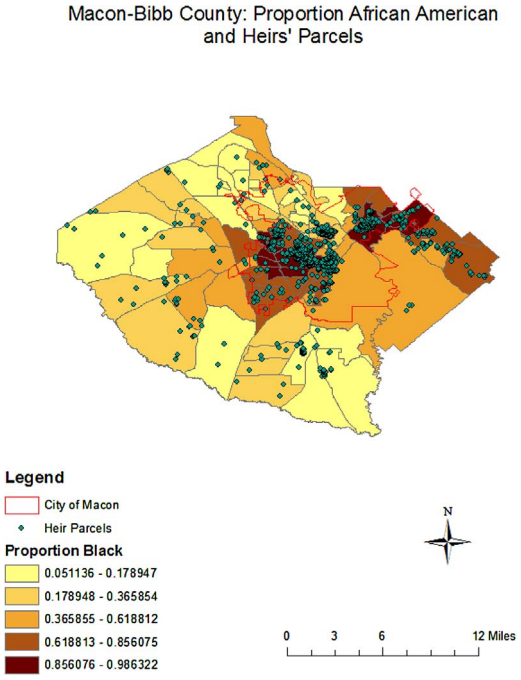

Fig. 2. Proportion African American and Heirs.

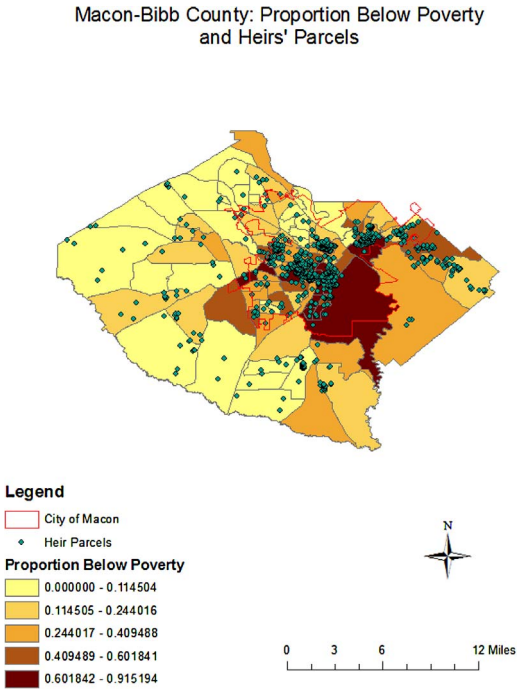

Fig. 3. Proportion Below Poverty and Heirs.

[2] Uniform Standards of Professional Appraisal Practice, U-3 (2014-15).

[3] WinGAP contains 196 databases with information on a wide range of variables pertaining to the physical aspects of property such as acreage, types of structures on the land, owner name and address, property address, and sale history.

[4] For administrative and political purposes, the city and county form a unified government in 2012.

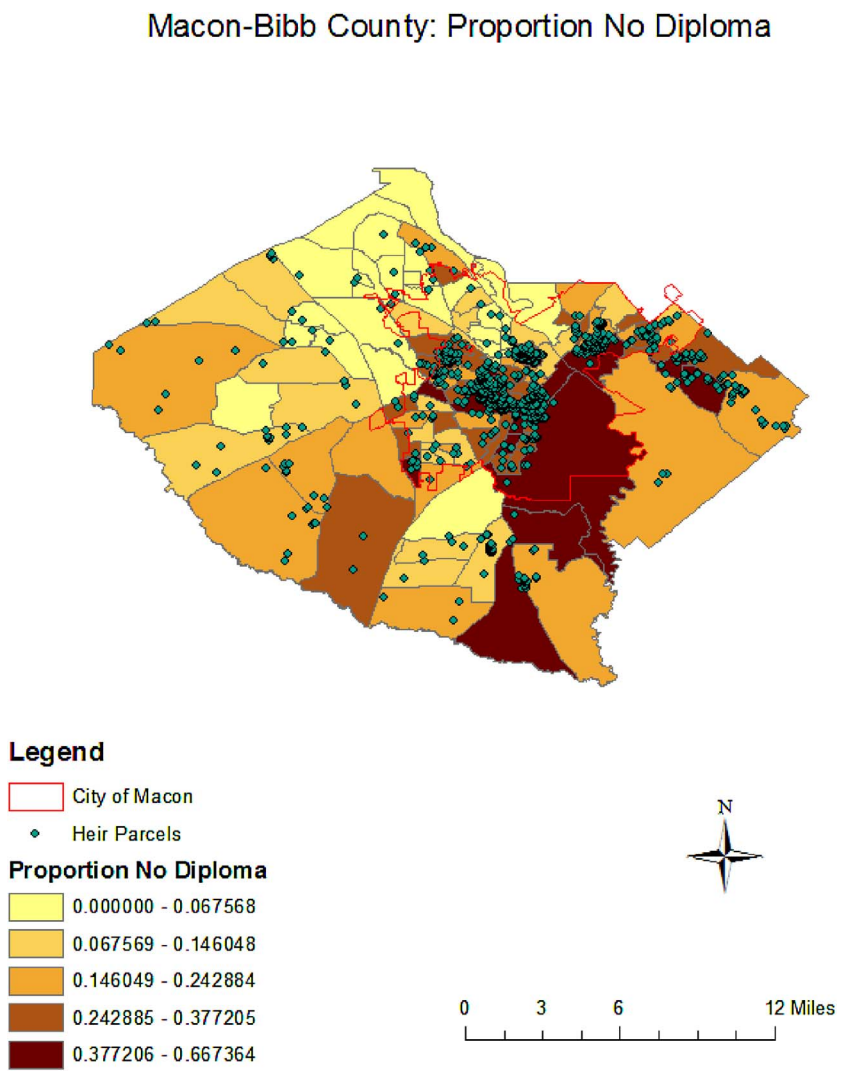

Fig. 4. Proportion No High School Diploma and Heirs.

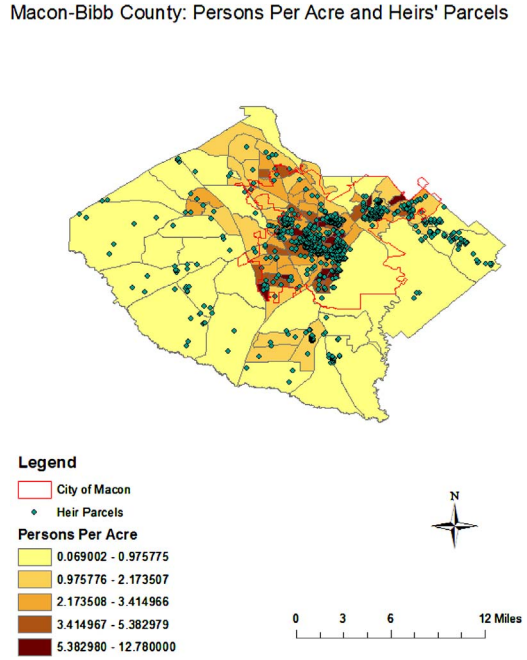

Fig. 5. Persons per Acre and Heirs.

likely to be found in incorporated sections of the county.

Results from the visual overlays are supported by Ordinary Least Squares (OLS) regression results in Table 3, which show that proportion African American, adults 25 or older without high school diploma, and population per acre are significant predictors of the number of heirs' parcels per acre.[5] Specifically, results indicate that the higher the proportion of African Americans in a CBG, the greater the proportion of adults with no high school education, or the greater the population density, the greater the number of heirs' parcels per acre. In terms of beta coefficients, proportion of population without a diploma has the greatest overall positive impact on the dependent variable, followed by proportion African American, and population per acre. Overall, results from this contextual analysis support *a priori* understandings of the heirs' property phenomenon as one that emerges from an environment of social marginalization. The R-squared value indicates that roughly one-third of the variation in the dependent variable is accounted for by these predictors. These analyses were also conducted in ArcGIS, ArcMap 10.3.1. The column headed "mean" shows that the average black proportion for the Macon-Bibb CBGs is 0.58; mean proportion below poverty is 0.32; those without diplomas average 0.22; and the mean population per CBG is 3 persons.

[5] Multicollinearity was assessed with the Variance Inflation Factor (VIF). Interactions among the predictors are indicated if the VIF for a given variable exceeds ten (Freund and Wilson, 1998, p. 194). None of the predictor variables had a VIF greater 4.0.

Table 3
Macon-Bibb County: Ordinary Least Squares Regression. Heirs' Parcels per Acre (n = 126).

Variables	OLS model Beta coefficient (standard error)	p-value	Mean (standard deviation)	Min-max.	Variable description
Intercept	−0.025 (0.007)	0.001	–		–
Black	0.041 (0.015)	0.006	0.58 (0.31)	0.05–0.99	Black population proportion
Below poverty	−0.013 (0.023)	0.574	0.32 (0.23)	0–0.92	Population proportion below poverty
Adult no diploma	0.081 (0.032)	0.013	0.22 (0.15)	0–0.66	Population proportion 25 or older without high school diploma
Population per acre	0.004 (0.002)	0.021	3.00 (2.16)	0.07–12.78	Population per acre
Heir per acre	–	–	0.03 (0.04)	0–0.24	Number of heirs' parcels per acre
R^2	0.341				
F-statistic	15.684 d.f. = 4, 121; p = 0.000				

3.2. Logistic regression

As discussed, the logistic models extend prior research focusing on parcel characteristics gathered by local taxing authorities.. The scale of analysis now moves from the neighborhood (CBG) to the individual parcel level. Dyer et al. (2009) isolated nine such key variables typically used to distinguish heirs' properties: parcel size, land value, building value and structural additions, appraised market value, whether taxpayer lives in state, whether parcel is in incorporated section of county, presence of structures on land, most recent year improvements or structures were built, and value of land per acre. Georgia Appleseed Center for Law and Justice (2013) also suggested that property address being different from mailing address, low land value, lack of recent sale, and lack of or dated property improvements are key indicators.

Because of data limitations, we were able to test the robustness of just three indicators identified by Georgia Appleseed Center for Law and Justice (2013). Wemodelled heirs' property classification as a function of: whether property had sold within last 30 years (last year of sale), whether property had a caretaker for tax purposes, whether mailing and property address were the same, and real estate value per acre. Inconsistency between property and mailing address could be operationalized a number of ways. We reasoned that the more conservative interpretation taken by Dyer et al. (2009) should be applied; that is, if the owner lived in a different state than the property, this may be suggestive of heirs' status. A caretaker variable was added on counsel from a real estate Attorney tasked with remediating dilapidated housing in Athens-Clarke County, Georgia, who advised that the notation "care of John Doe" listed beside a parcel is a strong indicator of heirs' property (Personal Communication B). "Care of" indicates that property taxes are being paid by an agent acting on behalf of those persons whose names are listed on the property deed.

For the dependent variable, heirs' property parcels were identified as those with the notation "heirs of" listed next to the owner's name. These were coded one, all others zero. For the predictor variables, three dichotomous variables were created for caretaker, last sale year, and out of state address. Parcels with a name field that included the notation "care of Person X" were coded one, others zero. If the most recent sale year for a parcel was more than thirty years prior to 2015 (1984 or older), we coded that parcel one and others zero. Tax experts and real estate attorneys council that properties with older sale dates are more likely to be heirs'. The selection of thirty years as a cut-off year was an arbitrary decision based on expert input from real estate attorneys and others working with heirs' property. The significance of this variable could vary depending on the time frame selected. If the mailing address for the property was in a different state than Kentucky or Georgia, respectively, the parcel was coded one, otherwise zero. The idea here is that a property is more likely to be heirs' if the owner lives in a state other than where the property is located (Georgia Appleseed Center for Law and Justice, 2013).

The per acre real estate variable is real estate value for each parcel divided by the number of acres for that parcel number. Lower per acre values are expected to be associated with heirs' parcels. Observations with a zero value for real estate value were excluded from the computations, which reduced the sample size to 7778 for Leslie County. Also, only parcels indicating "natural people" were included in the final sample; this filtered out commercial and governmental parcels. Sample size for Macon-Bibb is 44992.

Table 4
Leslie County: Logistic Regression of Known Heirs' Parcels. N = 7778.

Variables	Beta coefficient (standard error) Leslie	p-value	Mean (standard deviation)	Min–max.	Odds ratio	95% confidence interval
Intercept	−3.49 (0.086)	0.0001	–	–	–	–
Caretaker	2.58 (0.083)	0.0001	0.17 (0.37)	0–1	13.14	11.18–15.46
Last sale year	1.81 (0.088)	0.0001	0.40 (0.49)	0–1	6.13	5.16–7.29
Out of state address	−0.55 (0.000)	0.0001	0.14 (0.35)	0–1	0.56	0.47–0.72
Value per acre	−0.000002 (0.000)	0.0136	$23,731 ($56,140)	$11.00–$1.4 million	1.00	1.00–1.00
Heir	–	–	0.15 (0.35)	0–1	–	–
Percent concordant	83.1					
Wald chi-square	1462; d.f. = 4; p < 0.0001					

3.3. Leslie county

Table 4 contains maximum likelihood parameter estimates, *p*-values for the intercept and each predictor variable, odds ratio, and Wald chi-square estimates for the logistic model for Leslie County. All predictors were highly significant, although the out of state variable had an association opposite of what we expected.[6] Parcels with a caretaker and sale year prior to 1985 were significantly more likely to be an heirs' parcel; while those with an owner's address other than Kentucky were less likely to be heirs, other factors equal. An increase in the per acre sales price reduced the likelihood of heirs' status. Based on the logistic model, the probability of a parcel being heirs' is 0.58 if it has a caretaker, sale year before 1985, owner state of residence outside of Kentucky, and a $10,000 per acre sale price. The probability of heirs' status for property without a caretaker, sale year after 1985, owner residence in Kentucky, and sale price of $10,000 is 0.03. Caretaker and sale year are the strongest predictors of heirs' status; although significant, per acre price is negligible. Related, the odds ratio column shows that the odds of heir property classification increase by a factor of 13 for properties with a caretaker; parcels sold before 1985 are roughly 6 times as likely as those sold after 1985 to be heirs'; those with out of state landowners are about 0.60 times as likely; and per acre price changes have no effect on heirs' status.

Table 5 contains results for the logistic model for Macon-Bibb County. Parcels with a caretaker and sale year prior to 1985 were more likely to be heirs', but properties with an out of state owner address and those with higher per acre values were less likely to be heirs, other factors equal. The probability of a parcel being heirs' is 0.37 if it has a caretaker, sale year before 1985, owner state of residence outside of Georgia, and a $10,000 per acre sale price. The probability of heirs' status for property without a caretaker, sale year after 1985, owner residence in Georgia, and sale price of $10,000 is 0.004. The odds ratio column indicates that the odds are 32 to 1 that properties with a caretaker are heirs and roughly 9 to 1 that parcels with a sale year before 1985 are heirs'.

To assess how well the model identified known heirs' parcels, we examined overlap between known heirs' parcels and those we classed as predicted heirs' parcels. The latter grouping was composed by the logistic method we describe here as the "intuitive" approach because, as discussed, it relies on assumptions mainly from local level tax authorities and legal practitioners to identify heirs' parcels (Dyer et al., 2009; Georgia Appleseed Center for Law and Justice, 2013). Given the relatively higher coefficients for caretaker and last sale date, these were used to create a "predicted heirs" category using "if-then-else" statements in SAS. For instance, if a parcel had a sale date before 1985, and it had a caretaker indicator, it was classed as a predicted heirs' parcel, otherwise it was classed as a "non-heirs" parcel. The group of predicted heirs' parcels was then cross-referenced with the group of known heirs' parcels (identified in the respective databases by "heirs" or "heirs of") to identify intersections.

Table 6a shows the cross-reference of predicted heirs' parcels (selected by the logistic-based, intuitive method) with known heirs' parcels for Leslie County. The accuracy of the intuitive method is evaluated by calculating the percent of predicted heirs' parcels accounted for by known parcels. In this way, we get a sense of how correct this method is in selecting known or true heirs' parcels from a universe where heirs' status is not specified. A high percent of known heirs' parcels in the predicted heirs' category would indicate that the logistic model performed well in predicting known heirs' parcels. From Table 6a, we calculate that 67.47 percent (618/916) of all observations assigned to the predicted heirs' category were actual heirs' property.

Table 6a also shows that roughly 33 percent (298/916) of parcels are "false positives," that is classed as predicted heirs' but actually not one of the known heirs' parcels, and about 8 percent (526/6862) are "false negatives" (that is, actually heirs' parcels but not classed as such). Another way to state this is that the chances of a Type 1 error are about 33 percent and roughly 8 percent for a Type 2 error. The overall model accuracy, using just caretaker and year of last sale as predictors, is 89.4 percent (6954/7778).

Another way of examining consistency between the distribution of known heirs' parcels and a distribution of predicted heirs' parcels is to use predictive probabilities from the full logistic model to construct predicted heirs' groupings (Table 6b). The list of probabilities for each parcel is too extensive to replicate here but is available from the first author. This method uses all four of the predictors (i.e., caretaker, last sale year, owner address, and per acre value) in assigning probabilities and can be called the full logistic model approach. We can see how prediction accuracy is affected by using different probability thresholds or cutoff levels for heirs' classification. Let us assume for instance, that any observation with a predicted probability (of being heirs') of 0.10 or higher is an actual heirs' parcel. Table 6b shows that in this case, 1002 observations would be correctly classed as heirs', and 4378 would be correctly classed as non-heirs'.

At this cutoff, the overall percent of correctly predicted observations is 69 percent (5380/7778); but the percent of false positive heirs' predictions is also 69 percent, suggesting that at this low cutoff point, although roughly 90 percent (1002/1144) of heirs' parcels are correctly classed, close to 70 percent of parcels are falsely classified as heirs'. So while most of the heirs' parcels are captured at this level, there is also a lot of "junk" included in the predicted heirs' category. If the cutoff point is increased to 0.50, results are identical to those we see in Table 6a. Again, 618 real heirs' parcels are correctly classed as heirs'; model accuracy is 89.4 percent; but the false positive heirs' rate is reduced to about 33 percent. Results from the two-factor intuitive approach (Table 6a crosstab) are included in 6b for comparison purposes.

3.4. Macon-Bibb county

Table 5 contains results for the logistic model for Macon-Bibb-County. Parcels with a caretaker and sale year prior to 1985 were more likely to be heirs', but properties with an out of state owner address were less likely to be heirs, other factors equal. The probability of a parcel being heirs' is 0.37 if it has a caretaker, sale year before 1985, owner state of residence outside of Georgia, and a $10,000 per acre sale price. The probability of heirs' status for property without a caretaker, saleyear after 1985, owner residence in Georgia, and sale price of $10,000 is 0.004. The odds ratio column indicates that the odds are 32 to 1 thatproperties with a caretaker are heirs and roughly 9 to 1 that parcels with a sale year before 1985 are heirs'.

Again, using just caretaker and year of last sale to construct the predicted heirs' category for Macon-Bibb County, Table 7a shows that about 47 percent (420/897) of predicted heirs' parcels were known heirs' property. If 0.10 is selected as the cutoff, about 33 percent (483/1474) of predicted heirs' are known or actual heirs (Table 7b). But at this level, there is again a high false positive percentage (67.2 percent or 991/1474) (Table 7b). Increasing the cutoff to 0.50 increases the percentage of known heirs' in the predicted heirs' group to 47 percent (222/467), the same as the rate in Table 7a, but the false positive is still above 50 percent (245/467).

4. Conclusion

Study results have implications for federal assistance programs and land management activity and policy. With respect to the first issue, public agencies like the Federal Emergency Land Management Agency and Housing and Urban Development are tasked with providing various

[6] Multicollinearity among the independent variables was checked using the COLLIN option in PROC REG (SAS No Date).). The PROC REG continuous model was used only to assess collinearity among the predictor variables because this option is not available in SAS for logistic models. None of the predictor variables had a condition index greater than 3.15.

Table 5
Macon-Bibb County: Logistic Regression of Known Heirs' Parcels. N = 44,992.

Variables	Beta coefficient (standard error) Leslie	p-value	Mean (standard deviation)	Min-max.	Odds ratio	95% confidence interval
Intercept	−5.42 (0.088)	0.0001	–	–	–	–
Caretaker	3.47 (0.086)	0.0001	0.04 (0.20)	0–1	32.13	27.17–38.00
Last sale year	2.16 (0.088)	0.0001	0.15 (0.36)	0–1	8.68	7.30–10.30
Out of state address	−0.55 (0.156)	0.0004	0.05 (0.22)	0–1	0.58	0.42–0.78
Value per acre	–0.00002 (0.000)	0.0001	$32,971 ($34,976)	$7.00–$2.7 million	1.00	1.00–1.00
Heir	–	–	0.02 (0.13)	0−1	–	–
Percent concordant	87.3					
Wald chi-square	2697; d.f. = 4; p < 0.0001					

Table 6a
Leslie County Cross Tabulation of Known Heirs' by Predicted Heirs' Parcels.

	Predicted Heir		
Known Heir	No	Yes	Total
No	6336	298	6634
Yes	526	618	1144
Total	6862	916	7778

Table 6b
Leslie County Model Accuracy Assuming Varying Heirs' Parcels Cut Points.

	Correctly grouped		Incorrectly grouped		% Model Correctness	% False Positive	% False Negative
	Heirs	Non-heirs	Heirs	Non-Heirs			
Intuitive (2-factor)	618	6336	298	526	89.4	32.5	7.7
Cut point (4-factor)							
0.10	1002	4378	2256	142	69.2	69.2	3.1
0.20	693	6124	510	451	87.6	42.4	6.9
0.50	618	6337	297	526	89.4	32.5	7.7

Table 7a
Macon-Bibb County Cross Tabulation of Known Heirs' by Predicted Heirs' Parcels.

	Predicted Heir		
Known Heir	No	Yes	Total
No	43,704	477	44,181
Yes	391	420	811
Total	44,095	897	44,992

forms of financial assistance to natural disaster survivors. Certainly, events such as Hurricanes Katrina and Rita underscored the imperative of clear, marketable title for storm survivors applying for federal aid. Many of those with unclear titles were unaware of the precariousness of their ownership and were initially declared ineligible for aid, which intensified an already difficult situation. Governmental agencies are working in concert with non-profit groups to help clarify ownership (Schelhas et al., 2016). The success of these efforts will depend to a large extent on the degree to which specific communities and parcels can be pinpointed. The development of predictive techniques such as those described here would be useful for planners and policymakers in their efforts to identify places with the greatest need for titling assistance.

From a land management perspective, estimates of heirs' property extent would be helpful as well because of the necessary intersection of private and public land management activities. For instance, the US Forest Service's 2012 Planning Rule stipulates that national forests include social, economic, and cultural factors into revised forest plans. Heirs' properties in both the urban and rural South appear to concentrate in culturally-distinct, minority and or lower-wealth communities, many of which are directly adjacent to national forests in states such as South Carolina, Georgia, Alabama, and Mississippi. According to Johnson Gaither et al. (2015), more than 60 percent of the population in counties proximal to the Talladega National Forest in Alabama, Chattahoochee-Oconee in Georgia, Homochito, Delta, and Tombigbee in Mississippi, and the Francis Marion in South Carolina are African American. Information on heirs' property extent adjacent to national forests could help national forest fire managers understand better fire risks associated with these properties and how this may impact fire mitigation efforts on public lands. Again, one of the main drawbacks to heirs' ownership is the tendency for owners to under-invest in the properties, from both financial and managerial perspectives (Deaton et al., 2009). If there is relative lack of attention to woodlands on these properties, it may be that they are more likely than non-heirs' parcels to

Table 7b
Macon-Bibb County Model Accuracy Assuming Varying Heirs' Parcels Cut Points.

	Correctly grouped		Incorrectly grouped		% Model Correctness	% False Positive	% False Negative
	Heirs	Non-heirs	Heirs	Non-Heirs			
Intuitive (2-factor)	420	43,704	477	391	98.07	53.18	0.9
Cut point (4-factor)							
0.10	483	43,190	991	328	97.1	67.2	0.8
0.20	420	43,704	477	391	98.1	53.2	0.9
0.50	222	43,936	245	589	98.1	52.5	1.3

be vulnerable to wildfires because of intensive increases in forest understory (Deaton et al., 2009).

In a follow up to the research presented in this paper, we will pursue this question by mapping both known heirs' and non-heirs' parcels adjacent to national forests in select states across the South. Woodland acreage on these properties will then be classified according to Anderson Fuel classes (Madden et al., 2004). The resulting digital maps will be used to visualize areas of potential conflict and concern for the spread of fires and issues of development and private property investment. Also, online mapping capabilities and the generation of areal statistics will be demonstrated, thereby providing managers with maps, summary statistics of total heirs' properties/shared edges with national forests and heirs' property fire fuel characteristics, leading to a better understanding of the potential volatility of these lands.

The classification method examined here may be useful for selecting heirs' properties from tax rolls in instances where no indication of heirs' status is noted in the data; but its efficiency depends on the threshold that is drawn with respect to the probability levels assigned by the logistic model. An optimal threshold or cutoff probability level (of being heirs') that maximizes the proportion of heirs' parcels should be selected. In both Leslie and Macon-Bibb Counties, the known heirs' count was known, which allowed us to compare model results with the known heirs' parcel proportion. We were able to validate model results based on the true heirs' count. However, in most investigations of heirs' parcels at the municipal level, the known heirs' count will not be known; so classification of which properties are heirs' (based on predicted probabilities) will have to be made based on predicted probabilities alone.

Like any secondary dataset, the county level data used in this study had to be corrected for various errors such as duplicate entries, obvious misspellings, and parcels that had been joined or split, for example. The ArcMap program and GIS techniques used made for relatively easy and quick data corrections and variable coding. As mentioned, data accuracy can be improved by communicating directly with tax officials, especially in cases where few counties are involved.

These data provide a broad view of the heirs' property picture in Leslie and Macon-Bibb Counties. The data do not allow for open-ended investigations into landowners' emotive or cultural connections to the land. However, the data do provide us with a greater ability to generalize about heirs' properties, something which is not possible with qualitative investigations or limited samples. Surveying landowners or local tax authorities to identify heirs' parcels would also be much more time consuming than the method proposed here, in terms of the amount of time needed to design, administer, and analyze data. In addition, response rates would likely be unacceptably low for telephone or mail surveys. Given that heirs' properties may be more likely to exist in lower wealth and minority communities, response rates to any survey (whether mail, telephone, or face-to-face) for such populations, especially one asking about sensitive information concerning property ownership, may be even lower.

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