The Journal of
Regional Analysis & Policy

JRAP 39(2):131-140.

The Economics of Ghost Towns

Philip E. Graves#, Stephan Weiler*, Emily Elizabeth Tynon#
*University of Colorado#, Colorado State University** –USA

Abstract. The ghost towns of the American West are both intriguing historical artifacts and reflections of unique economic forces at work. In this study we develop linked labor and housing market models balancing the wages, rents, and local amenities of isolated boomtown sites to better understand the sources of such communities' dramatic cycles. High variance boomtowns provide a unique context for investment in housing and other foundational infrastructure, leading directly to the unusually transient local development patterns seen in ghost town settings. We use Colorado-based case studies to illustrate the relevance of the model. Comparisons with more modern rural settings in Appalachia and the Midwest suggest that the model provides a framework to better understand the process of rural decline more generally.

1. Introduction and literature review

"Ghost towns" are common terminology for completely depopulated communities, leaving scant evidence of their previous existence beyond the decaying buildings themselves. While such sites are ubiquitous in the Western United States, Appalachian and Midwestern towns have also experienced this phenomenon. All are typically found in isolated plains or mountain locations. Most of these towns were based on intensive mining booms typifying the extractive industries of the 19th and early 20th centuries, while some were oriented towards extensive ranching practices.

The rapid rises and falls of these communities are obviously linked to the parallel booms and busts of their local industries. Such booms and busts usually required both the quick acquisition, and the often equally rapid dispersion, of critical labor supply in isolated, difficult circumstances. From the dust of Tombstone to the brutal high-altitude conditions of Leadville, the living and working conditions of such boom and bust towns were usually inhospitable. Some compensating wage differentials for undesirable local conditions were clearly required, but what was their source? Furthermore, given the large amount of quick wealth that was often generated in such settings, it might seem surprising that localities remained so narrowly dependent on single industries since demands for non-basic goods could be large and growing.

This study links local labor and housing/fixed investment market models to frame the understanding of the sources and dynamics of ghost towns' dramatic cycles. This linkage will be seen to provide insight into these historical causes of boom and bust. Moreover, the modeling approach, and future empirical extensions of it, should enable testable predictions to be made about towns destined to become ghost towns in the future.

Negative amenities clearly constrain the ability of firms to attract labor. Yet extractive industries also generate a significant amount of Ricardian rents. Extraction occurs on fixed resources, such as grazing land property or mining claims on a particular mineral vein. Ownership of these varying quality resources generate varying amounts of Ricardian rents. Given the inhospitable settings, management must share a significant proportion of rents with its workers, to compensate them for pronounced local negative amenities.

Busts can occur due to either resource exhaustion, such as overgrazing or mineral depletion, or sudden drops in demand. Economic rents are returns over and above those needed to keep a resource in its current use (e.g., abnormally fertile land or concentrated ores). These rents on owned inputs can dissipate quickly, leading to rapid depopulation. Normally, transition and information cost difficulties hamper quick adjustment, but these industries naturally attract workers with low mobility costs, accelerating in- and out-migration. These same mobility characteristics, along with the well-understood uncertainty regarding the viability of the primary local economic base, lead to little local diversification and predominantly short-term investment perspectives.

The interaction of resource depletion, amenity compensation, and mobility is a specific focus of this work. Rents accrue to the owner of the extractive vein, with the wages going to labor embedding compensation for harsh environments. Limited horizons lead to reductions in optimal quality and quantity of infrastructure as investors will seek combinations of low-fixed-cost installations alongside requirements for higher short-term returns to offset the anticipated future decline of the local economic base. This paper examines the housing market as a quantifiable example of more general fixed investments, exploring disincentives present for communities possessing especially transient local economic bases.

To empirically evaluate the framework we offer in this study we analyze historical census data for Rocky Mountain mining communities. By examining historical local conditions such as population, male/female ratios, average wages, the number of dwellings, and other information, we test the predictive and explanatory power of the model's investment implications. Further, the model has applicability in the less extreme settings of more modern Appalachian mining and Midwestern agricultural communities, resulting in a greater understanding of the process of rural community decline.

In section II we first develop a single local labor market model of input market rents balancing disamenities, later introducing the implications for local wage/land-rent combinations and for housing markets. In section III we provide empirical support for the model, employing historical census data comparisons for the Rocky Mountain Region. Then in section IV we sketch the model's policy implications for Appalachia and the Midwest prior to a brief concluding Section V.

2. Methods and data

Ricardian input rents result from variation in quality of owned inputs (e.g., variation in ore quality in the mining context or variation in land fertility in the agricultural setting). Ore veins and land quality are expected to be depleted most rapidly near population concentrations, since nearby resources have lower transportation costs. Hence the highest Ricardian rents are expected to exist in more remote, less hospitable locations. The owners of resources in such locations must offer labor higher wages to compensate for local disamenities (see Roback, 1982) and for expected future moving costs upon resource depletion, which will be important in the ghost town context.

Hence the rents must be divided between owners and workers during the useful life of the resource. Workers must receive higher wages than elsewhere to compensate for harsh conditions and would be expected to self-select on mobility costs, with low-movement cost workers at remote boomtowns. In particular, single male workers are likely to be disproportionately represented in the labor market vis-à-vis the married, since the latter will have both higher moving costs and more family members to experience the negative local amenities.

The expectation of future resource depletion, moreover, has implications for the housing market in boomtown areas. Rents would be expected to be higher and housing durability lower, in some mix, since the going return to capital investment must be obtained in a smaller number of periods than is the case in more typical locations.

2.1. The Ghost Town Labor Market

The central theoretical observation regarding the ghost town labor market is that entrepreneurs will wish to locate among *n* sites so as to maximize the difference between the shadow value of their claims $P_N(n_i) \cdot N$, where N is the quantity of natural resources whose value is $P_N(n_i)$ and the compensation they must pay workers $W_L(n_i) \cdot L$, where L is labor hired at price $W_L(n_i)$. The nature of the sites need not be monotonic in distance from "civilization" (i.e. quality of veins higher at more distant locations and greater compensation required at more distant locations but one would generally expect this relationship. If distance from civilization per se is a disamenity, vein quality or land fertility must also be greater to compensate labor. Hence we will assume, for simplicity, that more distant sites are less desirable to households but more desirable to firms.

Firms are taken to be perfect competitors selling their products (e.g. homogeneous rare metals) on a national market. A typical firm will be maximizing:

$$\pi = P_Q \cdot Q - P_K(d) \cdot K - W_L(d) \cdot L - P_N(d) \cdot N \qquad (1)$$

where Q = output of the firm and K, L and N are capital, labor and natural resources, respectively. The input prices, as suggested by introductory discussion, will be functions of d, distance from "civilization." $P_K'(d)$ and $W_L'(d)$ are expected to be positive, indicating that the farther is the firm from existing settlements, the greater is the cost of both capital and labor, with particular emphasis here on required compensation for the harsh conditions facing labor. $P_N'(d)$ is negative reflecting the fact that output costs will be lower the higher is the quality of the ore or the greater the fertility of the land vis-à-vis nearby ore or field quality.

Ownership of the depletable resource, N, provides the Ricardian rents necessary for the required capital and labor compensation. That is:

$$P_N'(d) \cdot N \geq P_K'(d) \cdot K + W_L'(d) \cdot L \qquad (2)$$

Equation (2) merely argues that the greater Ricardian rents at more distant locations must be large enough to offset greater costs of capital and labor at such locations. If rents exceed the required compensation, extra normal profits will be earned by mine operators or the land owners.[1]

The workers will be self-selected by relocation costs, with low cost workers accepting firms' wage offers. The unique features of boomtowns suggest that the workers who consider such positions necessarily accept transient lifestyles. Therefore, adjustments are undertaken quickly, with depletion of rents leading to quick depopulation of the boom-bust town. Just as quickly, these workers will gravitate towards the next boomtown, assuming that rents are sufficient to attract workers to the new negative amenity environments.

The expectation of a precipitous local cycle would be expected to lead to reluctance by firms and workers to invest in the local community. The local community is built around an uncertain economic base: sudden depletions or product price reductions can easily cause a town's economic base to evaporate. Therefore, any investment in related trade and service activities will be minimal and transitory, explaining the dependence of such towns on similarly transient local traders.

In the following sub-section we develop a framework to understand these limited incentives for longer-term investment in terms of the local housing market. While housing investment is important in itself for determining the viability of a local community, the discussion of housing investment also applies to investment in other sectors and infrastructure in the face of dependence on a narrow and highly uncertain product market.

[1] In long-run equilibrium, firm entry would lead one to expect that all locations would be equally profitable, hence that Equation 2) holds as an equality.

2.2. Amenities and Investments in Ghost Towns

In the context of the unique factors influencing a boom/bust type of location, both firms and workers face distinctive combinations of wages and rents required for equilibrium (in this section, "rent" implies ordinary land-rents faced by firms and workers, in contrast to the Ricardian input rents discussed in the production process of sub-section a). As a result, wages and rents are a direct function of the amenity setting characterized by an extraction economy, where high variance of economic prospects are expected by both workers and firms.

The wage/rent model presented in this study is developed from and is an extension of Roback (1982), Rosen (1979), and Mueser and Graves (1995). Workers and firms are presumed rational and, therefore, choose to locate in this boom/bust setting in order to maximize utility and profits respectively. Workers are assumed to be identical in their preferences for wages, and in fact are focused more on offered wages relative to rents than would be typical. As already discussed, the type of worker drawn to this setting is a transient, lower skilled laborer seeking the short-run elevated wage potential of a booming site. The utility maximization problem for the representative worker, given some level of amenities[2], A, in this setting is to choose quantities of consumption goods, x, and l, the amount of residential land consumed, to satisfy a budget constraint:

$$\text{Max } U(x, l; A) \text{ subject to } W + I = x + lr. \qquad (3)$$

The wage income is signified by W, where $W \equiv w\bar{h}$, w being the hourly wage, $\bar{h}$ being a fixed quantity of labor supplied[3], rent denoted as r, and non-labor income is represented by I. Utility-equalizing combinations of wage and rent, holding amenities constant, are seen in the representative agent's indirect utility function, V. There are an infinite number of such indirect utility functions, or disamenity, that leave the representative worker indifferent among locations; areas with desirable amenities will experience in-migration driving up rents and driving down wages, and conversely.

[2] Amenities can take many forms such as climate or access to the culture and goods availability present in existing cities. For present purposes, one need only assume that the net value of the vector of the amenities present in a boom-bust type of location is lower than elsewhere.

[3] The higher wages might be expected to lead to greater work effort, particularly given the expectation that such long hours would be temporary.

This relationship is depicted in Figure 1, with V representing isoutility combinations of w and r for the representative worker. In the case of ghost towns, the utility-equating V′ function is to the right of the V curve for an amenity neutral location. That is, relative to more typical locations, the undesirable amenities of what will become a future ghost town will require some mix of lower rents or higher wages. If the V′ function were not to the right of V, thus providing higher w at the same r, workers would have no incentive to move to this type of negative amenity setting. The isoutility function V(A) shifts to the right when amenities (e.g. hostile climate and distance to civilization) are lacking to become $V(A_G<A_{typical})$, A_G signifying the undesirable amenity bundle workers associate with a location destined to become a ghost town. Hence, a higher wage will be paid in a ghost town location than in a positive amenity location, as a necessary compensating differential to attract and retain workers in difficult settings. The source of these compensating differentials are the economic rents from the labor market model of the preceding section.

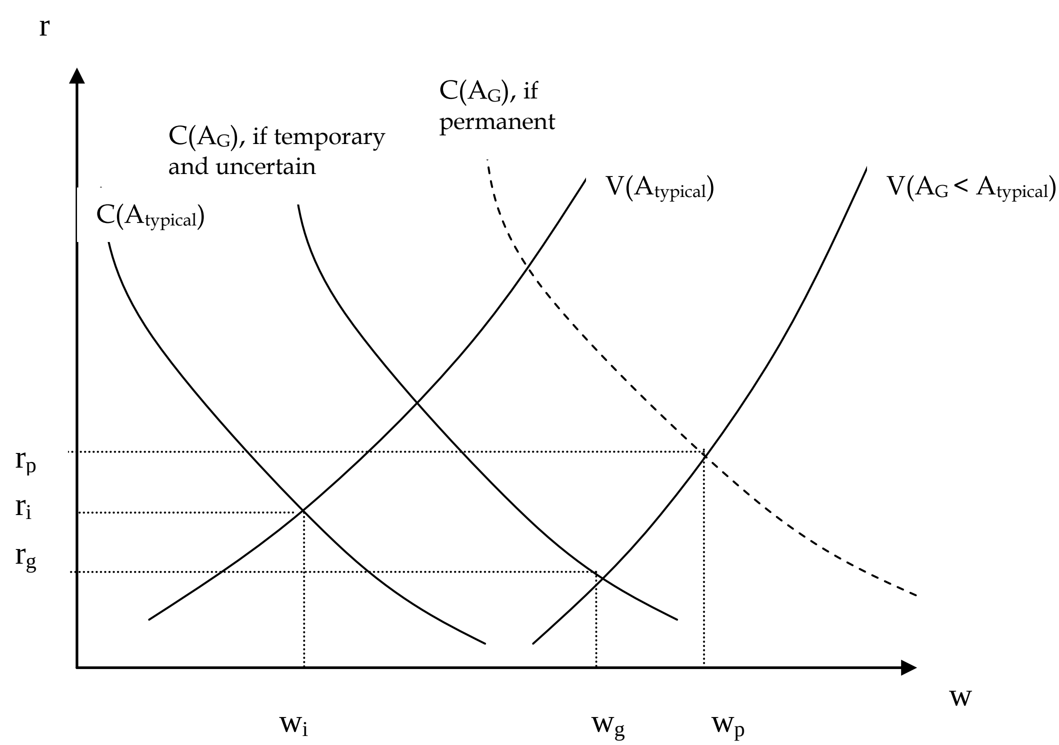

Figure 1.

In equilibrium, the firm's unit cost function reflects the fact that higher wages paid to workers must be offset by lower "net" rents at the optimal level of production.[4] In the boom/bust context, the representative firm sees positive locational amenities during booms due to their unique ability to capture excess profits due to Ricardian input rents. Therefore, the cost function in this environment making firms indifferent between this location and others is reflected in line $C(A_G>A)$.

The Boomtown equilibrium will depend on the expected size of the boomtown's core industry return stream balanced against the anticipated longevity and uncertainty of the boom itself. Capital will be allocated over space to equalize the risk-adjusted rate of return. Therefore, the net present value (NPV) of capital investments will be the same in all places despite different time patterns of returns from those investments. In terms of the boomtown, the longer the expected return stream and the lower the uncertainty of that return in a specific area, the more capital will flow in. This is reflected by the $C(A_G)$ Permanent dashed line in Figure 1. The more uncertain case is represented by the $C(A_G)$ Temporary curve, reflecting the fact that the locational amenity for firms is smaller with a consequently smaller amount of capital moving into the "boom" location.

[4] The "net" here reflects the sum of lower rent payments and the Ricardian input rents.

The rent effect is, in general, ambiguous; it will depend on how "bad" the Ghost Town amenities are for workers, relative to how "good" the Ghost Town amenities are for firms (e.g. how much gold or yield per acre relative to how uncivilized the conditions). The wage will, however, be higher with certainty since both the increase in demand for labor and the decrease in supply of labor work in the same direction. Both worker and construction behavior are fundamentally influenced by the perceived transiency of the boom. Workers obtain higher wages for both the negative amenity and volatile employment prospects. Given the ambiguous rent effect, builder perspectives on such transiency are likely to translate into a low incentive to provide durable place-specific investments in housing and commercial district construction.

The linked models of subsections a) and b) provide several testable hypotheses. First, one should observe higher and more variable wages in boomtown settings. Additionally, the theoretical framework suggests, ceteris paribus, reduced quantity and quality of permanent dwellings and other types of fixed capital investment in locations destined to become ghost towns. Thus, increases in low quality housing would be expected, with rents being relatively high for that quality of housing; followed by subsequent declines in the housing stock as the production amenity dissipates in Ghost Town settings. In-migrants will self-select to be those with lowest moving costs, with single males being the predominant type of Ghost Town resident as discussed earlier. Finally, population movements not explained by time trends are also more likely in Ghost Town settings, due to the quick responses of labor supply discussed earlier.

3. Data analysis: the Rocky Mountain mining region

To establish a useful empirical benchmark, we consider the Rocky Mountain region which featured many mining communities in the late 19th and early 20th centuries. Colorado has an extensive mining heritage, beginning with the discovery of gold in 1859, later including coal, gypsum, limestone, silver, and molybdenum. The primary source of data for this study is the United States Historical Census Data Browser assembled by the University of Virginia. Relevant categories and comparable data began with the 1870 tabulation, with analyses thus focused on the last three decades of the 19th century. Given the Rocky Mountain results, policy applications to Appalachian mining and Midwestern farming communities are explored in the following section to help understand the potentially broader policy relevance of the model for rural community decline.

3.1. Background

Colorado mining towns exhibited remarkably large boom and bust swings with similar patterns in many extractive locales. The boom years fostered substantial development for the mountain communities. Not only were laborers drawn to the sites, but others seeking to cash in on newly demanded services for the new dwellers rushed in. General stores, taverns, blacksmiths, medical and dental practices, inns, and many other service-related businesses blossomed. Houses were built, and the economies would have seemed to be sustainable.

The ripple effects, however, were extensive when the mine ore began to dwindle. The once thriving economies became Ghost Towns seemingly overnight. Buildings were left vacant, deteriorating rapidly–some were literally dismantled and burned to provide heat in the cold winters that were often prevalent. Laborers and service workers moved on to the next booming location. With laborers fleeing from the extractive industries, any support businesses present were quickly left without consumers, causing them to also abandon the community.

As an initial case study, we analyze the effects of the classic boom/bust economy of Lake County, Colorado. Perhaps more than any other county in Colorado, Lake County is the richest in mining history. Lake County was an original county dating back to the creation of the Colorado Territory in 1861, and ranked as Colorado's second most populous county in the late 1800's. The discovery of gold in 1860 in the California Gulch led to a rush of prospectors across the infamous 13,180-foot Mosquito Pass to seek their fortunes. The gold rush in Leadville, Lake County's primary mining town, began a series of prospecting cycles. The Silver Boom started in 1877, then quickly collapsed with the repeal of the Sherman Silver Purchase Act in 1893. Molybdenum began the next boom cycle in 1918, as the Climax Mine became the largest underground molybdenum mine in the world.

In addition, Teller County, Colorado is examined due to the discovery of gold in the town of Cripple Creek in 1890. Railways were already beginning to extend to Cripple Creek from all directions by 1891. By the time the town was officially incorporated in 1892, there were over 5,000 Gold Camp residents. Approaching the turn-of-the-century, expanding throughout Cripple Creek were 73 saloons, 49 grocery stores, 34 churches, 20 meat markets, 14 bakeries and 11 laundries. "Today the fame of the Cripple Creek Gold Camp ranks with London, Paris and other money centers of the world, for, while the great money centers may handle and control more of the world's assets, Cripple Creek actually adds more new money to the treasury of the world than any other place. Nearly $2,000,000 are added every month to the world's wealth by the product from the hills within The District of Cripple Creek" (Cripple Creek Times, 1904).

The area's mines were responsible for making the region the fourth largest gold producing location in the world. In the first year of production, mines reported about $250,000 taken from the ground. By 1893, miners had dug up $3 million in gold ore, and by 1899 about $59 million in ore had been extracted from the site. Toward the conclusion of the gold rush, area mines had produced $432 million.

Around the turn of the century, assay offices were as prevalent as general stores. Service related industries also began to flourish due to the increased demands of the miners. Wooden store fronts lined the dusty streets and tent cities quickly sprang up. In 1896, the town burned to the ground in two consecutive fires. Brick buildings then replaced the old wooden shops. Most of these brick buildings have been refurbished and now exist as casinos filled with visitors trying to hit a modern-day jackpot.

In Table 1 we illustrate the differences in demographic and labor market attributes for Lake County, Teller County, Arapahoe County, and the State of Colorado as a whole.[5] Lake County's population was dominated by the Leadville area from its inception, and was also geographically consistent beginning in 1879. Similarly, Teller County's dominant population center was Cripple Creek. Arapahoe County included Denver from 1870-1900. In 1902, Arapahoe County split apart and formed portions of Denver, Adams and Washington Counties. Therefore, Arapahoe will serve as a benchmark up until 1900. In 1900, Arapahoe County was the most populous county in Colorado. To incorporate local market dynamics for the early 20th century, Lake, Teller, and Colorado data are extended through the 1920 census.

3.2. Historical census analysis

Based on the model and the census data information available, our principal hypotheses for a boom/bust area, relative to other areas, include: 1) an overall high mean wage along with a high wage variance, 2) a high population variance, 3) a high male/female ratio with a high male/female ratio variance, and 4) greater variability in the number of dwellings. In Table 1 we summarize the cross-sectional and time-series data, as well as key descriptive statistics.

Manufacturing wages are the only wage data available, but these should reflect more general market rates for manual workers in the area. The overall mean wage in Lake County and Teller County across both its booms and busts was greater than Arapahoe County and Colorado as a whole. In terms of the higher overall mean wage hypothesis, the 1890 data point from Lake County is particularly instructive, as this was a year in the middle of the Silver Boom. Wages were 30 percent greater than in Arapahoe County, 42 percent greater than the state average, and 59 percent greater than Lake's own 1870-1900 mean.

Teller County wage data even more clearly confirm the model's hypotheses regarding wage dynamics. As noted in the historical background, the key decennial shift was from 1890 to 1900 with the gold boom. Indeed, Teller wages increased by 37 percent in the same decade which saw wages *decline* in all the other focal counties, as well as for the state as a whole. In 1900, the average wage was 31 percent higher than Arapahoe County and the State of Colorado as a whole, and was 17 percent greater than the sample period average in Teller County.

Variance that cannot be explained by a standard linear trend model is a simple benchmark for variability for such short time series. Linearity is an alternative to the specification of an exponential trend, although results using the latter are similar to those using linear trends. The trend comparison approach is still limited, as demonstrated in the case of wage variability. Wages are clearly more variable in Lake and Teller over 1870-1920, but the unexplained variance measure does not properly capture these cycles. In contrast, total population displays more concrete variance in Lake and Teller; the calculated unexplained variance is 0.9999 in Lake and 0.9847 in Teller as compared to Arapahoe County's 0.0617 and Colorado's 0.0061. The high population variance is due primarily to large variations in discovery and value of gold and silver – footloose migrant workers migrant workers damped the wage variation that would have otherwise occurred.

Clearly, both Lake and Teller Counties experienced a much greater degree of variation in population size. Lake County encountered this during the last part of the 1800's, a characteristic that continued even more strongly into the early 20th century with the effects of the silver bust. Lake's population rises in 1880, then again in 1900, but then decreases dramatically in 1920. Teller County had substantial increases in population

[5] Since the data for Lake and Teller counties are included in the State of Colorado data, true differences will be larger than the apparent differences.

Table 1. Historical census data: Lake, Teller, and Arapahoe Counties, CO, and the state of Colorado

	Average wage per worker	Total Population	Male/ Female Ratio	No. Dwellings	Population per Dwelling	Males per Dwelling	(Population * Average Wage) per Dwelling
Lake County							
1870	378	522	2.87	*	*	*	*
1880	517	23,563	3.47	*	*	*	*
1890	1,019	14,663	1.62	2,992	4.9007	3.0294	4,992
1900	648	18,054	1.63	4,103	4.4002	2.7302	2,851
1910	787	10,600	1.33	2,852	3.7167	2.1248	2,927
1920	1,286	6,630	1.22	2,853	2.3239	1.2766	2,989
1870-1900:							
MEAN	640	14,201	2.40	3,548	4.6505	2.8798	3,921
UNEXPLAINED VARIANCE	0.6217	0.6706	0.3981	n/a	n/a	n/a	n/a
1870-1920:							
MEAN	773	12,339	2.02	3,200	3.8354	2.2902	3,440
UNEXPLAINED VARIANCE	0.3682	0.9990	0.2785	0.5684	0.0628	0.0494	0.9881
Teller County							
1870	454	2,051	1.64	*	*	*	*
1880	223	12,684	1.46	*	*	*	*
1890	588	30,395	1.36	5,977	5.0853	2.9341	2,988
1900	805	29,002	1.43	7,684	3.7743	2.2237	3,037
1910	830	14,351	1.22	4,099	3.5011	1.9207	2,906
1920	1,500	6,696	1.13	1,999	3.3497	1.7799	5,025
1870-1890:							
MEAN	421	15,043	1.49	5,977	5.0853	2.9341	2,988
UNEXPLAINED VARIANCE	0.8692	0.0204	0.0316	n/a	n/a	n/a	n/a
1870-1920:							
MEAN	689	15,746	1.39	5,147	4.1592	2.3585	3,389
UNEXPLAINED VARIANCE	0.2155	0.9847	0.1159	0.3296	0.2011	0.1060	0.4331
Arapahoe County							
1870	700	6,829	1.82	*	*	*	*
1880	535	38,644	1.55	*	*	*	*
1890	785	132,135	1.34	23,122	5.7147	3.2766	4,485
1900	614	153,017	1.02	31,107	4.9191	2.4861	3,019
MEAN	658	82,656	1.43	27,115	5.3169	2.8814	3,752
UNEXPLAINED VARIANCE	0.9999	0.0617	0.0850	n/a	n/a	n/a	n/a
State of Colorado							
1870	603	39,864	1.65	*	*	*	*
1880	456	194,327	1.98	*	*	*	*
1890	720	412,198	1.47	81,127	5.0809	3.0230	3,658
1900	613	539,700	1.21	120,364	4.4839	2.4537	2,747
1910	969	799,024	1.17	183,874	4.3455	2.3423	4,211
1920	1,219	939,629	1.10	211,103	4.4510	2.3341	5,426
1870-1900:							
MEAN	598	296,522	1.5770	100,746	4.7824	2.7383	3,202
UNEXPLAINED VARIANCE	0.8785	0.0092	0.4664	n/a	n/a	n/a	n/a
1870-1920:							
MEAN	763	487,457	1.4300	149,117	4.5903	2.5383	4,010
UNEXPLAINED VARIANCE	0.2632	0.0061	0.2701	0.0209	0.3794	0.2638	0.3914

each decade approaching the 1890-1900 era, and then sharply fell in the following years. In contrast, Colorado and Arapahoe's populations steadily increased throughout each decade.

Lake's male/female ratio is also distinctive. Total male population peaked in Lake County in 1880, but the female population lagged behind until its eventual peak in 1900. In every census year, the male/female ratio was higher in Lake than Arapahoe and Colorado, and generally displayed greater unexplained variance, with a particularly sharp spike in 1880. Interestingly, as the bust took hold in the early 1900's, the male/female ratio approached "normal" statewide levels. These findings are themselves indicative of an isolated boom/bust economy. Prospecting-focused males are the dominant initial and highly variable population base, given their lower mobility costs as they seek short-term manual labor opportunities with high, but risky, rewards. The female population arrives later, more slowly, and more steadily. While Teller's gender ratio levels are somewhat lower than Lake's, they still exceed both Arapahoe's and Colorado's levels in the critical 1900 boomtown census count by 40 and 18 percent respectively.

Finally, the data also indicate the short-term nature of fixed investment in the Lake and Teller boom/bust economies, as represented by the variability of the number of dwellings. While the number of dwellings steadily increases in linear proportions in Arapahoe and Colorado, both Lake and Teller experienced much greater variability, with unexplained variance at 0.5684 and 0.3296 respectively. The number of dwellings increases until 1900 for both counties, and then begins to decline as the extraction period draws to an end. Dwellings are rarely considered to be non-durable short-term investments. However, their absolute decline in the first two decades of the 20th century by nearly 31 and 36 percent respectively in Lake County, and even more dramatically for Teller County at a rate of 47 and 51 percent respectively, suggest that such construction was indeed focused on the short-term.

4. Conclusions

4.1. Appalachian coal

Like the Rocky Mountains, the mountain areas of West Virginia are home to abundant extractable resources, with coal being the primary target. In contrast to the Rocky Mountain expanse, the Appalachian mining regions have evolved in a manner that is less dramatic. Appalachian towns have declined more slowly than one would expect based on their employment conditions.

West Virginia was blessed with enormous reserves of energy rich bituminous coal. These coal deposits occur in fifty-three of the fifty-five counties. Underlying the topography of the state are sixty-two individual veins of coal which are considered economically feasible to mine. As indicated by historical records, early settlers seemed to be quite aware of the rich black natural resources in the western sections of Virginia. Coal is reported to have been mined as early as 1810 when a mine was operated near Wheeling, in the northern panhandle. Coal has continued to grow in production since that time, with wage rates among the highest in blue-collar occupations. Over the last 30 years, however, technological improvements have led to decreasing needs for labor and cleaner burning oil has been substituted for coal in many applications. Hence, mining employment fell steadily in the latter stages of the 20th century. Yet despite the disappearance of many of the coal-based jobs in the region, coal towns have declined more slowly than would be expected by the histories of their Rocky Mountain brethren.

Home ownership, and the endogenous network/roots that come with it, seems to be a critical reason for the disparity between the boom and bust patterns across the regions. Formal/informal networks and interregional mobility costs play a major role in determining the ability of a local labor market to adjust to a given shock. Given high home ownership rates and the importance of local networks highlighted in Weiler (1997), migration involves a significant sacrifice relative to the boomtowns of the West. These high worker transition costs are underscored by the relatively slow adjustment to labor market shocks, as seen econometrically in Weiler (2000). Much of the housing in such hilly terrain, however, is based on fabricated and mobile homes, which have less longevity than typical flatland dwellings.

This finding highlights the possibility that mortgage interest deduction tax policies may have a wider array of unintended consequences than is currently understood. Varian (2005) recently argued that the mortgage deduction should be eliminated entirely, suggesting that there may be overconsumption of housing due to its unusually advantaged tax status relative to other assets. While speculative in the Ghost Town context, such policies can make homeownership attractive even in the face of variable employment prospects, increasing adjustment costs in stagnating regions. This problem is compounded by the fact that home/land values can decline rapidly in such areas, as underscored by this study's wage/rent model, further exacerbating mobility costs as the "terms of trade" of moving to an alternate location deteriorate.

4.2. Midwest farming[6]

The Midwestern agriculture region is another useful example of a seemingly promising rural setting founded on a localized natural resource-based agricultural economy which later stagnated. Farm employment has continually contracted since the end of World War I. Even current farm households only receive ten percent of their income from on-farm activities. Yet in contrast to the Rocky Mountain mining boom towns, the Midwest has experienced a much slower decay. The period of adjustment is at the opposite end of the spectrum as compared with towns like Leadville and Cripple Creek, Colorado, with Appalachian coal areas seem to occupy an intermediate point in the spectrum of rural community decline.

The context provided by the Homestead Act of 1862 further highlights the contrasts between the varying boom/bust behavior, especially for the polar extremes of Colorado mining towns and Midwestern plains communities. In the Colorado data, the overall state and flatlands of Arapahoe County were most affected by the inflow of Homesteaders, creating the boom of the late 19th century in agricultural eastern Colorado (Abbott, Leonard, and McComb, 1994). Yet despite the apparent legal advantages for booming Plains communities, the mining towns nevertheless showed considerably more evidence of boom (and bust) than the areas that were most heavily shaped by homesteading.

Nevertheless, homesteading and the Plains' agricultural base likely had a related effect on investment behavior. Building on the model presented in this study, the Midwest had considerably more investment in more durable housing and commercial structures than either the Ghost Town or Appalachian settings, some of this disparity is a likely a result of a distance effect that reduces mobility out of the Midwest; ghost towns, particularly, and Appalachia to a lesser extent are "easier to escape." In addition to this distance effect, these investments were based on the perception of far longer-term, as well as more stable, returns to the local farming industry.

As emphasized by Glaeser and Gyourko (2004), investments in durable structures will tend to significantly slow the adjustment of areas in economic decline. The contrast of the very slow transitions of Midwestern farming towns with the polar case of boom/bust Rocky Mountain Ghost Towns and the intermediate case of Appalachian mining communities conform to model expectations. Combining the joint labor and housing market model of boom/bust-towns employed here with Glaeser and Gyourko's compelling durable housing arguments result in a better understanding of the process of decline in rural communities.

Varying mobility costs will determine how communities adjust to shocks, with lower mobility costs sparking quick outmigration and economic senescence. The degree to which this process is in conflict with public interests is likely to differ by community, also varying directly with the mobility costs characteristics of the populace. Boomtowns which have been more successful over the longer term may eventually attract higher mobility cost residents, who will seek more private and public initiatives to reverse a town's economic fortunes. This combination of efforts might include economic diversification, tapping external resources (e.g. state and federal adjustment programs), local purchasing campaigns, and historical/cultural preservation and tourism. To some extent the ubiquitous nature of Midwestern disamenities (e.g., gray winters, humid summers) imply that such programs may be fruitless in the long-run (see Graves, 1979).

Ghost town economies are shaped by the unusually high-variance cycles in extractive industry settings, coupled with the positive amenities for firms during boom periods alongside on-going negative locational amenities for workers in these often harsh, isolated settings. The models offered here provide a perspective that incorporates these features, leading to situations where both firms and workers have especially narrow short-term perspectives on investment and labor returns. The result are economies with little diversification, rapid cycles, and fixed investment that is both limited and easily disposable.

While testing the full range of hypotheses of this theoretical structure is difficult given data limitations for the key periods of inquiry, such as the late 19th and early 20th century, historical census data can allow assessment of indirect indicators of the boom/bust experience. Initial inquiries regarding Lake and Teller counties in Colorado, home to the infamous high-altitude towns of Leadville and Cripple Creek, suggest that the paper's perspective helps to explain phenomena of boom and bust leading to ghost towns.

More slowly decaying extractive regions, such as coal mining in Appalachia and farming in the rural Midwestern United States, seemingly face similar difficulties in the late 20th and early 21st centuries, as downtown areas and infrastructure are slowly fading. Such areas are indicative of a spectrum of evolution and devolution, a spectrum that can be better understood in the context of this paper's modeling perspective.

[6] The discussion here ignores the recent boom in Midwest farming associated with the (probably misguided) policy of substitution corn-based ethanol for foreign oil.

References

Abbott, Carl, Stephen Leonard, and David McComb 1994. *Colorado: A History of the Centennial State*. Boulder, CO: University of Colorado Press.

Blomquist, Glenn C., Mark C. Berger, and John P. Hoehn. 1988. New Estimates of Quality of Life in Urban Areas. *American Economic Review* 78: 89-107.

Glaeser, Edward and Joseph Gyourko. 2004. Urban decline and durable housing. *Wharton Real Estate Center Working Paper*, 382. Philadelphia, PA: University of Pennsylvania.

Graves, Philip E. 1979. A Life-Cycle Empirical Analysis of Migration and Climate, by Race. *Journal of Urban Economics* 6:135-147.

Mueser, Peter and Philip E. Graves 1995. Examining the Role of Economic Opportunity and Amenities in Explaining Population Redistribution. *Journal of Urban Economics*, 37:176-200.

Roback, Jennifer 1988. Wages, Rents, and Amenities: Differences among Workers and Regions. *Economic Inquiry* 26: 23-41.

Roback, Jennifer 1982. Wages, Rents, and the Quality of Life. *Journal of Political Economy*, 90(6):1257-78.

Rosen, Sherwin 1979. Wage-Based Indexes of Urban Quality of Life. *Current Issues in Urban Economics*, Peter Mieszkowski and Mahlon Straszheim, eds. Baltimore: John Hopkins University Press.

Varian, Hal R. 2005. An Opportunity to Consider if Homeowners get too many Breaks. *The New York Times*.

Weiler, Stephan 2001. Unemployment in Regional Labor Markets: Using Structural Theories to Understand Local Jobless Rates in West Virginia." *Industrial and Labor Relations Review*, 54(3):573-592.

Weiler, Stephan 2000. Industrial Structure and Unemployment in Regional Labor Markets. *Industrial Relations*, 39(2):336-359.

Weiler, Stephan 1997. The Economics of the Struggling Structurally Unemployed. *Journal of Appalachian Studies*. 3(1):71-98.