Comparative Analysis of Housing in Conservation Developments: Colorado Case Studies

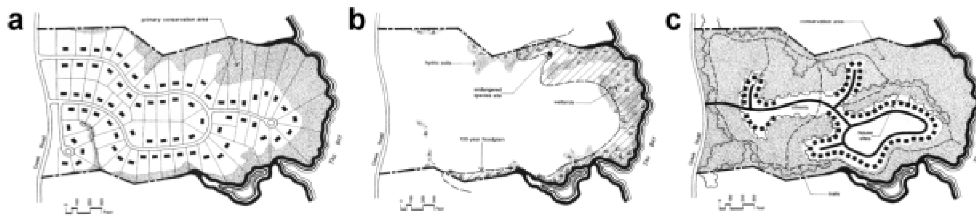
Authors Christopher Hannum, Steven Laposa, Sarah E. Reed, Liba Pejchar, and Lindsay Ex

Abstract Conservation development (CD) is an approach to the site design of a development property that combines residential development and land conservation. CD has been heralded as an environmentally-friendly development alternative and a means to finance land conservation. We employ a Box-Cox hedonic methodology using transaction data for all CD subdivisions in five Colorado counties, as well as a unique sample of homes in comparable nearby rural non-CD subdivisions to assess the value of the CD amenity to homeowners. Our research demonstrates significant sales price premiums for homes located in regulated and unregulated CDs relative to comparable non-CDs.

Conventional residential development poses several challenges to sustaining healthy ecosystems and human communities in the United States. Residential development is a leading driver of changes to biodiversity (McKinney, 2002) and ecosystem services that are critical for human well-being (Kroeger and Casey, 2007). Moreover, conventional residential designs have been linked to declines in the health of human communities (Frumkin, 2002). Land use and residential design also affect human well-being through public health, social equity, climate impacts, and community integrity (Dannenberg, 2003; Alberti 2005; Ewing, Bartholomew, Winkelman, Walters, and Anderson, 2008).

Although efforts to conserve natural resources on private lands have grown rapidly in recent years (Chang, 2010), land continues to be converted to residential and urban development at twice the rate that it is being protected (Aldrich and Wyerman 2005; USDA, 2009). Current funding for land conservation is inadequate to assemble an inclusive and ecologically viable network of conservation areas (Lerner, Mackey, and Casey, 2007). A recent National Association of REALTORS® (NAR) study demonstrated that environmental features are important to 90% of home buyers in the U.S. (NAR, 2008). The high rates of land development, conservation finance gap, and changing preferences among homeowners make this a critical time to examine new approaches for incorporating conservation objectives into development practices, financing land conservation, and providing a model for sustainable homeownership rates.

Exhibit 1 | CD Examples



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Standard economic theory suggests that as income rises, so too will demand for most goods, services, and amenities. Since economic growth inevitably leads to increases in income and living standards in the long run, this presents a conundrum for advocates of sustainable building practices and many environmentally-friendly housing attributes and amenities. Bloom, Nobe, and Nobe (2011) find a positive price premium associated with ENERGY STAR homes, while Aroul and Hansz (2011) find a similar premium for dual-pane windows. Goodwin (2011), examining survey data, finds that the importance placed on ENERGY STAR ratings and heating and cooling costs are negatively correlated with the subject's income. Many green amenities provide external benefits to society, but only cost savings to the individual directly affected. These costs matter less to high-income individuals, and if the green attribute provides an effective disamenity, as with compact fluorescent bulbs (Wall and Crosbie, 2009), that fact could inhibit adoption. Even where the green attribute does not create a disamenity, as with dual-pane windows, we would expect future income growth to slow the pace of adoption. However, some characteristics of a sustainable housing development might provide tangible aesthetic benefits to the individual homeowner and in such a case would expect greater possibilities for private supply of green housing amenities with limited need for government involvement.

Conservation development (CD) is an approach to the site design of a development property that combines residential development and land conservation with a goal of providing functional protection for natural resources (Milder, 2007; Pejchar, Morgan, Caldwell, Palmer, and Daily, 2007). CD includes a wide range of project types, ranging from just a few houses on large tracts of rural land, to suburban conservation subdivisions, to large master-planned communities in urban areas. CD has been heralded as an environmentally-friendly alternative to residential sprawl, as well as a means to finance land conservation. Exhibit 1 (Arendt, 1996) illustrates a CD (c) in contrast to a conventional dispersed development (a). In a CD, the natural resources of the property (b) are initially mapped and protected and home sites are then clustered on a smaller portion of the site.

Although CD has been in use for more than four decades in the U.S. and accounts for up to one-fourth of private land conservation (Milder and Clark, 2011) and a growing proportion of residential development activity, little is known about home sales, valuation trends, absorption patterns, and marketing strategies in CD projects relative to conventional subdivisions. Potential benefits of CD to developers and homeowners include reduced infrastructure and capital costs, higher perceived housing value and quality, faster absorption rates, market differentiation, and access to open space and opportunities for a healthy lifestyle (McMahon, 2010).

This study uses an extensive and unique dataset of home sales and tests for positive externalities in terms of residential home sale prices in CDs vis-à-vis sale prices for homes in non-CD projects. Although more information regarding our filtering process is discussed in the Methods and Data section, the authors grouped residential developments into four main categories: regulated CDs, unregulated CDs, 35-acre subdivisions, and large lot subdivisions.

Based on the diverse characteristics of the five Colorado counties and four types of residential developments, and given the limitations of the data, we investigated three research questions: (1) Are there significant differences in prices for homes in CD projects versus 35-acre, large lot, and unregulated CD projects? (2) Are there significant differences in prices for homes in CD projects across the five Colorado counties? (3) Are there significant differences in the total number of sales and transactions between CD projects and non-CD projects?

This research has broad applications to real estate developers, residential brokers and agents, real estate capital market participants, homeowners, decision makers, and land use planners at the local, state, national, and international levels. Investigating the outcomes of residential homes in CDs is of both academic interest and practical importance to the industry. The real estate industry benefits from an enhanced understanding of home values and sales trends in sustainable residential development projects. Additionally, our research will produce practical recommendations for land use planners and policymakers to adopt and revise CD ordinances that enable and encourage this emerging approach to sustainable residential development among local jurisdictions. The results of this project will help communities achieve cumulative, positive impacts for natural resource conservation and envision more sustainable models for residential development.

Literature

The introduction discussed several relevant articles from the conservation biology and ecology literature. The general gap between the conservation biology literature and real estate literature addressed in this article focuses on the financial aspects, impacts, and consequences of projects such as CDs. There is limited research addressing issues on the financial viability, risk and returns, subsequent home price appreciation rates, or lot absorption rates of CD projects.

The body of research on the influence of protected open spaces and home values is rich in case studies and public policy implications. Open spaces have been shown to influence the value of adjacent properties (Bolitzer and Netusil, 2000; Geoghegan, 2002), and nearby residents are more willing to pay for urban parks than more distant residents (del Saz Salazar and Menéndez, 2007). Other research indicates differences between the home pricing impacts of, and demand for, private subdivision open space and public open space (Bates and Santerre, 2001; Bowman, Thompson, and Colletti, 2009; Abbott and Klaiber, 2010). Towe (2009) finds a greater impact for privately-held farmland than for open space owned collectively by neighborhood associations. Irwin and Bockstael (2001) find evidence of a substantial premium associated with open space using an instrumental variables regression, and that similar estimates using OLS may be biased downward by endogeneity in land use.

While studies consistently find a positive value associated with proximity to open space, these results may have little applicability to the question of CD site planning and CD in unincorporated areas of Colorado specifically. In these areas, proximity to open space, be it publicly-owned wilderness or private rangeland, is the rule rather than an exception. At issue is whether protected open space as part of the site design has an observable price impact even in those areas where natural amenities are not scarce. Within the framework of evaluating the value of proximity to open space rather than location within a development of a given design, Irwin (2002) finds that permanently preserved open space (as in a CD) in Maryland provides a greater price impact than does similar but potentially developable open space.

Recent studies have also examined the valuation impact on housing, appreciation rates, and consumers' preferences for CD. Bowman, Thompson, and Colletti (2009) applied three methods to determine homeowners' value of conservation features in conservation-oriented subdivisions in Cedar Rapids, Iowa. The authors found higher five-year appreciation rates for homes in CD projects versus conventional subdivisions and that consumers' willingness to pay for conservation features was influenced by income, gender, and concerns about urban development (Bowman and Thompson, 2009). Reichert and Liang (2007) examining the housing market in Geauga, Ohio found no statistically significant difference in appreciation rates between CD and non-CD projects. The authors suggest that this finding may be due to a buyer preference for privately-held open space, rather than that owned collectively or in trust. As with all housing amenities, it may simply be the case that the full value of an open space amenity is immediately capitalized into the purchase price if neither that amenity nor its subjective valuation is changing over time.

Kopits, McConnell, and Walls (2009) find a positive price impact of shared open space, but conclude that this is inadequate to compensate for the loss of valued lot size, with cluster site planning leading to lower home prices overall. Mohamed (2006) focused on residential developments in Kingston, Rhode Island analyzing 184 lot sales, as well as absorption and development costs for CD compared with non-CD projects. The author found lower development costs per lot on average and fewer days on market (DOM) for lots in CD projects versus lots in conventional subdivisions.

Setting and Data

Colorado is a particularly appropriate setting for investigating the distribution and financial dimensions of CD projects, due to its rapidly growing human population,

Exhibit 2 | Sample Colorado County Statistics

	Chaffee	Douglas	Larimer	Mesa	Routt
Population	17,809	285,465	299,630	146,723	23,509
Housing units	10,020	106,859	132,722	62,644	16,303
Median home value	$248,100	$338,700	$246,000	$221,000	$422,300
Median household income	$42,941	$99,198	$56,447	$52,067	$60,876
Land area (sq. mi.)	1,013.40	840.25	2,596.00	3,328.97	2,362.03
Persons per sq. mi.	17.6	339.7	115.4	44.1	10.0

Note: The source is the U.S. Bureau of Census; all data from 2010 Census.

widespread adoption of local land use regulations to guide CD design, and the availability of project documentation and financial information for existing CD projects. We focused our research on five counties that represent a broad range of economic, demographic, geographic, and housing characteristics and have at least 16 unique CD projects (Exhibit 2). For example, according to the U.S. Census Bureau, 2010 population ranges from a low of 17,809 in Chaffee County to a high of 299,530 in Larimer County, land area from 840 square miles (sq. mi.) in Douglas County to 3,328.97 sq. mi. in Mesa County, and median home values (2006–2010) range from $221,000 in Mesa County to a high of $422,300 in Routt County. Together these counties account for approximately 41% of all Colorado CD projects.

Exhibit 3 illustrates the geographic location of the five Colorado counties. Larimer County is home to the Fort Collins-Loveland metropolitan statistical (MSA) area and Estes Park, a gateway community to Rocky Mountain National Park; Douglas County is located to the south and is included in the highly urbanized area of the Denver-Aurora MSA; Routt County includes extensive public lands, ranching communities, and the ski resort and vacation city of Steamboat Springs; Mesa County includes Grand Junction, the largest city on the western slope of the Rocky Mountains; and Chaffee County contains both rural mountain and agricultural regions in central Colorado.

We combined two unique datasets to address the gap in applied research on CD projects. The first is a spatial database of CD project locations and parcel and subdivision boundaries, which our working group[1] previously compiled for CD projects in 19 Colorado counties. We first identified counties that have adopted a land use regulation or ordinance that establishes guidelines or provides incentives to encourage development of CD projects. As of 2010, 33 counties in Colorado had adopted a CD ordinance. We then contacted each county's land use planning department to obtain a list of subdivisions that had been completed through the CD regulatory process. We identified the corresponding parcel and subdivision boundaries in the GIS database. Of the counties with CD ordinances, 29 had an

Exhibit 3 | Location of Sample Counties

available geographic information system (GIS) database of parcel and subdivision boundaries and 19 had completed at least one CD project. To date, we have mapped a diverse sample of nearly 400 CD projects in unincorporated areas of 19 counties. CD projects range in area from 2 to 900 ha, with 1 to 435 residential lots, and a mean of 62% of each property is set aside as protected open space.

In the five counties, we also identified conventional residential development projects for comparison to the CD projects. We selected the five counties to represent a range of characteristics—urban and rural; agricultural, natural resource, and service-based economies; and a variety of ecosystem types—and to be distributed across different geographic regions of the state (Exhibit 3). Within each county, we selected comparable conventional development projects to be located near the CD projects and to be as similar as possible in total area and development yield. We visually inspected parcel and subdivision boundaries, and legal descriptions from the tax assessor's data associated with the parcel database, to identify candidate developments for comparison. All comparable developments are located within 10 km, and most are located within 5 km, of the nearest CD project in each county.

Two types of comparable developments that we selected represent the primary land use planning alternatives for development of a conventional, dispersed

Exhibit 4 | Number of Developments by County and Category

	Larimer	Douglas	Mesa	Routt	Chaffee	Total
Regulated CD	49	5	9	10	7	80
Unregulated CD	10	3	8	2	3	26
Large Lot	20	16	19	9	9	73
35-Acre	4	9	2	8	3	26
Total	83	33	38	29	22	205

residential property in unincorporated areas of the counties: (1) projects developed through Colorado's 35-acre subdivision exemption, or (2) projects developed through the county's subdivision or zoning regulations for large lot development. The third type of comparable development represents an alternative option for development of a CD project: projects with significant inclusion of conservation design elements (e.g., clustering of housing), but which were not developed through the CD regulatory process. Often these 'unregulated' CD projects were also developed through the 35-acre subdivision exemption.

We merged the spatial database of CD and comparable development projects with the CoreLogic database,[2] a unique database comprised of approximately 1.7 million residential sale transaction records for the period 2000 to 2011:Q1 in Colorado. We used the parcel and subdivision boundaries, and associated attribute data, to identify residential sales transaction records within each type of development. Inaccurate or missing spatial locations associated with the residential sales transactions prevented a spatial join of the two datasets. Instead, we used a combination of parcel numbers and other unique identifying characteristics in the assessor's data (e.g., subdivision name) associated with the parcel database to join the attribute tables of the two datasets. We verified matching records in the joined database through visual inspection of residential and subdivision locations and comparison of data in additional attribute fields. Exhibit 4 shows the breakdown of developments by county and development category. In all, 205 developments met all criteria for inclusion in the final dataset. Exhibit 5 displays the average characteristics of the developments themselves and of the properties in the various development categories organized by county.

As shown in Exhibit 5, homes in regulated and unregulated CDs tend to be sold for more and be both newer and larger than homes in traditional large lot subdivisions. The developments themselves tend to be larger in traditional 35-acre subdivisions and comparable in large lot subdivisions, and regulated and unregulated CDs. The average number of lots, however, is comparable between regulated CDs and 35-acre developments (in which the average lot size is much larger) and higher in large lot and unregulated CDs. While some conventional developments are designed with open space, the percentage of open space in regulated and unregulated CDs is far higher. Accordingly, yield in regulated CDs is low relative to large lot and even unregulated CDs. Home sales per lot are

Exhibit 5 | Descriptive Statistics (All Developments)

	County	35-Acre	CD	Large Lot	Unregulated CD
Average Acreage	Chaffee	31.0	10.3	9.2	1.9
	Douglas	36.1	9.4	7.5	15.6
	Larimer	11.2	5.9	2.0	2.4
	Mesa	22.9	2.0	1.8	2.3
	Routt	35.9	14.6	6.4	29.3
	Total	30.6	7.1	4.6	5.9
Average Building Square Footage	Chaffee	2,531.0	2,421.1	2,573.4	2,352.0
	Douglas	4,967.8	5,594.4	3,240.7	6,270.0
	Larimer	1,791.0	3,679.1	2,412.1	3,670.1
	Mesa	2,113.0	3,128.3	2,432.2	2,867.2
	Routt	3,436.7	5,844.7	2,892.7	5,185.0
	Total	3,507.2	3,897.5	2,678.1	3,687.5
Average Sale Amount ($)	Chaffee	$563,000	$334,493	$387,130	$263,187
	Douglas	$925,442	$897,180	$434,770	$1,576,483
	Larimer	$320,400	$433,675	$292,027	$483,016
	Mesa	$535,000	$193,034	$233,827	$297,707
	Routt	$1,759,630	$1,857,924	$697,146	$1,641,504
	Total	$1,017,178	$604,925	$369,836	$615,917
Average Year Built	Chaffee	1980.3	2000.4	2000.7	1993.9
	Douglas	1995.8	2003.8	1986.9	1999.6
	Larimer	1964.8	1999.3	1986.3	1995.9
	Mesa	2000.1	2001.7	1988.8	2002.3
	Routt	1983.0	2001.6	1988.3	1995.3
	Total	1985.6	2000.2	1989.1	1998.0
Average Year of Sale	Chaffee	2007.3	2007.5	2007.0	2006.9
	Douglas	2004.0	2006.9	2003.6	2007.8
	Larimer	2003.6	2005.6	2004.2	2003.9
	Mesa	2008.1	2003.9	2003.7	2005.4
	Routt	2005.1	2004.9	2003.6	2002.6
	Total	2005.0	2005.5	2004.2	2005.1
Total Area (hectares)	Chaffee	144.6	31.4	75.6	38.1
	Douglas	342.5	375.6	255.9	367.9
	Larimer	40.1	76.1	41.8	69.5
	Mesa	88.0	33.7	26.7	56.3
	Routt	266.8	218.0	156.0	535.9
	Total	230.3	103.9	103.1	132.1
Open Space (hectares)	Chaffee	41.4	21.9	4.8	25.4
	Douglas	158.9	217.6	24.6	160.7
	Larimer	0.0	45.5	7.5	36.5
	Mesa	0.0	18.6	1.6	35.2
	Routt	15.1	164.1	3.0	51.2
	Total	22.5	66.5	5.1	50.3

Exhibit 5 | (continued)

Descriptive Statistics (All Developments)

	County	35-Acre	CD	Large Lot	Unregulated CD
Open Space (%)	Chaffee	28.6%	69.7%	6.3%	66.8%
	Douglas	46.4%	57.9%	9.6%	43.7%
	Larimer	0.0%	59.8%	18.0%	52.4%
	Mesa	0.0%	55.1%	6.0%	62.5%
	Routt	5.7%	75.3%	2.0%	9.5%
	Total	9.8%	64.0%	4.9%	38.0%
Number of Lots	Chaffee	7.3	9.6	23.1	50.3
	Douglas	24.9	32.8	92.6	71.7
	Larimer	3.0	14.6	49.8	52.8
	Mesa	5.5	13.9	24.9	19.1
	Routt	16.8	16.4	54.4	23.0
	Total	15.5	15.5	50.0	42.0
Yield (Lots per hectare)	Chaffee	0.050	0.254	0.356	0.812
	Douglas	0.075	0.102	0.343	0.201
	Larimer	0.075	0.212	2.166	1.006
	Mesa	0.065	0.446	1.266	0.353
	Routt	0.064	0.080	0.479	0.041
	Total	0.068	0.219	1.101	0.616
Transactions per Lot	Chaffee	0.137	0.299	0.288	0.079
	Douglas	0.679	1.787	0.963	0.205
	Larimer	1.583	1.265	1.230	1.883
	Mesa	1.182	2.568	1.527	1.386
	Routt	1.194	1.159	0.855	2.065
	Total	0.861	1.398	1.056	1.242
Sales per Lot	Chaffee	0.136	0.119	0.120	0.040
	Douglas	0.170	0.329	0.383	0.033
	Larimer	0.583	0.414	0.542	0.710
	Mesa	0.545	0.912	0.656	0.542
	Routt	0.403	0.244	0.380	0.543
	Total	0.268	0.414	0.446	0.454

comparable between regulated CDs, unregulated CDs, and large lot developments, yet lower for conventional 35-acre subdivisions. However, transactions per lot (which include sales of undeveloped land) are somewhat higher in regulated and unregulated CDs, perhaps due to the lower average age of the developments.

We began this endeavor with data from Core-Logic on 7,638 individual property transactions between 1998 and 2011: 3,285 from Larimer County, 1,928 from Douglas County, 1,360 from Mesa County, 906 from Routt County, and 159 from Chaffee County. Included were a wide variety of characteristics of the sale and of the property itself, linked to subdivision characteristics and locations through a subdivision identifier. While the data set did contain geocoding data for each property such as estimated latitudes and longitudes, these data were

Exhibit 6 | Sales by County by Development Category

	Larimer	Douglas	Mesa	Routt	Chaffee	Total
Regulated CD	167	44	43	29	6	289
Unregulated CD	282	6	45	17	6	356
Large Lot	482	548	253	168	27	1,478
35-Acre	5	34	6	51	3	99
Total	936	632	347	265	42	2,222

determined to give often implausible locations; therefore latitude-longitude data for the subdivision as a whole were used for each property within that subdivision.

For the purposes of a hedonic price analysis, many of these transactions would be invalid. Our two primary concerns were to filter out those transactions that were not sales and those transactions that were sales of developable land as opposed to finished homes. While the impact of location in a CD on the value of developable land is not without interest, the dataset was formed by a database, which links information taken at time of sale to current information about the property. As a result, a property sold may now include a 4,000 sq. ft. home built in 2008 and not reflected in the sale price of $40,000 in 2004; since there is little difference in the data, such an observation cannot be included. To address the first concern, we have restricted our sample to those transactions involving warranty deeds, joint warranty deeds, or special warranty deeds and have excluded all transactions with a sale price of zero. To address the second concern, we excluded all transactions with a year built listed after the year of sale, as well as those observations with no recorded year built or year of sale. After a trial run showed that properties listed with the same year built and year of sale sold for 93% less on average than properties with year built at least one year before the year of sale, we excluded those as well. In order to include distance variables, a further 65 observations were cut that lacked even subdivision level data. As a result of these cuts, our final five-county sample includes 2,222 observations corresponding to property sales. Exhibit 6 shows the breakdown of home sales in the final dataset by county and development category.

Methodology

Our methodology follows a standard hedonic model where the market price of a product is taken to be a reduced form function of demand and/or supply side characteristics (Rosen, 1974). Hedonic price models have been used extensively throughout the real estate and housing literature (Sirmans, Macpherson, and Zietz, 2005) using such characteristics as the square footage of a home, the presence of a finished basement or the presence and age of dual-pane windows (Aroul and

Exhibit 7 | Full Dataset Results

	Model 1		Model 2	
Variable	$\hat{\beta}(\sigma)$	Marginal Effect [%]	$\hat{\beta}(\sigma)$	Marginal Effect [%]
INTERCEPT	43.6696*** (0.9097)	–	43.6916*** (0.8838)	–
LIVING AREA	0.0245*** (0.0012)	$77.27	0.0236*** (0.0012)	$74.43
LOT AREA (IN SQ. FT.)	0.0001 (0.0000)	$0.06	0.0001 (0.0000)	$0.06
AGE	−0.0758*** (0.0350)	−$828.36	−0.0464 (0.0352)	−$506.68
NUMBER OF BATHROOMS	1.1958 (0.2812)	$17,858.63	1.0464*** (0.2822)	$15,628.36
DISTANCE TO LARGEST TOWN	−0.0001 (0.0001)	−$0.19	−0.0001 (0.0001)	−$0.32
GARAGE	2.6546*** (0.4500)	$55,197.00 [19%]	2.1296*** (0.4408)	$42,553.31 [15%]
DOUGLAS CTY	1.5506*** (0.5417)	$32,242.76 [11%]	2.6772*** (0.5087)	$53,496.26 [19%]
CHAFFEE CTY	−0.1089 (1.0721)	$−2,264.85 [−1%]	0.3622 (1.1053)	$7,237.33 [3%]
MESA CTY	−1.0417*** (0.3726)	$−21,659.89 [−7%]	−0.5281 (0.3726)	$−10,552.24 [−4%]
ROUTT CTY	10.7905*** (0.7778)	$224,368.68 [78%]	11.7352*** (0.7992)	$234,491.42 [85%]
REGULATED C.D.	2.7178*** (0.4581)	$56,512.42	4.0120*** (0.5092)	$80,166.58 [29%]
UNREGULATED C.D.	–	–	3.5008*** (0.5057)	$69,952.03 [25%]
y1998	−5.0352*** (1.3391)	$−104,697.34 [−36%]	−4.5779*** (1.4134)	$−91,475.22 [−33%]
y1999	−2.8544*** (0.6017)	$−59,353.14 [−21%]	−2.8124*** (0.5788)	$−56,197.59 [−20%]
y2000	−1.8272*** (0.6991)	$−37,993.40 [−13%]	−1.7995*** (0.6777)	$−35,957.39 [−13%]
y2002	0.6706 (0.6872)	$13,944.65 [5%]	0.5066 (0.6694)	$10,123.09 [4%]
y2003	0.4371 (0.6079)	$9,089.07 [3%]	0.4227 (0.5825)	$8,445.67 [3%]
y2004	1.5632*** (0.6190)	$32,503.71 [11%]	1.5362*** (0.5940)	$30,696.41 [11%]

Exhibit 7 | (continued)

Full Dataset Results

Variable	Model 1		Model 2	
	$\hat{\beta}(\sigma)$	Marginal Effect [%]	$\hat{\beta}(\sigma)$	Marginal Effect [%]
y2005	3.1218*** (0.5587)	$64,911.80 [22%]	2.8308*** (0.5372)	$56,563.73 [21%]
y2006	4.1347*** (0.6193)	$85,974.05 [30%]	3.9788*** (0.5922)	$79,503.10 [29%]
y2007	4.7277*** (0.6934)	$98,303.74 [34%]	4.5548*** (0.6717)	$91,013.40 [33%]
y2008	3.4543*** (0.7335)	$71,826.13 [25%]	3.2882*** (0.7148)	$65,705.06 [24%]
y2009	1.4168*** (0.7154)	$29,459.20 [10%]	1.1425 (0.6974)	$22,829.68 [8%]
y2010	0.2464 (0.7715)	$5,123.81 [2%]	0.1630 (0.7569)	$3,256.44 [1%]
y2011	1.2120 (1.0948)	$25,201.53 [9%]	1.2686 (1.0229)	$25,348.76 [9%]
R^2	0.7069	—	0.7161	—

Note: The number of observations is 2,222. Brackets indicate percentage change for Box-Cox marginal effects whereas $ figures indicate the dollar marginal effect. Parentheses indicate *t*-stats.
***Significant at the 5% level.

Hansz, 2011). Our dependent variable is the transformed sales price of the property, while the independent variables include binary year dummies and a vector of housing characteristics. Each resulting coefficient means little on its own, but the transformation can be reversed to derive a dollar marginal effect.

A likelihood-ratio test indicates that a Box-Cox power transformation of the continuous variables (Box and Cox, 1964) is likely to provide a better fit for the sample data than does a standard log-log hedonic model (equivalent to a Box-Cox transformation with $\theta = \lambda = 0$) and to limit, if not eliminate, potential problems of heteroscedasticity. Using such a transformation, the dependent variable (*Sales Price*) is raised to the power of λ while continuous independent variables are raised to the power of θ, with binary independent variables left untransformed. To complete the transformation, we then subtract one from the transformed variable and divide by its respective transformation parameter. The parameters θ and λ are then derived using maximum likelihood estimation. Our best fit estimate for λ is 0.2093, with a standard error of 0.0106 and for θ 0.7656 with a standard error of 0.0639.

$$
\begin{aligned}
tPrice = {} & \alpha + \beta_1 tLivingArea + \beta_2 tLotArea + \beta_3 tAge \\
& + \beta_4 LMean + \beta_8 tTotalBath + \beta_9 tBasementSqFt \\
& + \beta_{10} tBedrooms + \beta_{11} CD + \sum_{t=1998}^{t=2011} \beta_t y_t \\
& + \sum_j \beta_j X_j + \sum_i \beta_i X_i + \varepsilon, \qquad (1)
\end{aligned}
$$

where:

$tPrice = (Sales\ Price^{\lambda} - 1)/\lambda$;
$tLiving\ Area = (Living\ Area^{\theta} - 1)/\theta$;
$tLot\ Area = (Lot\ Area^{\theta} - 1)/\theta$;
$tAge = (Age\ of\ Home^{\theta} - 1)/\theta$;
$tTotal\ Bath = (\#\ of\ Bathrooms^{\theta} - 1)/\theta$;
$tBasementSqFt = (Basement\ Area^{\theta} - 1)/\theta$;
$tBedrooms = (\#\ of\ Bedrooms^{\theta} - 1)/\theta$;
$tLMean = (Travel\ Distance\ to\ Largest\ Town^{\theta} - 1)/\theta$;
y_t (1998...2011) = dummy year variable (1 = year sold, 0 = all others);
X_j = A vector of binary housing characteristics, including: Garage, Central Air, Pool, Waterfront, No Quality, Good Quality, Excellent Quality, Fair/Low Quality;
X_i = A vector of binary county variables including: Routt, Chaffee, Douglas, and Mesa; and
CD = A dummy variable for location within a regulated conservation development.

The baseline or null, a property for which all categorical variables take on a value of zero, would be located in Larimer County in a non-CD, sold in 2001 with average quality and no garage, pool or basement. Our methodology for selecting comparable subdivision, along with the Colorado Public Schools of Choice legislation and the large size of school districts in rural Colorado, lessens the importance of school district location in comparing properties.

Results

Our findings are broadly supportive of the idea that the location of a property within a CD constitutes an environmental amenity with a positive impact on the value of that property. Results from our five-county combined data set suggest a statistically significant increase in sales price of approximately 20% from location within a CD rather than an otherwise similar subdivision, which might be a rural large lot, 35-acre subdivision or unregulated CD. When the impacts of both location within a regulated or an unregulated CD are tested against a baseline of large lots and 35-acre developments they provide a positive marginal effect of roughly 25% and 29% of the purchase price of a home, respectively. In model 1, we include ''unregulated CDs'' (subdivisions that employ certain conservation practices, but skirt the regulatory process) in the baseline non-CD group; in model 1, unregulated CD is included as a separate subdivision category. It should be noted that while the difference between CD and the null is statistically significant at the 5% level in both model 1 and model 2, as is the difference between unregulated CD and the null in model 2, the difference between regulated and unregulated CDs in model 2 is not statistically significant.

Coefficients on our control variables are, for the most part, consistent with both theory and common sense. A larger home sells for more, as does a home with more bathrooms. Adding a square foot to the typical home adds $74.43 to the sales price of that home while adding a bathroom adds $15,628.36. Doubling both would roughly double the total market value of the home. Relative to the baseline location within Larimer County, homes in Douglas County and Routt County sell for more while homes in Mesa and Chaffee Counties sell for less. Coefficients for binary year variables tell the story of the Colorado housing market as a whole over the past 14 years: rapid price increases to 2001 (the baseline year) followed by two years of stagnation, an upswing from 2004 to 2007 then three years of price declines prior to a slight rebound in 2011. By 2010, housing prices in our sample had returned to approximately 2001 levels.

As expected, sales prices decreased with age and distance from the nearest major town. Age does not have a tremendous impact. The sales price of a home decreases by only $516 with an additional year of age and the effect is not statistically significant when dummy variables for both regulated and unregulated CDs are included, although it is when only the regulated CD variable is included. Our distance variables were calculated using coordinates for subdivisions rather than individual properties within those subdivisions due to problems with the reliability of individual property GPS coordinates within our data set. We tested four different distance variables, all or which use travel distance as opposed to linear distance: mean distance to the largest town in the county (*LMEAN*), minimum distance to the largest town in the county (*LMIN*), mean distance to the nearest town (*NMEAN*), and minimum distance to the nearest town in the county (*NMIN*). *LMEAN* was selected due to a marginally better fit. The impact of *LMEAN* in the full sample regressions is relatively small and insignificant; in part (as shown below) because it appears that the impact of *LMEAN* is quite different in different counties and for different development types.

One surprise is that for our full sample, which is primarily higher-end homes in rural areas or on the outskirts of towns, the size of lot did not have a statistically significant impact at the 5% level. An additional square foot of land raises the market price by only six cents, one additional acre by approximately $2,500. When we break down the sample by category, increasing lot size increases sale price by a small but statistically significant amount (9¢ per square foot or $4,062 per acre) for homes in non-CDs and by a large and significant amount (38¢ per square foot or $16,662 per acre) for homes in unregulated CDs. The low value associated with additional lot size in a non-CD in our sample leads to an implied value of land that is greater when held in common and perpetually preserved than when allocated to increase the size of individual private lots, in contrast to the findings of Kopits, McConnell, and Walls (2007), Reichert and Liang (2007), and Towe (2009.

For homes in regulated CDs, the impact of an extra square foot of land was both negative and statistically significant. The difference between non-CDs and unregulated CDs (in which ownership of land is subdivided fully during development) could be explained by amenity values, since unregulated CDs are designed with environmental amenities in mind. When comparing regulated and unregulated CDs, it might potentially be the case that larger individual lots within a CD diminish the amenity values to all from commonly-held open lands.

A glance at the binary year coefficients for the four subdivision categories suggest that while prices in categories were hit hard by the recent recession (with an approximate 30% drop peak-to-trough) and have begun to rebound in all four, they did not follow similar paths following the 2001 recession. In many parts of the country, the 2001 recession was a mere blip, but the Colorado tech industry had experienced rapid growth in the 1990s and the recession meant the loss of a significant number of high paying jobs. House prices in lower-amenity non-CD subdivisions increased somewhat less rapidly in the late 1990s but continued to increase throughout the 2000s. For high-amenity regulated and unregulated CDs, price growth in the late 1990s was more rapid and both experienced price drops following that recession, although both seem to have been affected more equally in the most recent downturn. When the dataset is subdivided by development category, as displayed in Exhibit 8, we find no evidence of a higher appreciation rate for CD or non-CD properties between 1999 and 2011. While this contradicts the findings of Bowman, Thompson, and Colletti (2009), it is not inconsistent with the idea of open space as a valued amenity, provided the value of that amenity is capitalized in the initial purchase price.

We ran two sets of regressions using single county subsamples: one using only those property characteristics that were available for all counties and another using all property characteristics available for that particular county. Chaffee County was excluded due to the limited number of sales. For the first, limited, set of regressions we see similar impacts for location within a CD in each county. Despite that fact, the regulated CD coefficients are statistically significant at the 5% level in Larimer, Douglas, and Mesa Counties and significant at the 10% level in Routt County. The unregulated CD coefficients are significant at the 5% level only in Larimer and Routt Counties and at the 10% level in Mesa County. Though the impact in Douglas County is large, there is too much statistical noise to indicate anything definite. The marginal impact of regulated CDs is quite similar to the full sample result in Larimer, Douglas, and Routt Counties (30%, 26%, and 31%, respectively) but a notably smaller 19% in Mesa County. While this could be partially the result of randomness due to reduced sample size, it might also be the case that counties in the urban and suburban Front Range or resort areas have a greater demand for environmental amenities than do blue-collar mountain

Exhibit 8 | Results by Development Category

	Regulated C.D.		Unregulated C.D.	
Variable	$\hat{\beta}(\sigma)$	Marginal Effect [%]	$\hat{\beta}(\sigma)$	Marginal Effect [%]
INTERCEPT	51.5253*** (3.8442)	—	42.5367*** (2.2227)	—
LIVING AREA	0.0185*** (0.0044)	$81.84	0.0273*** (0.0027)	$111.13
LOT AREA (IN SQ. FT.)	−0.0001*** (0.0000)	−$0.09	0.0002*** (0.0001)	$0.38
AGE	−0.0789 (0.0697)	−$1,526.13	0.1319 (0.0809)	$2,201.65
NUMBER OF BATHROOMS	2.4253*** (0.8956)	$52,380.60	0.7112 (0.5969)	$13,769.05
DISTANCE TO LARGEST TOWN	−0.0011 (0.0008)	−$3.74	0.0005*** (0.0005)	$1.34
GARAGE	2.8216 (2.1205)	$87,789.63 [18%]	4.9482*** (1.5938)	$138,248.97 [33%]
DOUGLAS CTY	4.6117*** (1.8488)	$143,487.76 [30%]	−0.8937 (5.183)	$−24,970.52 [−6%]
CHAFFEE CTY	−0.5232 (2.0848)	$−16,278.98 [−3%]	−5.82608*** (2.43742)	$−162,777.41 [−39%]
MESA CTY	−2.5206*** (1.0996)	$−78,426.06 [−16%]	−0.2264 (0.8541)	$−6,325.60 [−2%]
ROUTT CTY	17.3156*** (3.03966)	$538,757.82 [112%]	12.7699*** (1.6503)	$356,782.26 [85%]
y1998	—	—	—	—
y1999	−3.2459 (2.8436)	$−100,991.30 [−21%]	−5.3327*** (1.4156)	$−148,993.60 [−35%]
y2000	−5.6663 (4.2025)	$−176,302.26 [−37%]	−4.2325*** (1.9544)	$−118,253.33 [−28%]
y2002	0.3521 (2.0536)	$109,53.61 [2%]	−1.7621 (1.2263)	$−49,231.03 [−12%]
y2003	−1.7908 (2.8720)	$−55,718.10 [−12%]	−2.2497 (1.4107)	$−62,856.41 [−15%]
y2004	0.4658 (2.0235)	$14,492.19 [3%]	0.6073 (1.3275)	$16,967.08 [4%]
y2005	2.2183 (1.9979)	$69,020.12 [14%]	−1.1550 (1.2384)	$−32,268.67 [−8%]
y2006	2.1829 (2.2795)	$67,917.75 [14%]	1.4553 (1.3803)	$40,661.00 [10%]

Exhibit 8 | (continued)

Results by Development Category

	Regulated C.D.		Unregulated C.D.	
Variable	$\hat{\beta}(\sigma)$	Marginal Effect [%]	$\hat{\beta}(\sigma)$	Marginal Effect [%]
y2007	2.0570 (3.0161)	$93,842.52 [19%]	1.6528 (1.3934)	$46,177.83 [11%]
y2008	1.1117 (2.1551)	$34,588.06 [7%]	0.3180 (1.3299)	$8,883.26 [2%]
y2009	−2.4252 (2.1087)	$−75,457.82 [−16%]	−1.4237 (1.8482)	$−39,777.41 [−9%]
y2010	−1.6663 (2.2506)	$−51,845.41 [−11%]	−3.7980*** (1.5842)	$−106,115.11 [−25%]
y2011	0.4551 (2.1587)	$14,160.38 [3%]	0.36739 (2.8923)	$10,264.56 [2%]
R^2	0.7697	—	0.7353	—
N	289	—	356	—

	Non-C.D.		All C.D.	
Variable	$\hat{\beta}(\sigma)$	Marginal Effect [%]	$\hat{\beta}(\sigma)$	Marginal Effect [%]
INTERCEPT	46.2025*** (1.0207)	—	44.1064*** (1.9768)	—
LIVING AREA	0.0228*** (0.0013)	$66.56	0.0231*** (0.0025)	$91.82
LOT AREA (IN SQ. FT.)	0.0001*** (0.0000)	$0.09	0.0 (0.0000)	$0.00
AGE	−0.0990*** (0.0410)	−$939.56	0.0775 (0.0699)	$1,296.22
NUMBER OF BATHROOMS	0.6228*** (0.3139)	$8,551.16	1.6988*** (0.5440)	$32,443.87
DISTANCE TO LARGEST TOWN	−0.0006*** (0.0001)	−$1.28	0.0003 (0.0002)	$0.78
GARAGE	1.6044*** (0.4679)	$30,179.92 [12%]	5.1064*** (1.4741)	$140,633.66 [34%]
DOUGLAS COUNTY	1.9509*** (0.4444)	$36,697.80 [14%]	5.3031*** (1.2772)	$146,051.62 [35%]
CHAFFEE COUNTY	0.9765 (1.3237)	$18,368.65 [7%]	−1.8562 (1.7141)	$−511,21.19 [−12%]
MESA COUNTY	−0.9698*** (0.4477)	$−18,242.39 [−7%]	−0.2430 (0.7201)	$−6,692.77 [−2%]

Exhibit 8 | (continued)

Results by Development Category

	Non-C.D.		All C.D.	
Variable	$\hat{\beta}(\sigma)$	Marginal Effect [%]	$\hat{\beta}(\sigma)$	Marginal Effect [%]
ROUTT COUNTY	9.5479*** (0.7466)	$179,605.26 [71%]	17.6488*** (1.8923)	$486,060.15 [118%]
y1998	—	—	−3.8567*** (1.3318)	$−72,548.25 [−28%]
y1999	−6.5531*** (1.7167)	$−180,477.23 [−44%]	−1.9769*** (0.5581)	$−37,186.69 [−15%]
y2000	−5.1448*** (1.9685)	$−141,689.76 [−34%]	−1.1073 (0.6968)	$−20,830.19 [−8%]
y2002	−1.3274 (1.2694)	$−36,557.59 [−9%]	0.9638 (0.7968)	$18,129.45 [7%]
y2003	−2.7130 (1.5993)	$−74,716.50 [−18%]	1.5800*** (0.5730)	$29,720.66 [12%]
y2004	−0.2877 (1.2748)	$−7,922.67 [−2%]	2.1744*** (0.6391)	$40,903.47 [16%]
y2005	−0.0018 (1.2666)	$−50.04 [0%]	3.6406*** (0.537)	$68,483.80 [27%]
y2006	1.9550 (1.4060)	$53,842.01 [13%]	4.6663*** (0.5843)	$87,778.18 [34%]
y2007	1.9500 (1.2865)	$53,979.06 [13%]	5.7026*** (0.7487)	$107,270.65 [42%]
y2008	0.3782 (1.2935)	$10,414.65 [3%]	4.1475*** (0.8963)	$78,017.94 [31%]
y2009	−2.4133 (1.4356)	$−66,463.18 [−16%]	2.5105*** (0.7638)	$47,225.80 [19%]
y2010	−2.7880*** (1.3549)	$−76,784.25 [−19%]	1.3585 (0.9116)	$25,554.08 [10%]
y2011	−0.8720 (1.6849)	$−24,014.29 [−6%]	2.2079 (1.329)	$41,532.75 [16%]
R^2	0.691	—	0.7266	—
N	1,577	—	645	—

Notes: Brackets indicate percentage change for Box-Cox marginal effects. Parentheses indicate *t*-stats.

***Significant at the 5% level.

Exhibit 9 | County Level Regression Results (Coefficients with Robust SE)

Variable	Larimer	Douglas	Mesa	Routt
INTERCEPT	43.9499 (1.0394***)	54.60516 (1.6795***)	40.20772 (2.2347***)	53.10838 (4.0536***)
LIVING AREA	0.02464 (0.0016***)	0.0173 (0.0017***)	0.0219 (0.0046***)	0.0313 (0.0044***)
LOT AREA (IN SQ. FT.)	0.0000 (0.0000***)	0.0001 (0.0000***)	0.0001 (0.0001***)	0.0000 (0.0000)
AGE	−0.0251 (0.0301)	−0.2711 (0.0429***)	−0.0332 (0.0587)	0.0426 (0.2121)
NUMBER OF BATHROOMS	0.8673 (0.3439***)	0.0387 (0.4691)	1.0595 (0.6178)	1.4093 (0.9818)
DISTANCE TO LARGEST TOWN	0.0001 (0.0001)	−0.0001 (0.0003)	−0.0011 (0.0004***)	−0.0017 (0.0009)
GARAGE	2.4323 (0.5287***)	1.3931 (0.8921)	3.4800 (0.7673***)	1.8617 (2.2120)
REGULATED C.D.	4.1769 (0.5238***)	3.9077 (0.9651***)	2.4087 (1.1168***)	5.4603 (2.9085)
UNREGULATED C.D.	3.3882 (0.4099***)	5.7431 (3.7439)	1.7512 (0.9090)	8.6416 (3.3291***)
y1998	−4.8408 (0.5111***)	−4.4813 (1.3153***)	—	—
y1999	−2.4592 (0.7022***)	−2.7243 (0.5495***)	−0.8223 (2.0133)	−8.2263 (2.5363***)
y2000	−2.5490 (1.1006***)	−0.7490 (1.0103)	0.9097 (1.5448)	−8.0792 (2.5182***)
y2002	−0.0180 (0.7102)	−1.0095 (1.4641)	3.1704 (1.5656***)	−2.4913 (2.9350)
y2003	−1.1710 (0.7566)	1.7809 (0.5312***)	1.4821 (1.6020)	0.4055 (2.7495)
y2004	0.4165 (0.6319)	2.1599 (0.8651***)	4.5428 (1.4549***)	−0.7342 (2.5279)
y2005	1.4230 (0.6075***)	3.5000 (0.6050***)	5.9565 (1.3581***)	−0.1894 (2.6124)
y2006	1.9945 (0.6830***)	4.0163 (0.6109***)	9.3040 (1.4033***)	2.4271 (2.9187)
y2007	1.8944 (0.7323***)	4.5177 (0.9295***)	10.6510 (1.4167***)	4.4459 (3.4207)
y2008	0.91795 (0.6817)	2.2119 (0.5652***)	9.1983 (1.6769***)	5.4704 (3.6612)
y2009	−0.5906 (0.8680)	0.9087 (0.8672)	7.9867 (1.7427***)	−0.2219 (3.0556)

Exhibit 9 | (continued)

County Level Regression Results (Coefficients with Robust SE)

Variable	Larimer	Douglas	Mesa	Routt
y2010	−0.6226	1.1992	4.1676	−6.4026
	(0.7860)	(0.8760)	(1.8240***)	(5.6949)
y2011	−1.8645	0.7066	7.9273	2.5582
	(0.8310***)	(1.7139)	(2.3026***)	(2.9077)
R^2	0.6589	0.6015	0.5923	0.7683

Notes: Parentheses indicate *t*-stats. For Larimer, $N = 936$; for Douglas, $N = 632$; for Mesa, $N = 347$; for Routt, $N = 265$.

*** Significant at the 5% level.

counties such as Mesa. Without more data, this may be impossible to determine conclusively.

Where additional property characteristic information is available on a county-by-county basis, most results show the expected sign and scale. Pools increase the value of a home as do garages and central air conditioning, although not significantly in all counties. Basements and waterfront location (likely due to the definition of waterfront in the sample) do not. While a larger number of bathrooms increase the sales price of a home, a larger number of bedrooms (assuming an equivalent square footage) decrease it. Compared to the baseline condition of 'average quality,' homes with good or excellent quality sell for more (as do homes with no quality listed) while homes with fair or low quality sell for less.

In regressions using additional variables for property characteristics, the two counties with the largest numbers of available characteristics—Larimer and Mesa—show large decreases in the size of the CD coefficient relative to county subsample regressions using limited characteristics. In Larimer County, the marginal effect of regulated CDs falls from 30% to only 14%, although the coefficient remains statistically significant.

In Mesa County, the marginal effect falls from 19% to 12.3% while in Routt and Douglas Counties (where fewer additional characteristics are available the size) the impact of location within a regulated or unregulated CD is largely unaffected. In Larimer County, the coefficients for both regulated and unregulated CDs remain statistically significant when additional property characteristics are included while in Mesa County both become insignificant, although this may be due in part to the small sample size from Mesa County. These results suggest that part of the increased value associated with presence within a CD overall may be capturing unrecorded improvements in the homes themselves if, for example, homes in CDs are relatively more likely to be in good condition compared to those in other types of subdivisions.

Exhibit 10 | County Level Regression Results (Marginal Effects)

Variable	Larimer	Douglas	Mesa	Routt
LIVING AREA	$82.75	$66.49	$50.34	$225.55
LOT AREA (IN SQ. FT.)	$0.07	$0.12	$0.12	$0.06
AGE	$−296.01	$−3,601.10	$−250.28	$1,103.46
NUMBER OF BATHROOMS	$13,591.09	$733.42	$11,117.58	$47,949.50
DISTANCE TO LARGEST TOWN	$0.16	$−0.17	$−2.05	$−10.30
GARAGE	$53,023.62 [17%]	$36,452.42 [9%]	$50,188.74 [28%]	$91,775.94 [11%]
REGULATED C.D.	$91,057.46 [30%]	$102,248.01 [26%]	$34,739.08 [19%]	$269,171.36 [31%]
UNREGULATED C.D.	$73,863.27 [24%]	$150,274.46 [39%]	$25,256.44 [14%]	$425,992.45 [49%]
y1998	$−105,530.51 [−34%]	$−117,259.11 [−30%]	—	—
y1999	$−53,610.76 [−17%]	$−71,284.83 [−18%]	$−11,859.64 [−7%]	$−405,521.31 [−47%]
y2000	$−55,569.02 [−18%]	$−19,598.95 [−5%]	$13,119.67 [7%]	$−398,269.85 [−46%]
y2002	$−392.58 [0%]	$−26,415.73 [−7%]	$45,724.11 [25%]	$−122,808.50 [−14%]
y2003	$−25,527.74 [−8%]	$46,598.89 [12%]	$21,374.77 [12%]	$19,988.69 [2%]
y2004	$9,079.23 [3%]	$56,517.05 [15%]	$65,517.35 [36%]	$−36,194.93 [−4%]
y2005	$31,173.82 [10%]	$91,579.95 [24%]	$85,906.12 [47%]	$−9,334.36 [−1%]
y2006	$43,479.66 [14%]	$105,091.92 [27%]	$134,184.84 [74%]	$119,645.79 [14%]
y2007	$41,298.91 [13%]	$118,210.09 [31%]	$153,611.24 [84%]	$219,166.43 [25%]
y2008	$20,011.39 [7%]	$57,877.84 [15%]	$132,660.06 [73%]	$269,667.03 [31%]
y2009	$−12,875.68 [−4%]	$23,775.96 [6%]	$115,186.50 [63%]	$−10,936.42 [−1%]
y2010	$−13,573.61 [−4%]	$31,378.28 [8%]	$60,106.58 [33%]	$−315,618.56 [−37%]
y2011	$−40,648.22 [−13%]	$18,488.67 [5%]	$114,328.93 [63%]	$126,108.61 [15%]

Note: Brackets indicate percentage change for Box-Cox marginal effects.

Exhibit 11 | Extended County Level Regression Results (Coefficients with Robust SE)

Variable	Larimer	Douglas	Mesa	Routt
INTERCEPT	45.6200***	54.7006***	42.3353***	53.587***
	(1.123)	(1.6047)	(2.2947)	(4.1368)
LIVING AREA	0.0224***	0.0165***	0.0260***	0.0322***
	(0.0019)	(0.0022)	(0.0061)	(0.0045)
LOT AREA (IN SQ. FT.)	0.00001***	0.0001***	0.0001***	0.0000
	(0.0000)	(0.0000)	(0.0001)	(0.0000)
AGE	0.0154	−0.2324***	0.0224	0.0562
	(0.032)	(0.0467)	(0.0624)	(0.2091)
NUMBER OF BATHROOMS	0.7028***	−0.0352	0.8437	1.7380
	(0.3272)	(0.4793)	(0.6592)	(1.0474)
DISTANCE TO LARGEST TOWN	−0.0000	−0.0001	−0.0013***	−0.0017
	(0.0001)	(0.0003)	(0.0004)	(0.0009)
NUMBER OF BEDROOMS	−0.8383***	–	−1.4602***	−0.8383
	(0.3547)		(0.6718)	(0.9109)
GARAGE	2.4534***	0.9790	2.4529***	1.7454
	(0.4948)	(0.8290)	(0.8698)	
BASEMENT	1.8640***	0.2560	−1.7319***	—
	(0.4463)	(0.5465)	(0.8112)	
FINISHED BASEMENT	−2.6850***	−0.3953	—	—
	(0.3937)	(0.3833)		
CENTRAL AIR	0.6165	—	1.1908	—
	(0.4293)		(1.3310)	
NO QUALITY REPORTED	7.4356***	—	−2.5606	—
	(0.8614)		(1.4757)	
EXCELLENT QUALITY	10.9539***	1.5333	0.9278	—
	(2.5152)	(3.0542)	(1.2640)	
GOOD QUALITY	3.8698***	1.1001***	0.4309	—
	(0.4489)	(0.5462)	(0.8781)	
FAIR OR LOW QUALITY	−2.1805***	—	−2.6369	—
	(0.9768)		(1.4337)	
POOL	1.5694***	—	0.6802	—
	(0.6358)		(0.6555)	
WATERFRONT	−0.4190	—	—	—
	(1.8481)			
REGULATED C.D.	1.8950***	3.8310***	1.5257	5.1867
	(0.5254)	(1.2421)	(1.5761)	(2.9272)
UNREGULATED C.D.	2.2084***	5.7890	1.0996	8.8679***
	(0.3499)	(3.7583)	(1.1081)	(3.3542)

Exhibit 11 | (continued)

Extended County Level Regression Results (Coefficients with Robust SE)

Variable	Larimer	Douglas	Mesa	Routt
y1998	−5.2488***	−4.3416***	—	—
	(0.6223)	(1.0613)		
y1999	−1.5491***	−2.7161***	−0.8217	−8.2994***
	(0.7035)	(0.5241)	(2.0545)	(2.5720)
y2000	−2.2197***	−0.8680	0.6465	−8.1100***
	(1.0894)	(0.9894)	(1.5517)	(2.5274)
y2002	0.5876	−0.9755	3.2566***	−2.5889
	(0.6730)	(1.4874)	(1.5667)	(2.9605)
y2003	−0.3886	1.8030***	1.5256	−0.0564
	(0.7174)	(0.5135)	(1.6166)	(2.7280)
y2004	1.2155***	2.1126***	4.8424***	−0.9115
	(0.5746)	(0.8010)	(1.4539)	(2.5327)
y2005	2.0164***	3.4278***	6.0922***	−0.2189
	(0.5640)	(0.5776)	(1.3691)	(2.6408)
y2006	2.4144***	3.9157***	9.1358***	2.3082
	(0.6330)	(0.5971)	(1.4029)	(2.9120)
y2007	2.1606***	4.4696***	10.1347***	4.1604
	(0.6491)	(0.9213)	(1.4340)	(3.4900)
y2008	1.0014	1.6120***	9.5560***	4.8215
	(0.6244)	(0.6076)	(1.5989)	
y2009	−0.1560	0.8311	7.7524***	−0.6304
	(0.8170)	(0.8852)	(1.6734)	(3.1140)
y2010	−0.6630	0.9794	3.8029***	−6.4823
	(0.7888)	(0.8673)	(1.7849)	(5.6945)
y2011	−2.8867***	0.4589	7.0361***	2.2148
	(0.7381)	(1.7272)	(2.1638)	(2.9694)
R^2	0.8149	0.5957	0.6251	0.6601

Notes: Parentheses indicate *t*-stats. For Larimer, $N = 936$; for Douglas, $N = 632$; for Mesa, $N = 347$; for Routt, $N = 265$.
***Significant at the 5% level.

Exhibit 12 | Extended County Level Regression Results (Marginal Effects)

Variable	Larimer	Douglas	Mesa	Routt
LIVING AREA	$62.17	$61.51	$56.22	$230.23
LOT AREA (IN SQ. FT.)	$0.07	$0.12	$0.11	$0.05
AGE	$149.27	−$3,006.04	$159.02	$1,443.10
NUMBER OF BATHROOMS	$9,100.33	−$648.52	$8,332.10	$58,609.43
DISTANCE TO LARGEST TOWN	−$0.03	−$0.38	−$2.18	−$10.00
NUMBER OF BEDROOMS	−$11,317.93	—	−$14,866.89	−$29,973.10
GARAGE	$44,196.44 [18%]	$24,939.11 [7%]	$33,291.88 [20%]	—
BASEMENT	$33,578.80 [14%]	$6,521.70 [2%]	$−23,505.66	—
FINISHED BASEMENT	$−48,369.23 [−20%]	$−10,069.39 [−3%]	—	—
CENTRAL AIR	$11,106.23 [5%]	—	$16,161.59 [10%]	—
NO QUALITY REPORTED	$133,949.76 [56%]	—	$−34,753.66 [−21%]	—
EXCELLENT QUALITY	$197,330.27 [−21%]	$39,061.44 [10%]	$12,593.14 [7%]	—
GOOD QUALITY	$69,712.52 [29%]	$28,025.21 [7%]	$5,848.08 [3%]	—
FAIR OR LOW QUALITY	$−39,279.96 [−16%]	—	$−35,789.55 [−21%]	—
POOL	$28,271.25 [12%]	—	$9,231.92 [5%]	—
WATERFRONT	$−7,548.14 [−3%]	—	—	—
REGULATED C.D.	$34,137.22 [14%]	$97,594.29 [26%]	$20,707.78 [12%]	$253,416.84 [30%]
UNREGULATED C.D.	$39,782.75 [16%]	$147,473.92 [39%]	$14,924.09 [9%]	$433,270.85 [51%]

Note: Brackets indicate percentage change for Box-Cox marginal effects.

Conclusion

Housing markets at the national, regional, and city levels are recovering from the housing crash of 2007. Conservation development projects are not immune to the stigma and negative consequences of households deleveraging, increasing defaults, decreasing second home markets, and lower homeownership rates (Burger and Carpenter, 2010). Numerous transactions were eliminated from our study due to deed types reflecting foreclosures and public sales. As the country eventually recovers from the Great Recession of 2007 and 2008 with improved economic conditions, interest in CDs and other housing transactions is likely to improve.

Our research focused on three questions. Based on our analysis, we conclude there are significant differences in prices for homes in CD projects versus 35-acre, large lot, and unregulated CD projects; there are significant differences in prices for homes in CD projects across the five Colorado counties; and there are significant differences in the total number of sales and transactions between CD projects and non-CD projects.

Despite low per hectare yields, CDs may not represent an unattractive alternative to developers of rural land or land on the urban/rural fringe. As other authors (Mohamed, 2006; Bowman, Thompson, and Colletti, 2009) have noted, there are reasons to expect cluster development plans like CDs to decrease developer costs rather than raise them—if we compare plans for the same site. While lot size does itself represent an amenity, the results suggest that the impact of additional privately-held land is only 9 cents per square foot or $4,062 per acre. Given the average lot size of a home in a large lot development (4.6 acres), allocating two-thirds of the land of the development site to conservation would provide roughly twice the price premium of allocating the same land to larger individual lots.

Our research demonstrates a significant sales price premium for homes located in CDs relative to comparable non-CD projects, while controlling for housing, time, and location factors. We find that while the price premium associated with regulated and unregulated CDs is similar, the impact of property characteristics on prices in the two categories may differ. Understanding such differences between CDs and non-CDs will help developers and residential brokers create appropriate development and marketing strategies. If CD projects are also ecologically beneficial, our results suggest that this approach to development is a viable tool for conservation finance.

This research is limited to sales transactions for the five counties and four development categories. We do not address initial lot sales, net absorption trends, time to construct a home after the initial closing, or the value of the initial home; we capture only sales subsequent to all of these events. It is therefore possible that further research into the initial development, marketing, and home construction factors may complicate or confirm our results. If a relationship exists between turnover and CD status within specific school districts only, our data set may not capture bias induced by school district. Additionally there is very limited research on the overall financial returns to the developer with sufficient data such as time-dependent development costs, expenses, and lot sales to calculate internal rates of returns. Although our extensive dataset included transactions indicating foreclosures, we did not address how CD projects compared to non-CD projects during the recent housing downturn.

Endnotes

1 This article is a product of the Global Challenges Research Team on Conservation Development, School of Global Environmental Sustainability, Colorado State University (http://cd.colostate.edu).

2 The primary residential dataset is a unique database of approximately 1.7 million residential sale transaction records for the period 2000 to 2011:Q1 in the State of Colorado collected by CoreLogic (http://www.corelogic.com/).

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Christopher Hannum, Colorado State University, Fort Collins, CO 80523-1771 or christopher.hannum@colostate.edu.

Steven Laposa, Alvarez & Marsal Real Estate Advisory Services, Denver, CO 80202 or slaposa@alvarezandmarsal.com.

Sarah E. Reed, Colorado State University, Fort Collins, CO 80523-1401 or sarah.reed@colostate.edu.

Liba Pejchar, Colorado State University, Fort Collins, CO 80523-1771-1474 or liba.pejchar@colostate.edu.

Lindsay Ex, City of Fort Collins, Fort Collins, CO 80523 or lindsayex@gmail.com.