To: City of Bend Citywide Transportation Advisory Committee
Attn: Susanna Julber, Karen Swirsky, and Eric King
From: Michelle Porter and Steve Porter, Residents of Bend
Date: September 6, 2018

Public Comment:

Empirical Evidence Demonstrating the Inferiority of One-Way Streets to Two-Way Streets

Dear Bend Citywide Transportation Advisory Committee:

A spate of recent empirical research using statistical, case study, and survey methods compares one-way and two-way streets across a variety of variables. These studies collectively demonstrate and quantify:

1) the inferiority of one-way streets to two-way streets across social, economic, and efficiency measures;
2) the economic and social losses incurred when two-way streets are converted to one-ways; and
3) the gains realized when one-way streets are reconfigured as two-ways.

Below, we outline evidence showing that one-way streets increase traffic accidents, deaths, and injuries; reduce pedestrian and bicycle activity; raise crime levels; degrade property values; harm business results; decrease city tax revenue; and diminish transportation system efficiency. We also explain economic mechanisms that cause these problems to be self-sustaining.

Proposals for conversion of two-way streets to one-way streets in the City of Bend should be rejected on the basis of this evidence. By the same token, conversion of existing one-way streets to two-way streets in Bend should be considered, consistent with the goals to "move people and products around Bend efficiently, safely and reliably," "facilitate economic development," and generate "viable funding."

Indeed, "conversion to two-way streets can positively affect downtown communities in terms of mobility, safety, economic resilience, and livability,"[1] facts reflected in the actions of over 100 U.S. cities that either have reconfigured or are now in the process of reconfiguring their one-way streets to two-ways.

[1] Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research*, Vol. 36, No. 1 (2015).

SUMMARY

- One-way streets are inferior to two-way streets across all significant social, economic, and transportation system efficiency measures.

- One-way streets have been empirically shown to:
    - Promote traffic collisions, injuries, and deaths;
    - Stunt pedestrian and cyclist activity;
    - Increase crime levels;
    - Reduce property values;
    - Hurt business results;
    - Diminish city tax revenue; and
    - Reduce transportation system efficiency.

- Any proposals for conversion of existing two-way streets to one-ways in Bend should be rejected.

- Consideration should be given for reconfiguration of existing one-way couplets to two-way streets in Bend.

INTRODUCTION

> *One-way networks are seen as confusing for visitors, less conducive to economic activity and a livable environment, and require vehicles to travel additional distance in order to reach their destination.*[2]

Multi-lane one-way ("MLOW") streets are a 70-year old relic of Cold War-era urban planning. Their purpose, when popularized in the 1950s and 1960s, was two-fold.[3] First, they were meant to serve as "mini-freeways" to shuttle suburbanites through declining downtowns, rather than to facilitate travel within downtown corridors. Second, they were thought useful for expediting mass evacuations in the event of a Soviet nuclear attack, a premise based solely upon conjecture. MLOW logic was accordingly unsound from the start.[4]

Now, with the benefit of various lines of empirical inquiry evaluating MLOW streets and comparing them with two-way configurations, it is possible to lay bare the acute inferiority of one-way streets across multiple social, economic, and transportation efficiency measures.

The succeeding pages review this empirical literature, presenting the findings thematically as follows:

1. One-way streets increase road collision risk.
2. One-way streets elevate road user mortality and injury rates.
3. One-way streets decrease pedestrian and cyclist activity.
4. One-way streets facilitate crime.
5. One-way streets degrade property values.
6. One-way streets weaken local business results.
7. One-way streets reduce city tax revenue.
8. One-way streets harm transportation system efficiency.

It may be summarily stated, without equivocation or qualification, that one-way streets fail communities across an array of measures. They are an outdated, dangerous, and damaging artifact from a time when Nikita Khrushchev led the Soviet Union and the first handheld calculator was still years away from invention.

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[2] Gayah, V and C. Daganzo, "Analytical Capacity Comparison of One-Way and Two-Way Signalized Street Networks." *Transportation Research Record: Journal of the Transportation Research Board,* Vol. 2301 (2012).

[3] Throughout this report, we refer to urban multi-lane one-way streets as "MLOWs" or simply "one-ways." Our discussion does not relate to single-lane one-ways, or to one-way streets in rural contexts. All referenced literature and case studies reflect urban multi-lane one-way streets.

[4] Hopper, T., "Taking a U-Turn on the One-Way Street," *National Post* (2012).

Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research*, Vol. 36, No. 1 (2015).

Indeed, over 100 U.S. cities are acting upon these facts, removing their one-way streets to restore two-way traffic flows and their attendant benefits. These cities include, among many others: Austin, Texas; Charleston, South Carolina; Cincinnati, Ohio; Dallas, Texas; Denver, Colorado; Des Moines, Iowa; Fort Collins, Colorado; Kansas City, Missouri; Lafayette, Indiana; Lexington, Kentucky; Louisville, Kentucky; Lubbock, Texas; Minneapolis, Minnesota; New Haven, Connecticut; Oklahoma City, Oklahoma; Sacramento, California; South Bend, Indiana; Toledo, Ohio; Vancouver, Washington; Wailuku, Hawaii; and West Palm Beach, Florida.[5]

One-way streets have no role in Bend. Any proposal to reconfigure two-way streets to one-ways should be immediately rejected, and existing one-way couplets should be changed to two-ways.

> "[W]hen it comes to designing or retrofitting streets, the burden of proof shouldn't fall on those who want [two-way streets]. It should be on those who think the speedway ideology of the 1950s serves much of a purpose half a century later."[6]

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[5] Riggs, W. and J. Gilderbloom, "How Multi-Lane, One-Way Street Design Shapes Neighborhood Life: Collisions, Crime and Community," *Local Environment*, Vol. 22, No. 8 (2017).

Marsico, A., "New Study Shows Dangers of One Way Streets," KDKA, CBS Pittsburgh (2015).

Florida, R. and A. Boone, "Do Two-Way Streets Help a City's Economy?" *CityLab* (2018).

Gilderbloom, J. and W. Riggs, "'Two-Ways' to Fix Our Neighborhoods," *Planetizen* (2015).

Ehrenhalt, A., "The Return of the Two-Way Street: Why the Double-Yellow Stripe is Making a Comeback in Downtowns," *Governing* (2009).

Badger, E., "Why One-Way Streets are Bad for Everyone but Speeding Cars," *The Washington Post* (2015).

Missoula Redevelopment Agency, "Front Street/Main Street Two-Way Conversion Feasibility Study" (2015).

Baco, M., "One-Way to Two-Way Street Conversions as a Preservation and Downtown Revitalization Tool: The Case Study of Upper King Street, Charleston, South Carolina," *All Theses* (2009).

Gilderbloom, J., "Two-Way Streets Can Fix Declining Downtown Neighborhoods," *Planetizen* (2014).

Blasko, E., "Will Two-Way Streets Bring Success to Downtown South Bend?" *South Bend Tribune* (2015).

To the extent one-way streets remain in use today, such as in downtown Portland, Oregon, the context in which those one-way streets are being utilized must be recognized. These occur where: 1) usage is in a tight, narrow grid of "slow, safe" streets; 2) blocks are short (about 200 feet); 3) crosswalks are regular (every 200 feet); and 4) traffic signals are carefully timed to slow traffic so that it cannot exceed 20mph. See: Riggs, W. and B. Appleyard, "The Economic Impact of One to Two-Way Street Conversions: Advancing a Context Sensitive Framework," *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*, Vol. 11, No. 2 (2018).

[6] Ehrenhalt, A., "The Return of the Two-Way Street: Why the Double-Yellow Stripe is Making a Comeback in Downtowns," *Governing* (2009).

DISCUSSION

1. One-Way Streets Increase Collision Risk

The likelihood of vehicle collision on one-way streets is substantially higher than on benchmark two-way streets. Broadly, ***the risk of crash has been shown to double on one-ways*** relative to two-ways, deriving from three complementary sources: 1) increased vehicle speed; 2) altered driver psychology; and 3) reduced driver attentiveness.

One landmark empirical study analyzed the effects of converting urban MLOWs to two-way streets, finding a dramatic reduction in total vehicle collision risk following introduction of two-way traffic flows.[7]

Reconfiguration from one-ways to two-ways evaluated in the study led to an immediate reduction in collisions by 13% to 27%. The salutary effects then more than doubled as time passed: Traffic collisions fell by 36% to 60% one year after the change was made.

Remarkably, these decreases in traffic collisions occurred despite a contemporaneous *increase* in the total number of cars traveling the converted two-way roadways. When this growth is accounted for (by evaluating traffic collisions on a per-vehicle basis), the reduction in total traffic collisions was 43% to 71%.

One-way "control" streets (i.e., nearby one-way roads that remained one-ways during the study period), did not experience collision reductions; rather, collisions on these benchmark streets grew, in the range of 4% to 42% on a per-vehicle basis.

The per-vehicle "safety gap" between one-way and two-way streets accordingly expanded by 47% to 113%; that is, ***a vehicle traveling on a one-way street was observed to be 47% to 113% more likely to be involved in a collision than a comparable vehicle on a comparable two-way street***.

These statistics enable estimated changes in collisions if two-way streets are converted to a one-ways. The empirical findings imply a ***56% to 150% increase in total collisions on newly installed one-way streets***

[7] Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research*, Vol. 36, No. 1 (2015).

immediately following conversion, and a ***rise in the range of 75% to 245% over the longer term, on a per-vehicle basis***.[8]

Confirming these findings, subsequent empirical work compared 22 one-way tracts with 168 two-way tracts. This analysis showed that ***tracts with high one-way street concentrations generated 2,992 additional collisions per year***.[9] ***Per-capita total collisions over a 1-year period were 100% to 131% higher on one-way streets***.[10]

The differential in collision risk between one-way and two-way streets largely derives from traffic speed disparities. Vehicles on one-way streets tend to travel faster, regardless of speed limits, thereby generating higher risk levels that translate into more crashes.

"People speed on one-way streets because there is less friction from opposing traffic, and because of the temptation to jockey from lane to lane…[creating] the 'road-racer frame of mind.'"[11]

In general, MLOW streets provide an impression of lower driver dangers, which incites higher speeds. "Without the danger of oncoming traffic," drivers obtain an increased sense of security, thereby feeling comfortable increasing

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[8] Riggs, W. and J. Gilderbloom, "How Multi-Lane, One-Way Street Design Shapes Neighborhood Life: Collisions, Crime and Community," *Local Environment*, Vol. 22, No. 8 (2017).

Gilderbloom, J. and W. Riggs, "'Two-Ways' to Fix Our Neighborhoods," *Planetizen* (2015).

Badger, E., "Why One-Way Streets are Bad for Everyone but Speeding Cars," *The Washington Post* (2015).

Jaffe, Eric, "The Many Benefits of Making One-Way Streets Two-Way," *CityLab* (2015).

[9] Riggs, W. and J. Gilderbloom, "How Multi-Lane, One-Way Street Design Shapes Neighborhood Life: Collisions, Crime and Community," *Local Environment*, Vol. 22, No. 8 (2017).

Gilderbloom, J. and W. Riggs, "'Two-Ways' to Fix Our Neighborhoods," *Planetizen* (2015).

[10] Riggs, W. and J. Gilderbloom, "How Multi-Lane, One-Way Street Design Shapes Neighborhood Life: Collisions, Crime and Community," *Local Environment*, Vol. 22, No. 8 (2017).

Gilderbloom, J. and W. Riggs, "Two-Ways to Fix our Downtowns," Urban Affairs Association Presentation (2016).

Gilderbloom, J. and W. Riggs, "'Two-Ways' to Fix Our Neighborhoods," *Planetizen* (2015).

[11] Duany, A., et al. *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream*. North Point Press (2000).

travel speed.[12] This linkage is well established in empirical studies,[13] and the findings are consistent with generalized behavioral-economic models of risk.[14] That is, if perceived external risks fall (whether that perception is accurate or not), risk-seeking behaviors rise. In the instance of roadway travel, risk-seeking behaviors take the form of escalated operating speeds.

A compounding problem is that "one-way streets correlate with decreased levels of driver attention."[15] Thus, in addition to higher speeds, inattentive drivers are more likely on one-way streets. The result is increased frequency of crashes.

In part, attentiveness of drivers declines due to reductions in perceived external risk levels, the same mechanism that gives rise to higher speeds. But a separate pathway also contributes. "One-way streets correlate with decreased levels of driver attention" due partly to "increased user confusion." Since one-way networks tend to reduce accessibility, require higher numbers of vehicle turns to reach destinations, and generally add to vehicle miles traveled ("VMTs"), driver attentiveness per mile traveled on one-ways falls relative to two-ways, thereby elevating collision risks.[16]

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[12] Jaffe, Eric, "The Many Benefits of Making One-Way Streets Two-Way," *CityLab* (2015).

[13] Tarris, J., et al., "Predicting Operating Speeds on Low-Speed Urban Streets: Regression and Panel Analysis Approaches," *Transportation Record Research: Journal of the Transportation Research Board*, Vol. 1523 (1996).

Poe, C. and J. Mason Jr., "Analyzing Influence of Geometric Design on Operating Speeds Along Low-Speed Urban Streets: Mixed Model Approach," *Transportation Record Research: Journal of the Transportation Research Board*, Vol. 1737 (2000).

Martens, M., et al., "The Effects of Road Design on Speed Behaviour: A Literature Review," European Commission under the RTD Programme (1997).

Skene, M., "'Traffic Calming' on Arterial Roadways?" Institute of Transportation Engineers Compendium of Technical Papers (1999).

[14] Kahneman, D., "Maps of Bounded Rationality: Psychology for Behavioral Economics," *The American Economic Review*, Vol. 93, No. 5 (2003).

Thaler, R. *Misbehaving*. Norton (2015).

[15] Gayah, V., "Two-Way Street Networks: More Efficient than Previously Thought?" *Access,* No. 41 (2012).

[16] Gayah, V., "Two-Way Street Networks: More Efficient than Previously Thought?" *Access,* No. 41 (2012).

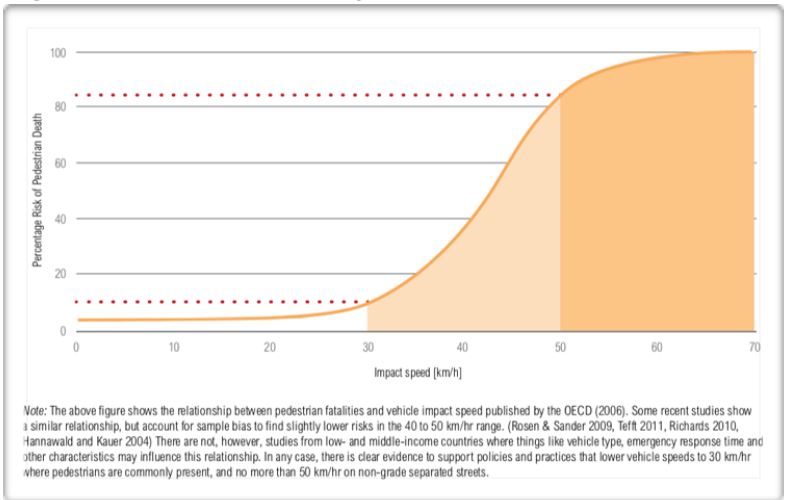
2. One-Way Streets Elevate Road User Mortality and Injury Rates

As the risk of total vehicle collisions rises on one-way streets, so too does the risk of injury and fatality. Higher traffic speeds contribute to the greater rates of disablement and death that occur on one-way streets.

Statistically, the risk of a crash resulting in serious injury or a hospital trip ***more than doubles*** on one-way streets when compared with two-way streets; that is, ***the likelihood of traffic-related injury is over 100% greater on MLOW streets***.[17]

Risks are particularly elevated for pedestrians and cyclists, since their vulnerability to injury or fatality in traffic collisions is already high and grows significantly as traffic speeds rise.[18] This empirical relationship is generally depicted in Figure 1 (note: x-axis shows kilometers per hour).[19]

Figure 1: Pedestrian Mortality Risk & Vehicle Speed



[17] Riggs, W. and J. Gilderbloom, "How Multi-Lane, One-Way Street Design Shapes Neighborhood Life: Collisions, Crime and Community," *Local Environment*, Vol. 22, No. 8 (2017).

Gilderbloom, J. and W. Riggs, "Two-Ways to Fix our Downtowns," Urban Affairs Association Presentation (2016).

Gilderbloom, J. and W. Riggs, "'Two-Ways' to Fix Our Neighborhoods," *Planetizen* (2015).

Badger, E., "Why One-Way Streets are Bad for Everyone but Speeding Cars," *The Washington Post* (2015).

Marsico, A., "New Study Shows Dangers of One Way Streets," KDKA, CBS Pittsburgh (2015).

[18] Barrios, L., "Killing Speed," *Injury Prevention*, Vol. 6 (2000).

Tefft, B., "Impact of Speed and a Pedestrian's Risk of Severe Injury or Death," *AAA Foundation for Traffic Safety* (September 2011).

[19] "Cities Safer by Design," World Resources Institute, graphic entitled "The Relationship Between Pedestrian Safety and the Impact Speed of Vehicles" (2015).

MLOWs exhibit a well established relationship between vehicle speed and fatality/injury risks for pedestrians and cyclists (emphasis added):

- "Since they encourage higher speeds, ***one-ways have consistently been found to be hot spots for pedestrian fatalities***."[20]
- "Traffic tends to move faster on a wide one-way road than on a comparable two-way street, and ***slower traffic means fewer accidents***."[21]
- "[One-way] streets create ***unsafe and unfriendly conditions for pedestrians and bicyclists***."[22]
- Slower traffic speeds on two-way roads mean that accidents "are much more likely to be fender-benders at left-turn intersections, not ***harrowing high-speed crashes involving cars and pedestrians [as are more likely on MLOWs]***."[23]

Even more vulnerable than adult pedestrians and cyclists are children. Motor vehicle injuries are already the leading cause of injury death among children and adolescents, so conversion from two-way to one-way streets magnifies these dangers, with hazards particularly elevated in residential areas.[24]

Due to their smaller size and incomplete physiology, children are especially likely to be hit - and injured - in the presence of higher-speed one-way traffic.[25] Statistically, ***the child injury rate is 2.5 times higher on one-way streets than two-way streets***. And substantial socioeconomic regressiveness is found in these statistics, with children in the lowest-income neighborhoods ***three times*** more likely to be injured, disclosing one powerfully inequitable social result stemming from introduction of one-way streets.[26]

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[20] Hopper, T., "Taking a U-Turn on the One-Way Street," *National Post* (2012).

[21] Badger, E., "Why One-Way Streets are Bad for Everyone but Speeding Cars," *The Washington Post* (2015).

[22] Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research*, Vol. 36, No. 1 (2015).

[23] Ehrenhalt, A., "The Return of the Two-Way Street: Why the Double-Yellow Stripe is Making a Comeback in Downtowns," *Governing* (2009).

[24] Wazana, A., et al., "Are Child Pedestrians at Increased Risk of Injury on One-Way Compared to Two-Way Streets?" *Canadian Journal of Public Health*, Vol. 91, No. 3 (2000).

Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research*, Vol. 36, No. 1 (2015).

[25] Wann, J., et al., "Reduced Sensitivity to Visual Looming Inflates the Risk Posed by Speeding Vehicles When Children Try to Cross the Road," *Physiological Science*, Vol. 22, No. 4 (2011).

McLean, A., et al., "Aggressiveness of Bull-bars in the Event of a Collision with a Child Pedestrian: Head-form Test Results for Three Bull-bar Products," Road Accident Research, University of Adelaide (1998).

[26] Wazana, A., et al., "Are Child Pedestrians at Increased Risk of Injury on One-Way Compared to Two-Way Streets?" *Canadian Journal of Public Health*, Vol. 91, No. 3 (2000).

As with adult pedestrians and cyclists, child injury and fatality derive from higher speeds and reduced driver attentiveness.[27]

But it is not only higher speeds and driver inattentiveness that lead to higher pedestrian injury and mortality rates on one-way streets. ***Increased dangers for pedestrians are essentially designed into one-way streets*** as a result of the greater number different "conflict sequences" that can occur between pedestrians and vehicles on one-ways (emphasis added):

> Superficially, it would seem that crossing a single direction of traffic on one-way streets is preferable to crossing a two-way street. As is often the case, the conventional wisdom is wrong. In fact, ***crossing a one-way street presents greater difficulties to the pedestrians than crossing a two-way street. The explanation lays in the greater numbers of different vehicle/pedestrian conflict sequences that are encountered in crossing a one-way street***.[28]

Quantitative analysis of this effect finds that ***one-way streets generate up to eight times more potential vehicle/pedestrian conflict sequences*** than two-way streets in typical road configurations and, due to the particulars of the conflict sequences, those on one-ways are more likely to occur at higher vehicle speeds.[29]

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[27] Gayah, V and C. Daganzo, "Analytical Capacity Comparison of One-Way and Two-Way Signalized Street Networks." *Transportation Research Record: Journal of the Transportation Research Board,* Vol. 2301 (2012).

Duany, A., et al. *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream*. North Point Press (2000).

Jaffe, E, "The Many Benefits of Making One-Way Streets Two-Way," *CityLab* (2015).

Wann, J., et al., "Reduced Sensitivity to Visual Looming Inflates the Risk Posed by Speeding Vehicles When Children Try to Cross the Road," *Physiological Science*, Vol. 22, No. 4 (2011).

Wazana, A., et al., "Are Child Pedestrians at Increased Risk of Injury on One-Way Compared to Two-Way Streets?" *Canadian Journal of Public Health*, Vol. 91, No. 3 (2000).

[28] Kit Meng, L. and S. Thu, "A Microscopic Simulation Study of Two-Way Street Network Versus One-Way Street Network," *Journal of the Institution of Engineers, Singapore*, Vol 44, No. 2 (2004).

[29] A "conflict sequence" is any permutation of pedestrian-vehicle roadway intersection actions that can generate a collision.

Walker, G.W., et al., "Downtown Streets: Are We Strangling Ourselves on One-Way Networks?" *TRB Circular E-CO19: Urban Street Symposium* (2000).

Kit Meng, L. and S. Thu, "A Microscopic Simulation Study of Two-Way Street Network Versus One-Way Street Network," *Journal of the Institution of Engineers, Singapore*, Vol 44, No. 2 (2004).

Naturally, additional roadway injuries and deaths carry substantial financial costs. Total economic losses associated with each roadway fatality is approximately $1.4 million, and a serious injury accident generates losses of $1.0 million.[30]

While it is, in our opinion, crass and grossly inadequate to place a dollar figure on the value of a person's life, the above values - no matter their inadequacies - should be recognized for what they represent. Chief among the contributors to those amounts is lost economic productivity of the people who are either killed or disabled from traffic collisions. The figures accordingly are not limited to "private" losses; rather, these productivity losses hurt the broader local economy and are thus partially borne by the entire community.

3. One-Way Streets Decrease Pedestrian and Cyclist Activity

Research shows that walking and cycling rates are based upon the factors of "safety [and] perceptions of safety."[31] As actual and perceived safety falls due to increased traffic speeds and collisions on one-way streets, fewer people choose (or dare) to walk or bike. Indeed, a doubling of injury/fatality collision risk on MLOW streets provides strong incentive to forgo non-vehicle travel along or across one-way streets.[32]

Importantly, the reduction in safety that leads to reduced pedestrian and cycling rates initiates a negative feedback loop that leads to yet lower rates of walking and biking. Thus, even small changes in safety - let alone a statistical doubling of risk - can generate large and negative consequences of non-automotive travel rates.

Empirical analysis describes the net effect of reduced walking and cycling rates as reducing the overall safety levels of pedestrians and cyclists. That is, as fewer people walk or bike, the statistical likelihood of injury or death for any pedestrian/cyclist goes up.[33] This feedback factor, on its own, means that a small decrease in the share of transportation comprised by walking and cycling can itself ***double*** risk of injury or death for all pedestrians and cyclists. Figure 2 illustrates.

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[30] Blincoe, L., et al., "The Economic and Societal Impact of Motor Vehicle Crashes," U.S. Department of Transportation, National Highway Traffic Safety Administration, DOT HS 812013 (May 2015 (Revised)).

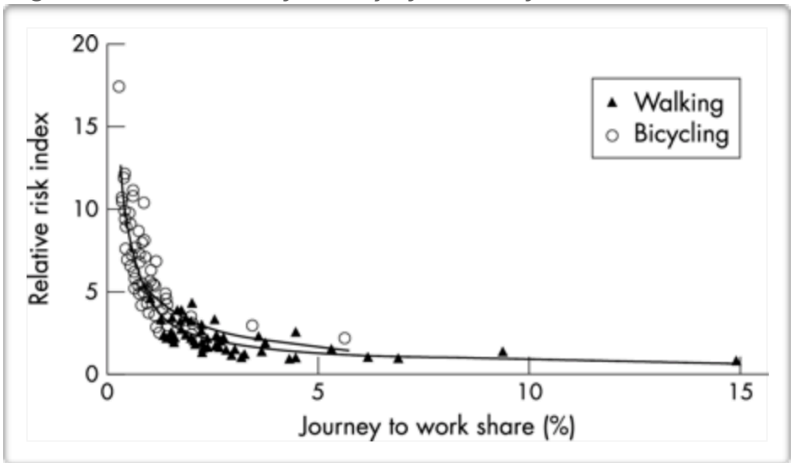
[31] Tovar, M. and Kilbane-Dawe, "Effects of 20mph Zones on Cycling and Walking Behaviours in London," Par Hill Research Ltd. (2013).

[32] Hopper, T., "Taking a U-Turn on the One-Way Street," *National Post* (2012).

Walker, G.W., et al., "Downtown Streets: Are We Strangling Ourselves on One-Way Networks?" *TRB Circular E-CO19: Urban Street Symposium* (2000).

[33] Jacobsen, P., "Safety in Numbers: More Walkers and Bicyclists, Safer Walking and Bicycling," *Injury Prevention*, Vol. 9 (2003).

Figure 2: Pedestrian/Cyclist Injury/Mortality Risk & Mode Share



In this way, ***one-way streets generate a vicious cycle of reduced safety that discourages walking and biking***. As safety levels for pedestrians and cyclists fall, walking and cycling activity declines. This decrease elevates the risks of injury or death for remaining pedestrians and cyclists, which further discourages walking and biking. The cycle thus self-perpetuates and adds to congestion, pollution, and a host of related negative effects.[34]

A by-product of reduced walking and cycling activity is a reduction in the number of so-called "eyes on the street," which invites crime that yet further depresses walking and biking.

Collectively, powerful negative feedback loops emerge from these forces, and the result is a "bad equilibrium" of low walking and cycling rates, elevated vehicle congestion, and diminished overall safety levels. The bad equilibrium "persists because no participant has any rational incentive to deviate from it"; a broader erosion of street life pervades when one-ways are introduced.[35]

The opposite occurs on two-way streets, where increased *traffic* safety serves to enhance *general* safety, and vice versa. "Both ideas of safety - traffic and crime - are served by the same quality: people, and their eyes on the street. Sidewalks busy with pedestrians are a crime deterrent. More people on the street - including on bikes - creates safety in numbers."[36] These forces generate a positive feedback loop that results in a "good equilibrium" of

[34] For more discussion of the nexus between non-vehicle road safety and attendant social and economic effects, see: Porter, "Public Comment: Evidence Demonstrating the Efficiency, Safety & Economic Benefits of 20mph Speed Limits" (July 13, 2018).

[35] Woolridge, M., "Bad Equilibria (and What to Do About Them)," in De Raedt, et al. (Eds.) *ECAI 2012*. IOS Press (2012).

[36] Sadik-Khan, J. *Streetfight.* Viking (2016).

enhanced pedestrian and cyclist activity, reduced vehicle congestion, decreased crime, and enhanced overall conditions for positive street life.

4. One-Way Streets Facilitate Crime

A disproportionate amount of crime occurs on MLOW streets, for two key reasons. First, as described, crime rises on one-way streets because faster and more dangerous traffic discourages pedestrian and cyclist use of the roadways. This decreases the number of "eyes on the street" that ward off crime, an effect that has been empirically validated across various measures.[37]

Second, one-way streets with relatively fast-moving traffic make it easier for criminals to watch for police and flee the scene of a crime. Drug deals, for instance, are easier to make on MLOW streets because dealers can pull over to make a deal while traffic moves around them:[38]

> One-way streets are the gun, drug, and sex distribution centers for a city. Why? You need a two or three lane one-way street where you can pause to negotiate the deal and get out of there quickly. You can't do that on a two-way street because it slows down traffic. That's why the one-way two/three lane street works best for pimps, drive by shootings, and drug dealers. If you break the law, its better to drive 50 mph on a one-way with no obstacles.[39]

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[37] Aiyer, S., et al., "From Broken Windows to Busy Streets: A Community Empowerment Perspective," *Health Education & Behavior* (2014).

Zimmerman, M., "Forget Broken Windows: Think 'Busy Streets'," *CityLab* (2018).

"How to Cut the Murder Rate," *The Economist* (2018).

Plowden, S. and M. Hillman, *Speed Control and Transport Policy*, Policy Studies Institute, Ch. 10 (1996).

[38] Badger, E., "Why One-Way Streets are Bad for Everyone but Speeding Cars," *The Washington Post* (2015).

[39] Hanka, M. and J. Gilderbloom, "How One-Way Thinking is Hurting Historic Downtown Neighborhoods," Working Paper: http://sun.louisville.edu/preservation/one-waystreetver12-012908-5B1-5D%20.pdf (accessed August 2018).

Supporting this anecdotal logic, empirical evidence shows a ***23% reduction in total crime on two-way streets*** converted from MLOWs, within the first three years of the conversion. ***Vehicle-related crimes decline by approximately 30%*** on reconfigured two-way streets, and ***robbery crimes fall by 72%***.[40]

That is, ***on one-way streets, total crime rates are 30% higher, vehicle crimes are 43% greater, and robberies 257% more likely.***

These crime effects of one-way streets are recognized not only in research literature, but also by municipal authorities who are acting to remove one-way streets from their traffic systems in part to decrease crime: "Around the country, ***cities have been converting one-way streets into two-way streets in light of evidence that they make traffic safer by reducing collisions for drivers, cyclists, and pedestrians [and] reduce crime***."[41] (Emphasis added.)

"What we're doing …. [with] one-way streets…is we're over-engineering automobility…***we created places that also became a magnet for crime***."[42] (Emphasis added.)

5. One-Way Streets Degrade Property Values

Higher traffic speeds, increased collisions, elevated rates of pedestrian/cyclist/child injury and death, and escalated crime are all direct results of one-way streets. They collectively diminish the attractiveness and vitality of an area, with their effects manifesting quantitatively in eroded property values.[43]

This erosion is unsurprising since property values reflect the quality of surrounding conditions: "Every attractive feature of a city ends up being capitalized, at least in part, into higher property values."[44] Every unattractive and

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[40] Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research*, Vol. 36, No. 1 (2015). (Note: Significantly, these effects were observed even as "control" crime rates grew by at least 5%, with vehicle-related crime rising 36% during the study period.)

Riggs, W. and J. Gilderbloom, "How Multi-Lane, One-Way Street Design Shapes Neighborhood Life: Collisions, Crime and Community," *Local Environment*, Vol. 22, No. 8 (2017).

Gilderbloom, J. and W. Riggs, "Two-Ways to Fix our Downtowns," Urban Affairs Association Presentation (2016).

Gilderbloom, J. and W. Riggs, "'Two-Ways' to Fix Our Neighborhoods," *Planetizen* (2015).

[41] Florida, R. and A. Boone, "Do Two-Way Streets Help a City's Economy?" *CityLab* (2018).

[42] Badger, E., "Why One-Way Streets are Bad for Everyone but Speeding Cars," *The Washington Post* (2015).

[43] Badger, E., "Why One-Way Streets are Bad for Everyone but Speeding Cars," *The Washington Post* (2015).

[44] Moretti, E. *The New Geography of Jobs*. Mariner Books (2012).

dangerous feature of a city or any more refined geographic designation - such as a street or neighborhood - likewise is capitalized into values. And any shift in the balance between attractive and unattractive features changes the outcome: Higher traffic speeds, more traffic dangers, and increased crime reduce property valuations.

Researchers summarize it this way: "If you own a house in a neighborhood with one-way streets, your home value drops to ***approximately half*** that of homes in neighborhoods with two-way streets."[45] (Emphasis added.)

Statistics show that ***property values on one-way streets are approximately 34% to 45% below the value of homes on comparable two-way streets***. Notably, the negative consequences of property valuation are not limited to just the one-way streets themselves; rather, ***the negative effects of one-way streets bleed out to nearby roads, hurting property valuations on neighboring streets even if they remain two-ways***.[46]

One-way residential streets also experience significantly higher rates of abandonments and foreclosures, and property improvement rates are negatively impacted. Property investment levels are less than half on one-way streets compared with two-ways; on the other hand, ***property improvement rates more than double when one-ways are converted to two-ways***.[47]

Data relating to property improvement rates are significant because residential properties require financial inputs, including maintenance and upkeep, simply to retain their relative valuation. In the absence of such investment, values decline. And as a single property's condition deteriorates, it pulls down the worth of neighboring properties. This external effect reduces incentive for neighboring owners to invest in their properties, and it reduces their ability to obtain credit for improvements even if they desire to do so.[48] A vicious cycle of reduced values begetting

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[45] Riggs, W. and J. Gilderbloom, "How Multi-Lane, One-Way Street Design Shapes Neighborhood Life: Collisions, Crime and Community," *Local Environment*, Vol. 22, No. 8 (2017).

Gilderbloom, J. and W. Riggs, "Two-Ways to Fix our Downtowns," Urban Affairs Association Presentation (2016).

Gilderbloom, J. and W. Riggs, "'Two-Ways' to Fix Our Neighborhoods," *Planetizen* (2015).

Badger, E., "Why One-Way Streets are Bad for Everyone but Speeding Cars," *The Washington Post* (2015).

[46] Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research*, Vol. 36, No. 1 (2015).

Gilderbloom, J. and W. Riggs, "Two-Ways to Fix our Downtowns," Urban Affairs Association Presentation (2016).

[47] Gilderbloom, John and William Riggs, "Two-Ways to Fix our Downtowns," Presentation before the Urban Affairs Association, April 9, 2015.

[48] Rufolo, A., "Housing Decay: Cause of Symptom of Urban Decline?" *Federal Reserve Bank of Philadelphia Business Review* (1978).

reduced maintenance begetting reduced values accordingly ensues. This sort of downward spiral is generally known as a "poverty trap" and is a type of "bad equilibrium" that, once entered, is difficult to escape.[49]

Importantly, because ***the external cause of this poverty trap cycle is roadway safety***, a secondary effect that reduces property value also emerges. This effect relates to area walkability as a significant factor in property value. As conditions become inimical to pedestrians and cyclists, area walkability decreases, thereby reducing property valuations. Empirical work shows this relationship to be highly sensitive; even small reductions in walkability can generate very large downward revisions in property value.[50]

While the financial ramifications of one-way streets are abundantly large and negative, their *meaning* is not fully disclosed by the statistics. Property values reflect the quality of life enjoyed by the people who inhabit those properties. Property values decline because of a deterioration in life quality associated with those places, an economic relationship revealed through what is known as "hedonic price."

This implies a subtle but ***severe regressiveness built into any change of roadways from two-way streets to one-ways***: People with greater wealth are able to flee the poverty trap upon introduction of one-way streets simply by incurring a financial loss in the sale of their property. Those with less wealth are not able to incur the realized financial loss on their property (even though the unrealized loss exists in fact) *and*, since they are unable to leave the decaying area, *fully suffer the lower quality of life implied by the lower values*. The ***harms of converting to one-way streets are inordinately visited upon those at the lower end of the socioeconomic spectrum***.[51] Simply put, residents who must remain on one-ways have no choice but to "accommodate and resign themselves to the situation."[52]

On the other hand, conversions from one-ways to two-ways can dissolve property trap economics, raise property values, reduce damaging inequality, and raise living standards across the board and particularly for the least-advantaged households.

This effect is illustrated in Charleston, South Carolina. Following conversion of one-way streets to two-ways there, an immediate effect was found in increased real estate transactions, reflecting the willingness for new investment

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[49] Moretti, E. *The New Geography of Jobs*. Mariner Books (2012).

[50] Cortirght, J., "Walking the Walk: How Walkability Raises Home Values in U.S. Cities," CEOs for Cities Paper & Presentation (2009).

[50] Speck, J. *Walkable City*. Northpoint Press (2012).

Leinberger, C. and M. Alfonzo, "Walk this Way," Metropolitan Policy Program at Brookings, Brookings Institution (2012).

[51] Moretti, E. *The New Geography of Jobs*. Mariner Books (2012).

[52] Jones, B., "One Way to Neighborhood Deterioration?" *Journal of Planning Education and Research*, Vol. 5, No. 3 (1986).

to be made along two-way streets but not one-ways: "Another gauge of the success of the one-way to two-way conversion is the ***drastic increase in property sales that occurred after the conversion***." (Emphasis added.) This effect also was observed in Louisville, Kentucky, where sales of properties on MLOWs converted to two-ways increased 39% shortly after conversion.[53] Moreover, econometric models developed to evaluate the impact of converting one-ways to two-ways found, "***with 99 percent certainty, the [conversion to two-ways] is significantly associated with higher property sale prices***."[54] (Emphasis added.)

6. One-Way Streets Weaken Local Business Results

The Urban Land Institute, in its "Ten Principles for Rebuilding Neighborhood Retail" report, states: "In most cases, one-way streets should be converted to two-way streets to eliminate the raceway effect of one-way arterials and give the streets more of a neighborhood character."[55] Urban planners Duany Plater-Zyberk agree: "One-way streets should generally be avoided in retail areas."[56]

Indeed, the conversion of key retail thoroughfares to one-ways in cities is "usually the first harbinger of urban blight." An often-referenced example is Cincinnati, Ohio, where ***40 percent of businesses closed*** after Vine Street became a one-way.[57]

One-way streets distribute motor vehicle traffic unevenly in business areas, diminish storefront visibility, reduce valuable pedestrian and cyclist activity, decrease storefront motor vehicle traffic volumes, and increase blight. These problems in turn lead to substantive financial losses for local business, and those losses generate bankruptcies and closures.[58]

The experience of a key retail street in Miami, Florida, that was converted from two-way to one-way helps illustrate just a single mechanism by which one-way streets harm retail environments:

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[53] Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research*, Vol. 36, No. 1 (2015).

[54] Baco, M., "One-Way to Two-Way Street Conversions as a Preservation and Downtown Revitalization Tool: The Case Study of Upper King Street, Charleston, South Carolina," *All Theses* (2009).

[55] Beyard, M., et al., "Ten Principles for Rebuilding Neighborhood Retail," Urban Land Institute (2003).

[56] Duany, A., et al. *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream*. North Point Press (2000).

[57] Hopper, T., "Taking a U-Turn on the One-Way Street," *National Post* (2012).

[58] Cervero, R. and K. Kockelman, "Travel Demand and the 3Ds: Density, Diversity, and Design, Transportation Research Part D: Transport and Environment, Vol. 2, No. 3 (1997).

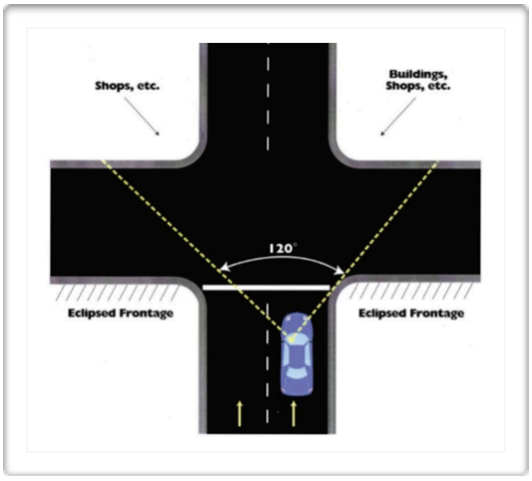
Leinberger, C. and M. Alfonzo, "Walk this Way," Metropolitan Policy Program at Brookings, Brookings Institution (2012).

> …[T]raffic planners in Miami turned two streets in Little Havana into a one-way pair, such that people drive to work on SW Eighth Street—"Calle Ocho," the retail heart of the district—and drive home from work on SW Seventh Street, which is entirely residential. The problem with this configuration, in addition to the fact that drivers are always jockeying for the fastest lane, is that people don't shop on their way to work; they shop on their way home. Unsurprisingly, merchants on Calle Ocho were devastated. Decades later…this once vibrant main street continues to struggle.[59]

Even if traffic is present in front of retailers at the right time of day, one-way streets decrease the likelihood that a driver sees the retailers' storefronts. "***On one-way street networks, precious storefront exposure is lost*** when one direction of travel is removed, causing one side of every cross street to be partially 'eclipsed' from view…"[60] (Emphasis added.)

It is estimated that ***25 percent of storefront space is eclipsed on one-way streets***, an effect readily illustrated by Figure 3, which was generated by the national community planning firm Glatting Kercher Anglin Lopez Rinehart, Inc. that specializes in urban design, transportation planning, and engineering.[61]

Figure 3: Storefront Eclipsing



[59] Duany, A., et al. *Suburban Nation: The Rise of Sprawl and the Decline of the American Dream*. North Point Press (2000).

[60] Walker, G.W., et al., "Downtown Streets: Are We Strangling Ourselves on One-Way Networks?" *TRB Circular E-CO19: Urban Street Symposium* (2000).

[61] Walker, G.W., et al., "Downtown Streets: Are We Strangling Ourselves on One-Way Networks?" *TRB Circular E-CO19: Urban Street Symposium* (2000).

Reduced visibility is particularly relevant for many businesses along Bend's retail corridors: "Specialty stores that rely on impulse sales and depend on high margins per sale do better on two-way streets, since only half their potential customers would see them on a one-way couplet."[62]

The increased speeds and driver inattentiveness on one-way streets amplify the effects of visibility reductions with respect to retailer business results.[63]

> Because users of one-way streets are more likely to accelerate beyond the posted [speed] limit, storefronts and signs will be even less visible. Because the shopper does not typically plan purchases from small businesses on commercial streets, they can be considered "impulse" purchases. For this type of sale, storefront visibility from a moving automobile is essential, even if the shopper intends to return to the store on foot.[64]

As with reducing the quality of vehicle traffic, one-way streets also lead to fewer pedestrians and cyclists traveling by storefronts, which corresponds with reduced business revenue.[65]

Just as conversion from existing two-way streets to one-ways harms business results, reconfiguring existing one-ways to two-way travel generates significant retail and investment returns.

No fewer than hundreds of businesses in dozens and dozens of cities have experienced significant improvements in financial results following conversion from one-ways to two-ways. These experiences illustrate the damaging effects of one-way streets on business, serve to underline the importance of not introducing one-way streets where two-ways currently exist, and argue strongly in favor of replacing existing MLOWs with two-way streets.

Case studies from an array of diverse cities reflect this pattern of economic benefits associated with conversion to two-way streets in retail areas.

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[62] "Should Cities Convert One-Way Streets to Two Way?" Thoreau Institute (2008).

[63] Hanka, M. and J. Gilderbloom, "How One-Way Thinking is Hurting Historic Downtown Neighborhoods," Working Paper: http://sun.louisville.edu/preservation/one-waystreetver12-012908-5B1-5D%20.pdf (accessed August 2018).

[64] Baco, M., "One-Way to Two-Way Street Conversions as a Preservation and Downtown Revitalization Tool: The Case Study of Upper King Street, Charleston, South Carolina," *All Theses* (2009).

[65] "The Economic Benefits of Sustainable Streets," New York City Department of Transportation (2013).

"Good for Business: The Benefits of Making Streets More Walking and Cycling Friendly," Heart Foundation (2011).

In Vancouver, Washington, ***conversion from one-way to two-way streets downtown led to increases in retail sales between 10 percent and 20 percent***.[66] Now, "[t]wice as many cars drive past their businesses each day and the once-feared traffic congestion has never occurred."[67]

The impacts of conversion in Vancouver were so strong the head of its downtown association said, "***One-way streets should not be allowed in prime downtown retail areas. We've proven that***."[68] (Emphasis added.) Following conversion to two-way streets, Vancouver, Washington, added:

- 71,000 square feet of mixed-use commercial complexes; and
- 21 luxury condominiums.[69]

After converting to two-way streets, Austin, Texas, experienced significant growth in businesses located on and near the new two-way roads. This facilitated follow-on development that included:

- A new city hall;
- Residential complexes with 294 apartments and 185 condominiums;
- New retail space measuring 22,000 square feet; and
- A residential high-rise with 258 units and ground-floor retail.

In Fort Collins, Colorado, conversion to two-way streets catalyzed redevelopment including:

- 11 new residential projects; and
- 600% anticipated expansion of retail space by 2022.

Des Moines, Iowa, added 520,000 square feet of new office space after conversion.

Other cities as diverse as Lafayette, Indiana; Toledo, Ohio; and West Palm Beach, Florida, also experienced significant development, including increases in retail, restaurants, and residential investment, following conversion to two-ways.[70] Business owner surveys reflect the effects: "One vehement voice opposing conversion [from one-way to two-way streets] has since mellowed. His ***business was transformed, from struggling to profitable,***

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[66] Missoula Redevelopment Agency, "Front Street/Main Street Two-Way Conversion Feasibility Study," March 2015.

[67] Speck, J. *Walkable City*. Northpoint Press (2012).

[68] Speck, J. *Walkable City*. Northpoint Press (2012).

Ehrenhalt, A., "The Return of the Two-Way Street: Why the Double-Yellow Stripe is Making a Comeback in Downtowns," *Governing* (2009).

[69] Missoula Redevelopment Agency, "Front Street/Main Street Two-Way Conversion Feasibility Study," (2015).

[70] Missoula Redevelopment Agency, "Front Street/Main Street Two-Way Conversion Feasibility Study" (2015).

and now he wishes to see adjoining streets converted from one-way to two-way because he thinks it would further increase profits."[71] (Emphasis added.)

Similar business-related benefits were reflected in the experience of South Bend, Indiana, even before MLOWs there were converted to two-ways. That is, the ***mere act of planning to convert to two-ways had already generated economic benefits*** in South Bend:

- Local entrepreneurs "announced plans to ***open a new upscale restaurant*** on Main Street downtown - in part because of the planned conversion project." (Emphasis added.)
- "The impending switch also helped influence Real America to ***invest in the redevelopment of the LaSalle Hotel***." (Emphasis added.)
- "And it has convinced South Bend-based Great Lakes Capital to consider ***future investments in downtown*** as well." (Emphasis added.)
- Altogether, it is estimated by the city's mayor that ***$100 million in private investment was rooted in the anticipated switch to two-way streets***.[72]

Based on these immediate results, it is unsurprising that South Bend "Mayor Pete Buttigieg and Scott Ford, the city's executive director of Community Investment, have repeatedly referred to it [i.e., conversion to two-ways] as ***the 'single best investment'.***"[73] (Emphasis added.)

From an economic perspective, these experiences illustrate economic "multiplier effects": The change from MLOWs to two-ways improves business visibility and accessibility, which improves sales. Revenue increases and profit growth catalyze investment in local development and retail, taking the form of new-business entrepreneurship and existing business expansion, both of which generate their own positive downstream effects that provide additional economic returns.

The positive multiplier effect of converting from one-way streets to two-ways is confirmed by empirical data, which show ***statistical growth in incomes and housing deriving from road reconfiguration to two-ways***.[74] This multiplier effect reflects the economic mechanisms associated with other positive "place-based policies," of which

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[71] Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research (*2015).

[72] Blasko, E., "Will Two-Way Streets Bring Success to Downtown South Bend?" *South Bend Tribune* (2015).

[73] Blasko, E., "Will Two-Way Streets Bring Success to Downtown South Bend?" *South Bend Tribune* (2015).

[74] Moretti, E. *The New Geography of Jobs*. Mariner Books (2012).

Florida, R. and A. Boone, "Do Two-Way Streets Help a City's Economy?" *CityLab* (2018).

Gilderbloom, J. and W. Riggs, "Two-Ways to Fix our Downtowns," Urban Affairs Association Presentation (2016).

research has shown that, ***for every one dollar spent in public funds, several more dollars are invested by private businesses***, which provokes a "virtuous cycle of growth."[75] The opposite effect - a negative multiplier that generates a poverty trap - prevails when public funds are spent on counterproductive policies like adding one-way streets.

Conversion from one-way streets to two-ways is "good for grocery stores, restaurants, and coffee houses,"[76] as well as the industries of arts and entertainment, recreation, accommodation, and professional services businesses.[77] As these businesses benefit from improved revenue and profit, their ability and likelihood to invest in additional improvements, assets, and employees go up. As businesses purchase more local services, buy new assets, and add employee hours, additional money flows through the local economy, benefiting both the immediate recipients of these new contracts as well as the rest of the community and the local government.[78]

Case studies of cities that have undergone conversion of their retail streets from MLOWs to two-ways illustrate how the reconfiguration generates positive feedback loops and a "good equilibrium." Labor and urban economist Enrico Moretti explains:

> A boarded-up property that turns into an active retail store brings more business to nearby stores, increases foot traffic, and reduces loitering and crime on the entire block. A business that improves its facade benefits not just its own building but all the properties around it. A new job… creates social benefits in the form of reduced public assistance and reduced crime. Dealing with these externalities is the secret of successful local economic development.[79]

In summary, the statistical data and case study evidence show:

1) One-way streets are inferior to two-way streets for retail business results;
2) The conversion of existing two-ways to one-way streets profoundly hurts business results, with large, negative feedback effects - as in the 40% rate of business closure following one-way conversion in Cincinnati, Ohio;

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[75] Moretti, E. *The New Geography of Jobs*. Mariner Books (2012).

Florida, R. and A. Boone, "Do Two-Way Streets Help a City's Economy?" *CityLab* (2018).

[76] Gilderbloom, J. and W. Riggs, "'Two-Ways' to Fix Our Neighborhoods," *Planetizen* (2015).

[77] Florida, R. and A. Boone, "Do Two-Way Streets Help a City's Economy?" *CityLab* (2018).

[78] Moretti, E. *The New Geography of Jobs*. Mariner Books (2012).

Florida, R. and A. Boone, "Do Two-Way Streets Help a City's Economy?" *CityLab* (2018).

[79] Moretti, E. *The New Geography of Jobs*. Mariner Books (2012).

3) The conversion of existing one-way streets to two-ways is demonstrably better for retail business and generates follow-on investment, housing, and income gains that benefit the broader local economy;
4) Retaining one-way streets, rather than switching them to two-ways, imposes large hidden costs on local businesses, investors, employees, residents, and local government - and, by extension, the entire local economy. That is, even if business results appear strong on one-way streets, the evidence shows those results would be stronger following conversion to two-ways.

7. One-Way Streets Diminish City Tax Revenue

Property taxes on the average one-way block are ***50 percent lower*** than property tax revenues on the average two-way block.[80] One-way streets are a tremendously expensive (and frivolous) indulgence that most cities simply cannot bear: "cities might not be able to afford multi-lane one way streets because the impact on tax base is significant."[81]

With respect to Bend, the city stands to lose significant tax revenue by converting two-way streets to one-ways. And the city stands to gain tax revenue by converting existing one-ways to two-ways. ***Since one-way streets also are responsible for higher government spending needs, the net result of any one-way street is a large funding gap that grows year by year***. This effect derives from two parallel mechanisms.

First, lower property values and reduced business activity generate lower property and other taxes the city uses to fund operations. Within Bend, these operations include streets and transportation, police, fire, emergency medical services, and community projects.[82]

Second, one way streets increase the need for certain of these tax-funded services, particularly police, fire, and emergency medical due to increased collisions and fatalities on one-ways - and thus increase city operating costs.[83] ***In Louisville, Kentucky, for instance, additional costs for police, fire, and ambulance due to one-***

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[80] Riggs, W., et al. "East Breckenridge: A case study of one vs. two-way streets," Proceedings of the International Making Cities Livable Conference (2014).

Gilderbloom, J. and W. Riggs, "'Two-Ways' to Fix Our Neighborhoods," *Planetizen* (2015).

[81] Riggs, W., et al. "East Breckenridge: A case study of one vs. two-way streets," Proceedings of the International Making Cities Livable Conference (2014).

[82] Gilderbloom, J. and W. Riggs, "'Two-Ways' to Fix Our Neighborhoods," *Planetizen* (2015).

"Where the Money Goes: A Report on City Property Taxes," League of Oregon Cities (2013).

[83] Marsico, A., "New Study Shows Dangers of One Way Streets," KDKA, CBS Pittsburgh (2015).

way streets are approximately $1 million each year.[84] With one-way streets, the funding sources dry up, even as funding needs go up. Thus, a smaller pie of funds must be used to address increased funding needs as a direct result of one-way streets, and the city suffers accordingly.

By contrast, in Fort Collins, Colorado, ***conversion from one-way streets to two-way streets is projected to increase property tax revenue by 885%*** by 2025.[85] Fort Collins is not unique in this respect; the movement of over 100 U.S. cities to reconfigure their one-way streets to two-ways provides at least *prima facie* evidence that these cities perceive fiscal benefits associated with doing so.

8. One-Way Streets Harm Transportation System Efficiency

The above-described drawbacks to one-way streets are substantial and are not offset by improved traffic throughput of one-way streets. In fact, studies show that "…two-way streets may serve traffic more efficiently…"[86]

First, one-way streets often increase average distance traveled. Two-way streets give drivers the option to travel the shortest distance possible, while one-way networks impose circuitous routing.[87] One-ways contribute to higher VMTs and attendant side-effects including increased fuel consumption, emissions, and accident exposure. Because these circuitous routes and higher VMTs do not add value to each trip, they are low-value VMTs and thus erode the average economic value of VMTs on the roadway, making the transportation system less economically efficient.

Second, there is evidence that drivers will go out of their way to avoid traveling on one-way streets if possible. That is, instead of prioritizing the shortest A-to-B route, a meaningful share of drivers will prioritize the flexibility, safety, and superiority of surroundings afforded by two-way streets even if one-ways would connect them with their destinations more directly. "It flips the conventional wisdom of traffic engineers."[88] This adds to VMTs, pollution, and travel time variability. Additionally, because these VMTs are remedial in nature (i.e., they are added to the

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[84] Gilderbloom, J. and W. Riggs, "'Two-Ways' to Fix Our Neighborhoods," *Planetizen* (2015).

[85] Missoula Redevelopment Agency, "Front Street/Main Street Two-Way Conversion Feasibility Study" (2015).

[86] Gayah, V., "Two-Way Street Networks: More Efficient than Previously Thought?" *Access,* No. 41, (2012).

[87] Badger, E., "Why One-Way Streets are Bad for Everyone but Speeding Cars," *The Washington Post* (2015).

Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research*, Vol. 36, No. 1 (2015).

[88] Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research*, Vol. 36, No. 1 (2015).

system in order to overcome drawbacks of the system), they are of the lowest economic value. This effect makes the transportation system less economically efficient.

Third, one-way streets may serve fewer trips per unit time than two-ways when trip lengths are short. This adds to travel times and further erodes the economic efficiency of the system. One-way networks are "less efficient because they restrict the rate at which people reach their destinations."[89]

Fourth, one-way networks are confusing and frustrating for users, particularly visitors. On one-way networks, drivers can often see their destinations but cannot reach them, increasing driver stress and thus reducing social efficiency of the transportation system.[90]

Fifth, with one-ways, a single transit stop for opposite route directions may need to be located on two different streets.[91] This latter effect reduces ridership and adds VMTs to roadways as "marginal" transit riders revert to single-occupancy vehicle travel, thus adding congestion, harming transit operations, and further decreasing the economic efficiency of the transportation system.[92]

"Two-way roads…'normalize' the streets…creating a greater choice of routes [and] improving wayfinding."[93] From a user perspective, two-ways are more intuitive and navigable, regardless of travel mode.

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[89] Gayah, Vikash V., "Two-Way Street Networks: More Efficient than Previously Thought?" *Access,* No. 41, (2012).

[90] Walker, W., et al., "Downtown Streets: Are We Strangling Ourselves on One-Way Networks?" *TRB Circular E-CO19: Urban Street Symposium*, (2000).

Gayah, Vikash V., "Two-Way Street Networks: More Efficient than Previously Thought?" *Access,* No. 41, (2012).

[91] Walker, W., et al., "Downtown Streets: Are We Strangling Ourselves on One-Way Networks?" *TRB Circular E-CO19: Urban Street Symposium*, (2000).

Gayah, Vikash V., "Two-Way Street Networks: More Efficient than Previously Thought?" *Access,* No. 41, (2012).

[92] Jacobs, J. *The Death and Life of Great American Cities*. The Modern Library (1992).

[93] Badger, E., "Why One-Way Streets are Bad for Everyone but Speeding Cars," *The Washington Post* (2015).

RECOMMENDATIONS

We provide below two generalized recommendations based upon the foregoing.

1. Proposals for New One-Way Streets in Bend Should Be Rejected

Existing two-way streets in Bend should not be converted to one-way couplets. Two-way streets outperform one-ways on important social, economic, and transportation system measures, and conversions carry up-front expenses in the range of $20,000 to $100,000 per mile of roadway.[94]

The follow-on costs of one-way roads (e.g., increased collisions, reduced property values, degraded business results, decreased tax revenue, and elevated emergency medical spending) mean that the up-front investment in conversion is likely to never be recouped. Rather, evidence shows that the "investment" will lead to negative economic multiplier effects that only hurt the economy and fiscal position of government.

As Jane Jacobs states, "Decaying cities, declining economies, and mounting social troubles travel together. The combination is not coincidental."[95] One-ways reduce safety, degrade property values, harm businesses, decrease tax revenue, and generally reduce livability; the effects are empirically shown and are not coincidental but are instead widespread, predictable, and persistent features of one-way streets.

Table 1 summarizes the empirical results of converting two-way streets to one-ways. Where a range is found in the empirical statistics, low and high values are shown. In the event empirical findings are not quantified but are directional in nature, a qualitative description is given.

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[94] The cost to convert 2.5 miles of roadway from one-way to two-way in Louisville totaled $250,000, implying a per mile conversion rate of $100,000. This figure reflects expenses associated with stoplight and sign conversion, re-striping, and changes to signal timing. See Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research*, Vol. 36, No. 1 (2015). Sources pointing to the U.S. Department of Transportation state that on the low end conversion costs can start at $20,000 per mile. See Hopper, T., "Taking a U-Turn on the One-Way Street," *National Post* (2012). These cost estimates are consistent with statistics set forth in the Federal Highway Administration website, which estimates the costs of conversion at $20,000 to $200,000 depending roadway distance converted and number of signal modifications.

[95] Jacobs, J. *The Death and Life of Great American Cities*. The Modern Library (1992).

Table 1: Summarized Effects of Converting Existing Two-Way Streets to One-Way Streets

Measure	Result (Low)	Result (High)
Safety Measures		
Total Traffic Collisions	+56%	+150%
Traffic Speeding	Higher	Higher
Driver Inattentiveness	Higher	Higher
Pedestrian/Cyclist Mortality/Injury Rates	+100%	+100%
Child Mortality/Injury Rates	+150%	+200%
Pedestrian/Cyclist Activity	Lower	Lower
Crime Measures		
Total Crime	+30%	+30%
Vehicle Crime	+43%	+43%
Robbery Crime	+72%	+72%
Economic Measures		
Property Values	-34%	-45%
Property Improvement Rates	-50%	-50%
Socioeconomic Equitability	Lower	Lower
Business Closures	Higher	Higher
Storefront Visibility	-25%	-50%
Retail Revenue	-9%	-17%
Local Private Investment	Lower	Lower
Real Estate Development	Lower	Lower
Housing Growth	Lower	Lower
Fiscal Measures		
Property Tax Receipts	-50%	-50%
Other Tax Receipts	Lower	Lower
Police, Fire & EMS Spending Needs	Higher	Higher
Vehicle Transportation Measures		
VMTs	Higher	Higher
Trip Service	Lower	Lower
Driver Confusion	Higher	Higher
Transit Service/Usage	Lower	Lower
Average VMT Economic Value	Lower	Lower

2. Existing One-Way Streets Should Be Converted to Two-Way Streets

Two-way streets outperform one-way streets on all meaningful measures, and the benefits of two-way streets directly address many of the issues facing Bend. Restoring two-way streets more than pays for conversion costs.

Converting MLOWs to two-ways "…goes hand in hand with downtown economic strategies that inspire broader housing construction… In most places, two-way streets appear to make neighborhoods safer and more livable."[96]

"[C]onverting multi-lane one-way streets to two-way streets is a smart and affordable policy….It's a win-win for the city neighborhoods, children, developers, and homeowners."[97] "Travelers and residents prefer two-way streets for a variety of economic and livability reasons…"[98]

"Regardless of the size of the city…one-way to two-way street conversion should *always* increase the efficiency of downtown networks…[and] can improve livability…"[99]

"[E]mpirical analysis shows that conversions [from one-way to two-way] can result in busier yet slower streets that have the potential to increase the vitality of an area and promote economic regeneration through fewer traffic collisions, reductions in crime, and increased property values."[100]

Reflecting these facts, over 100 U.S. cities have already converted or are now converting streets from MLOWs to two-ways and are "seeing phenomenal results."[101] Bend should be among them.

Table 2 summarizes the empirical results of converting one-way streets to two-ways, showing low and high values from empirical study or, in the absence of quantification, a directional description.

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[96] Florida, R. and A. Boone, "Do Two-Way Streets Help a City's Economy?" *CityLab* (2018).

[97] Gilderbloom, J. and W. Riggs, "'Two-Ways' to Fix Our Neighborhoods," *Planetizen* (2015).

[98] Gayah, V., "Two-Way Street Networks: More Efficient than Previously Thought?" *Access,* No. 41 (2012).

[99] Gayah, V., "Two-Way Street Networks: More Efficient than Previously Thought?" *Access,* No. 41 (2012).

[100] Riggs, W. and J. Gilderbloom, "Two-Way Street Conversion: Evidence of Increased Livability in Louisville," *Journal of Planning Education and Research*, Vol. 36, No. 1 (2015).

[101] Marsico, A., "New Study Shows Dangers of One Way Streets," KDKA, CBS Pittsburgh (2015).

Florida, R. and A. Boone, "Do Two-Way Streets Help a City's Economy?" *CityLab* (2018).

Table 2: Summarized Effects of Converting Existing One-Way Streets to Two-Way Streets

Measure	Result (Low)	Result (High)
Safety Measures		
Total Traffic Collisions	-36%	-60%
Traffic Speeding	Lower	Lower
Driver Inattentiveness	Lower	Lower
Pedestrian/Cyclist Mortality/Injury Rates	-50%	-50%
Child Mortality/Injury Rates	-33%	-50%
Pedestrian/Cyclist Activity	Higher	Higher
Crime Measures		
Total Crime	-23%	-23%
Vehicle Crime	-30%	-30%
Robbery Crime	-42%	-42%
Economic Measures		
Property Values	+53%	+82%
Property Improvement Rates	+100%	+100%
Socioeconomic Equitability	Higher	Higher
Business Closures	Lower	Lower
Storefront Visibility	+33%	+100%
Retail Revenue	+10%	+20%
Local Private Investment	Higher	Higher
Real Estate Development	Higher	Higher
Housing Growth	Higher	Higher
Fiscal Measures		
Property Tax Receipts	+100%	+100%
Other Tax Receipts	Higher	Higher
Police, Fire & EMS Spending Needs	Lower	Lower
Vehicle Transportation Measures		
VMTs	Lower	Lower
Trip Service	Higher	Higher
Driver Confusion	Lower	Lower
Transit Service/Usage	Higher	Higher
Average VMT Economic Value	Higher	Higher

CONCLUSIONS

We conclude the following:

1. One-way streets generate significant losses across all significant social, economic, and fiscal measures, and these drawbacks are not offset by gains, if any, in transportation system efficiency. In fact, transportation system efficiency - particularly economic efficiency - can be substantially reduced by one-way streets.
2. One-way streets increase the risk of vehicle collision by approximately 100% relative to two-way streets.
3. Injury and mortality risks are roughly doubled on one-way streets relative to two-way streets. Risks are especially elevated for pedestrians and cyclists, and most elevated for children, who are 2.5 times more likely to be injured or killed on one-way streets.
4. Pedestrian and cyclist activity levels are reduced by one-way streets as a result of reduced safety, leading to, among other things, increased vehicle congestion.
5. One-way streets facilitate crime due to diminished street life. Total crime levels are 30% greater on one-way streets, and vehicle and robbery crimes exhibit even higher incidence relative to two-way streets.
6. One-way streets reduce property values in the range of 50% relative to two-way streets.
7. Business results are substantially harmed by one-way streets owing to various factors. Reduced levels of business revenue, profit, investment, employment, and housing all stem from one-way streets.
8. City tax revenue is reduced by one-way streets as a result of lower property taxes and diminished business activity. Plus, a greater share of city funds must be inefficiently reallocated toward police, fire, and emergency medical services due to higher collisions, injuries, fatalities, and crime that arise from one-ways streets. A funding gap accordingly grows over time as a result of one-way streets.
9. One-way streets often add VMTs to the transportation system and increase driver confusion. One-way streets reduce the overall level of transportation system efficiency from an economic perspective.
10. ***Proposals for new one-way streets in Bend should be rejected*** on the basis of one-way streets' overwhelming negative implications for the city across all significant social, economic, and fiscal measures.
11. ***Existing one-way streets in Bend should be reconfigured as two-ways*** to capture the social, economic, and fiscal benefits associated with two-way streets relative to one-ways.

Thank you for your consideration.

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ABOUT THE AUTHORS

Michelle Porter

Michelle is an expert in valuation, economic analysis, and quantitative methods. She has been engaged by Fortune 500 companies, SMEs, U.S. and international government entities, and leading law firms to provide expertise in high-stakes commercial litigations, negotiations, and asset transactions. Her consulting work has encompassed advisory roles in industries including pharmaceuticals, medical devices, banking, telecommunications, consumer goods, software, and transportation technologies, among many others. Michelle is co-author of the book entitled *IP Strategy, Valuation, and Damages* (LexisNexis). Her articles have appeared in *les Nouvelles*, *Intellectual Asset Management*, *Intellectual Property Magazine*, *Smart Business, Los Angeles Daily Journal*, *The Recorder,* and *China Intellectual Property*, and she has been quoted by *Forbes*. Michelle has spoken before such groups as the Intellectual Property Law Committee of the Chicago Bar Association, Google, and Motorola Mobility. Her work has been recognized with the Accenture International Consulting Competition Top Honors Award, the IE Women Leaders Scholarship Award, the *les Nouvelles* Best Article Award, and the Micronomics Economic Research Award. In addition, Michelle has served as an advisor to the Forte Foundation's MBALaunch for Women, President of the IE Business School Southern California Alumni Association, Co-Chair and Executive Committee Member of Young Professionals Advisory Council at the Farmer School of Business, and an instructor in microeconomics. Michelle graduated *cum laude* from Miami University in Oxford, Ohio, majoring in economics. She received her MBA from IE Business School in Madrid, Spain.

Steve Porter

Steve is a recognized authority on economic analysis and valuation. He has provided expert testimony in high-stakes commercial litigation on topics including economics, valuation, statistics, econometrics, market definition, consumer choice, business strategy, and pricing, among others. He has consulted with Fortune 500 corporations on intellectual property licensing, asset transactions, and valuation issues, and he has conducted economic impact analyses, including work performed on behalf of the Los Angeles Superior Court. His articles have published in the *Journal of Legal Economics*, *les Nouvelles*, the *Patent, Trademark & Copyright Journal*, the *Journal of the Patent and Trademark Office Society*, and *Intellectual Asset Management*, among others. He also is co-author of *IP Strategy, Valuation, and Damages* (LexisNexis), a treatise on intellectual property economics. Steve has been an invited speaker before the Chicago Bar Association, the Attorney General's Office of the State of Arizona, and various law firms and corporations, where he has lectured on topics ranging from economic analysis and valuation to econometrics and game theory, and he has been quoted by and featured in the editorials section of the *Wall Street Journal*. Steve is a recipient of the William J. McKinstry Award in economics, the *Wall Street Journal* Scholar Award, the Micronomics Economic Research Award, and the IE Fund Leadership Scholar Award. He has served as a teaching assistant in economics at the Dolibois European Center in Luxembourg, an ad hoc referee for the *Journal of Forensic Economics*, and as Co-Chair and an Executive Committee Member of Young Professionals Advisory Council at the Farmer School of Business. Steve graduated *summa cum laude* and with University Honors from Miami University in Oxford, Ohio, completing dual majors in economics and marketing. He was granted his MBA, with honors by the Dean and Board of Academic Affairs, from IE Business School in Madrid, Spain, graduating 5th in a class of more than 400. Steve holds the Series 65 securities license.