ANALYSIS OF FREE BUSING IN KANSAS CITY

Prepared by the Center for Economic Information
at the University of Missouri Kansas City
for the Kansas City Area Transportation Authority

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Contents

1. Introduction

The Kansas City Area Transportation Authority (KCATA) is collaborating with the Center for Economic Information at the University of Missouri Kansas City in order to better understand the impacts of the proposed zero-fare policy. The Center for Economic Information (CEI) was established in November of 1994 as a research unit in the Department of Economics of the College of Arts and Sciences at the University of Missouri Kansas City. Our mission is to apply information technology in support of economic decision-makers in the public and private sectors, and academic researchers. The CEI has completed research for the public and private sectors. We have public sector clients as small as a fire district, and as large as the Federal Department of Housing and Urban Development. The research we do with and for the public sector will typically make use of

our strengths in the use of geographic information systems (GIS), economic statistics, and econometrics. Our major public sector projects in the past include GIS-based surveys of the housing conditions of over 100,000 parcels in cities on both sides of the state line of the Kansas City Metropolitan Area. The research that we conduct for the private sector is usually focused on the ability of the CEI to summarize, organize and analyze large data sets employ GIS and economic statistics. Our client list in the private sector ranges from small firms to large manufacturers.

The Transportation Authority contacted CEI to perform an analysis of the proposed zero-fare policy. Accordingly, we estimated an economic model to assess the impact of the policy; we also reviewed data about the relationship between zero-fare policy and climate change mitigation; and, finally, the effect of zero-fares on ridership and operations. Based on our analysis, it is our expectation that the proposed policy will improve the quality of life in the Kansas City area.

2. Input-Output Analysis

To begin, we performed an input-output analysis with social accounting matrices of the proposed policy using a software application known as IMPLAN. Input-Output (I-O) modeling is based on the work of Nobel Prize winner Wassily Leontif. The foundational concept is that all industries, households, and government in the economy are connected through buy-sell relationships, therefore a given economic activity supports a ripple of additional economic activity throughout the economy.

IMPLAN uses annual, regional data to map these buy-sell relationships so users can predict how specific economic changes will impact a given regional economy or estimate the effect of past or existing economic activity. IMPLAN is a leading provider of economic impact data and analytical software. The company began in 1972 working with the US Forest Service and has grown to a current user base of academics, governments, economic developers, corporations, nonprofits, and consultants. IMPLAN is attractive because of its transparency. Analysts can view the background data used in the models and customize them with local data and knowledge.

Our initial analysis focused on the following counties: in Kansas, Johnson, & Wyandotte counties, and in Missouri, Clay, Platte & Jackson counties because these are the counties that the Transportation Authority primarily services. We also performed the analysis for Missouri separately at KCATA's request, as the Transportation Authority believed that this would be of interest to policymakers on the Kansas City Missouri City Council. The results for both analyses can be found in this document.

To proceed with the IMPLAN analysis, once the geography of the study area is specified, a particular economic "event" must be defined in order to generate a particular economic impact. Examples of economic events accepted by IMPLAN include construction projects,

relocation of corporate headquarters, etc. To model the impact of the proposed zero-fare policy, we assume that KCATA's total fare collections would be released as an injection into the regional economy and hence amount to an increase in consumer income - it is akin to a fiscal stimulus. We assume that the loss of fare revenue could be replenished with general government revenue. In other words, we assume that there are no significant changes in the tax structure.

The following facts are relevant to the definition of the economic event of interest. The Transit Authority currently charges $1.50 per ride for fixed route service. RideKC Freedom, the KCATA complementary paratransit service, is $3.00 per trip. However, RideKC Freedom-on-Demand has a base charge of $5 per trip as it is not a required service. KCATA serviced approximately 12.7 million passengers during service year 2018, with total fare revenue of $9.4 million. This $9.4 million is the event of interest and we model these monies as an injection to the regional economy; specifically, they amount to an increase in consumer income, as mentioned. If fares are abolished, the money will be retained by consumers and spent in the local economy. Relatedly, this $9.4 million will have to be financed, under zero-fare, from tax revenues in the City budget.

It should furthermore be mentioned that $9.4 million is a conservative estimate. Studies show that reductions in fare lead to increases in ridership, an issue we address later in the report when discussing price elasticities, which may require an expansion of bus services in the area. This expansion of service may mean higher frequency service and the addition of more buses to the fleet. We do not have data to clarify this issue at the moment. For the time being, moreover, the analysis assumes that the injection of monies into the local economy will be due to current bus users. New users are not measured in the IMPLAN analysis, and there may well be a considerable number of new users, hence we report conservative estimates.

Once the economic event of interest is specified, IMPLAN requires that the user define the income level of the consumer in order to properly model the economic impact. Based on information provided by KCATA to CEI, and shown in the table below, we have information on the distribution of income for bus riders in 2019. As can be easily seen in the table, the majority of riders have income less than $40,000 per annum. The modal category is $30,000-$39,000. Generally speaking, consumers with lower incomes have higher multipliers and the fact that KCATA's ridership is mainly low-income means that we expect a higher economic impact. Put somewhat differently, lower income consumers tend to be constrained and unable to save. This produces a higher "bang for the buck" effect. It is clear that very few high-income individuals ride the bus under the current pricing structure. In particular, passengers earning $50,000 and above are less than 10% of total passengers. This income distribution indicates, as is well known among economists, that low-income populations find it difficult to maintain their automobiles; a car is an expensive proposition requiring regular maintenance, payments for unexpected repairs, insurance, and gasoline. The bus, therefore, is a viable proposition for low-income populations. It's good economics.

Done RideKC_2019Survey_BusReport_Combined.pdf

N=3224	Route		Total
	Local Metro-Express	MAX	
Total	78.5%	21.5%	100.0%
Q40. Your household's total annual income in 2018			
$0-$19,999	20.9%	34.2%	23.9%
$20K-$29,999	25.4%	22.7%	24.8%
$30K-$39,999	31.9%	16.5%	28.4%
$40K-$49,999	14.4%	13.3%	14.2%
$50K-$69,999	5.0%	5.2%	5.1%
$70K-$99,999	1.8%	4.1%	2.3%
$100K+	0.6%	3.9%	1.4%

Before proceeding to enumerate the details of the economic impact of the proposed policy, we provide a general overview of the regional economy. Recall that the regional economy consists of the five county area defined earlier in this document. Regional value added is approximately $122 billion with 1.3 million employed persons overall. The largest regional employer is restaurants and the industry with the highest value added is real estate. The detailed breakdown is as follows:

- Industries with the highest employment are (measured as FTEs):
    - Restaurants - 72,632.
    - Wholesale trade - 54,000
    - Real estate - 50,098
    - Education - 47,404
    - Hospitals - 41,219
- Industries with the highest total output are:
    - Real estate - $18.7 billion
    - Light truck and utility vehicle manufacturing - $15.9 billion
    - Wholesale trade - $13.4 billion
    - Hospitals - $6.8 billion
    - Management of companies - $6.5 billion

Next, we proceed to a discussion of the total impact of the proposed policy. Regional gross domestic product (GDP) will increase by $13,615,461 according to the IMPLAN model. This increase should be considered a very conservative estimate; a more optimistic estimate would be $17,930,968, which entails a higher assumed multiplier. To reiterate,

this estimate only includes current users and omits the impact of new users. It should be stressed that the economic impact of the proposed policy is small but nevertheless significant. This proposed policy change would have a meaningful impact on the economic livelihood of KCATA's passengers and those new passengers who may now be motivated to utilize bus services. For those living paycheck to paycheck, as most Americans are, even an additional $50 per month of income can make the difference in deciding which bills to pay.

Where will this extra money be spent? That is the next logical question. The following industries will be most affected according to the IMPLAN model. Each sector is shown followed by the estimated size of the impact:

- Real estate - $2,195,838.
- Hospitals - $716,913.
- Wholesale trade - $606,503
- Insurance carriers - $448,834

Please note that these are the sectors with the highest impact. Many sectors will be affected, but these are the top four. Obviously, the real estate sector is the most important. Increasing consumer incomes has a meaningful and significant effect on the ability of people to pay for their rents and mortgages. This fact is especially important because we can say that the proposed policy will help alleviate, in a meaningful way, the housing crisis in Kansas City. It is not a panacea by any means but it will have an effect. That is not all. There is the possibility that additional funds will now be available for home improvement projects and repairs. There is also the real possibility that housing values will improve in the city as a whole; we note that this effect is not explicitly predicted by the model, but it is plausible. An additional impact lies in the possibility that the higher quality of life will attract business to Kansas City, thus attracting new residents and business.

Hospitals are the second largest impact category. It is clear that there will be additional spending on medical priorities. This category covers emergency room visits and closely correlates with purchases of medications. Again, this additional yearly income could make all the difference for a family trying to decide whether to see the dentist this year, just to cite another example.

Thirdly, we have wholesale trade; this includes spending at establishments like COSTCO and Sam's Club. Finally, and fourthly, we have insurance carriers. It should not be under-emphasized that this is an important category of spending for working class households. This category covers all types of insurance, e.g., renter's insurance.

It should also be pointed out that there will be an injection of tax revenue into the regional economy. Local and state government tax revenue will increase by $679,217 based on the input-output analysis of IMPLAN. We can decompose total local and state government

revenue impact as follows. Note that this covers the entire study area, not only Jackson County:

- Sales tax - $311,242
- Property tax - $220,409
- Additional minor tax income

In terms of jobs, the equivalent of about 95 jobs will be created with the proposed zero fare policy.

We would be remiss if we merely focused on the estimated economic impact as quantified in the input-output model. There are two additional aspects of the issue that are relevant to the argument for the zero-fare policy, which we will discuss in this report. Firstly, increased utilization of public transportation leads to a reduction in greenhouse gas emissions. This effect is significant and important. Secondly, zero-fare will plausibly lead to an increase in ridership as will be made clear by the discussion of price elasticity of bus fares. Thirdly, although we do not discuss this possibility in depth, zero-fare may reduce traffic congestion and the need for parking; such an impact would improve quality of life in the city.

3. Zero-fare and Climate Change

Let us begin with consideration of climate change issues. The fact of the matter is that electric power generation and transportation are the largest source of Greenhouse Gas Emissions in the US. Shifting from private vehicles to public transport would lead to a large reduction in emissions, as we explain below. The U.S. Department of Transportation's Federal Transit Administration (FTA) collects and analyzes data from across the country on public transportation fuel use, vehicles deployed, rides taken, and other key metrics that allow us to understand the impact of zero-fare on climate change mitigation. These data, taken from the National Transit Database and combined with information from the U.S. Department of Energy and the U.S. Environmental Protection Agency, provides valuable insight into the impacts of automobile, truck, SUV, and public transportation travel on the production of greenhouse gas emissions. National level data show significant greenhouse gas emission savings by use of public transportation, which offers a low emissions alternative to driving. Based on an examination of FTA's data (FTA 2010) public transportation can reduce greenhouse gas emissions by:

- Providing a low emissions alternative to driving.
- Facilitating compact land use, reducing the need to travel long distances.

Carbon dioxide makes up 95% of all transportation-related greenhouse gas emissions. Cars, SUVs, and pickup trucks running on conventional gasoline, diesel, and other fuels emit carbon dioxide. Combined, these vehicles account for roughly two-thirds of transportation-related emissions, ranking transportation as the second largest source of total U.S.

greenhouse gas emissions. Reducing greenhouse gas emissions from private transportation will likely require a broad range of strategies, including increasing vehicle efficiency, lowering the carbon content of fuels, and reducing vehicle miles of travel. Public transportation can be one part of the solution, particularly zero-fare public transport (FTA 2010).

According to FTA (2010), national averages demonstrate that public transportation produces significantly lower greenhouse gas emissions per passenger mile than private vehicles. Leading the way is heavy rail transit, such as subways and metros, which produce 76% less in greenhouse gas emissions per passenger mile than an average single-occupancy vehicle (SOV). Light rail systems produce 62% less and bus transit produces 33% less. These estimates were calculated from fuel usage and passenger mile data in the 2008 National Transit Database, standard emissions factors for different fuels are from the U.S. Department of Energy, and sub-regional electricity emissions factors are from the U.S. Environmental Protection Agency. Note that the environmental benefits of public transportation vary based on the number of passengers per vehicle, the efficiency of the bus or train, and the type of fuel used.

U.S. bus transit, the FTA argues, which has about a quarter (28%) of its seats occupied on average, emits an estimated 33% lower greenhouse gas emissions per passenger mile than the average U.S. single occupancy vehicle. The savings increase to 82% for a typical diesel transit bus when it is full with 40 passengers. That is why zero-fare transit is so important to curbing Greenhouse Gas Emissions: increasing capacity utilization, as expected under a zero-fare policy, would lead to a high impact factor.

Switching to riding public transportation is one of the most effective actions individuals can take to reduce their carbon footprint, much more so than purchasing hybrid or electric vehicles. Car transportation alone accounts for 47% of the carbon footprint of a typical American family with two cars—by far the largest source of household emissions and, as such, the largest target for potential reductions. The average passenger car in the U.S. produces just under 1 pound of carbon dioxide per mile traveled. If just one driver per household switched to taking public transportation for a daily commute of 10 miles each way, this would save 4,627 pounds of carbon dioxide per household per year—equivalent to an 8.1% reduction in the annual carbon footprint of a typical American household. This benefit has a greater impact than other actions, such as replacing light bulbs with compact fluorescents (a 1.6% reduction based on 20 out of 25 light bulbs change) or adding R-40 insulation to a home attic (a 1.2% reduction).

Public transportation, furthermore, reduces emissions by facilitating higher density development, which conserves land and decreases the distances people need to travel to reach destinations. In many cases, higher density development would be more difficult without the existence of public transportation because more land would need to be devoted to parking and travel lanes. By facilitating higher density development, public

transportation can shrink the footprint of an urban area and reduce overall trip lengths. In addition, public transportation supports increased foot traffic, street-level retail, and mixed land uses that enable a shift from driving to walking and biking. Public transportation can also facilitate "trip chaining", such as combining dry-cleaning pick-up, shopping, and other errands on the way home from a station. Finally, households living close to public transportation tend to own fewer cars on average, as they may not need a car for commuting and other trips. A reduced number of cars per household tends to lead to reduced car use, and driving may cease to be the habitual choice for every trip.

Studies show, according to FTA (2010), that for every additional passenger mile traveled on public transportation, auto travel declines by 1.4 to 9 miles. In other words, in areas served by public transportation, even non-transit users drive less because destinations are closer together. One study used modeling to isolate the effect of public transportation on driving patterns rather than that effect combined with denser land use creating a need for improved public transportation. That study, conducted by consulting firm ICF and funded through the Transit Cooperative Research Program, found that each mile traveled on U.S. public transportation reduced driving by 1.9 miles. It concluded that public transportation reduces U.S. travel by an estimated 102.2 billion vehicle miles traveled (VMT) each year, or 3.4% of annual U.S. VMT. Moreover, the report argued, by reducing congestion, transit lowers emissions from cars stuck in traffic. The Texas Transportation Institute's 2007 Mobility Report estimates that by reducing congestion, transit saved an estimated 340 million gallons of fuel in 2005. Combining the emissions savings from passengers taking transit rather than driving, with VMT reduction due to transit's impact on the built environment, and savings from reduced congestion due to transit, the ICF report finds that public transportation reduces carbon dioxide emissions by 37 million metric tons annually.

4. Demand and Ridership Implications

Another relevant consideration is the issue of demand management. It would be useful to know for planning purposes what is the effect on bus utilization of zero-fare. This information would allow the transit authority to estimate the effect on ridership and plan for any possible changes to the fleet that may be required. Will zero-fare lead to overcrowded buses? Will more buses need to be added to particular routes? Will higher frequency service be required? Addressing the issue of demand management will shed some light on these questions.

Economists deal with the issue of demand management and price sensitivity using the concept of elasticities, defined as the percentage change in consumption resulting from a one percent change in price, all else held constant. A high elasticity value indicates that a good is price-sensitive; that is, a relatively small change in price causes a relatively large change in quantity demanded. A low elasticity value means that prices have relatively little effect on quantity demanded. The degree of price sensitivity refers to the absolute elasticity value regardless of whether it is positive or negative. For example, if the elasticity of transit ridership with respect to transit fares is –0.5, then each one percent increase in

transit fares causes a 0.5 percent reduction in ridership, so a ten percent fare increase will cause ridership to decline by about 5 percent. It can be readily seen that knowing the elasticity is an important factor in determination of the effect of zero-fare on ridership.

Economists use several terms to classify the relative magnitude of elasticity values. Unit elasticity refers to an elasticity with an absolute value of one, meaning that price changes cause a proportional change in consumption. Elasticity values less than one in absolute value are called inelastic, meaning that prices cause less than proportional changes in consumption. Elasticity values greater than one in absolute value are called elastic, meaning that prices cause more than proportional changes in consumption. For example, both 0.5 and –0.5 values are considered inelastic because their absolute values are less than 1.0, while both 1.5 and –1.5 values are considered elastic because their absolute values are greater than 1.0.

Many factors can affect how prices affect consumption decisions. They can vary depending on how elasticities are defined, type of good or service affected, category of customer, quality of substitutes, and other market factors. It is important to consider these factors in elasticity analysis. Some factors that affect transit elasticities, as reflected in currently available research, are summarized below. This information is taken from Litman (2004):

- ***User Type***. Transit dependent riders are generally less price sensitive than choice or discretionary riders (i.e. people who have the option of using an automobile for that trip). Certain demographic groups, including people with low incomes, nondrivers, people with disabilities, high school and college students, and elderly people tend to be more transit dependent. In most communities, transit-dependent people are a relatively small portion of the total population but a large portion of transit users, while discretionary riders are a potentially large but more price elastic transit market segment. It is plausible that a zero-fare policy induces more discretionary riders into bus utilization.
- ***Trip Type.*** Noncommute trips, according to Litman (2004), tend to be more price sensitive than commute trips. Elasticities for off-peak transit travel are typically 1.5 to 2 times higher than peak-period elasticities, because peak-period travel largely consists of commute trips. It is therefore plausible that ridership will increase in off-peak hours under zero-fare.
- ***Geography.*** Large cities tend to have lower price elasticities than suburbs and smaller cities, because they have a greater portion of transit-dependent users. Annual transit ridership tends to increase with city size due to increased traffic congestion and parking costs, and improved transit service due to economies of scale. For Kansas City, therefore, we expect a relatively higher elasticity.
- ***Type of Price Change.*** Transit fares, service quality (i.e. service speed, frequency, coverage, and comfort), and parking pricing tend to have the highest impact on transit ridership. Own-price elasticities appear to increase somewhat as fare levels increase, but we do not expect this issue to be serious in the Kansas City area.

- ***Direction of Price Change.*** Transportation demand models often apply the same elasticity value to both price increases and reductions, but there is evidence that some changes are nonsymmetric. Fare increases tend to cause a greater reduction in ridership than the same size fare reduction will increase ridership. This factor needs to be taken into account.

If the transit system wants to attract significantly more riders and reduce automobile travel, however, fares will need to decline and services improve to attract more price-sensitive discretionary riders. A zero-fare policy will do just that.

Another important conclusion of Litman (2004) is that no single transit elasticity value applies in all situations. Various factors affect price sensitivities including type of user and trip, geographic conditions, and time period as we noted above. Available evidence suggests that the elasticity of transit ridership with respect to fares is usually in the –0.2 to –0.5 range in the short run (first year), and increases to –0.6 to –0.9 over the long run (five to ten years). This means that optimistically a 1% reduction in the fare leads to a 0.5% increase in ridership. Clearly it can be seen that zero-fare will have an impact on ridership, although the impact is inelastic. Moving from $1.50/ride to zero-fare will possibly induce a 20%-50% increase in ridership within the first year, with larger effects in later years especially if the zero-fare policy is appropriately advertised and marketed and public policy encourages a culture of "riding the bus". It should be noted that we cannot, with the information available to us, infer which routes will be most impacted, only that ridership will in all likelihood increase.

5. Conclusion

In conclusion, we would like to briefly stray from the strictly economic aspects of the analysis. Henri Lefebvre's famous idea of a Right to the City has stirred up numerous discussions over the years. The Right to the City has been interpreted and used in many ways, often in the sense of human rights and access to urban resources. Obviously, bus transport is an essential component of providing residents a Right to the City. The transition from charging a fare to free bus transport will improve urban inclusivity and rights for the residents of Kansas City. Moving towards free bus transportation also accords well with the United Nations Charter on the Right to the City. In particular:

> Cities should guarantee for all persons the right to mobility and circulation in the city, in accordance with an urban and interurban circulation plan and through an accessible public transportation system, provided at a reasonable cost and adequate for different environmental and social needs (gender, age, capacity, etc.). (ARTICLE XIII. RIGHT TO PUBLIC TRANSPORTATION AND URBAN MOBILITY)

The Right to the City is about a society where all city inhabitants, including people of color, immigrants, youth, and those from the working classes have the power to shape the

decisions and the conditions that affect our lives. A Right to the City means concrete improvements that result in stronger communities and a better state of being for our friends, families, and for our children's futures. And it makes good economic sense. A Right to the City means justice in housing, education, transportation, and jobs; community safety and security, neighborhood sustainability, environmental justice, and the right to culture, celebration, rest, and public space. These are the material and economic results of taking back the city. These are the goals that the Right to the City frames. Free public transportation in Kansas City would be a major step forward in the struggle for the Right to the City. Kansas City, by implementing a mass transit policy of free public transportation, would be placing itself in the forefront of the movement for the Right to the City.

Appendix A: IMPLAN analysis of Missouri counties only

We also performed Multiple Region Input-Output analysis for the following counties using the IMPLAN model:

- In Missouri - Clay, Platte & Jackson

We define the three counties above as the study area. Some general economic characteristics of the study area are for calendar year 2017:

- Regional value added is $65.7 billion
- Total employment is 688,896 persons
- There are a total of 396 industries
- Industries with the highest employment are:
    - Real estate - 26,031
    - Education - 25,364
    - Wholesale trade - 24,693
    - Full service restaurants - 22,516
    - Limited service restaurants - 21,091
- Industries with the highest value added are:
    - Light truck and utility vehicle manufacturing - $15.9 billion
    - Real estate - $10 billion
    - Wholesale trade - $5.9 billion
    - Hospitals - $3.4 billion

KCATA has provided information on total revenue from fare collections during service year 2018. We assume that implementation of no-fare service will mean that these dollars become available for the study area in the form of household income. Total fare collections in 2018 were $9,437,352.

This policy change will have the following regional economic impacts:

- Regional gross domestic product (GDP) will increase by $11,518,175 according to the model. This increase should be considered a very conservative estimate; a more optimistic estimate would be $17,930,968, which entails a higher assumed multiplier.
- There will be a redistribution of income representing an injection of tax revenue. Local and state government tax revenue will increase by $538,036
    - We can decompose total local and state government revenue impact as follows:
        - Sales tax - $234,666
        - Property tax - 180,246
        - Additional minor tax collections

- The following industries will be most affected:
    - Real estate - $2 million
    - Hospitals - $581,913
    - Wholesale trade - $448,585
    - Financial services - $392,871
- There will be 83 jobs created.

Appendix B: IMPLAN Analysis of Johnson County Only

We also performed Multiple Region Input-Output analysis for the following counties using the IMPLAN model:

- In Kansas - Johnson County Only

Some general economic characteristics of the study area are for calendar year 2017:

- Regional value added is $45.5 billion

- Total employment is 456,697 persons
- There are a total of 346 industries
- Industries with the highest employment are:
    - Real estate - 26,031
    - Wholesale trade - 21,986
    - Education - 15,993
    - Corporate management - 15,717
- Industries with the highest value added are:
    - Real estate - $7.8 billion
    - Wholesale trade - $6.1 billion
    - Corporate management - $3.9 billion
    - Insurance carriers - $3.1 billion

KCATA has provided information on total revenue from fare collections during service year 2018. We assume that implementation of no-fare service will mean that these dollars become available for the study area in the form of household income. Total fare collections in 2018 were $941,970.

This policy change will have the following regional economic impacts:

- Regional gross domestic product (GDP) will increase by $1,073,570 according to the model. This increase should be considered a very conservative estimate; a more optimistic estimate would be $1,789,743, which entails a higher assumed multiplier.
- There will be a redistribution of income representing an injection of tax revenue. Local and state government tax revenue will increase by $59,588
    - We can decompose total local and state government revenue impact as follows:
        - Sales tax - $29,538
        - Property tax - $20,124
        - Additional minor tax collections
- The following industries will be most affected:
    - Real estate - $195,835
    - Hospitals - $56,230
    - Wholesale trade - $50,987
    - Insurance carriers - $40,804
- There will be 8 jobs created.

References

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