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Impact of Surface Coal Mining on West Virginia Property Values



Quenton Delane Burner Jr
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By

Quenton Burner

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Project Advisor: Kathryn Bender

Second Reader: Stephanie Martin

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I hereby recognize and pledge to fulfill my responsibilities as defined in the Honor Code and to maintain the integrity of both myself and the College as a whole.

Quenton Delane Burner Jr

Quenton Delane Burner Jr

Acknowledgements

I am doing this research because I grew up in West Virginia, which is a state commonly known for its mountainous terrain and bountiful coal.

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Abstract.

The fossil fuel industry has been a leading industry for our economy for many years, but fossil fuels have also had an impact on the well-being of local environments. There are many practices of extracting fossil fuels, and some of them have long-lasting social and environmental costs. The use of surface mining techniques is a topic that has generated controversy due to its impact on the environment and community health. This study uses the hedonic pricing method to investigate the impact that surface coal mines have on residential property values in West Virginia. I hypothesize that the statistical analysis will show that as the number of surface mines and their average production increases, the median value of housing units in a county will decrease because coal-mining dependent counties in West Virginia have lower total median property values than the state-level median. After running multiple log regressions, a statistically significant negative relationship was found for properties within 10 miles of the surface mining site, and appraisal value. For properties within 10 miles of the site, appraisal value decreased by 39%. State and county officials should consider all the costs and benefits involved with granting new permits for surface mine production sites

Introduction.

Housing prices are typically a direct reflection of its amenities, which is about what makes a property more desirable or adds value to it. For example, a community in a safe location and beautiful landscape would enhance property value and be considered a retirement destination. Infrastructure also plays a role in determining amenities, because communities that have well-taken care of roads and recreation opportunities are also more valuable. There are also disamenities on the other end of the spectrum though, such as eye sores, lack of infrastructure and recreation opportunity, lack of revenue, etc. all can negatively affect property value on a community and county-level. The relationship between house price and the characteristics of the surrounding location is complex, and there are also notable impacts on property valuation based on environmental externalities.

Studies on location-specific attributes of property value are hard to come by though, and the impact of an area's environment on property value is hard to observe because the environment is constantly changing. Viewing the impact on property value as a third party that is dealing with unintended consequences of a coal production site is much different though, because there are observable impacts created by coal production sites. It is important to look at how surface mines are impacting property value, because counties with lower property values have lower tax revenues and more disamenities. West Virginia has hundreds of open-permit surface mines, and they are responsible for millions of tons of coal production each year (Annual Coal Report, 2015). Surface mining is commonly practiced by mining companies for its efficiency of extracting coal. What effect does surface mining practices have on the property values of the surrounding area though? The coal industry practice known as “surface mining,” causes many different environmental problems that have the potential to negatively impact

housing property values within the impact radius of these sites. This is especially concerning, because, in the 2016 election, Donald Trump promised to bring the coal industry back to glory in West Virginia stating, “I will bring back coal. Clean, beautiful coal.” in reference to the West Virginia coal industry and won 68% of the WV votes in the 2016 election. (Dimanno, 2018). He received overwhelming support for this promise, likely due to West Virginia’s ability to produce a significant amount of coal each year and provide coal mining jobs. The state is also full of coal due to its mountainous terrain, so exploiting the resource seems economically viable. He is yet to keep his promise, though he has removed many significant environmental regulations and climate policies that govern clean air, water, wildlife, and toxic chemicals (Popovich, 2020). Reviving the West Virginia coal industry may not be in the best interest of West Virginians though, because coal production has negative impacts on not only the environment, but nearby communities as well.

Literature Review.

Coal creates more carbon dioxide emissions than any other fossil fuel, and these emissions heavily contribute to things such as global warming and health risks. When coal is burned it releases several airborne toxins and pollutants which include mercury, lead, sulfur dioxide, nitrogen oxides, and particulates. Health impacts can range from asthma and breathing difficulties, to brain damage, heart problems, cancer, neurological disorders, and premature death (UCSUSA, 2019). The pollutants can also be detrimental to a local environment, and because burning coal for energy is practiced worldwide in countries such as the United States, China, India, Germany, etc. there are significant global impacts on the environment as well.

The most popular strategy for extracting coal is a process called “surface mining” (Holzman, 2019). A specific type of surface mining that is especially harmful to the environment is known as mountaintop removal. This form of surface mining is the process of stripping an entire mountainside of trees and clearing out bushes in order to create space to mine resources such as coal. The companies responsible for mountaintop removal will then blow off the top of the mountain with explosives in order to get to the coal within the mountain. This process produces a significant amount of debris, which is also one of the main reasons it is so terrible for the environment. The debris is typically disposed of in whatever nearby river or valley has space, which contaminates the water and destroys habitats (Hendryx, 2007). The wildlife can be devastated by this process and animals can either end up dead or defected from drinking the faulty water.

The area that is stripped usually does not recover as well, and vegetation never returns to an area where surface mining occurred (Hendryx 2007). Coal mining companies in West Virginia are some of the main culprits of surface mining because of how efficiently it allows the

resource to be reached and extracted; also, they have a great variety of mountains to work with. West Virginia is one of the only states where the whole state is a part of the Appalachian region, and mountaintop removal has destroyed nearly 500 mountains in the Appalachian region (Boggess, 2018). This causes a giant eye-sore for people in the area, and according to the majority of the research, aesthetics plays a huge role in property value, and whether an individual or business will move to an area. Surface mines are known to decrease the value of the landscape (Williams, 2011). The process reduces once beautiful mountains to barren, grey landscapes. In addition, the effects of mining on land are irreversible: the deep ecological transformations caused by mining cannot be undone using current reclamation and mitigation techniques. (Williams, 2011).

A hedonic pricing evaluation based on high poverty areas and mountaintop removal sites showed that the addition of a surface mine to the average county significantly decreases aggregate property values by between .34% and 1.7% (Williams, 2011). West Virginia was one of the thirteen states examined in the study. Factors such as the environmental damages, health risks, and even aesthetic that is created from the destroyed mountain were all considered for the study. The results show that each person's property value in the area declines as the environmental effects of the area rise, which supports the hedonic property value concept. Since the area or county facing poverty has low wages, which is another factor in decreasing property value, the people who own these housing units suffer in that regard as well. (Williams, 2011).

Surface mining does not just harm the environment though; workers are at increased risk for diseases such as cancer when mining coal. The area around the coal mining feels the consequences as well, which also puts the people residing there at increased risk. The impact of surface mining on the environment and individual health are notable to say the least, which is

why experts have conducted studies to get a clearer understanding of just how notable and impactful the social costs of surface mining is. For example, public health studies that have been conducted in West Virginia for the past ten years show that the number of excess deaths is 1,200 more for people who live near surface mining sites, and specifically mountaintop removal sites. This means that areas that are near these sites are known to produce more deaths from diseases that are caused by pollutants released by surface mines (Hendryx, 2017). This research was conducted by Michael Hendryx, a professor at Indiana University who was interested in the effect that mountaintop removal had on the people of the surrounding area of the mountain.

These deaths are likely correlated to the fact that diseases and health risks such as cardiovascular disease, lung cancer, pulmonary disease, and birth defects are prominent in areas in counties in which there are surface mining sites. It is quite difficult to find studies that can confirm causality between the environmental damages caused by coal production, and the higher rates of diseases in areas that share the same area as a surface mining site. Another relevant study from Hendryx though, is based on a survey of 16,493 West Virginians which found that people in areas within proximity of these coal mining sites were more likely to get those diseases. The results showed that as coal production increased, health status worsened and risk for diseases such as cardiopulmonary disease, lung disease, cardiovascular disease, diabetes, and kidney disease increased (Hendryx, 2007).

Surface mining does create jobs for these people though, as “3,3341 jobs were dedicated to surface mines in 2019” (Statista, 2021). Also, the average salary of a surface miner is around $50k, which is higher than the average median household income in southern coal counties such as Boone, Mcdowell, and Logan. (BLS, 2021). Coal mining is not only a major contributor to West Virginia's economy due to the mountainous terrain of the state, it is also one of the primary

sources of electricity in the United States. West Virginia is the only state completely within the Appalachian region, which is a wide stretch of mountainous terrain with an abundance of natural resources located in the eastern part of the United States (ARC, 2021).

Although this can be a problem as well, because the Appalachian region is known to have poverty-stricken areas, lack of a diverse economy, lack of new infrastructure, and overall underdevelopment compared to the rest of the U.S. Theory on why this is, is called the "resource curse," or the idea that places with a lot of natural resources are likely to be poorer because resource industries, like coal mining, dominate the local economy and prevent other economic sectors from growing (Brumfeld, 2019). The Coal Industry was the mono economy because it kept more diverse opportunities outside of the region due to lack of infrastructure and development according to Adam Wells, the Director of Community and Economic Development (Brumfeld, 2019). People associated with the Appalachia region have been calling for the diversification of Appalachia's economy in the Appalachia Regional Commission, and in its first report, ARC called for large-scale investment in transportation and other infrastructure to spur diverse economic development in the region (ARC, 2019). The West Virginia coal economy was able to carry the state at one point, but as times have changed the U.S. is moving further away from away from the Coal Industry, which has seemingly caused the collapse of WV coal county economies.

The areas within coal dominated economies are facing poverty not due to lack of economic diversity and opportunity to expand. Counties like Logan, Boone, and McDowell are hit with some of the highest poverty rates in West Virginia. These counties are surrounded by mountainous terrain, and mountaintop removal sites are very popular within these counties. These were coal counties, but with the coal jobs declining due to environmental protection

policies and mountaintop removal sites requiring machines more than workers, unemployment is high as well as poverty. From 2008 to 2012, the poverty rate in McDowell hovered at 33.5% (Sadowski, 2014). These are extremely high rates and make it extremely tough to bounce back or recover from especially accounting for factors such as the environmental damage caused by coal mining.

The government is supposed to protect low-income areas from environmental degradation and has even taken steps such as passing environmentally friendly policies (Gormley, 2013). For example, Bill Clinton passed reform in 1994 to protect minority and low-income areas from health-endangering environmental risks created by companies looking to profit off the resources in an area, in West Virginia's case the resource being coal. For example, The Hobet Mine is located on the border of Lincoln and Boone County, and was widely regarded as the state's biggest mountaintop removal operation site. At the peak of production for the site in 2002, it was producing 5 million tons of coal in a single year (Rucker, 2016). The environmental damages from producing that much coal in a single year are detrimental to the community health, and the waste from production that is dumped into nearby water sources such as rivers, damages water quality. The company was also famously known for refusing to pay its workers health benefits, which led to a worker strike in 1994. The mine eventually went bankrupt, and the counties have not recovered from the damages caused. Boone County has a poverty rate of 23%, and a per-capita income of $21,387 (U.S. Census Bureau). Lincoln County's poverty rate is at 28%, with a per-capita income of $19,114 (U.S. Census Bureau). This is compared to the national average poverty rate of 14%, and the national per-capita income of $29,979 (U.S. Census Bureau).

All the effects of surface mining meet the criterion from the 1994 reform, as we know surface mining stresses the natural environment and puts the people in the area at extreme health and welfare risks. Which is a sign that the practice should be made completely illegal, as they violate reform protocol. Although, coal companies will continue to produce unchecked unless stricter environmental reforms are passed to prevent the people of these areas and the environment from suffering. These companies not having to compensate the people within proximity of these sites for the environmental effects of production is a consequence of negative externalities. In fact, 40% of rivers are not safe to drink from in West Virginia for humans or aquatic life, and too polluted to pass simple water quality safety thresholds largely due to pollution from decades of mining. "912,650 people in West Virginia, consumed water from drinking systems that were out of compliance with the U.S. Safe Drinking Water Act (SDWA), at various points between June 1, 2016, and May 31, 2019" (WVPB, 2019). 378 out of 448 water systems in WV violated the Safe Water Drinking Act at least once throughout this time frame, and systems serving low socioeconomic status and minority communities were among the top offenders. It is no coincidence that these communities are taking the largest hits from environmental damage.

Implementing policy to protect from environmental degradation and effectively forcing it upon coal production companies via fines/carbon tax would reduce the social costs of coal production and enhance the private costs. A carbon tax puts a price on carbon dioxide emissions, which coal is infamous for creating. Carbon taxes encourage people, businesses, and governments to produce less carbon dioxide emissions (Tax Policy Center, 2018). The Coal Severance Tax, which is a tax on coal production adds approximately $214 million into West Virginia's economy even for counties that are not mining dependent. 75% of the net proceeds is

distributed to coal-producing counties. 25% of the net proceeds are distributed to all counties and municipalities of the state, based on population (WV Treasury, 2021). The goal of externalities is for private and social costs to meet in the middle, but the market is tricky and reacts differently than intended too sometimes. The coal severance tax was implemented to keep mining companies from overproducing, because overproduction of coal in an area contributes to negative socioeconomic and environmental externalities.

The Severance Tax has recently been modified by Jim Justice of West Virginia. "Although Gov. Jim Justice signed a bill recently to bill lowering severance taxes on thermal or steam coal in West Virginia from five percent to three percent." (AJR, 2019). This bill was implemented in order to enhance coal production, and give a boost to the coal economy, but just recently "The U.S. Department of Justice is seeking $3.2 million in penalties from Appalachian coal mines owned by West Virginia Gov. Jim Justice over claims they violated a settlement meant to prevent pollution" (AP, 2021). The coal mining companies run by the West Virginia Governor were violating EPA guidelines, and the increased production that resulted from lowering the coal companies tax burden had a negative effect on local air quality, water systems, and health.

Although, because coal mining sites are good for providing local jobs, it is important not to dismiss workers in the coal industry who unintentionally contribute to externalities by working for these privatized companies. Surface mining was responsible for 3,345 jobs as of 2019. Since 2010 though, the amount of surface mining jobs has decreased by a little above 2,500 (Statista, 2021). To remedy this, it is worth researching alternative renewable/clean energy options, so that coalminers could have access to training programs and be qualified to work at these clean energy sites instead. According to the Solar Foundation, American solar jobs have

increased by 167% by adding 156,000 jobs from 2014 to 2019 (Solar Foundation, 2021). Minorities account for 34% of the solar workforce, with 17% being Hispanic, 8% being Asian and 8% being African American, which is a significant increase in representation from the Oil and Gas Industry (Edwards, 2021).

Some of the pros of surface mining are things like the efficiency of the process. Surface mining is much more efficient than regular coal mining because the process allows companies to reach coal within the mountain that would be unreachable otherwise (U.S. Energy Information Administration). It is also cheaper for companies as they do not have to pay as many workers a monthly salary, but what really plays a large role in saving companies' money is the benefits these companies do not have to provide to the workers. This means they will not have to pay salaries every month and provide benefits like health insurance (which can be costly considering the dangerous nature of their work) and paid vacation time. They can also minimize the chances of dealing with the sky-high expenses, legal complications and PR challenges, which will inevitably arise if their workers would suffer injuries or even die because of mining accidents (Regoli, 2015).

The production of coal increased significantly since strip mining practices were introduced in West Virginia in the 1960's. The demand for physical labor and workers has decreased as the technology increased. This is where problems arise, though, because the coal mining companies are employing less workers, which affects people local to a site because it makes it harder to find work. Which is good because it puts less workers at risk for being exposed to coal-based health problems, but the resource has renewable substitutes. Taking funding away from running these machines used for surface mining practices such as strip mining could save a significant amount of money, because these machines can cost millions of

dollars (Nolan, 2013). In order to invest into cleaner, sustainable, and renewable energy. wind and solar energy are both efficient substitutes for coal and with the proper funding and policy, it could create jobs for West Virginians and there are even some Solar and Wind energy companies that target former coal miners to work for their companies (Cardwell, 2017).

Renewable energy alternatives to coal could potentially provide jobs and reduce negative externalities and the overall negative impact on the environment and local property values. A multi-site hedonic analysis was conducted in order to find the impact of wind power projects on residential property values in the United States (Hoen, 2009). This is the other spectrum of a fossil fuel site, because it is a clean energy alternative site. The site being examined is a wind facility, and wind energy is a renewable energy alternative for burning coal. The base hedonic model in the study tested for three stigmas: Area stigma, Scenic Vista stigma, and Nuisance stigma. Each stigma measured different aspects of sales prices influenced by the presence of the turbine such as distance and visibility, and it showed no statistically significant effect on home or sales price, which is much different than the mountain top removal site results.

Area Stigma is a concern that the general area surrounding a wind energy facility will appear more developed, which may adversely affect home values in the local community regardless of whether any individual home has a view of the wind turbines. Scenic Vista Stigma is a concern that a home may be devalued because of the view of a wind energy facility, and the potential impact of that view on an otherwise scenic vista. Nuisance Stigma is a concern that factors that may occur near wind turbines, such as sound and shadow flicker, will have a unique adverse influence on home values.

Moreover, in the Temporal Aspects Model, which is a model that was created in order to incorporate the role time played/make time-based measurements in the context of the stages of

the wind facility progression. The first-time measurement being the price of homes that were sold before the announcement of the wind facility, compared to the price of homes after announcement. The data showed an increase in home price after the announcement of the wind facility. Specifically, homes that sold more than two years prior to the announcement of the wind facility and that were located more than five miles from where the turbines were eventually located are found to have transacted for lower prices - not higher - than homes situated closer to the turbines and that sold at any time after the announcement and construction of the wind facility (Hoen, 2009).

Overall, it seems that the view of the wind turbine would be the only thing of substance but even then, no statistically significant negative results on housing property were shown as a result of having wind turbines in the area, which is very inspiring for looking into as a clean energy alternative for coal. Therefore, there was no statistically significant evidence of a Nuisance stigma. Hoen likely used GIS (Geographic Information System) for his study because GIS provides several variables to distinguish between the amenities and disamenities, an amenity would be something that may contribute to an increase in housing prices, while a disamenity would be something that decreases property value. GIS data also provides topography data, which may influence environmental attributes. Topography data would also play a role in how to account for the aesthetic/visibility of the sites, which is a key variable that lowers property value.

Surface mining sites are infamous for creating eyesores and disamenities due to the process of stripping the landscape of an area. “The current surface mining practices in West Virginia (WV) consist of conventional mining unit operations including drilling, blasting, digging, loading, haulage, and dumping. Draglines are used in some mines for stripping and direct dumping of overburden material into excavated areas. The WV ranks second in the nation

for explosives consumption (Apodaca 2010). Almost 350,000 tons were used in WV surface coal mining in 2009. Considering an average price of blasting agents (bulk emulsions, slurry and ANFO) of $1.14 per kg, the surface coal mines in WV spent almost $400 million for explosives alone. This does not include additional blasting accessories such as detonators, boosters, detonating cords, lead lines, additional costs for labor, explosives truck-delivery, and shot services. The addition of the drilling, digging and loading costs for the blasted material amounts to a significant overall cost to mine operators." (Nolan, 2013). This process is not only costly but damages the surrounding environment due to things like acid drainage and valley fills from removing and dumping overburden.

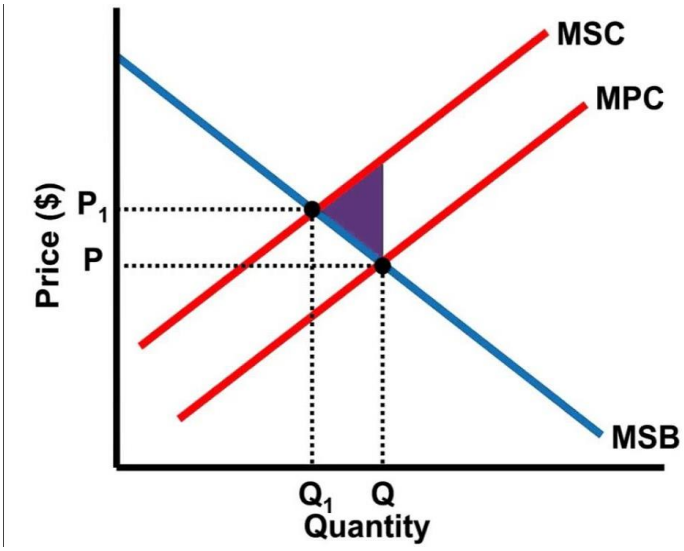
There are many environmental risks that come with extracting and burning coal. The first step for these counties surrounding surface mining sites in order to get out of poverty is to overcome some of the factors that are keeping them as a result of these sites such as health risks and tragically low property values. Switching to production of renewable energies in West Virginia would give the affected counties a chance to recover economically and environmentally.

The status of the environment and whether it is time to move forward on from fossil fuels is currently a hot topic, so my research is looking into whether the social costs outweigh the economic benefits of surface mining. Many people are affected by the presence of pollution stemming from these sites, so for my research I wanted to incorporate the impact of externalities in order to sufficiently measure how people are impacted by surface mining in the context of their property value. This allows the economic aspect to roll into play, as people are always trying to create new opportunities, enhance quality of life, and increase their assets.

Theoretical Framework

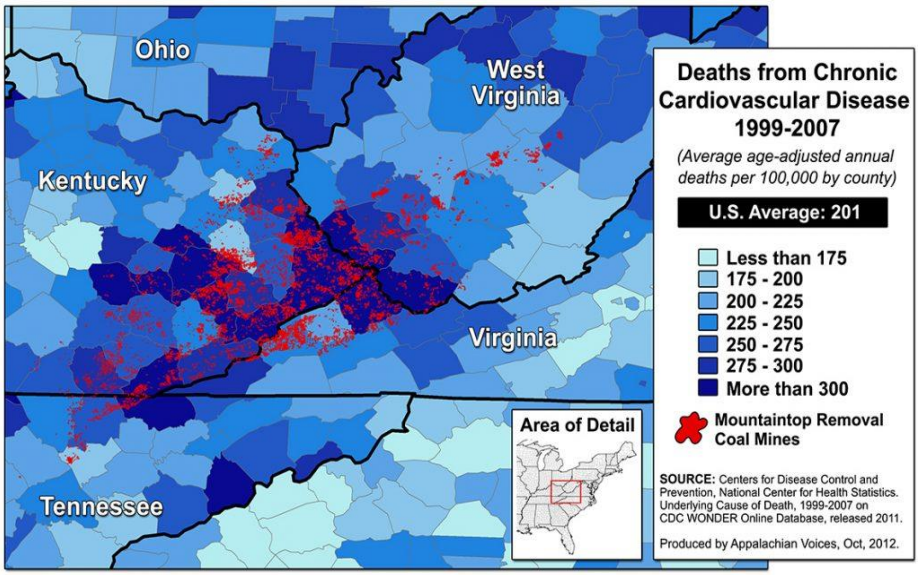
One of the main reasons coal counties are so poverty stricken is the social costs such as environmental damage, health risks, destruction of habitats, low quality water, and visible eyesores created from the mountaintop removal sites are significantly outweighing the private production cost for the companies. If the socioeconomic costs of production outweigh the benefits of production, it is not in the best interest of the people for these sites to be revived. The market in **Figure. 1** is overproducing, which has then created a deadweight loss. P and Q is what the private marking is providing, although the point P1 and Q1 is what would be socially optimal, because that is where marginal social costs (MSC) = marginal social benefits (MSB). In this graph MSC is higher, because there is a negative externality that the production site is not paying for, which society then burdens the consequences of for no compensation. To summarize when externalities are negative, marginal private costs (MPC) are lower than marginal social costs (Helbling, 2010). The government can correct this externality by imposing a per unit tax on production, which would reduce the supply and help create socially optimal costs.

Figure 1. Negative Externality Graph (externality graph in economics - Bing images)



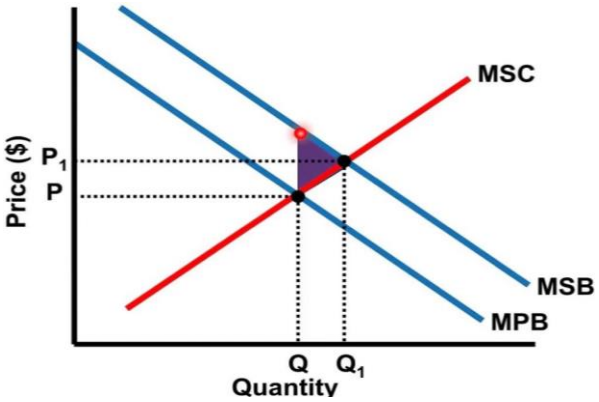
Environmental characteristics such as visible disamenities, upkeep of water systems, distance from each surface mining site, and flood risk are variables that could have an impact on property value. Air pollution is an example of a negative externality that is created from a coal production site, which could then put local communities at higher risk for diseases such as Cardiovascular Disease (**Figure 2**). The polluter (surface mining site) makes decisions based only on the direct cost of and profit opportunity from production and does not consider the indirect costs to those harmed by the pollution. The social costs of production are larger than the private costs. Those indirect costs could be decreased quality of life, higher health care costs for an individual/family that owns property near a surface mining site, or forgone production opportunities (basically meaning surrendering the opportunity to produce something other than coal).

Figure 2. Cardiovascular disease in Mining Counties (graph showing the impact of mountaintop removal in coal counties - Bing images)



There are also positive externalities, and amenities in a community can help create these. P and Q is what would be considered mutually beneficial in **Figure. 2,** but the MSB is greater than the MSC and MPB at Q1 and P1. Society is reaping the benefits of a positive externality, that they did not have to account/pay for.

Figure 3. Positive Externality Graph (externality graph in economics - Bing images)



The Hedonic Pricing Theory is useful in measuring property value because the method accounts for other external influencing elements that may add or subtract from the property value. “Each of these correlations can be measured to determine a degree of confidence (i.e., significance) and then subsequently be used to build a hedonic pricing model. Hedonic pricing models can be useful to determine the intrinsic value of each attribute, as well as to predict transaction prices” (Monson, 2009).

Description of Data.

This research incorporated surface mining sites across the state and used county level data to see how distance from the surface mining site, among other independent variables impacts property value. In my research I focused on Tax Class 2, which is owner-occupied residential property used exclusively for residential purposes, for my study I incorporated the two most common Tax Class 2 residencies in WV, which are "Residential 1 family properties" and "Mobile Homes". Property value appraisal values were collected from data from the WV tax assessor site. Collecting government level data will allow me to obtain the most accurate information, although I was limited to appraisal values. The GPS Visualizer site allowed me to geocode in order to find the latitude and longitude of properties and surface mines, which allowed me to find the distance between them.

6 surface mines from 3 randomly selected mining-dependent counties in West Virginia were observed. Multiple distance variables were created, such as the impact of being located within 10 miles of the site has on property values. I also observe whether a property is high flood risk or not, because surface mining areas are also high flood risk. I also observed three randomly selected non-coal dependent counties in order to see how the other explanatory variables impacted property value without accounting for distance from a surface mining site.

Stigmas were used to organize which counties were observed, and to help determine what variables to include so that they accounted for disamenities and captured community characteristics. Area Scenic Stigma is a concern that a home may be devalued because of the view of a disamenity created by the surface mine site, and how that view has an impact on otherwise good-looking land. Quality of Life Stigma is the concern that there are health risks potentially created from sites such as enhanced risk of disease, and even damaged water systems.

Production Stigma will see if missed production opportunities have a unique adverse influence on home values because of the externalities effect. Blowing up mountains, deforesting large tracts of land, polluting streams, destroying roads from the trucks and machines going in and out of the site, flooding, etc. are all factors that could contribute to these stigmas, and potentially discourage employers from moving into the area.

The gathered data was then used for whether an area was a frequent violator of the SDWA according to the study "Watered Down Justice," for the Quality-of-Life Stigma, presence of valley fills (3,000 or more) for the Area Scenic Stigma, and flood risk (high or low) of an area for the Production Stigma. Typology data was gathered from the United States Department of Agriculture's Economic Research Service to determine whether a county was coal mine dependent according to the Typology data. The Annual Coal Report, U.S. Census, U.S. Energy Information System, and WV. gov sites were also used to gather relevant data.

Summary of Mining Dependent counties data (Table. 1)

County	Freq.	Percent	Cum.
Boone	273	34.00	34.00
Logan	294	36.61	70.61
Mcdowell	236	29.39	100.00
Total	803	100.00	

Variable	Obs	Mean	Std. Dev.	Min	Max
TotalAppra~l	803	51568.87	44115.49	0	312400
LatitudePr~y	803	37.82461	.3513809	37.2505	40.07348
LongitudeP~y	803	-81.73276	.3357057	-82.43669	-79.78046
LatitudeSu~e	803	37.75221	.2649101	37.38444	38.11111
LongitudeS~e	803	-81.75579	.2232543	-82.08577	-81.445
DistanceMe~s	803	22665.68	33423.01	54.12856	276140
DistanceMi~s	803	14.0838	20.7681	.0336339	171.5854
Flood	803	.7011208	.4580521	0	1
Log_Apprai~l	803	10.38158	1.430137	.01	12.65204
PropertyAdd	803	402	231.9504	1	803
Miles	803	.5516812	.4976318	0	1
Counties	803	1.953923	.7953223	1	3

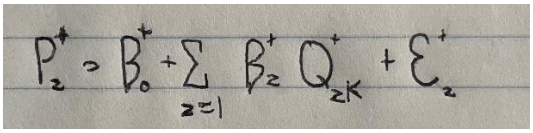
Empirical Analysis.

The premise of my research is a cost benefit analysis based on the social costs compared to the private benefits of production from mountaintop removal sites. More specifically, I am measuring the impact of coal mining on property values within radius of these sites and translating hedonic property value model characteristics and incorporating explanatory variables. For my research I will use a hedonic property value model, which is a model that uses market data and then breaks down the house sales price into its components, specifically property characteristics, neighborhood characteristics, and environmental characteristics. For example, diseases such as lung cancer are much more prominent for people in these areas, but there are so many other variables that must be taken into consideration that makes it quite difficult for researchers to draw causality conclusions. Although a model using regression and statistics and incorporating relevant models to help confirm statistical significance.

The goal of my research is to use a hedonic property value model to see the impact surface mining sites have on nearby property values. I used tax-assessed price as the key dependent variable for determining property value, although there are other ways such as property tax, but the tax assessor value seems more concrete. A log and multi-linear regression model should effectively account for factors such as neighborhood and environmental effects they have on property values. So, the hedonic equation will use a multiple linear regression method to allow multiple explanatory variables to be viewed at a time. I measured the effects of surface mining by gathering county level data. Geocoding allowed me to gather the exact distance between surface mine sites and houses in one county compared to other counties was not measured in Williams hedonic price analysis. Also, it only shows aggregate impact, not specific pricing relative to distance from surface mining sites (Williams, 2011).

The southernmost counties in West Virginia are where surface mining sites are most prevalent. Hoen's study does not consider the possibility of individual negative impacts and does not account for factors such as flooding and quality of water systems (Hoen, 2009). Each property can be viewed as a product that has a price p that is determined by a set of attributes z= (z1, z2, ..., zn), of n different characteristics with known values. The function p(z)= p(z1, z2, ..., zn) defines the implicit effect that any variable zl has on the price of the commodity. By analyzing how p changes with respect to a change in zl , keeping all other variables constant, the impact of zl can be isolated. (Williams, 2011). So, extending this framework to this study in particular, p is the appraisal value of each property observed.

Figure 4. Log-Linear Hedonic Model



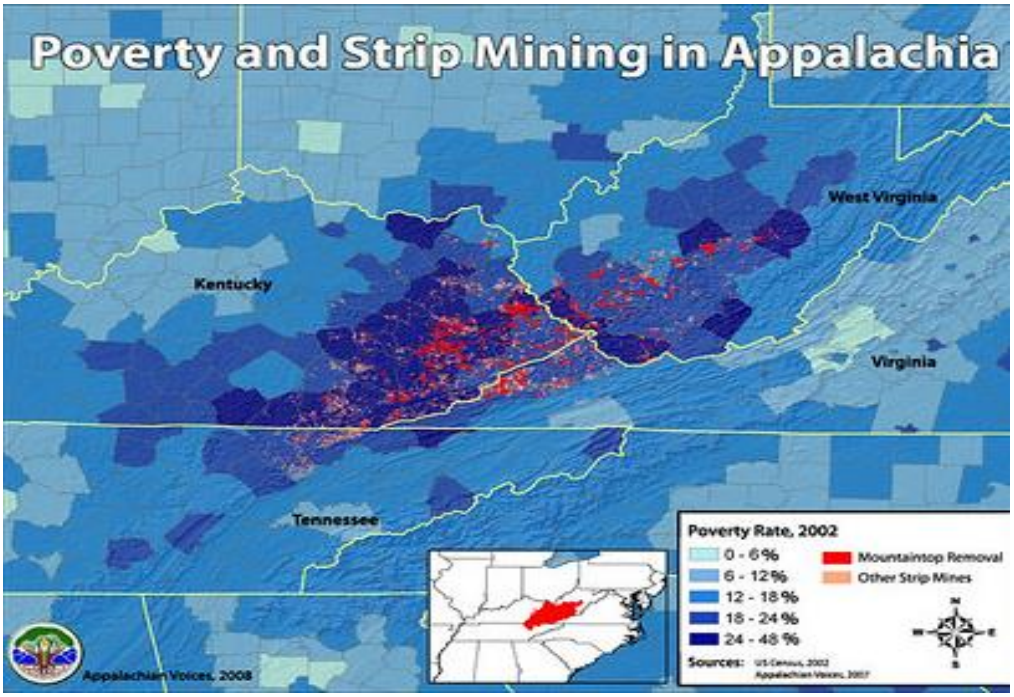
The dependent variable is the tax-assessed value and the neighborhood variables along with environmental characteristic variables that are used as explanatory variables.

Environmental and Neighborhood Characteristics Descriptions

Property Address (Numbered)
Property distance from each site (Miles)
Water systems (Frequent Violators)
Impact on Production (Flood Risk 1=High, 0=Low)
Tax Classification (Tax Class 2)
Residential Status (Single-Family/Mobile Home)
Land Use (Residential)
Mining Dependent (yes or no)
Miles (Properties within 10 miles = 1, Properties outside of 10 miles = 0)
Deeded Acres

The surface mining sites are most prevalent in southern counties such as Mcdowell, Boone, and Logan county. They have the highest number of communities exposed to surface mining sites, and they produce the most amount of coal through surface mining (Appalachian Voices, 2015). A randomization method for selecting communities within each county helped control for endogeneity. Poverty rate in Boone county is 24.3%, Mcdowell is 33.3%, and Logan is 23.3%. For context, West Virginia's poverty rate as a state is 17.8%, so it is safe to assume that these southern counties heavily influenced by coal mining are contributing to higher state level poverty rate. As you can see in **Figure 4**, the red represents areas where surface mining is occurring, and the darker blue represents higher levels of poverty.

Figure 5. Poverty and Strip Mining in WV (graph showing the impact of mountaintop removal in coal counties - Bing images)



Results

The study uses standard error log and multiple linear regressions in order to tell how accurate the Hedonic model was. **Table 2** shows the Prob > F represents the p-value for the overall regression, and in each regression the value is less than 0.05, this indicates that the combined explanatory variables have a statistically significant relationship with the dependent variable. The "DistanceMiles" variable measured the distance in miles from each surface mining site, in each regression ran for mining-dependent counties there was a statistically significant relationship between distance from surface mine, and total appraisal value at the 95% confidence interval, except for McDowell county. The coefficient for the McDowell county regression did not suggest a statistically significant relationship between appraisal value and distance. Although, a dummy variable was created under the name "Miles" where properties within 10 miles of the mine = 1, and properties outside of 10 miles = 0. Values of property decreased by $8,630 for properties within 10 miles of the site, and a 0.000 P-value was observed for the "Miles" variable.

The p-value in **Table 2** confirms that there was a significant negative relationship between properties within 10 miles of the site and appraisal value. There was no statistically significant relationship observed for the deeded acres variable, but there was a significant relationship between flood risk and appraisal value. For high flood risk properties there was a $5,967.22 increase in appraisal value. This could likely be explained by waterfront properties being more valuable than regular properties. The model also contains a log regression where the log of total appraisal is the dependent variable, and there was a significant negative relationship

observed between properties within 10 miles of a surface mine. Properties within 10 miles were .2972 or 29.72% lower in value than properties outside of 10 miles of the mine.

The coefficient for the Boone county regression suggests that for every 1-mile increase in distance from surface mining site, a corresponding $518.65 increase in appraisal value was observed (**Table 9).** Also, or every 1 increase in deeded acres there was a corresponding $224.77 increase in property value is observed. Although, there was no statistically significant relationship between flood risk and total appraisal for Boone county. The R-squared value for this regression is 0.2471, which suggests that 24.71% of the appraisal value can be explained by the independent variables. The log regression observed a significant negative relationship between properties within 10 miles of a surface mine and appraisal value. Properties within 10 miles were .59 or 59% lower in value than properties outside of 10 miles of the mine (**Table 8).**

The coefficient for Logan county regression suggests that for every 1-mile increase in distance from the surface mining site, a corresponding $273.85 increase in property value was observed. Also, for every 1 increase in deeded acres there was a corresponding $1,102 increase in property value (**Table 6**). There was also no statistically significant relationship between flood risk and total appraisal in Logan county. The R-squared value is 0.1612, which suggests that 16.12% of the appraisal value can be explained by the independent variables, despite there being very few explanatory variables used in the model. The log regression model showed a significant negative relationship between Appraisal value and the “Miles” variable as well. Properties within 10 miles of the surface mine were .52 or 52% lower in value than properties outside of 10 miles (**Table 7).** There was no statistically significant relationship between flood risk and appraisal

value for non-mining dependent counties, but there was a significant relationship between deeded acres and appraisal value (**Table 11**).

Finally, a log regression combing all mining dependent counties observed was ran. A significant negative relationship was observed for properties within 10 miles of the surface mining site, and appraisal value. For properties within 10 miles of the site, appraisal value decreased by 39% (**Table 13**). Also, for every 1 increase in deeded acres there was a corresponding slight increase in appraisal value. The R-squared for this model states the variables observe can explain 11% of the appraisal value.

Table 2: Mcdowell County Log Regression

Source	SS	df	MS	Number of obs	=	235
				F(4, 230)	=	3.09
Model	10.5938554	4	2.64846385	Prob > F	=	0.0166
Residual	196.918889	230	.856169084	R-squared	=	0.0511
				Adj R-squared	=	0.0345
Total	207.512745	234	.886806601	Root MSE	=	.92529

log_TotalA~l	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
DeededAcres	.111385	.1024372	1.09	0.278	-.0904503	.3132202
Miles	-.2997607	.1312375	-2.28	0.023	-.5583421	-.0411793
PropertyA	.0013079	.0013487	0.97	0.333	-.0013495	.0039652
Flood	.5284519	.2105865	2.51	0.013	.1135267	.9433771
_cons	9.251121	.3254295	28.43	0.000	8.609916	9.892325

Table 3: McDowell County Multiple Linear Regression

Source	SS	df	MS	Number of obs	=	235
				F(3, 231)	=	6.31
Model	4.7396e+09	3	1.5799e+09	Prob > F	=	0.0004
Residual	5.7801e+10	231	250219327	R-squared	=	0.0758
				Adj R-squared	=	0.0638
Total	6.2540e+10	234	267266077	Root MSE	=	15818

TotalAppra~l	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Flood	5967.226	2561.59	2.33	0.021	920.159	11014.29
Miles	-8630.83	2165.261	-3.99	0.000	-12897.02	-4364.644
DeededAcres	2245.06	1750.499	1.28	0.201	-1203.924	5694.044
_cons	21481.16	2421.288	8.87	0.000	16710.53	26251.79

Table 4: McDowell County Variable Summary

Variable	Obs	Mean	Std. Dev.	Min	Max
TotalAppra~l	236	21605.08	16318.16	400	119600
County	0				
DeededAcres	235	.2655123	.6018582	.0148	7.08
LatitudePr~y	236	37.45477	.2088523	37.29443	38.92387
LongitudeP~y	236	-81.53735	.2314719	-82.42358	-79.85096
LatitudeSu~s	236	37.3859	.0013902	37.38444	37.38722
LongitudeS~s	236	-81.465	.0190438	-81.48306	-81.445
DistanceMe~s	236	18636.47	26806.1	3491.076	222612.1
DistanceMi~s	236	11.58016	16.65654	2.169254	138.3248
Flood	236	.7669492	.4236729	0	1
Miles	236	.5889831	.493064	0	1
PropertyA	236	118.5	68.27152	1	236

Table 5: Logan county Log Regression

Source	SS	df	MS	Number of obs	=	293
				F(4, 288)	=	14.69
Model	28.0891518	4	7.02228795	Prob > F	=	0.0000
Residual	137.689683	288	.478089175	R-squared	=	0.1694
				Adj R-squared	=	0.1579
Total	165.778834	292	.567735734	Root MSE	=	.69144

log_TotalAppr~l	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
DeededAcres	.0074632	.0025791	2.89	0.004	.002387	.0125395
Miles	-.5223381	.0891391	-5.86	0.000	-.6977848	-.3468915
PropertyAddress	.0004566	.0008184	0.56	0.577	-.0011541	.0020674
Flood	-.0133179	.1502524	-0.09	0.929	-.30905	.2824142
_cons	11.15865	.2434912	45.83	0.000	10.6794	11.6379

Table 6: Logan county multiple linear regression

Source	SS	df	MS	Number of obs	=	293
				F(3, 289)	=	18.51
Model	1.1242e+11	3	3.7474e+10	Prob > F	=	0.0000
Residual	5.8497e+11	289	2.0241e+09	R-squared	=	0.1612
				Adj R-squared	=	0.1525
Total	6.9739e+11	292	2.3883e+09	Root MSE	=	44990

TotalApprai~l	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
DeededAcres	1102.807	167.6727	6.58	0.000	772.7924	1432.822
DistanceMiles	273.8514	131.6139	2.08	0.038	14.80807	532.8947
Flood	-703.0021	6118.688	-0.11	0.909	-12745.84	11339.84
_cons	64456.2	5752.904	11.20	0.000	53133.29	75779.1

Table 7: Logan county Summary of Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
TotalAppra~l	294	70324.15	48914.89	2800	312400
County	0				
DeededAcres	293	2.648614	16.23289	.0344	197.28
LatitudePr~y	294	37.8701	.2494133	37.32664	40.07348
LongitudeP~y	294	-81.90161	.2970542	-82.17583	-79.97407
LatitudeSu~e	294	37.82097	.0061411	37.815	37.82727
Longtitude~e	294	-81.96511	.1176277	-82.08577	-81.85083
DistanceMe~s	294	21465.5	33113.64	54.12856	276140
DistanceMi~s	294	13.33805	20.57586	.0336339	171.5854
Flood	295	.7118644	.4536641	0	1
Miles	295	.6067797	.4892951	0	1
PropertyAd~s	295	148	85.30338	1	295
log_TotalA~l	295	10.87593	.9883537	.01	12.65204

Table 8: Boone County Log Regression

Source	SS	df	MS		
				Number of obs	= 273
				F(4, 268)	= 7.85
Model	105.953749	4	26.4884374	Prob > F	= 0.0000
Residual	904.579625	268	3.37529711	R-squared	= 0.1048
				Adj R-squared	= 0.0915
Total	1010.53337	272	3.71519623	Root MSE	= 1.8372

log_TotalA~l	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
PropertyA	.0000211	.0018203	0.01	0.991	-.0035629	.0036051
Acres	.0105971	.002037	5.20	0.000	.0065865	.0146077
Flood	-.2289861	.2855994	-0.80	0.423	-.79129	.3333178
Miles	-.5941527	.2608252	-2.28	0.024	-1.10768	-.0806255
_cons	10.03576	.3719194	26.98	0.000	9.303506	10.76802

Table 9: Multiple Linear Regression for Boone County

```
. regress TotalAppraisal DistanceMiles Acres Flood
```

Source	SS	df	MS		
Model	1.0557e+11	3	3.5191e+10	Number of obs	= 273
Residual	3.2172e+11	269	1.1960e+09	F(3, 269)	= 29.42
				Prob > F	= 0.0000
Total	4.2730e+11	272	1.5709e+09	R-squared	= 0.2471
				Adj R-squared	= 0.2387
				Root MSE	= 34583

TotalApprai~l	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
DistanceMiles	518.6502	89.69209	5.78	0.000	342.0625	695.238
Acres	224.7726	38.63413	5.82	0.000	148.7089	300.8363
Flood	7206.141	4446.558	1.62	0.106	-1548.34	15960.62
_cons	25795.39	4468.713	5.77	0.000	16997.29	34593.49

Table 10: Summary of Variables for Boone County

Variable	Obs	Mean	Std. Dev.	Min	Max
TotalAppra~l	273	58013.55	39635.16	0	279200
County	0				
LatitudePr~y	273	38.09211	.2565301	37.2505	39.68056
LongitudeP~y	273	-81.71561	.360062	-82.43669	-79.78046
LatitudeSu~e	273	37.99481	.162092	37.76972	38.11111
LongitudeS~e	273	-81.78176	.1016858	-81.85472	-81.64056
DistanceMe~s	273	27304.69	38150.9	1828.493	246618.9
DistanceMi~s	273	16.96635	23.70587	1.136173	153.2419
Flood	273	.6300366	.4836811	0	1
Miles	273	.4871795	.5007536	0	1
PropertyA	273	137	78.95252	1	273

Table 11: Non-Mining Counties Log regression

Source	SS	df	MS	Number of obs	=	621
				F(2, 618)	=	6.27
Model	9.00229785	2	4.50114892	Prob > F	=	0.0020
Residual	443.358155	618	.717408017	R-squared	=	0.0199
				Adj R-squared	=	0.0167
Total	452.360452	620	.729613633	Root MSE	=	.847

log_Apprai~l	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Flood	.0102688	.0681699	0.15	0.880	-.123604	.1441415
DeededAcres	.003239	.0009186	3.53	0.000	.0014351	.0050429
_cons	11.11481	.0469138	236.92	0.000	11.02268	11.20694

Table 12: Summary of Variables for non-mining dependent (1.Ohio 2.Pocahontas 3.Greenbrier)

```
. tab Counties
```

Counties	Freq.	Percent	Cum.
1	164	26.41	26.41
2	237	38.16	64.57
3	220	35.43	100.00
Total	621	100.00	

Variable	Obs	Mean	Std. Dev.	Min	Max
TotalAppra~l	621	99452.17	115394.3	4200	1238600
County	0				
DeededAcres	621	4.743324	37.08439	0	884.18
Flood	621	.47343	.499696	0	1
log_Apprai~l	621	11.13504	.8541742	8.34284	14.02949
Property	621	311	179.4115	1	621

Table 13: Log regression for All Mining Dependent Counties

```
. regress Log_Appraisal Acres Flood Miles
```

Source	SS	df	MS	Number of obs	=	800
				F(3, 796)	=	34.66
Model	176.918806	3	58.9729354	Prob > F	=	0.0000
Residual	1354.24492	796	1.70131271	R-squared	=	0.1155
				Adj R-squared	=	0.1122
Total	1531.16372	799	1.91635009	Root MSE	=	1.3043

Log_Apprai~l	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Acres	.0028318	.0003098	9.14	0.000	.0022236	.00344
Flood	.1474593	.1027786	1.43	0.152	-.0542898	.3492085
Miles	-.3952945	.0937328	-4.22	0.000	-.5792872	-.2113017
_cons	9.772674	.1314731	74.33	0.000	9.514599	10.03075

Conclusion

The study clearly shows a negative relationship between appraisal value and distance from the surface mining site. Statistically significant results for the coal mining dependent counties observed gives information about the impact of surface mines, and how they could potentially decrease residential property valuation within proximity of the site and on a county level.

Although, this study has certain limitations, as the access to data for creating more explanatory variables was limited. Information such as eye sores using GIS and housing characteristics play a significant role in determining property value, and a study including variables such as number of bedrooms, bathrooms, floors, etc. would make for a good study. The use of many models such as distance stability, temporal aspects, and hedonic property models would all be relevant for this research. Demographic/covariate data by community (age, education, income, health insurance) could help explain the social costs of surface mining and get a broader grasp of the impact of externalities. There are also other forms of mining that were not included in the study such as underground mining, so a study looking into the impact distance has on sales price or appraisal value for a property would be interesting.

In conclusion, removing the surface mining practice will be difficult because West Virginia is known for its coal economy. Although, the loss in property value can affect these mining-dependent counties in the form of lower tax revenue which. Additional costs to these counties could come in the form of increased health care costs and lower worker productivity associated with worsened health outcomes. Decreased potential future benefits from lack of recreation and not being an attractive retirement destination due to things like visible disamenities. Also, the depreciation of public infrastructure from heightened noise pollution and

damaged roads caused by truck traffic going to and from the mine. Finally, the decision to grant a permit for an additional surface mine should consider all the costs and benefits involved, considering that the impact on appraisal value estimated in this study has a small sample size, and not enough explanatory variables to capture the total social costs associated with surface coal mining.

References

Allen, E. (2020, February 06). Study Finds West Virginia Counties Among 'Worst in Nation' For Drinking Water Violations. Retrieved May 11, 2021, from https://www.wvpublic.org/news/2019-09-24/study-finds-west-virginia-counties-among-worst-in-nation-for-drinking-water-violations

AJR Network. (2019, March 27). Gov. justice signs bill lowering coal severance tax. Retrieved March 26, 2021, from https://wajr.com/gov-justice-signs-bill-lowering-coal-severance-tax/

Angrist, J. D. (2006). Instrumental variables methods in experimental criminological research: What, why and how. Retrieved December 11, 2020, from file:///Users/julietburner/Downloads/Angrist%20-%202006%20(1).pdf

Annual coal reports - U.S. Energy Information Administration (EIA). (n.d.). Retrieved March 26, 2021, from https://www.eia.gov/coal/annual/

Appalachian counties served by ARC. (2020, September 14). Retrieved March 26, 2021, from https://www.arc.gov/appalachian-counties-served-by-arc/

AP Macroeconomics. (2015). Negative Externality Graph. Retrieved March 26, 2021, from https://www.bing.com/images/search?view=detailV2&ccid=Ggop196s&id=23F3EB1C1BBE4513B4A6FC9C3A1E73CFFEAB603C&thid=OIP.Ggop196s2NOowyGmAatn2AHaEK&mediaurl=https%3A%2F%2Fi.ytimg.com%2Fvi%2FWCyHGaV-SLI%2Fmaxresdefault.jpg&exph=720&expw=1280&q=positive%2Bexternality%2Bgraph

&simid=608010353771306744&ck=2E630D8AC3192014BAE246E4AD7677E7&selectedIndex=0&FORM=IRPRST&idpp=overlayview&ajaxhist=0

Arch coal Inc. Retrieved March 26, 2021, from https://www.annualreports.com/Company/arch-coal-inc

Brumfield, N. (2019, September 19). Why is APPALACHIA POOR? Retrieved March 26, 2021, from http://expatalachians.com/explaining-why-appalachia-is-poor

Bureau, U. (2020). Census.gov. Retrieved November 12, 2020, from https://www.census.gov/

Cardwell, D. (2017, September 30). What's Up in Coal Country: Alternative-Energy Jobs. Retrieved December 2, 2019, from https://www.nytimes.com/2017/09/30/business/energy-environment/coal-alternative-energy-jobs.html.

Dil, C. (2021, March 11). ABC news. Retrieved March 26, 2021, from https://abcnews.go.com/US/wireStory/doj-seeks-32m-west-virginia-governors-coal-companies-76399866

Edwards, N. (2021, March 10). Replacing high paying oil jobs with clean energy jobs is not so easy. Retrieved March 26, 2021, from https://www.forbes.com/sites/neiledwards/2021/03/10/replacing-high-paying-oil-jobs-with-clean-energy-jobs-is-not-so-easy/

Gormley, N. (2013, January 3). The Poverty of Mountaintop Removal Mining. Retrieved December 3, 2019, from https://earthjustice.org/blog/2013-january/the-poverty-of-mountaintop-removal-mining.

Gps visualizer's address locator. Retrieved March 26, 2021, from http://www.gpsvisualizer.com/geocoder/

Fednick, K. (2019, September 24). Watered Down Justice. Retrieved March 26, 2021, from https://www.documentcloud.org/documents/6428650-WateredDownJustice.html

Helbling, T. (2010, December). Finance and Development. Retrieved November 12, 2020, from https://www.imf.org/external/pubs/ft/fandd/2010/12/basics.htm

Hendryx, M. (2007). The American Journal of Public Health (AJPH) from the American Public Health Association (APHA) publications. Retrieved October 31, 2020, from https://ajph.aphapublications.org/doi/full/10.2105/AJPH.2007.113472

Hendrix, C. (2020, October 21). Trump promised to bring back coal in Appalachia. Here is why that didn't happen. Retrieved October 30, 2020, from https://www.dispatch.com/story/news/environment/2020/10/20/trump-promised-bring-back-coal-appalachia-has-he/5866420002/

Hendryx, M. (2009, July). Mortality in Appalachian Coal Mining Regions: The Value of Statistical Life Lost - Michael Hendryx, Melissa M. Ahern, 2009. Retrieved

October 31, 2020, from https://journals.sagepub.com/doi/abs/10.1177/003335490912400411

Hoen, B., Wiser, R., Cappers, P., Thayer, M., & Sethi, G. (2009, December 02). The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis. Retrieved October 31, 2020, from https://www.osti.gov/biblio/978870

Holzman, D. C. (2011, November 1). Mountaintop Removal Mining: Digging Into Community Health Concerns. Retrieved December 3, 2019, from https://ehp.niehs.nih.gov/doi/full/10.1289/ehp.119-a476.

Monson, M. (2009). Valuation Using Hedonic Pricing Models. Retrieved March 26, 2021, from https://ecommons.cornell.edu/bitstream/handle/1813/70656/2009_62_73_Monson.pdf?sequence=1&isAllowed=y

Nolan, T. A. (2013, March 14). Selection of overburden surface mining. Retrieved March 26, 2021, from https://aries.energy.vt.edu/content/dam/aries_energy_vt_edu/journal_paper_environmentally_responsible_mining_technology/Nolan_TA_Kecojevic_V_International%20Journal%20of%20Coal%20Science%20Technology_2014.pdf

Popovich, N., Albeck-ripka, L., & Pierre-louis, K. (2020, October 16). The Trump Administration Is Reversing Nearly 100 Environmental Rules. Here's the Full List. Retrieved November 12, 2020, from

https://www.nytimes.com/interactive/2020/climate/trump-environment-rollbacks-list.html

Poverty and Strip Mining in Appalachia. (2002). Retrieved March 26, 2021, from https://www.bing.com/images/search?view=detailV2&ccid=itzl9Mqt&id=5B067606A9D104098E25B3274EFAF9189BA7200E&thid=OIP.itzl9MqtJDVPeF9hNFJ7OgHaFt&mediaurl=https%3A%2F%2Flive.staticflickr.com%2F3554%2F3385962176_f814d69d5c.jpg&exph=386&expw=500&q=graph%2Bshowing%2Bthe%2Bimpact%2Bof%2Bmountaintop%2Bremoval%2Bin%2Bcoal%2Bcountie&simid=608008902070912732&ck=044ECDD1ED498AAA6146413168A2F8BD&selectedindex=6&form=IRPRST&ajaxhist=0&pivotparams=insightsToken%3Dccid_%252FKF09Phh%2Acp_94AB864D15EE56786F44FB024C781C6C%2Amid_AC889BC50B54AD5BE5125E7A840BEEA66B878802%2Asimid_608032923823069709%2Athid_OIP.%21_KF09PhhE6RG8s2c4zK-QgHaEX&vt=0&sim=11&iss=VSI

Property Tax Classifications. (2020). Retrieved December 11, 2020, from https://tax.wv.gov/Business/PropertyTax/Pages/PropertyTaxClassifications.aspx

Reports, S. (2016, August 05). The rise and demise of a West Virginia coal mine. Retrieved November 12, 2020, from https://www.reuters.com/investigates/special-report/usa-coal-hobet/

Sadowski, D. (2014, November 4). Despite long mining history, poverty straps many in West Virginia. Retrieved December 1, 2019, from https://www.ncronline.org/blogs/earthbeat/eco-catholic/despite-long-mining-history-poverty-straps-many-west-virginia.

The Hidden Costs of Fossil Fuels. (2008, July 15). Retrieved December 4, 2019, from https://www.ucsusa.org/resources/hidden-costs-fossil-fuels.

Summary of Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. (2018, September 17). Retrieved December 4, 2019, from https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice.

Surface mine permits open as of 12/1/2020. (2020, December 1). Retrieved March 26, 2021, from https://minesafety.wv.gov/PDFs/SURFACE.pdf

Tax Policy Center. (2018, May 17). What is a carbon tax? Retrieved November 12, 2020, from https://www.taxpolicycenter.org/briefing-book/what-carbon-tax

Union of Concerned Scientists, U. (2017, November 15). Coal Power Impacts. Retrieved November 12, 2020, from https://www.ucsusa.org/resources/coal-power-impacts

Williams, A. M. (2011). "The Impact of Surface Coal Mining on Residential Property Values: A Hedonic Price Analysis". University of Tennessee Honors Thesis Projects. https://trace.tennessee.edu/utk_chanhonoproj/1414