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From this issue on, the journal will be divided into two sections, a refereed section (Section I), and a non-refereed section (Section II). The refereed section will publish double-blind, peer-reviewed articles. The non-refereed section will publish articles with a focus on local and regional economies. Part II articles will be sent to peers for comments, however, they will not go through the double-blind review process.



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## The Effects of Recreational Lake Areas on Urban Home Prices: Case of Oklahoma City

Muhammad Qayyum  
Iona University

### Abstract

*In this paper, we analyze the effects of recreational lake areas on home prices. We examine single family homes in Oklahoma City close to Lake Hefner, while controlling for other structural and locational characteristics. We use manually collected data from 1678 homes sold from September 2012 till March 2015 in four zip codes adjacent to Lake Hefner in Suburbs of Oklahoma City. We analyze the data using the hedonic model. Hedonic Pricing Model is used to assess the influence of recreational lake area on home pricing. The zip code analysis reveals that people seem to avoid the homes in the area where the main entrance is located due to noise and traffic congestions particularly during holidays. For all other zip codes, without the entrance, people are willing to pay the premium for being closer to the lake. The topic has importance for residential developers, real estate investors and appraisers, and community planners. The results indicate that lake recreational areas add value to property even without the lake views.*

**Keywords:** Real Estate, Property valuation, Hedonic Model, Home value, House price drivers, Residential property.

### 1. Introduction

There are quite a few lake recreation areas in urban regions surrounded by residential and commercial properties. In this paper, we examine the effects of such recreational area lakes on home prices. The topic is especially important for residential developers, real estate investors and appraisers, and community planners.

There are many reasons people may prefer to live near these areas. Lakes are used for recreational activities, such as boating and fishing. Living near a waterway reduces travel expenses and, in some cases, provides a great view. On the other hand, living in such an area can have drawbacks, such as traffic congestion and noise, especially during vacation season and on weekends.

Previous literature suggests a location closer to the ocean with a view of the water has a positive effect on a home's value (Seiler et al., (2001), Bond et al., (2002), (Cohen et. al., 2015) and Benson et al., (2000). Papers regarding lakes are focused on the positive impact of lake views (and/or multiple small bodies of water) on home prices (Cohen et. al., 2015). Conversely, there is a negative impact of traffic congestion on home prices in urban areas (Jin and Rafferty 2018).

In this current endeavor, we focus on the distance from one recreational lake area instead of multiple small bodies of water. In addition, we examine whether investing in homes close to lakes and recreational areas will still be attractive for investors and homeowners if views are taken out of the equation. We argue that views and their values depend on individual preferences. In our data, houses do not have a lake view. There is a wall around the lake preventing homes from having water views.

To examine this relationship, we chose Lake Hefner for our analysis. This lake is a

popular recreational area near Oklahoma City. We believe that it is interesting to analyze lake areas in Oklahoma because the State of Oklahoma has more man-made lakes than any other state. We analyze data from four zip codes adjacent to the lake. These four zip codes surround the lake from all sides. There is only one entrance to the lake, and it is in zip code 1. We focus on a single city because prices in different cities can be affected by per capita income of that city (Qayyum & Yuyuengongwatana, 2016).

Hedonic pricing model is used to examine the relationship between the recreational lake area and home prices. Results indicate there is a premium associated with houses not located in the same zip code as the entrance to the lake. Our findings show that there is no significant relationship between distance from the lake and housing price in zip code 1. This indicates that in the zip code where the entrance to the lake is located, there is increased traffic congestion and noise, thus reducing the premium associated with these houses. On the other hand, for all other zip codes, the results show that home prices decrease as we move away from the lake. These results indicate that people prefer to live closer to the lake except for the zip code where the entrance is located. The rest of the paper is organized as follows: Section 2 presents the literature review, Section 3 explains data and methodology, Section 4 discusses the results, and section 5 presents our conclusion.

## 2. Literature Review

There is an extensive literature on the effects of water bodies on home prices but these studies are mostly focused on views. Plattner and Campbell (1978) analyze condominiums units in Eastern Massachusetts from 1973 to 1976. They report a price premium of 4% to 11% for properties with a lake view.

Benson et al., (1998) analyze almost 5,000 market transactions to find the effect of view on properties. They categorized these transactions by view type such as ocean, mountain and lake. They discover that for single family homes, there is a premium of 147% for properties with an ocean front, 35% for ocean view, and 10% for partial ocean view. Overall, they find an average premium of about 25% for properties with ocean, lake or mountain view.

Benson et al., (2000) focus on single-family homes as they examine data for 6,949 home sales from 1984 to 1993 in Bellingham, Washington. They discover that there are price premiums ranging from 8% to 127%, depending on the quality of an ocean/lake view and the distance from the water. They also report that an unobstructed ocean view can give a 59% price premium. Rush and Bruggink (2000) investigate homes in 21 towns of Long Island, New Jersey using a hedonic model. They find that there is a 0.3% premium per front foot for single family homes located on a bay and 0.4% price premium on single-family homes located on the ocean.

Bond et al., (2002) analyze the impact of a lakefront view on home value. They use a unique building code to divide homes in two groups, homes with lake view and homes without lake view. They find that there is a premium for properties with a lake view and a very desirable view can add almost 89.9% to home value. Further analysis reveals that square footage is positively related to home prices and desirable lakefront views add value to a home.

Nelson et al., (2005) examine the impact of artificial water canals on residential sales prices. They analyzed 793 sales transactions from May 1998 to November 2003 in Arlington, Texas. Their results show a price premium for canal-front properties on the magnitude of 11% on average.

Conroy and Milosch (2011) look at the premium associated with houses near coastal areas. They analyze premium for residential housing prices in San Diego County using 9755 home sales during 2006. They use the hedonic pricing model to analyze their data; they find that for every mile increase in distance from the coast, the price of the home falls approximately \$8,680. Their results show there is a premium associated with homes near coastal regions, and this premium decreases as the distance from the coast increases. They use the home's age, number of bedrooms, number of bathrooms, and square footage as housing variables.

Cohen et al., (2015) investigate the effect of distance from the nearest lake on home prices. Examining home sales, in a Connecticut town with multiple bodies of water between 2000 and 2009, they find that homes closer to lakes have a premium. We argue that different bodies of water can have distinctive characteristics, such as size and/or view of the lake. To overcome that heterogeneity, we use one recreational lake area located in the center of the four zip codes.

The lake is located in an urban area so there is a possibility of traffic congestion inversely affecting the home prices. Jin and Rafferty (2018) examine effects of traffic congestion on home value. Their data is from the US Great Lakes Megaregion that includes metropolitan areas like Chicago, Detroit, Minnesota, Cleveland, St. Louis, and Pittsburgh and ten states, Wisconsin, Minnesota, Michigan, Iowa, Illinois, Ohio, Kansas, Indiana, Kentucky, and Missouri. They discover that although there is no significant relationship between traffic congestion and home value in rural and non-metropolitan areas, traffic congestion has a negative effect on home prices in urban areas.

Sirmans et al., (2005) review 125 empirical studies. They find that in most studies the number of bedrooms, square footage, number of bathrooms, garage, fireplace, and pool have a positive while age has a negative correlation with home value. These variables are used as structural variables in most hedonic models. In our study, we use the same control variables as Bond et al., (2002), Sirmans et al., (2005), Winson-Geideman et al., (2011), and Conroy and Milosch (2011). Age is another control variable we use in our study. Winson-Geideman et al., (2011) study the effects of age on the value of historic homes in designated historic districts. They find that, due to historic significance, age has a positive impact on houses that are more than 119 years old.

### **3. Data and Methodology**

The area selected is an urban area located in the suburbs of Oklahoma City. We selected this area because of its homogeneous socioeconomic characteristics, physical boundaries (major roads), and of course, proximity to lake recreational areas. Housing sales data is manually entered from Zillow's website. Individual home distance from the lake and other landmarks is measured using google maps. The distance from Lake Hefner is the displacement of the house from the nearest part of the lake. The focus is on the zip codes adjacent to the lake but without a lake view. Figure 1 shows the lake and surrounding area. Our dataset contains 1678 observations of single-family homes sold from September 2012 through March 2015. The data provides information on the home's sales price, size, number of bedrooms, age, lot size, and address.



There are a few observations with missing information in one or more of these categories. We also remove any outliers from the dataset. We create dummy variables for distance, e.g., if the distance from the lake is a half mile or less, the value of the variable is 1 and 0 otherwise. Similar dummy variables are created for every half mile distance.

As discussed in the literature section, we use the hedonic pricing model for housing (Freeman 2003). This model is also used by Conroy and Milosch (2011), among others, to assess the effect of coastal distance on house pricing. Hedonic regressions statistically estimate the relation between certain characteristics of a property and its market value. The hedonic pricing model considers a house to be a composite good because it possesses many attributes. The home characteristics are divided into three categories: structural, neighborhood, and variables of interest. Therefore, it can be represented as

$$P = f(S, T, R)$$

Where P is the sale price of housing, S is a vector of structural characteristics, such as the number of bedrooms and bathrooms, square footage, and lot size. T is a vector of spatial and neighborhood characteristics, such as distance from downtown and highways, and R represents the variables of interest, distance from the lake.

Table 1 provides descriptive statistics for all variables within all zip codes. The value of single-family homes is given in US dollars. The age of the houses is given in years. Using google maps, distances from each house to Lake Hefner, highway 74 and downtown Oklahoma City are measured manually in miles. The mean distances from the lake and downtown Oklahoma City are nearly 1.63 miles and nearly 12.01 miles, respectively. Summary statistics indicate that, on average, the houses have a covered area of approximately 2200 square feet and average age of 57 years. The mean value of a single-family home in these zip codes is approximately \$229,637.

**Table 1: Descriptive Statistics for Full Sample Size**

Variable	Description	Mean	Standard Dev	Mi n	Max
Log SellPrice	Log of sale price	12.05	0.69	9.62	14.81
SellPrice	Sale price of the house	229637.6	0	15000.00	2700000.00
bed	Number of bedrooms	3.15	0.77	1.00	7.00
bath	Number of Bathrooms	2.39	0.92	0.00	8.00
age	Age of the house	39.51	18.38	0.00	85.00
age2	Age square	1898.34	1420.77	0.00	7225.00
Sqft	Square footage of the house	2128.50	985.06	363.00	9900.00
Lot Size	Size of the lot in Square feet	10603.48	7083.36	1224.00	91444.00
DowntownOK	Distance from downtown Oklahoma City	12.01	3.51	1.10	26.10
Log Downtown	Log of distance from downtown	2.44	0.32	0.10	3.26
distancefree74	Distance from highway 74	2.71	1.60	0.00	7.60
log Hwy Dist	Log of Distance from highway 74	0.79	0.69	-2.30	2.03
LakeHefners	Distance from Lake	1.63	0.98	0.03	6.00
Log Lake Dist	Log of distance from lake	0.25	0.76	-3.46	1.79
Lake 0 to 0.5 <sup>a</sup>	Dummy: house within 0.5 miles of the lake	0.11	0.31	0.00	1.00
Lake 0.5 to 1.0	Dummy: house is between 0.5 to 1.0 miles of the lake	0.23	0.42	0.00	1.00
Lake 1.0 to 1.5	Dummy: house is between 1.0 to 1.5 miles of the lake	0.20	0.40	0.00	1.00
Lake 1.5 to 2.0	Dummy: house is between 1.5 to 2.0 miles of the lake	0.13	0.34	0.00	1.00

<sup>a</sup> None of these houses are adjacent to the lake or offer a clear view of the lake. The minimum distance is 0.03 miles.

#### 4. Results

We present our regression results in Table 2. In the model, we include the log lake distance variable to provide the lake premium estimation. All coefficients are significant at the 1% level, except for the number of bedrooms, which is not significant in any of our models. Previous literature shows mixed results for the relation between home price and number of bedrooms. Simrans et al., (2006) finds having a higher number of bedrooms has a positive effect on home price. On the other hand, Boarnet and Chalermpong (2001), analyzing data from Orange County, suggest that this relationship is negative. Our results are more in line with Stevenson (2004), who finds that in Boston, a home's number of bedrooms has no effect on the price. Perhaps this relation depends on the area and preferences of residents in that area.

**Table 2: Regression results for Full Sample Including All Zip Codes**

Variable	Model 1		Model 2	
	Coefficient	t-value	Coefficient	t-value
Const	12.30533	116.85	12.36886	121.18
Bed	-0.02723 <sup>c</sup>	-1.79	-0.02543 <sup>c</sup>	-1.70
Bath	0.16575 <sup>a</sup>	10.19	0.15888 <sup>a</sup>	9.97
Sqft	0.00033 <sup>a</sup>	20.94	0.00033 <sup>a</sup>	21.30
Lot size	0.00001 <sup>a</sup>	7.83	0.00001 <sup>a</sup>	7.99
Age	-0.02829 <sup>a</sup>	-15.77	-0.02608 <sup>a</sup>	-14.60
age2	0.00034 <sup>a</sup>	13.71	0.00032 <sup>a</sup>	13.09
Log Downtown	-0.37716 <sup>a</sup>	-10.33	-0.38227 <sup>a</sup>	-10.67
log Hwy Dist	0.05820 <sup>a</sup>	5.44	0.08268 <sup>a</sup>	7.51
Log Lake Dist	0.03619 <sup>a</sup>	2.93		
Lake 0 to 0.5 <sup>d</sup>			-0.03706	-1.16
Lake 0.5 to 1.0			-0.11917 <sup>a</sup>	-5.04
Lake 1.0 to 1.5			-0.21806 <sup>a</sup>	-8.52
Lake 1.5 to 2.0			-0.12313 <sup>a</sup>	-4.37
Adj. R-squared	0.71		0.73	
F-Statistic	467.53		370.99	
No. of obs.	1678		1678	

Note: Dependent variable is sale price of the house. Bed is number of bedrooms, Bath is number of bathrooms, sqft is square feet covered area of the house minus garage. Lot size is size of the land where house is constructed, age is age of the house in years, Log Downtown is log of distance from downtown, Log Hwy Dist is log of distance from nearest highway i.e. highway 74 and then we have dummy variables for distance from lake.

<sup>a</sup> indicates significance at the 0.01 levels

<sup>b</sup> indicates significance at the 0.05 levels

<sup>c</sup> indicates significance at the 0.10 levels

<sup>d</sup> None of these houses are adjacent to the lake or offer a clear view of the lake. The minimum distance is 0.03 miles.

The variable of interest Log Lake Dist. has a coefficient of 0.0362, suggesting that a 10% increase in distance from the lake is associated with a 3.62% increase in price. The model 1 results also suggest that an additional bathroom is associated with a 16.6% higher sales price. The coefficient for square feet of structure is positive and significant, indicating that a 100-square-foot increase in structure is associated with a 3.30% higher price. Lot square footage is significant, and the effect is much smaller, with each 100 additional square feet of lot size associated with about a 0.01% higher price. The coefficient for age is negative, implying a decrease in price with age. The coefficient for age square is positive, suggesting the effect decreases as age increases; in other words, doubling the age would not double the age effect. Perhaps after a certain age the house acquires a certain historic charm or antiquity that helps stabilize the price.

The log distance from the freeway (LnFreeDist) variable is positive. We can argue that due to the noise and air pollution effects of busy highways, buyers may prefer to purchase homes farther from highways and freeways (Langley 1976), thus reducing home prices closer to highways. The log distance from downtown (LnDowntownDist) is negative, suggesting that home prices decrease as distance from downtown increases for a given home.

In Model 2, we have included lake distance dummies by mile up to 2 miles with a half-mile increment for each dummy variable. Our results for model 2 are similar to those in Model 1. As such, we estimate whether there is any premium on the houses based on distance from the lake. We find that the coefficient for houses located within a half mile of the lake is negative and not significant. For houses located between a half mile and one mile from the lake, the coefficient is negative and significant, and translates to a 11.9% decrease in price for houses located at that distance compared to houses that are beyond two miles. This effect increases for houses between one and 1.5 miles to 21.8%, and for those between 1.5 to two miles, the effect is 12.3%. That is, house prices are still lower at that distance compared to houses located beyond two miles. These results show that the negative relation between home prices and distance from the lake starts to decrease after 1.5 miles. Yet, the price of houses beyond 2 miles is higher than that of all houses closer than 2 miles. We suggest this negative effect can be attributed to traffic and noise, which is why the farther we move from the lake, the more the negative effect begins to diminish. To analyze further, we run our model on each zip code area separately. The results are shown in Table 3.

**Table 3: Regression Results on Each Zip Code Separately**

Variable	Zip Code 1		Zip Code 2		Zip Code3		Zip Code 4	
	Coeff	t-value	Coeff	t-value	Coeff	t-value	Coeff	t-value
Const	14.85623 0	21.52	12.04302 -	35.97	11.73466 0	102.7	11.43926 0	51.55
Bed	0.015324 0.167454	0.45	0.067325 <sup>b</sup> -	-1.96	0.028004 0.046463	1.47	0.042504 <sup>c</sup> 0.128691	1.87
Bath	0.000261 <sup>a</sup>	4.65	0.148836 <sup>a</sup> -	4.34	0.000252 <sup>b</sup>	2.16	0.000137 <sup>a</sup>	5.02
sqft	0.000017 <sup>a</sup>	7.53	0.000479 <sup>a</sup> -	13.05	0.000012 <sup>a</sup>	11.55	0.000005 <sup>a</sup>	6.08
Lot size	0.030306 <sup>a</sup>	5.17	0.000002 -	0.81	0.027764 <sup>a</sup>	5.97	0.024933 <sup>a</sup>	2.47
age	0.000297 <sup>a</sup>	-5.83	0.0002972 <sup>a</sup>	-5.42	0.000321 <sup>a</sup>	-7.95	0.000230 <sup>a</sup>	-7.48
age2	0.000297 <sup>a</sup>	4.83	0.0002972 <sup>a</sup>	4.65	0.000321 <sup>a</sup>	4.30	0.000230 <sup>a</sup>	3.45
Log Downtown	1.483840 <sup>a</sup>	-4.69	0.2487422 -	-1.58	0.054665 -	-1.53	0.075546 -	0.92
log Hwy Dist	0.036171 -	-0.67	0.0695718 -	0.513	0.041721 <sup>c</sup>	1.86	0.041119 <sup>b</sup>	2.00
Log Lake Dist	0.035781 -	0.47	0.1080853 <sup>a</sup>	-2.39	0.024714 <sup>c</sup>	-1.71	0.080633 <sup>a</sup>	-3.58
Adj. R- squared	0.78		0.73		0.66		0.54	
F-Statistic	173.48		119.31		87.67		58.09	
No. of obs.	437		399		410		432	

Note: Dependent variable is sale price of the house. Bed is number of bedrooms, Bath is number of bathrooms, sqft is square feet covered area of the house minus garage. Lot size is size of the land where house is constructed, age is age of the house in years, Log Downtown is log of distance from downtown, Log Hwy Dist is log of distance from nearest highway i.e. highway 74 and then we have dummy variables for distance from lake.

<sup>a</sup> indicates significance at the 0.01 levels

<sup>b</sup> indicates significance at the 0.05 levels

<sup>c</sup> indicates significance at the 0.10 levels

Table 3 results show that in zip code 1 the coefficient for log Lake Dist is positive and not significant, while for the other three zip codes the coefficient for this variable is negative and

significant. The main entrance to Lake Hefner's recreational area and the marina is in the middle of zip code 1, and, due to traffic congestion and noise, buyers are not as likely to consider homes in this area. This is consistent with Jin and Rafferty (2018) that traffic congestion has a negative impact on home value thus reducing the premium associated with proximity to the lake, making the relationship statistically insignificant in this zip code. Consequently, if we take this zip code out then for the other areas it shows that buyers like to have properties close to the lake area without exposure to the gate entrance.

**Table 4: Regression Results Without Zip Code 1**

variable	Model 3		Model 4	
	Coeff	t-value	Coeff	t-value
Const	11.60550	103.46	11.60160	101.78
Bed	-0.02140	-1.37	-0.02221	-1.42
Bath	0.14512 <sup>a</sup>	8.63	0.14731 <sup>a</sup>	8.77
Sqft	0.00032 <sup>a</sup>	19.26	0.00032 <sup>a</sup>	19.45
Lot size	0.00001 <sup>a</sup>	6.49	0.00001 <sup>a</sup>	6.47
Age	-0.02725 <sup>a</sup>	-14.97	-0.02698 <sup>a</sup>	-14.7
age2	0.00034 <sup>a</sup>	12.22	0.00034 <sup>a</sup>	12.25
Log				
Downtown	-0.09537 <sup>a</sup>	-2.44	-0.10577 <sup>a</sup>	-2.66
log Hwy				
Dist	0.06869 <sup>a</sup>	6.94	0.07587 <sup>a</sup>	7.24
Log Lake				
Dist	-0.02570 <sup>b</sup>	-2.11		
Lake 0 to				
0.5 <sup>d</sup>			0.07611 <sup>a</sup>	2.37
Lake 0.5 to				
1.0			-0.00068	-0.03
Lake 1.0 to				
1.5			-0.04359	-1.5
Lake 1.5 to				
2.0			-0.01956	-0.62
Adj. R-squared	0.64		0.64	
F-Statistic	248.27		187.88	
No. of obs.	1241		1241	

Note: Dependent variable is sale price of the house. Bed is number of bedrooms, Bath is number of bathrooms, sqft is square feet covered area of the house minus garage. Lot size is size of the land where house is constructed, age is age of the house in years, Log Downtown is log of distance from downtown, Log Hwy Dist is log of distance from nearest highway i.e. highway 74 and then we have dummy variables for distance from lake.

<sup>a</sup> indicate significance at the 0.01 levels

<sup>b</sup> indicate significance at the 0.05 levels

<sup>c</sup> indicate significance at the 0.10 levels

<sup>d</sup>None of these houses are adjacent to the lake or offer a clear view of the lake. The minimum distance is 0.03 miles.

In table 4, we run the same analysis used for table 2, but in table 4 we drop zip code 1. Our results for model 3 indicate that home prices in these three zip codes decrease as the distance to the lake increases. The coefficient for log Lake Dist is  $-0.0257$ , suggesting a 10% increase in distance from the lake is associated with a 0.257% decrease in price. In model 4, the dummy variable for distance from 0 to a half a mile has a positive and significant coefficient indicating that the house prices closer to the lake are higher than those beyond two miles from the lake. This data indicates that once the congestion and traffic noise near the entrance is removed, those properties become more desirable to people wanting to live near the lake. Other dummy variables are not significant. Based on these results, we can argue that most houses having some premiums are located very close (between 0 to 0.5 miles) to the lake.

## 5. Conclusion

Given the advantages and disadvantages of owning homes close to recreational lake areas, the question of the value of such homes requires empirical investigation with the new data and time frame. To differentiate our study from prior literature we provide new data and time frame using a single lake recreational area to avoid heterogeneity caused by using multiple bodies of water. We focus on distance from the lake, not view. That's why Lake Hefner is selected because none of the houses is adjacent to the lake. We analyze 1678 homes in the zip codes adjacent to Lake Hefner in Oklahoma City and sold from September 2012 through March 2015. Our initial results indicate that people prefer to live away from the lake and are willing to pay higher prices. However, deeper zip code analysis demonstrates that homebuyers only avoid zip code 1, which is where the only entrance to the lake is located. On the other hand, homes in zip codes farther from the entrance and closer to the lake are more desirable, therefore command a premium. Overall, our results show that even without direct view, homes closer to the lake command a premium, while this relationship does not hold for the homes closer to the entrance. This study is useful for real estate appraisers who can include this additional variable while valuing properties. Also, real estate developers can assess the impact of lake recreational areas on their houses and plan their projects accordingly.

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## **Developing a Transparency Guide for the One-Time Influx of COVID-19 Relief Funds to Local Governments: Lessons from Arkansas**

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### **Abstract**

*Since the outbreak of the COVID-19 pandemic, local governments (i.e., cities and counties) have received an influx of funds from the United States Treasury Department to help pay for unexpected eligible expenses and replace lost revenue. Concerned citizens have observed that governments may [inadvertently] create opportunities for public-sector corruption through their disbursement processes. Adding to the corruption concerns are the difficulties local government officials have reported in interpreting ambiguous provisions in the U.S. Treasury's guidelines on the funds' allowable uses. Using lessons from Arkansas local governments, this paper presents a practical guide for governments and their residents to understand and implement best practices for using, tracking, and being transparent with the COVID-19 relief funds. Our research can help governments prioritize what information to make available to stakeholders, including their residents and the U.S. Treasury.*

**Keywords:** COVID-19 pandemic, relief funds, local government, transparency, open government

### **Introduction: Transparency in Emergency Situations**

In January 2020, the World Health Organization declared the COVID-19 pandemic a public health emergency of international concern (World Health Organization, 2020). Since the pandemic's declaration, the U.S. Treasury has released trillions of taxpayer dollars to state and local governments to mitigate the pandemic's impact on individuals and businesses. It is not unusual for the federal government to release funds to mitigate the impact of disasters or pandemics (Rhodes, 2020). However, failing to track the use of those funds can weaken the efficiency of the crisis response and result in corruption (Deslatte, 2020; Gallego et al., 2021; Vrushi & Kukutschka, 2021). For example, Jenkins et al. (2020) predicted that some portion of the COVID-19 relief funds disbursed to the healthcare sector would be lost to corruption, based on their research of previous crises.

On March 27, 2020, the U.S. Congress passed the Coronavirus Aid, Relief, and Economic Security (CARES) Act, releasing \$2.2 trillion in taxpayer funds to provide fast and direct economic aid to the American people harmed by the COVID-19 pandemic (Coronavirus Relief Fund, 2021). Within this \$2.2 trillion package, the CARES Act established the Coronavirus Relief Fund (CRF), which allocated \$150 billion for states, local governments, and tribes to respond to, prevent, and prepare for COVID-19 (Coronavirus Relief Fund, 2022). One year later, on March 11, 2021, congress passed the American Rescue Plan Act (ARPA), releasing

an additional \$1.9 trillion to combat the COVID-19 pandemic and its public health and economic impacts. Of the \$1.9 trillion package, ARPA allocated \$350 billion under the Coronavirus State and Local Fiscal Recovery Funds (SLFRF) program to eligible state, local, territorial, and tribal governments to respond to the virus's economic and public health impacts. Further legislation has set aside additional state and local recovery funding, including the Coronavirus Response and Relief Supplemental Appropriations Act and the Infrastructure Investment and Jobs Act (Airi, 2021).

### **Background: A Breakdown of Funds Provided to Arkansas**

Arkansas has received over \$8 billion in COVID-19 relief funds from a combination of funding portfolios, including CARES, ARPA, and others (Hardin Scott, Director of Communications Arkansas Department of Finance and Administration, email to author, July 21, 2022; CTEH, 2021). Over \$3 billion was provided to Arkansas under the CARES Act, from which \$1.25 billion was disbursed directly to the state government through CRF (Coronavirus Relief Fund, 2021). CARES funding is complicated as some of it was provided directly from the federal government to state agencies and did not require appropriation (Hardin Scott, Director of Communications Arkansas Department of Finance and Administration, email to author, July 21, 2022). Under ARPA, Arkansas has received over \$5 billion. Just like under CARES, ARPA disbursed about \$2.8 billion directly through the state government (State of Arkansas Department of Finance and Administration, 2021), while the other sums were disbursed through other grant portfolios (Hardin Scott, Director of Communications Arkansas Department of Finance and Administration, email to author, July 21, 2022).

### **CRF Funds to Arkansas's Local Governments**

From our research, of the \$1.25 billion in CRF funds released to the state, the Arkansas CARES Act Steering Committee disbursed \$150 million to cities, towns, and counties: \$75 million for cities and towns, and \$75 million to counties (Louthian, 2020). Approximately 500 cities and towns and all 75 counties within the state have received these funds (State of Arkansas Department of Finance and Administration, 2021).

### **ARPA Funds to Arkansas's Local Governments**

A breakdown of the \$2.8 billion in ARPA funds on the Arkansas Department of Finance and Administration (DFA) website shows that \$1.6 billion was designated as the State Fiscal Recovery Fund, another \$1 billion as the Local Fiscal Recovery Fund, and another \$158 million as the Coronavirus Capital Project Fund (Arkansas Department of Finance and Administration, 2021). Approximately \$586 million in ARPA funds has been disbursed to counties as of May 2022 (United States Department of Treasury, 2021b). Counties and other local governments have until December 31, 2024, to obligate ARPA funds (that is, commit them to specific needs) and until 2026 to complete projects and spending related to the obligated funds (Federal Register, 2021).

## **How Has Arkansas Promoted Transparency in Its Use of COVID-19 Relief Funds?**

There were controversies during the initial rollout of applications for CARES ACT funds in 2020, though Arkansas governor Asa Hutchinson moved quickly to resolve them (Brantley, 2020). Subsequently, as the influx of funds was rolled, local governments, especially counties, were not clear on how they could use or report their use of the relief funds. For example, with ARPA funds, counties and school districts reported technical difficulties in understanding the use of some categories of the funds (Howell, 2022; KFSM, 2021; Villines, 2021). A difficulty some county officials reported was that the U.S Treasury's guidelines were better suited to urban localities and unsuitable in some of Arkansas's more rural localities (Lindsey Holman, CEO and Principal of Holman Strategies LLC, in discussion with the authors, September 2021). In addition, pressure groups in some counties asked their county officials to pause the spending of ARPA funds until the public could weigh in on the appropriate needs and uses for the funds (Sissom, 2021). This was a problem: the lack of clarity may not only promote misuse of funds but also inhibit well-intentioned government officials from using the funds to serve their residents because of propriety concerns and fear of legal action by the U.S. Treasury Department.

In August 2021, the Arkansas DFA's Office of Accounting was concerned that proper and adequate documentation for audit purposes was not being requested and appropriately maintained at the state agency level (State of Arkansas Department of Finance and Administration, 2021). As a result, the DFA executed a contract with emergency response firm CTEH, in partnership with emergency management firm Hagerty Consulting, to provide a COVID-19 cost recovery grants management system as well as expert support and guidance to the state (Louthian, 2020; State of Arkansas Department of Finance and Administration, 2021). It is unclear whether the DFA's contract and partnership with CTEH and Hagerty Consulting extend technical expertise to local governments on how ARPA funds can be spent, tracked, and reported online.

In January 2022, the U.S. Treasury Department released an updated Coronavirus State and Local Fiscal Recovery Final Rule ["Final Rule" (FR)] that took effect on April 1, 2022. The federal policy on eligible uses was modified to provide more flexibility for smaller rural governments to use the funds for the provision of government services. The U.S. Treasury recognized that rural communities needed the ability to address the negative impacts of COVID-19 while addressing long-standing disparities in rural communities. That is why the updated policy provided recipients with the option to take up to \$10 million of their SLFRF funds and designate those dollars as revenue replacement funds to use towards the provision of government services. For many counties in the state, this allowance from the U.S. Treasury would help them spend the funds in a federally compliant way while addressing the unique needs of their communities (Lindsey Holman, CEO and Principal of Holman Strategies LLC, in discussion with the authors, July 2022). The Final Rule also provided significant clarification regarding other federal grant compliance requirements. In addition, other supporting guidance from the U.S. Treasury has continuously been updated, including:

- SLFRF Reporting and Compliance Guide
- SLFRF Project and Expenditure Report Portal User Guides
- SLFRF Final Rule FAQs
- SLFRF Final Rule Overview
- SLFRF Recovery Plan Guides

- SLFRF/OMB Single Audit Alternative Memo

These updates and the new guidance from the U.S. Treasury give more tools to SLFRF recipients that should significantly drive down the risk of non-compliance and recouplement of federal funds.

## **Literature**

The one-time influx of funds was designed to help local governments assist residents with unexpected eligible expenses and replace lost revenue due to the pandemic. However, if local governments spend the influx of funds in a way that they or residents cannot track, this lack of transparency could promote secrecy and foster corruption (Gallego et al., 2021). Similarly, Amedee et al. (2011) and Deslatte (2020) warned that a climate ripe for the indulgence of self-interest at the people's expense would erode public trust.

### **Why We Need a Transparency Guide for the Influx of Funds at the Local Government Level**

Corruption can arise from the tendency of some public officials to act dishonestly or compromise internal controls for their personal gain (Levi & Smith, 2021). Local governments experience more problems with transparency and internal controls than other levels of government (Cuadrado-Ballesteros, 2014; De Araujo & Tejedo-Romero, 2016; Guillamón et al., 2011) because they are more averse to open-government initiatives (Cuadrado-Ballesteros, 2014). However, transparency is important for local governments because they oversee basic essential services that can impact their residents' daily lives. For example, Arkansas county governments oversee essential services like law enforcement, firefighting, ambulances, transportation, sewer, trash pickup, and water for their residents (Arkansas Code, 2017). Corruption's negative impact on any of these essential services can seriously impact people's lives, but transparency can deter corruption (da Cruz et al., 2016).

### **What We Mean by "Transparency"**

*Transparency* in this study refers to publishing and tracking the use of COVID-19 relief funds on official local government websites to allow residents to access credible and durable information promptly and efficiently (Porumbescu, 2015). Our definition is an operational one: Kraah and Mertens (2020) stated that "transparency involves the online publicity of all the acts of government and their representatives providing civil society with relevant information in a complete, timely, and accessible manner" (p. 1). Similarly, da Cruz et al. (2016) explained transparency as existing when governments report in a manner that is accessible and convenient to residents - why, what, and how they are spending public funds. Thus, transparency goes beyond mere access to information; it demands that information be published online in a format that all stakeholders can understand and utilize to improve the lives of COVID-19 impacted Arkansans (de Araujo & Tejedo-Romero, 2016; Kalulu et al., 2019). Public officials cannot demonstrate integrity and good performance without reporting their acts to residents in accessible ways (da Cruz et al., 2016).

## **Why Web Transparency Matters**

Web transparency is a form of open government initiative. Others include data portals, social media, and online meetings. All of these help the public to monitor government spending and other crucial political and administrative activities (Tavares & da Cruz, 2020). Research shows that public websites play a crucial role in promoting government transparency, resident participation, and government-resident collaboration (Bertot et al., 2010; Cuillier & Piotrowski, 2009; Tavares & da Cruz, 2020). They also promote equal and sustained public access to government information (Bertot et al., 2010), which in turn enhances public trust (Amedee et al., 2011; Pina et al., 2007) and discourages corruption (Bertot et al., 2010).

Research has also suggested that citizens frequently seek real-time information online during emergencies, such as the COVID-19 public health emergency. An open-data approach eliminates many barriers to resident communication that governments have historically experienced (Graham et al., 2015). Web transparency allows residents to participate more broadly in times of crisis as they seek, collect, create, and share information online. Studies show that local governments are increasingly using web pages and social media platforms to communicate with their residents during crises (Conrado et al., 2016; Merchant et al., 2011; Mergel, 2013).

Some local governments in other states have been tracking and reporting the use of funds online. For example, city governments in Los Angeles (LA Controller, 2020), Chicago (City of Chicago, 2022), and New York (Independent Budget Office of the City of New York, 2022) have dashboards that track COVID-19-related spending. Though these programs do not necessarily organize data, their efforts are notable.

## **Study Design**

Our study employed a multimethod approach. We used a content-analysis approach (Berelson, 1952) to collect information from county websites on how they tracked and reported the use of ARPA funds. We also administered an online survey (Sue & Ritter, 2012) to county officials to collect information. The Institutional Review Board at the University of Central Arkansas reviewed and approved the protocol before we conducted the survey.

## **Data Collection and Analysis**

Our data collection and analysis covered Arkansas's 75 counties. First, we conducted a content analysis of their official government websites in early 2022 to see whether they reported using or spending ARPA funds and how they reported such information to residents. The objective of this step was to identify data gaps. Next, we provided a survey to all 75 Arkansas county judges to explore open-access communication content. The survey was also a type of content analysis (Tavares & da Cruz, 2020). We received 24 completed surveys.

The survey focused on four major areas:

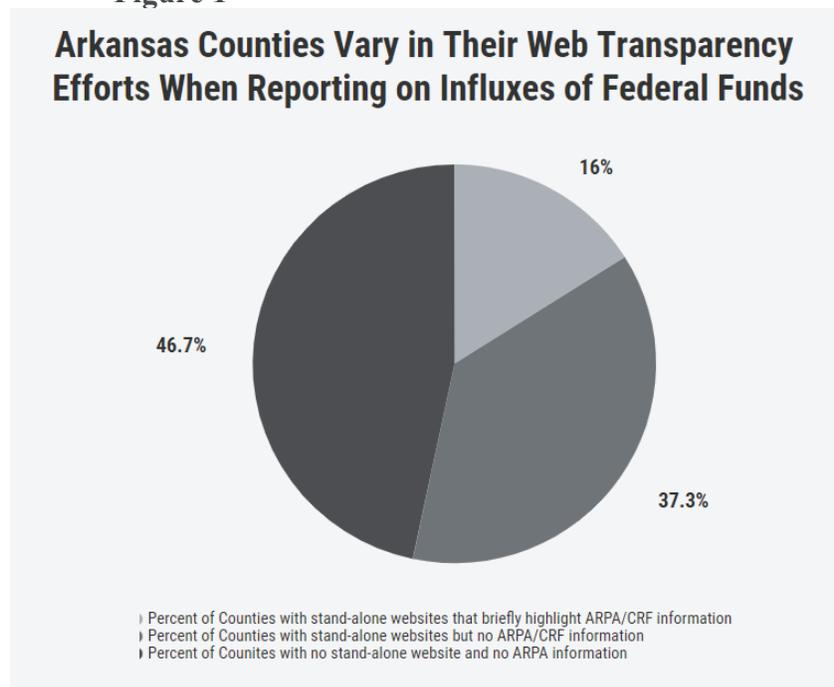
1. Do you need technical assistance with understanding ARPA funds?
2. Where do you need the most technical assistance?
  - a. Use and Spending
  - b. Tracking

- c. Reporting
  - d. Other
3. Does your office have measures for tracking and reporting ARPA funds to residents? If yes, please describe those measures.
  4. Does your office have methods for tracking and reporting ARPA Funds to the U.S. Treasury?

## Results and Discussions

The results from the transparency survey demonstrate that only 12 counties briefly highlight ARPA/CRF funding activity. Meanwhile, 28 counties have stand-alone websites that fail to report any ARPA/CRF related information. 35 counties failed to report any ARPA or CRF funding information whatsoever due to their lack of a stand-alone web transparency resource for taxpayers to learn about influxes of federal funds earmarked for COVID-19 related expenditures.

Figure 1



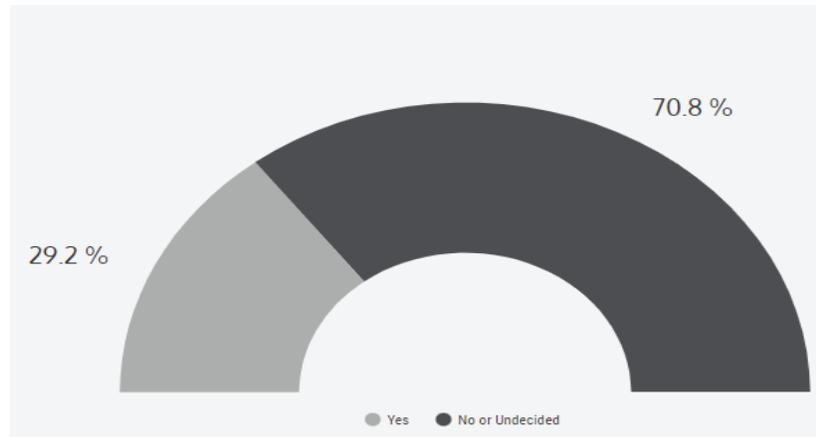
Next, we present our survey results in the same order as our survey questions.

### *Need for Technical Assistance*

The survey for developing a transparency guide for the influx of federal funds sampled all 75 Arkansas counties. We received 24 counties' responses, comprising 33% of the state. Amongst the 24 respondents, 29.2% (seven counties) said yes, they needed technical assistance with understanding how to be transparent in their county's use of ARPA funds. The remaining 70.8% (17 counties) declined technical assistance (see Figure 2).

**Figure 2**

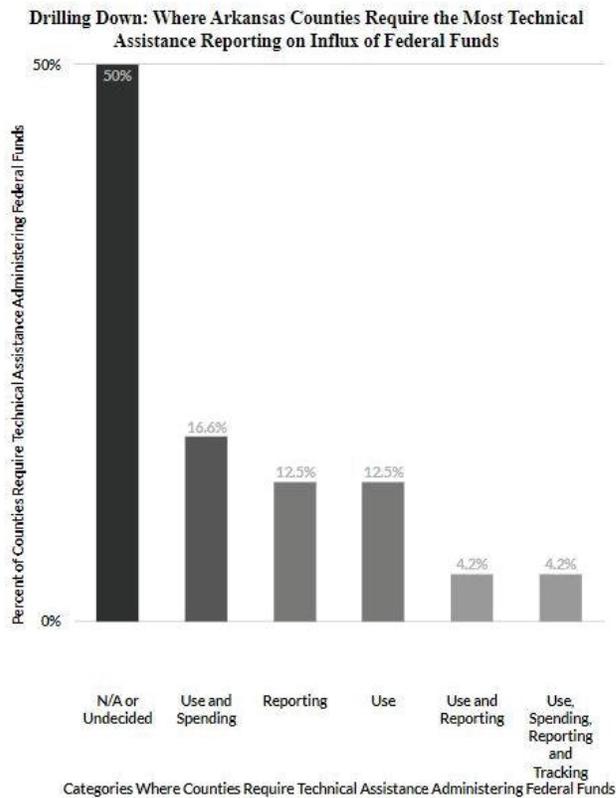
Share of Arkansas Counties Needing Help with ARPA Funding



**Where Arkansas Counties Require the Most Technical Assistance**

There was a wide variance across six unique responses in terms of Arkansas counties' need for technical assistance in administering ARPA/CRF disbursements. Fifty percent of respondents, or 12 counties, indicated they did not need any technical assistance utilizing ARPA/CRF funds. The next largest subset of four counties requested technical assistance with both the use and spending of federal ARPA/CRF funds. Three counties required assistance in reporting on federal fund disbursements due to overly complex U.S. Treasury Department guidance on reporting requirements and follow-up for counties. However, another three counties needed assistance on only the use of those funds. These counties' reticence toward making independent use determinations could be attributed to their lack of technical expertise to make efficient use determinations from the U.S. Treasury's guidance, which is extensive and requires intensive legal interpretation in terms of the breadth of possible legitimate uses for ARPA/CRF funds by counties. One county required assistance with both the use and reporting of federal funds. Meanwhile, the last respondent county indicated it required technical assistance with all four aspects of ARPA/CRF funds, namely the use, spending, reporting, and tracking of ARPA/ARF disbursements to final beneficiaries. Figure 3 shows the distribution of needs as it relates to ARPA/CRF funding to Arkansas counties.

**Figure 3**

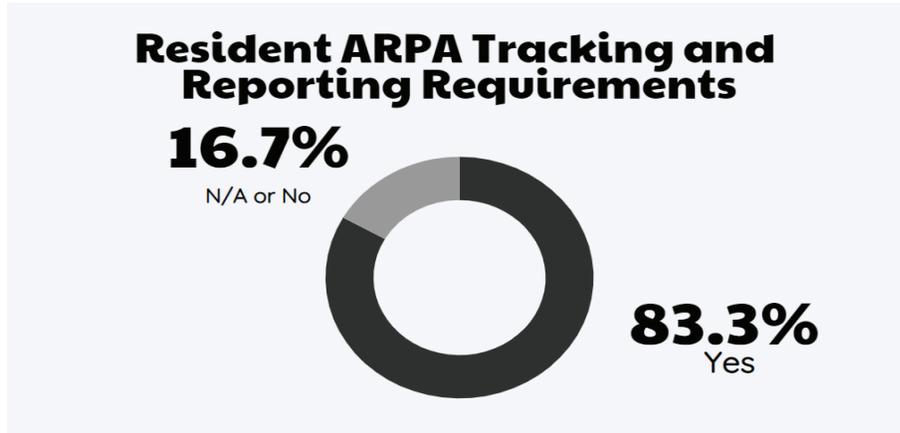


### How Arkansas Counties Track and Report on Their Use of ARPA Funds to Arkansas Residents

When we collected data in March 2022, no county fully reported or tracked the use of ARPA funds online. However, out of Arkansas’s 75 counties, 40 have stand-alone websites; the other 35 have some or minimal web presence through the state’s Arkansas.gov platform. At the time of our survey, no county fully reported on how they spent or tracked the relief funds they received. Twelve counties briefly highlighted some information on ARPA and CRF funds on their websites or referred users to information on grant expenditures in their budgets, audit reports, or other spending records. Those records lacked detailed data on relief fund disbursement amounts and recipients.

The vast majority of respondents have some mechanism in place to report and track ARPA disbursements to Arkansas residents. However, two counties have no requirements to track or report any ARPA disbursements. This puts the administration of these dollars at risk of misuse by opportunistic county officials. Figure 4 below shows the share of counties that implemented practical steps to allow residents to track ARPA disbursements.

Figure 4



The largest category of county respondents, 41.7%, reported that they had not spent the ARPA disbursement yet or had no plan to report such information to their county constituencies. Next, 20.8% of counties in the survey utilized county websites or the local news to make residents aware of how the county intended to spend ARPA funding. Another 12.4% of counties distributed ARPA spending information through their county treasurer’s office, while another 12% opted to retain a consultant for the same purpose. Also, 8.3% of counties partnered with the Arkansas Association of Counties (AAC) or the National Association of Counties (NACO) consultants. Finally, 6% of counties chose to include a line item in their county budget to allow county-level employees to share information related to county ARPA spending.

### **How Arkansas Counties Track and Report on Their Use of ARPA Funds to the U.S. Treasury**

Of the 24 counties that completed the survey, 21 said that they track and report their ARPA spending to the U.S. Treasury. The other three counties said they were undecided or did not report this information.

### **Creating a Relief Funds Transparency Checklist**

To encourage transparency in the use of relief funds, we created a checklist of suggested items for local governments to track and report on their websites. We developed this checklist from existing best-practices research on transparency during emergencies, then added items from the Interim Final Rule (United States Department of Treasury, 2021a), the updated Final Rule (Federal Register, 2022), and the Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards (2 CFR § 200 [2013 as amended]).

**Transparency Checklist**

Type of Information	On County Website?	Additional information
<b>1. Statement on compliance with policy standards on fund use and reporting</b>		
<b>2. Procurement</b>		
Current requests for proposals/quotes (RFPs/RFQs)		
Past RFPs/RFQs		
Current bidders		
Past bidders		
Current bid amounts, or at least the range of the bid amounts		
Past bid amounts, or at least the range of the bid amounts		
Current bid winners		
Past bid winners		
Current winning bid amounts		
Past winning bid amounts		
<b>3. Budget</b>		
Current year's adopted budget (or separate General Ledger line items for relief funds in the budget)		
Previous (one) year's adopted budget		
<b>4. Audits</b>		
Current year's audit		
Previous (one) year's audit		

## Checklist Considerations

Here, we describe in more detail how counties can comply with each of the numbered checklist items above.

**1. Compliance with reporting standards:** Recipients of ARPA funds are generally required to follow the use and reporting provisions of the U.S. Treasury’s Final Rule and the Uniform Guidance. Recipients must also meet deadlines for submitting relevant reports. Counties with compliance questions may seek advice from the Association of Arkansas Counties (2021) or a qualified consultant. Costs for administering and managing ARPA funds, including consulting fees, are eligible under ARPA, as are costs for ensuring compliance with legal, regulatory, and other requirements (Federal Register, 2021; National Association of Counties, 2022.).

**2. Compliance with procurement standards:** Procurement refers to the process of acquiring goods and services from third parties. Government procurement of goods and services is vulnerable to corruption because of the volume of contracts, the large sums involved, and the opportunities for bribery (Bauhr et al., 2020; Purwanto & Emanuel, 2020). Further, detecting procurement fraud can be challenging because it can occur at any point in the bid process: pre-solicitation, solicitation, or submission.

2 CFR § 200.317–327 explains the expectations for recipients to comply with procurement standards. Recipients must also follow the applicable laws and regulations in their jurisdictions with respect to procurement purchases. To procure property or services pursuant to a federal award, the process must allow for “full and open competition” as set forth in 2 CFR § 200.319–320.

The Uniform Guidance in 2 CFR § 200 describes how to comply with the following procurement methods: micro-purchases, small purchases, sealed bids, requests for proposals, and, under specific circumstances, non-competitive procurement. When purchases are below the Simplified Acquisition Threshold (currently \$250,000), the recipient may use informal procurement methods (i.e., micro-purchases and small purchases) as applicable. However, when the purchases exceed this threshold, the recipient must use formal procurement methods (i.e., sealed bids and requests for proposals). The methods for both informal and formal procurement are described below.

### Informal Procurement

*Micro-Purchases:* Micro-purchases may be awarded without using the competitive bid process so long as the recipient determines that the price is reasonable based on its research, purchase history, experience, or other factors (2 CFR § 200.320(a)(1)). The recipient must document this determination. Furthermore, recipients should alternate micro-purchases among qualified suppliers to the extent practical.

A micro-purchase is one where the *aggregate* amount of the purchase does not exceed the micro-purchase threshold (currently \$10,000), except in the case of construction subject to the Wage Rate Requirements, where the limit is \$2,000 (48 CFR § 2.101). The micro-purchase threshold applies in aggregate, *not* on a per-item basis.

Recipients may self-certify that they qualify for a micro-purchase threshold of up to

\$50,000 on an annual basis. The self-certification must contain the micro-purchase threshold set by the recipient, the justification for the threshold, and supporting documentation that the recipient is one of the following:

- A low-risk auditee, as set forth in Section 200.520;
- Subject to an annual internal institutional risk assessment to identify, mitigate and manage financial risks; or
- Subject to a higher threshold consistent with state law for public institutions.

The recipient must self-certify every year and must maintain the required documentation to support the certification.

*Small Purchases:* The Uniform Guidance provides that small purchases (2 CFR § 200.320(a) (2)) are those that are above the micro-purchase threshold (currently \$10,000 in most cases) but below the Simplified Acquisition Threshold (currently \$250,000). To use the small purchase method, the recipient must obtain price quotes from an “adequate number of qualified sources” as determined by the recipient. An explanation as to what constitutes an “adequate number of qualified sources” for purposes of the Uniform Guidance has not been issued. While the Recipient of ARPA funds must follow the Uniform Guidance rather than state procurement rules, the State of Arkansas, for example, requires a minimum of three qualified prospective contractors for goods or services costing between \$20,000 than \$75,000 for state contracts (Arkansas Department of Transformation and Shared Services, 2021). Small purchases do not require formal bids. Instead, the recipient may use listed pricing on vendor websites or in vendor catalogs, obtain informal vendor price quotes, or employ other pricing methods.

## **Formal Procurement**

*Sealed Bids:* Procurement using sealed bids may be appropriate for purchases greater than \$250,000 (2 CFR § 200.320(b)(1)). The recipient must publicly solicit sealed bids for a fixed-price contract and award the contract to the lowest responsible bidder who meets all material terms and conditions for the invitation to bid.

When using the sealed bid method, the recipient must provide a complete and realistic purchase description and ensure that two or more bidders are willing and able to compete for the business; the procurement lends itself to a firm fixed price, and the winning bidder can be selected based on lowest quoted price. The recipient must publicly advertise its request for sealed bids and must solicit bids from an adequate number of qualified sources with sufficient time to respond before the bid period closes. The solicitation must include specifics of the items or services being sought and the date when the sealed bids will be opened. The recipient must publicly open all sealed bids and may reject bids if there is a “sound documented reason.”

*Requests for Proposals:* The recipient should use a request for proposal to make the award in situations where a sealed bid is not appropriate, such as when factors besides price are important (such as, but not limited to, trademarked or proprietary information) (2 CFR § 200.320(b)(2)).

The recipient evaluates the proposals and awards the contract to the party whose proposal is the “most advantageous” to the recipient when considering both price and other necessary factors. The recipient must publicize the request for proposals, solicit proposals from an adequate number of sources, and identify all factors it will consider, along with each factor’s relative importance.

*Non-competitive Procurement:* The Uniform Guidance allows recipients to follow non-

competitive procedures in certain limited instances (2 CFR § 200.320(c) (1)–(3) and (5)). For purposes of the SLFRF funds, these instances include micro-purchases (described above); items only available from a single source; public exigency or emergency which will not allow for a delay caused by a competitive bid process; or after solicitation of bids where the competition is deemed inadequate.

The Uniform Guidelines also emphasize contracting with small businesses, minority-owned businesses, women-owned businesses, and labor surplus firms when possible (2 CFR § 200.321). Methods to ensure consideration of these businesses include placing them on solicitation lists, dividing the total contract into smaller parts (when feasible), and requiring the award winner to use these methods when selecting subcontractors. When drafting the contract for procurement, certain provisions must be included, as described in the appendix to the Uniform Guidelines (2 CFR § 200, Appendix II).

Local governments can foster transparency by promptly reporting procurement information through open and centralized platforms like government websites. Residents would be able to see procurement information such as the following:

- Current requests for proposals (RFPs)
- Archived RFPs
- Current bidders
- Past bidders
- Current bid amounts (or, at least, the range of bid amounts)
- Past bid amounts (or, at least, the range of bid amounts)
- Current bid winners
- Past bid winners
- Current winning bid amounts (or, at least, the range of bid amounts)
- Past winning bid amounts (or, at least, the range of bid amounts)

**3. Compliance with budget standards:** Fiscal transparency protects local governments' budgets. Best practices can include publishing county budgets online (Bernick et al., 2014), strengthening policies around accounting systems and internal controls (like recordkeeping), implementing strict procurement policies around the disbursement of funds, upholding the separation of powers, performing due diligence on contractors, and more (Vrushni & Kukutschka, 2021). Counties should ensure that financial data are available online for residents and officials to easily access and scrutinize. Counties should also note that the Interim Final Rule requires recipients whose population exceeds 250,000 residents to provide the U.S. Treasury with the budget adopted for each project, by jurisdiction, associated with SLFRF funds (United States Department of Treasury, 2021a).

**4. Compliance with internal controls and audit standards:** Each recipient must develop and implement internal controls to ensure that the recipient is managing the SLFRF funds in compliance with federal statutes and regulations (2 CFR § 200.318), including awarding projects that constitute eligible uses of the funds. Recipients must also ensure that they document award determinations.

Furthermore, recipients must maintain oversight of the award to ensure that the contractors perform in accordance with the awarded contract. Recipients can strengthen audits and other oversight policies and roll out technological tools that can help with real-time auditing during the spending period. After setting up these tools, recipients should inform their staffs as a

deterrent to corrupt practices (2 CFR § 200.318). Recipients can also implement plans to conduct rigorous after-the-fact auditing of transactions that took place during the spending period and publish them online. Funds can be set aside for such audits (Khadem, 2020).

## Conclusion

The one-time influx of relief funds to local governments was designed to help with the unanticipated expenses and lost revenue as a result of the pandemic. Residents and governments need to follow the money to deter corruption. Releasing waves of public funds without following the money creates a fertile ground for corruption (Jenkins et al., 2020). For ideal transparency, local governments should publish real-time COVID-19 relief-fund expenditures online at least monthly. It would also be ideal for local governments to publish information online on the outcomes of their procurement processes related to ARPA funds, including the contract awardees, contract amounts, communities served, number of residents with access to programs before and after, and other key details.

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## **Commercialization in LEO: Perceived Importance, Willingness to Pay, Willingness to Risk, Domain-Specific Knowledge, and Openness to Experience as Constructs**

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### **Abstract**

*This quantitative study aims to measure the keys to the sustainability of space tourism by analyzing students' attitudes on willingness to pay, willingness to risk, domain-specific knowledge, openness to experience, and their relationship with the importance of a low Earth Orbit (LEO) ecosystem. On June 7, 2019, NASA announced it would allow commercial use of its portion of the International Space Station (ISS) with plans for development in LEO. NASA's long-term goal is to turn operations to the private sector, becoming a consumer of the human spaceflight enterprise and sparking a commercial demand in LEO. Using space tourism as the first step in LEO commercialization, this research aims at several individual factors that relate to the perceived importance of developing a sustainable LEO ecosystem. We designed a survey, dispersed it among students as potential future consumers, and analyzed 126 responses. Using a SAS regression analysis, we found that openness to experience strongly relates to an LEO ecosystem's importance. However, willingness to pay, willingness to risk, and domain-specific knowledge were not.*

Keywords: willingness to pay, willingness to risk, openness to experience, space tourism, LEO ecosystem

The U.S. Congress passed the National Aeronautics and Space Administration Transition Authorization Act in 2017, calling for NASA to develop an ISS Transition Plan to expand human presence in Low Earth Orbit (LEO) through international, academic, and industry partners (Cruz, 2017). The ISS Transition Plan allows commercial use of its portion of the ISS with plans for development in LEO (nasa.gov, 2019). NASA's long-term goal is to turn over operations to the private sector, becoming a consumer of the human spaceflight enterprise and sparking a commercial demand in LEO. The transition is described as (moving) "from the current regime that relies heavily on NASA sponsorship to a regime where NASA could be one of many customers of a low-Earth orbit non-governmental human space flight enterprise." (Cruz, 2017, pg.131).

Were such a transition to successfully occur, it would represent a great example of Schumpeter's process of "Creative Destruction" (Schumpeter, 1961; Landgroodi, 2017). Such destruction is difficult to predict because it is challenging to predict consumer demand due to limited historic purchase patterns in something new like LEO commercialization. As we develop later, space tourism is a likely first step in LEO commercialization. Unlike previous studies of space tourism that used an information acceleration theory to predict growth (e.g., Crouch *et al.*, 2009), we adopt the more Schumpeterian approach of examining socio-psychological issues and

conduct a study more focused on what would *motivate* consumer demand for space tourism (Karadağ, 2016; Landegroodi, 2017; Prasetyo, 2019). As space tourism is asking consumers to risk their lives and considerable sums of money, this study focuses more on the perceived importance of developing a sustainable LEO ecosystem with space tourism as the starting point.

### **Creative Destruction in the Space Industry**

Because of economic, political, and environmental factors, the U.S. Space Shuttle program officially ended on August 31, 2011, after paving the way for private shuttle companies (Houston, 2013). Earlier policies drawn from an era where NASA sponsored or led most of the work are considered “old space” policies and focused on clear and identifiable concrete challenges directed by centralized agencies. The “old space” markets were business-to-government or business-to-business services. The “new space” consists of companies that use decentralized innovation systems. The “new space” market is a key driver in the global space economy and focuses on business-to-consumer services (Robinson & Mazzucato, 2019).

Companies such as Blue Origin have a “vision of enabling a future where millions of people are living and working in space for the benefit of Earth,” SpaceX speaks of “making life multi-planetary.” One of the most accessible missions for creating a sustainable LEO ecosystem is transporting private individuals—who have paid a considerable sum of money—into space. While these space flights could pursue scientific outcomes, the more likely purpose for these private space flights is tourism. Indeed, while Blue Origin and SpaceX tout aims far beyond space tourism, Virgin Galactic’s current system is capable only of space tourism missions.

The costs associated with developing the sustainable LEO ecosystem as the first step to achieving grander space travel ambitions are still a substantial financial risk for private companies (Leigland, 2018). Some public funding is likely necessary to create an LEO ecosystem. Hence, these space companies require sufficient public support to make governmental investments into space popular or acceptable and the interest of wealthy individuals to purchase spaceflights and invest in the company.

From another aspect, NASA concentrates on “in-space manufacturing, regenerative medicine, bioengineering, and other fields that may lead to a scalable, financially self-sustaining demand for low-Earth orbit capabilities” (nasa.gov, 2019, pg. 24). However, this study aims to investigate the keys to attaining public support for a sustainable LEO ecosystem. Specifically, we seek to further the understanding of consumers’ motives and attitudes toward space tourism. We aim to answer: How do personal factors relate to how important a person feels that NASA is working with businesses to develop a sustainable ecosystem in LEO?

We briefly review prior research into consumer attitudes toward space tourism to achieve this aim. Drawing from these studies and the personality literature, we hypothesize four relationships between the importance of an LEO ecosystem and a person’s willingness to pay, willingness to risk, domain-specific knowledge, and openness to experience. We next describe the study methodology. The last section of our study discusses key findings from data analysis and implications for sustainable space tourism development.

### **The Growing Movement Toward an LEO Ecosystem**

The FAA considers *commercial space transportation* as the movement of or means of moving objects, such as satellites and vehicles carrying cargo, scientific payloads, or passengers to and from or in space (Benjamin, 2018, pg. 87). Lockheed Martin, Raytheon, Boeing, and Orbital ATK manufacture 73.8% of the market share of space reusable vehicles (SRV). SpaceX, Virgin Galactic, and Blue Origin are creating more industry competition contributing to price competition from which consumers benefit (Benjamin, 2018). The years 2020 and 2021 were historical for NASA, SpaceX, Virgin Galactic, and Blue Origin. They launched their first-ever private space shuttles from U.S. soil and private astronauts and space tourists. The segmented consumer markets are commercial, military, and government. However, Lee and von Tunzelmann (2005) describe a model of a national innovation system that comprises five actors: government, industry (firms), research institutes (public and private), foreign companies, and universities. NASA created an emerging multi-actor space ecosystem approach that involved a more open-ended objective that does not have a unified or clearly defined end game (Mazzucato & Robinson, 2018).

New products and services from these emerging U.S. space ventures are flooding the marketplace. These include revolutionary, low-cost services now being offered by U.S. companies in the fields of Earth observation, space situational awareness, satellite tracking, space launch, and space manufacturing. After many years of promising advancements, “new space” companies bring revolutionary products to the marketplace, shifting space power leadership back toward the U.S. (Moltz, 2019).

However, legal, financial, and technical preparation costs can discourage potential private bidders from competing for projects (Leigland, 2018). De Schepper *et al.*, (2015) noted widespread agreement among practitioners and academics that private-public partnership (PPP) preparation costs are higher than preparation costs associated with traditional public procurement. In some cases, it undermines the primary cost-effectiveness rationale of PPPs and negatively impacts the economic and financial viability of the project.

To help with some of the high costs, the U.S. government created program initiatives to stimulate small U.S.-based high-tech firms by supporting high-risk research and development to provide technological innovations for public agencies to achieve their missions for the broader market (Wallsten, 2000). The initiative has become a significant funder of high-risk innovation in the U.S. instead of private venture capital investments (Audretsch, 2003; Block & Kellar, 2015; Lerner, 1999). Public support for NASA and the LEO ecosystem is essential to sustain funding for these initiatives. The notion of space tourism is a principal mechanism to build and sustain popular support for space programs.

### **Previous Examinations of Popular Attitudes Toward Space Tourism**

Crouch (2001) describes the early generation of space tourism beginning on Earth as the movement of astronomical observers to different locations to observe better certain astronomical phenomena such as eclipses and planet movements. Studies also measured attributes of space tourism derived from the duration of the visit, market demand, willingness to pay, and most popular activities (Crouch, 2001). A Space Tourism market study completed in 2002 expected suborbital annual passengers of 15,000 and \$700 million in space tourism revenues by 2021 (Chang, 2015). Another study forecasted that suborbital space tourism would generate over 12,000 passengers, more than \$676 million in revenues, and ticket prices at \$50,000 by 2021 (Ziliotto, 2010). That has not happened.

While the development and adoption of the space tourism industry segment have been slow, commercial space tourism and transportation demand expectations will surge in the upcoming years (Benjamin, 2018). Furthermore, 2020 and 2021 were historical years for space tourism. SpaceX, Virgin Galactic, and Blue Origin launched their first historical private space shuttles from U.S. soil, with private astronauts as space tourists. Virgin Galactic is advertising a ticket price of \$450,000 for a 90-minute commercial flight into space (Kay, 2022).

Previous studies describe the transformation of the first powered airplane flight to the first shuttle missions. The qualifications for being awarded USAF Astronaut Wings profoundly affect travel and the tourism industry (Benjamin, 2018; Crouch, 2001; Crouch et al., 2009). These studies examined general consumer interest in space tourism and what tourism experiences would attract consumers.

Consumer interest appeared very high in these previous studies. Nevertheless, much has changed in 20 years. NASA grounded its space shuttle fleet in 2011 but not before a second catastrophic loss in 2003. On the positive side, the number of countries participating in space projects increased from 28 to 70 between 1996 and 2017 (Lee *et al.*, 2021). Space enthusiasts can support LEO development even if they can or do not desire to travel themselves. Therefore, we suggest that an investigation of attitudes toward a sustainable LEO with a starting point of space tourism is necessary for building a framework for market creation.

## Importance

Studies show that the public sector focuses on the political environment while the private sector focuses on the market environment (Alford & Greve, 2017). Private sectors more specifically focus on a single organization strategy. Doing so can lead to quicker innovations. NASA is driving market creation using private-public partnerships to develop an innovation ecosystem. An *innovation ecosystem* consists of customers, subcontractors, infrastructure, suppliers, competencies, or functions and the links or relationships between them (Mazzucato & Robinson, 2018). The new commercial actors can drive costs down. The emerging multi-actor ecosystem approach has involved a more open-ended objective that does not have a unified or clearly defined end game (Mazzucato & Robinson, 2018).

Through these multi-actor ecosystems, funding opportunities in creating new marketplace technologies also emerge for investors. However, the difference between private and public financing institutions is time and risk. According to Mazzucato & Robinson (2018), public funding institutions often provide longer lead times and the willingness to engage with high uncertainty, thus making R&D expenditures attainable through mission-oriented public institutions such as the National Science Foundation and Advanced Research Projects Agency. These public funding institutions play a vital role in the innovation chain and market-making (Block & Keller, 2015). However, developing an LEO ecosystem also contains uncertainty, time lags, and failures in exploring new opportunities. Public understanding and support for the *importance* of an LEO ecosystem should sustain public funding for innovation, even if there are occasional setbacks and failures. For that reason, public awareness of PPPs' benefits in creating an LEO orbital econ reflects global and consumption-related values, and evaluations of brand attributes are related to the perceived importance of consumer preference for consumer products or services (Vinson et al., 1977). Therefore, understanding the importance of developing an LEO ecosystem is necessary based on the value perceived by consumers and evaluating attributes on consumers' expectations.

## **Willingness to Pay**

According to the standard economic theory of consumer choice, it is essential to know consumers' *willingness to pay* (WTP) for current and new product and service prices (Jedidi & Zhang, 2002). WTP is defined as the maximum price at or below which a consumer will buy one unit of the product (Varian, 1992). Marketers gauge consumers' WTP to create pricing and promotion strategies, measure value and develop new products (Anderson et al., 1993; Jedidi & Zhang, 2002; Shaffer & Zhang, 1995, 2000).

Studies also show that a consumer's WTP is the most significant indicator of brand loyalty and equity (Aaker & Moorman, 2017; Netemeyer et al., 2004). Therefore, consumer brand purchasing behavior indicates their willingness to pay a premium price considering the perceived value cost and brand uniqueness (Netemeyer et al., 2004). We suggest that a higher WTP for a space tourism event would indicate the person has a higher estimation of the importance of a sustainable LEO ecosystem. Accordingly, we hypothesize the following:

*H1a: Willingness to pay is positively related to the importance of a sustainable LEO ecosystem*

## **Willingness to Risk**

According to consumer research, Mandel (2003) states that *risk* is defined as either uncertainty or consequences (Campbell & Goodstein, 2001; Dowling, 1986). Consumers' risk perceptions determine their evaluations, choices, and behaviors (Dowling, 1999). The higher the perceived risk, the more negative consequences are associated with consumers becoming wary and risk-averse (Campbell & Goodstein, 2001; Oglethorpe & Monroe, 1994).

De Wulf *et al.*, (2001) define *trust* as a consumer's confidence in a brand's reliability and integrity. Trusting behaviors are related to consumers' willingness to engage in risk-taking behavior. Trust also encourages a person to take risks because of positive expectations (Walczuch & Lundgren, 2004). Delgado-Ballester & Munuera-Aleman (2005) study consumers' acknowledgment of risk according to trust as the experience of a recognized brand name. Within NASA's multi-actor ecosystem, many recognizable brands, such as Virgin Galactic, Blue Origin, and SpaceX, are beginning to fulfill consumer space tourism expectations.

Therefore, we suggest that an individual's *willingness to risk* (WTR) by engaging in space tourism, much as their WTP to engage in space tourism, indicates that the person values a sustainable LEO ecosystem more highly. Therefore, we hypothesize the following:

*H1b: Willingness to risk is positively related to the importance of a sustainable LEO ecosystem*

## **Domain-Specific Knowledge**

Tied closely are consumers' knowledge and expectations. As previously stated in this study, the risk is directly related to consumers' evaluation of products and services. Consumers' WTR is central to their evaluations, choices, and behaviors (Dowling, 1999). Narrowing in from consumer expectations to consumer knowledge, we focus on *domain-specific knowledge* (DSK) held in long-term memory. DSK is defined as memorized information that can lead to action permitting specific task completion over indefinite periods (Tricot & Sweller, 2013). Values

developed from DSK are used in market analysis for greater precision and effectiveness in market segmentation. These values can act as a bridge between global, descriptive, and evaluation beliefs about product attributes.

The acquisition of DSK is costly, however. Engaging in memorization to accrue DSK requires extensive cognitive resources. We posit that individuals' level of investment in allocating the resources needed to develop DSK for the space program is also likely to suggest their weighted importance in developing a sustained LEO ecosystem. Therefore, we hypothesize:

*H2: Domain-specific knowledge is positively associated with the importance of a sustainable LEO ecosystem*

## **Openness to Experience**

*Openness to experience* (OTE) is associated with the Five-Factor Personality Model (Costa & McCrae, 1992) and captures the extent to which individuals are broad-minded, curious, imaginative, and original (McCrae, 1987). People high in OTE are more willing to embrace new concepts and are highly motivated to actively seek new and varied experiences (Baer & Oldmaham, 2006; McCrae & Costa Jr, 1997). Also, those high in OTE appreciate new ways of doing things and the potential for improving and changing the status quo through observing novel and diverse information and knowledge (McCrae & Costa Jr, 1997). Lastly, previous studies show that people with OTE are more likely to trust and have knowledge-sharing behavior (Matzler et al., 2008; Walczuch & Lundgren, 2004).

Those rated high in OTE are revolutionary in nature and show an affinity for experimentation, indicating an openness to support private companies' opportunities to develop a sustainable LEO ecosystem (George & Zhou, 2001). Furthermore, OTE centers around novel ideas and experiences, suggesting that these individuals value unique "out of this world" experiences. Therefore, we hypothesize the following:

*H3: Openness to experience is positively related to the level of importance of a sustainable LEO ecosystem*

## **Methodology**

This study used a sample of 125 college students enrolled in undergraduate business courses in a mid-sized public university in the southwestern United States. Thirty-six percent of the respondents hailed from outside the United States. The average and median ages of the respondents were 22 years old. The relative youth of the sample is helpful because they are more likely to represent the future beneficiaries of and participants in an LEO economy.

## **Measures**

This study uses a five-point Likert-type scale (1 = not at all important, 5 = very important) to measure the dependent variable of importance: "How important is it that NASA is working with businesses to develop an orbit economy (Orbit Econ) in LEO?"

We measure WTP using direct and indirect questions for this study. Brown et al. (1996) argue that it is cognitively more effortless for a respondent to decide if a specific price for a product is acceptable than to assign a price directly. We asked respondents, "What is the highest price you would pay for a two-day trip on a rocket ship in LEO?" Consequently, we presented a

series of five price options and asked which the respondent was most likely to purchase. The respondent could also indicate they would not go to space under any condition. However, responses for the two measures of WTP correlated poorly ( $r=.17$ ). We used the direct question of the highest price a person would pay for the analysis. We again used two items to measure willingness to risk for this study. The first question addressed the probability of a positive event (safe flight) in similar studies (Kozak *et al.*, 2007; Ritchie *et al.*, 2017). The second question asked about respondents' willingness to participate even though they could perish in spaceflight (Wolff & Larsen, 2017; Wolff & Larsen, 2016). We then averaged these scores for the analysis.

DSK measurement used five items: Is NASA private or publicly funded? Who was the first man to walk on the moon? Who built the engines for the Space Shuttle Program? When was the last year in which a space shuttle flew? Which of these shuttles was destroyed in catastrophic accidents? We summed the number of correct answers to measure the respondent's overall knowledge.

This study measures OTE using items derived from the NEO Five-Factor Inventory (Costa & McCrae, 1992). The scale has been used in numerous previous studies and is deemed highly credible (George & Zhou, 2001; Matzler & Grabner-Kräuter, 2006; Zhang *et al.*, 2019).

## **Analysis and Results**

We used SAS 9.3 to conduct an ordinary least squares (OLS) regression analysis. Given all variables' continuous or interval nature, OLS is an appropriate evaluation technique (Montgomery *et al.*, 2012). Missing values in some observations reduced the sample size to 118 for the analysis. Table 1 holds the summary statistics for the sample. Table 2 holds the results of the regression analysis. The hypotheses regarding a positive relationship between willingness to pay, willingness to risk, and domain-specific knowledge received no support ( $p>0.10$  in all cases). Hypothesis 3 concerning a positive relationship between the level of importance in building a sustainable LEO ecosystem and openness to experience is strongly supported ( $p<0.001$ ). We also tested an alternate model using the indirect measure of willingness to pay and found the same results. The highest variance inflation factor was only 1.09, suggesting no significant issues with multicollinearity. An analysis of Cook's D indicated one highly influential observation. Removing that observation from the analysis did not significantly change the results.

**Table 1: Means, Standard Deviations, and Coefficients for Key Variables**

Variable	<i>Importance of an LEO Ecosystem</i>					
	Mean	SD	1	2	3	4
1 Importance	3.64	1.07				
2 High Price <sup>a</sup>	1.37	9.90	-0.01			
3 Risk	5.27	2.44	0.15	0.11		
4 Openness	35.51	6.52	0.42	-0.12	0.18	
5 Knowledge	2.65	1.05	0.05	-0.03	0.06	0.07

**Note(s):** <sup>a</sup>\$ Million, coefficients 0.18 and greater are significant at  $p < 0.05$  level. For this table  $n = 118$

**Table 2: Results of the Regression Analysis**

High Price (1)	0.15
Willingness to Pay (2)	0.87
Willingness to Risk	0.87
Domain-Specific Knowledge	0.86
Openness to Experience	0.0001***
$R^2$	0.20
Adjusted $R^2$	0.16

**Note(s):**  $n = 118$ ; \* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$ ;  
Standardized coefficients are shown

## Discussion

Given the cost and complexity of creating an LEO ecosystem, understanding factors positively related to how important an individual views a sustainable ecosystem is essential to its development. Considering that space tourism is one of the early components of that sustainability, part of our research involved a person's willingness to pay and risk participating in space tourism. However, we found no significant evidence that a person's willingness related to how important they viewed an LEO ecosystem. While this outcome may have been because of methodical limitations, as we discuss later, it also may suggest a hopeful situation for the backers of a sustainable ecosystem. People may think an LEO ecosystem is important even if they do not wish to participate in that ecosystem directly. The same is true for the lack of a relationship between the space program's knowledge and the importance of the LEO ecosystem. People may think it is important even if they do not know the details.

The positive relationship between OTE and its importance is essential for promoting an LEO ecosystem. Individuals with higher OTE scores prefer and are loyal to brands that promote

a fun and playful experience (Matzler et al., 2006). Valuing creativity, individuals with high OTE favor complex tasks with multiple means and unclear ends (e.g., Campbell, 1988; Huber, 1985; George & Zhou, 2001). Therefore, those scoring high in OTE may value an LEO ecosystem for its challenge and complexity.

Previous studies show that OTE is useful in marketing segmentation and targeting because those scoring high on OTE respond stronger to stimuli (Matzler & Grabner-Kräuter, 2006). Studies have also shown that OTE positively affects brand evangelism (Doss & Carstens, 2014). OTE people also spread positive word-of-mouth messages (Anastasiu & Dospinescu, 2018). OTE consumers look for conversation-worthy topics to post on social media, giving brands a constant free and credible advertising stream. Furthermore, marketers know how to connect with individuals high in OTE, allowing promoters of an LEO ecosystem to connect with these individuals more effectively (Caliskan, 2019).

### **Limitations and Future Study**

While a sample of college students perhaps represents the future customers of a sustainable LEO ecosystem, they do not necessarily represent individuals who currently can invest funds and influence governmental policy. Therefore, additional studies with more middle-aged respondents would be necessary. Furthermore, we developed measurement items for three of the four dependent variables. We used established items for only OTE. It was also only OTE where we found a significant relationship, so the developed items may not be effective. Indeed, we discussed earlier the poor correlation between the two willingness to pay items. It may be that neither was effective. As for domain knowledge, respondents potentially looked up answers on the web while others relied only on their knowledge. Also, using only five items to measure domain knowledge may be too few to accurately assess the respondents' knowledge level. We recommend more work be done to develop validated measures for these key constructs.

### **Conclusion**

One Bank of America analyst estimates the space economy will eclipse a trillion-dollar annual market within a decade (Sheetz, 2020). Based on the results of our study, supporters of a sustainable LEO ecosystem do not have to want to fly in space or even know the history of NASA. Those supporters are creative individuals who value tackling complicated tasks and enjoy fun and playfulness along the way. Suppose these lofty projections for the space industry are to come to fruition. In that case, it will require disciplined financial investments, sound technology, and an atmosphere that engages people who thrive on new experiences. Hence, perhaps people like Jeff Bezos and Elon Musk seem like ideal evangelists for an LEO ecosystem.

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## **A Primer on the Cryptocurrency Market<sup>1</sup>**

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### **I. Introduction**

The 2007-2008 Great Recession created a fertile background for the development of cryptocurrencies. The major driver of the cryptocurrency development was the increasing loss of trust in the government and the banking industry to protect the value of their assets. Global investors had long been trying to find an alternative to the national payment system that would allow them to transfer money without having to go through a set of government regulations and the constraints of the traditional banking system. Bitcoin. After the onslaught of the pandemic, the world witnessed a rapid rise in the use of cryptocurrencies. Cryptocurrency, which is another illustration of disruptive technology, has the potential of transforming the financial landscape into a new, though uncertain terrain.

The growing use of cell phones, the internet, and social media helped the growth of cryptocurrencies. The introduction of Bitcoin futures trading on the Chicago Mercantile also gave a boost to the price of bitcoin. Although cryptocurrencies may have been used informally in certain countries previously, Bitcoin is the first to achieve worldwide recognition and respectability. Bitcoin was founded by the mysterious figure, Satoshi Nakamoto. Since its inception in 2009, Bitcoin emerged as the fastest-growing coin in the cryptocurrency market. The cryptocurrency market itself experienced prolific growth in terms of the number of cryptocurrencies and the volume of trades using a cryptocurrency. The number of cryptocurrencies listed in Coinmarketcap<sup>3</sup>, a website that lists such currencies, increased from about 6000 a year ago to 11,145. Many of the cryptocurrencies are pegged to some major currencies such as the US dollar, British pound –sterling or Euro, or a basket of major currencies.

### **II. What is cryptocurrency?**

Cryptocurrency is a digital currency that facilitates online transactions. The mysterious founder of Bitcoin, Nakamoto (2008), in a white paper titled, “Bitcoin: A Peer-to-Peer Version of Electronic Cash System” said that this version “would allow online payments directly sent from one party to another party without going through a financial institution” (P. 1). He added that regular transactions need to be vetted by a third party such as a financial intermediary to

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<sup>3</sup> <https://coinmarketcap.com>.

avoid double-spending. Nakamoto proposed a solution that avoids double spending by a monitoring system through a peer-to-peer network.

The arrival of Cryptocurrency has challenged the very concept of money as we know and are used to. We are used to thinking that money has a national origin. Modern money is composed of fiat money, which is the liability of the government, and bank deposits which are liabilities of banks. The confidence in the government and the banking system makes the payment system work even though it is not backed by gold or any other commodity and maintains the stability of the payment system. All transactions involving bank deposits are maintained by the ledgers of the banking system and bank deposits are protected in the USA by the Federal Deposit Insurance Corporation (FDIC). While traditional money is backed by confidence in the government and the banking system, Bitcoin and other cryptocurrencies are not backed by any tangible or intangible assets. Since cryptocurrencies are not legitimized by the government or the banking system, nor are they backed by reserves with the central bank, cryptocurrency holders risk having to lose a part or all of their investments in a financial crisis, specific to the cryptocurrency market or the overall financial market, as recent events show.

Cryptocurrencies generate ‘trust’ through their complex, inimitable computer algorithms. Since there is no traditional institutional backing of cryptocurrency, its security assumes added significance. Transactions involving most cryptocurrencies are recorded on a secure online ledger protected by a strong cryptography. These transactions are recorded and connected through a network of chains and nodes called Blockchains. Blockchain technology verifies and secures each transaction using powerful computers – a process known as mining. Miners solve complex computational problems to chain a new transaction to a block of transactions or link different blocks of transactions. The miners of bitcoin are rewarded with a new bitcoin. Blockchain technology is dubbed as a revolutionary technology that takes the concept of digital transactions to a new height by digitizing, distributing, and protecting all online transactions.

An important question for investors and researchers in cryptocurrencies is to know what are the rates of exchanges with traditional currencies and how they are determined. The currencies which have some relations with the traditional currencies are called 'stable coins'. Senner and Sornette (2018) in ‘The Holy Grail of Crypto Currencies: Ready to Replace Fiat Money’, classified cryptocurrencies into 3 types:

1. Stablecoins collateralized by other cryptocurrencies: Stablecoins are cryptocurrencies pegged to other stable assets such as gold or currencies such as the US dollar. Examples are BitUSD pegged to the US dollar and BitCNY pegged to the Chinese Renminbi.
2. Stable coins collateralized by fiat currencies: USDT claims to be fully backed by US dollars.
3. Stablecoins without collateral: They are pegged to a weighted basket of a fiat currency, other cryptocurrencies and some macroeconomic indicators. For example, Carbon is pegged to the US dollar but can be pegged to the CPI (Consumer Price Index) in the future.

### III. History of volatility in the cryptocurrency market

The short history of cryptocurrency has been plagued by a high degree of volatility. Coins like Bitcoin and Ethereum have experienced a high degree of volatility. On any typical day, it is not unusual to witness an increase of 10-20% or even a decrease of similar percentages (Lee, 2018). Bitcoin price plunged to below \$20,000 in 2022 from a high price of \$68,000 just one year prior in 2021 in one of the worst meltdowns in its recent history (Partz, 2022). Cointelegraph identified five bear markets for Bitcoin (Partz, 2022). Although the volatility in the cryptocurrency market can generally be attributed to ups and downs in the confidence of investors, there are specific reasons for the meltdown that occurred at different times, as the following narrative shows.

1. June 2011–Feb 2013: Between April 2011 and June 2011, the price of Bitcoin increased from \$1 to \$32. But soon after, its value slumped down to \$.01 in a matter of a few days. The reason for this dramatic fall was security breaches at Mt. Gox, a Japanese crypto exchange that mostly traded in Bitcoin
2. November 2013-January 2017: Bitcoin price reached \$100 in April 2013 and \$1000 in Nov 2013, an impressive monthly growth of 130%. But the price fell over the next two years to \$170 by 2015. A significant reason for this decline could be connected to restrictions implemented by the Chinese government on Bitcoin.
3. December 2017-December 2020: Bitcoin price soared from \$1000 in January 2017 to \$20,000 by the end of 2017, a spectacular average growth of 60% per month. One year later, by the end of December 2018, the price bottomed out at \$3200. The price fall was caused by security issues in another Japanese cryptocurrency hack. With the banning of advertisements for initial coin offerings by big tech titans such as Facebook, Google, etc., bitcoin suffered a jolt in its price. Crypto regulations, imposed by the Securities and Exchange Commission led to the declining applications for bitcoin exchange-traded funds, ultimately leading to a crash in the bitcoin market.
4. April 2021- October 2021: During this period, the price fell from \$63000 to \$29,000. The bear market can largely be attributed to media reports about the high cost of mining and problems related to the social and environmental cost of mining due to high electricity costs.
5. Nov 2021 to July 2022: The price fell from a peak value of \$68000 to below \$22000 in 2022. Thus the cryptocurrency market was dealt a harsh blow in 2022. The total market value of all cryptocurrencies in 2021 was about \$3 trillion when the cryptocurrency reached a peak. The downward slide began right after then.

The second largest cryptocurrency market is Ethereum, which is a blockchain-based software platform that can be used for sending and receiving value globally with its cryptocurrency, ether. Ethereum launched its token in August of 2014, 50 million ETHs were sold at a price of \$0.31 per coin which raised over \$16 million for the project. The current price of Ethereum today is

\$1,507.59 per ETH/USD, with a market cap of \$173.4 billion. The major difference between Bitcoin and Ethereum is that transactions on the Ethereum network can contain executable code, while data affiliated with Bitcoin network transactions is only used to record transaction information. Bitcoin has a market share of 39.6% while Ethereum has a market share of 18.8%. Bitcoin and Ethereum are both highly volatile when compared to stocks and Ethereum is considered more volatile than Bitcoin. In February 2022, Morgan Stanley reported that since 2018, Ethereum has been about 30% more volatile in price than Bitcoin. The greater volatility is attributed to the greater concentration of Ethereum among holders. Table 1 shows the current prices and market cap of the five largest cryptocurrencies.

**Table 1: Today's Cryptocurrency Prices**

Name	Price	Market Cap	Volume (24h)
Bitcoin	\$29,185.97	\$565,157,807,008	\$21,624,910,824
Ethereum	\$1,887.07	\$227,200,623,475	\$10,263,229,832
Tether	\$1.00	\$81,657,614,467	\$31,268,535,773
BNB	\$322.05	\$50,194,340,231	\$1,120,098,001
USDC	\$1.00	\$30,502,462,456	\$4,495,326,772

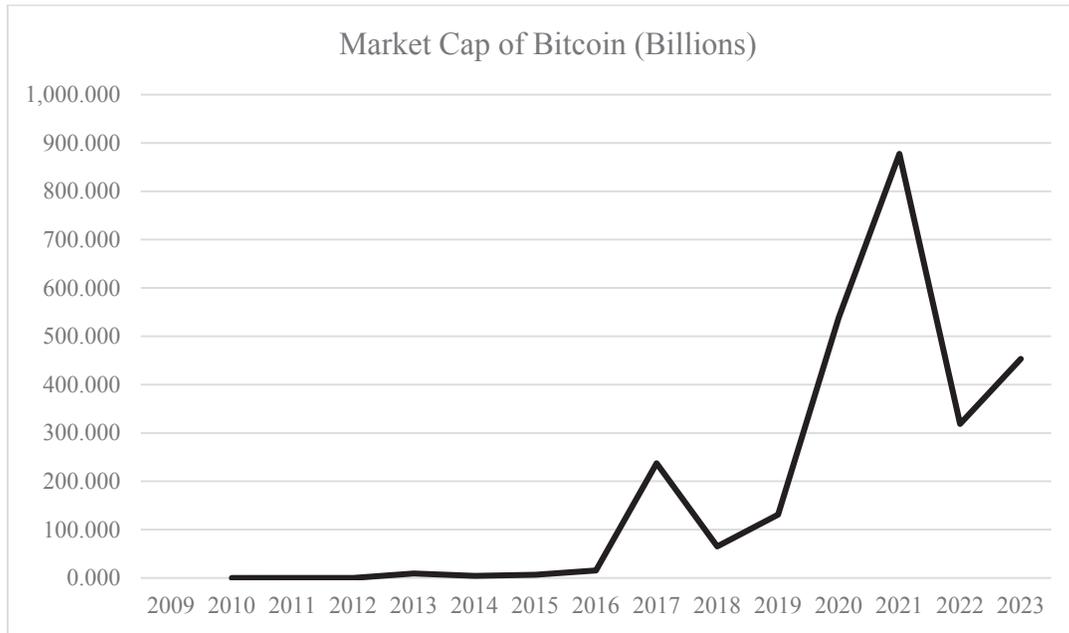
Source: <https://coinmarketcap.com>.

The aggressive increase in the interest rate by the Fed affected the crypto market like the other financial markets. By mid-April 2022, the value of all cryptocurrencies fell to \$2 trillion, followed by another 35% plunge by May 2022. The total value of Bitcoin plunged by 60% of its value during 2022 and the price of Bitcoin bottomed out at \$29000.

The meltdown in the cryptocurrency is largely attributed to the plight of TerraUSD Classic stablecoin. Terra started as a payment app in South Korea and soon built a \$60 billion crypto market. The price rose because of big-shot investors; The TerraUSD stablecoin (USTC) was originally introduced to maintain a stable 1:1 peg with the United States dollar through blockchain algorithms rather than equivalent cash reserves. On May 7, 2022, the price of the USTC fell to 35 cents. The failure of USTC to maintain its dollar peg triggered a massive panic in the crypto market and caused a chain reaction in the rest of the crypto market due to massive liquidations.

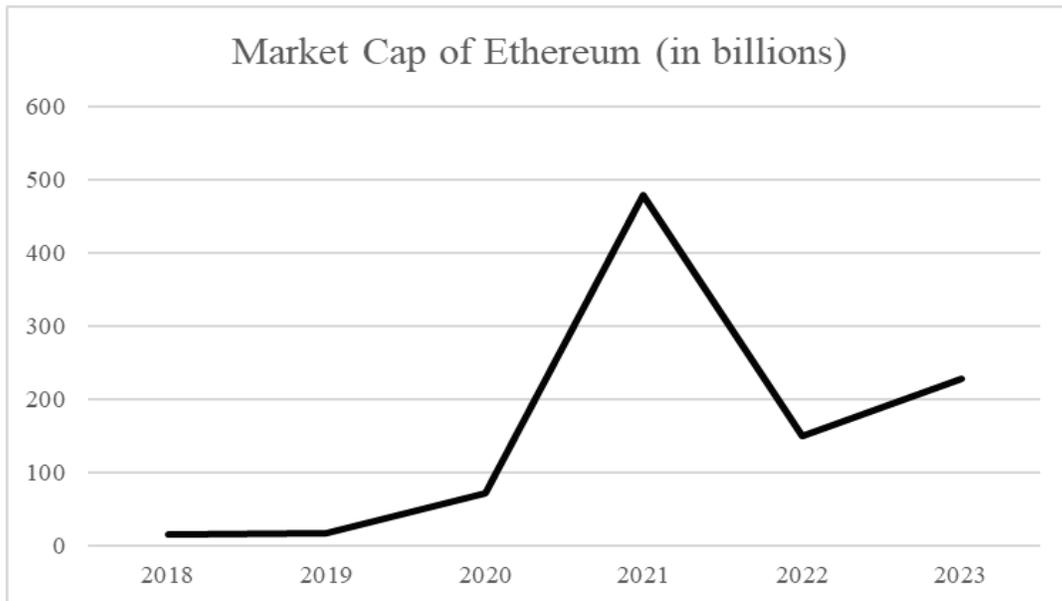
The graph below shows the market capitalization of Bitcoin through the years. As shown in Figure 1, Bitcoin's market cap had one peak around 2017 and another one in 2021, and in each case, the peak was followed by a steep plunge in the market value. Today, cryptoassets account for a total combined market cap of \$350 billion. Major financial institutions such as Fidelity Investments and CME Group are heavily involved as well as schools such as Harvard, Yale, and Stanford University.

**Figure 1**



Source: <https://coinmarketcap.com>.

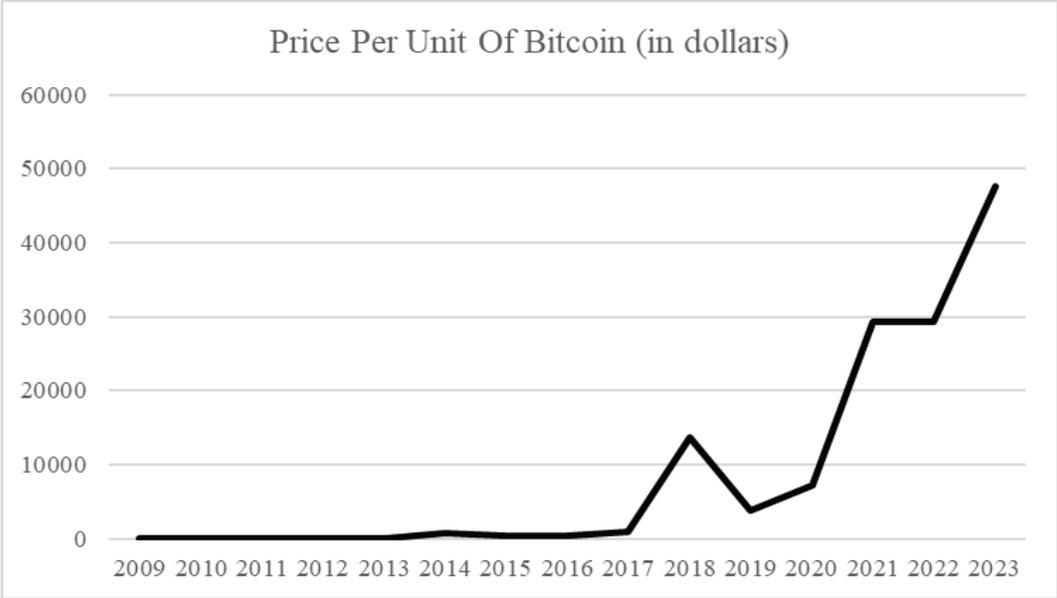
**Figure 2**



Source: <https://coinmarketcap.com>.

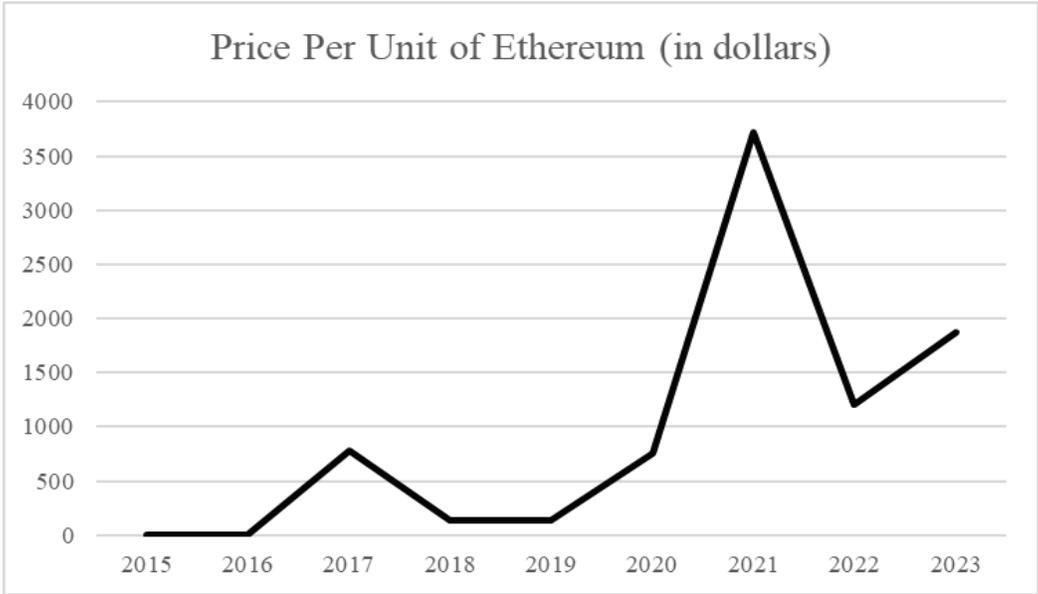
The market meltdown in 2022 had a cascading effect on institutions that had a major stake in the Cryptocurrency market. First to fall was Core Scientific, the largest mining company in the United States that mines bitcoin, which filed for bankruptcy because of falling crypto prices and rising energy costs.

Figure 3



Source: <https://coinmarketcap.com>.

Figure 4



Source: <https://coinmarketcap.com>.

The crisis in the cryptocurrency market in 2022 was the culmination of a host of factors. On the demand side, global inflation, the increase in interest rates by the Fed, and the looming recession discouraged investors from buying stocks and cryptocurrencies. Finally, the Ukrainian war, continuing supply-side challenges, and unabated inflation caused a great deal of uncertainty about the stock market among investors. Added to this was the scandal involving the crypto exchange FTX (short for “Futures Exchanges”), a cryptocurrency exchange and hedge

fund. The FTX exchange is a crypto trading and derivatives platform. Before its bankruptcy, FTX offered margin trading and options in cryptocurrency. The bankruptcy of cryptocurrency in 2022, affected investors; confidence in other cryptocurrency exchanges.

#### **IV. Regulations and the Cryptocurrency market**

Cryptocurrency exchange FTX collapsed in early November of 2022 following a report by CoinDesk which highlighted potential leverage and solvency concerns involving FTX-affiliated trading firm Alameda Research. The collapse of FTX shook the crypto market, which lost billions at the time, falling below a \$1 trillion valuation. Client deposits have been moved to the trading firm, Alameda Research, from the exchange without the investors' knowledge. To add to its problems, FTX experienced a possible hack within hours of the resignation of its CEO, in which hundreds of millions worth of tokens were stolen.

Since transactions and trading of digital currency are carried outside of the regulatory framework within which banks and other financial institutions operate, the government has been playing catch-up games with the crypto markets. In 2010, a comprehensive set of regulations titled 'Dodd-Frank Wall Street Reform and Consumer Protection Act', was passed by the US Congress to promote a safe environment for depositors and investors and to rein in aggressive practices of financial institutions *in the aftermath of the 2007 financial crisis*. Unlike traditional exchanges, cryptocurrency exchanges are not regulated by the Security and Exchange Corporation (SEC), so investors' money are not protected by the SEC or any Federal insurance such as FDIC (Federal Deposit Insurance Corporation).

The collapse of the crypto exchange was perhaps the proverbial straw that broke the camels' back. The government started taking action against unscrupulous entities and regulating the cryptocurrency market like other financial markets. The SEC is in the process of tightening rules making it difficult for asset managers to move customer's money into other firms without informing their investors. The proposal would develop a new set of rules to rein in self-serving institutions so that institutions such as FTX cannot dupe the customers by siphoning money for illegal purposes. The US government wants to enforce rules requiring brokers of all digital agents, crypto, and non-crypto currencies to report gains to the IRS. The Federal government plans to impose taxes on capital gains in cryptocurrencies and is expecting to raise \$28 billion in revenue over 10 years which will be used to finance infrastructure spending.

Despite attempts by cryptocurrencies to have them legitimized, governments in various countries are trying to impose restrictions on trading them and many governments are still leery of them. The U.K. and Japan regulators banned Binance, one of the biggest cryptocurrency exchanges in June, 2021. Cryptocurrencies have a particular appeal for the underground economy that includes money laundering and other black market transactions. In addition to losing tax revenue, the government is concerned about whether the wider use of cryptocurrencies causes major instabilities in the financial system. A "stress test" conducted by the Economist magazine (August 7-17<sup>th</sup>, 2022) suggests that holders of bitcoins would lose hundreds of billions of dollars in case of the collapse of bitcoin. Tether, a stable coin tethered to the US dollar, issued \$62 billion worth of tokens which are supposed to be redeemable in dollars, one dollar per token.

However, the ‘Economist’ magazine reported these tokens are backed by 5% cash or treasury bills and 50% of assets are kept in commercial paper – a risky investment. Another cryptocurrency platform ‘Tether’ ended up paying a fine of about \$15 million for misleading investors about its reserves against any possible loss. The Chinese government banned mining cryptocurrencies early this summer in China which previously devoted two-thirds of global energy to harvest bitcoin. The Chinese government is on the path of becoming the first country to issue its own digital currency.

## V. Conclusion

The fast development of the cryptocurrency market is the product of financial crises causing dissatisfaction and loss of trust in the traditional banking system and the need to avoid the perceived burdensome regulations, particularly as the cross-border regulations increased. Since 2009, various types of cryptocurrencies have developed, some of them tied to one of the major currencies, experiencing a strong growth rate. However, the wide fluctuations in the price and recent scandals involving FTX undermined investors’ confidence in the cryptocurrency market. Cryptocurrency revolutionized the payment system by offering a decentralized, computationally elegant system so that each transaction is protected by the inimitable algorithm. It is reasonable to believe that for some time, the two parallel systems, traditional and cryptocurrency will continue. With the creation of a private payment system, clients will have more choices to transact, trade, and invest.

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