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Research Paper

An Economic Analysis of Cordon Pricing (Case study: New York City CBD)

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Abstract

Cordon pricing has emerged as a critical Transportation Demand Management (TDM) strategy aimed at reducing traffic congestion, improving air quality, and generating revenue for sustainable transportation investments. This study evaluates the economic impacts of implementing a cordon pricing scheme in New York City's Central Business District (CBD), where chronic congestion imposes significant economic and environmental costs. Using the New York Best Practice Model (NYBPM), we analyze two pricing scenarios—High-Toll ($20), and Low-Toll ($5)—to assess their effects on traffic flow, emissions, and economic outcomes. The findings demonstrate that cordon pricing generates substantial economic advantages by quantifying benefits through the Value of Time (VOT) and the traffic-weighted emission factor. One major benefit stems from the annual decrease in Vehicle Hours of Delay (VHD), while the other results from reduced emissions, both of which yield significant financial gains. By providing a data-driven evaluation of these economic outcomes, this research highlights the potential of cordon pricing as a strategic policy tool that balances financial efficiency, environmental responsibility, and equitable urban mobility planning.

Keywords: Economic Analysis, Cordon Pricing, Value of Time, Vehicle Hours of Delay

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1. Introduction

The economic dimension of transportation projects is as crucial as their impact on mobility, influencing productivity, trade, and regional development (Magoutas et al., 2023; Rosik & Wójcik, 2023; Shi et al., 2024). Without proper economic assessment, even beneficial projects may lead to financial inefficiencies (Macheret & Razuvaev, 2024). A positive benefit-to-cost ratio (BCR) is essential to justify investments and prevent economic burdens. This is even more critical in Transportation Demand Management (TDM) strategies, where cost-effective strategies focus on switching modes, adjusting departure times, and even canceling trips (An & Casper, 2011; Transportation Systems Management and Operations Benefit Cost Analysis Compendium, 2015). In the absence of a clear economic justification, TDM initiatives risk resistance and limited impact. Hence, integrating economic analysis ensures efficient resource allocation and long-term viability.

Cordon pricing is one of the TDM strategies with a considerable economic effect, as it requires drivers to pay a fee to enter or travel within a specified area, such as the city center (Baghestani et al., 2021). Since this approach directly involves public payments, evaluating its economic effects is essential to ensure that the benefits outweigh the costs and that the system is fair and sustainable. Singapore, London, Stockholm, Oslo, and Milan have successfully implemented cordon pricing, which has reduced congestion, emissions, and traffic accidents while generating revenue for urban development (Aasness, 2014; Aasness & Odeck, 2023; Croci, 2016; Eliasson, 2009; Hosford et al., 2021; Phang & Toh, 1997; Sumalee, 2007; Tang, 2021). However, it has also faced challenges in cities like Edinburgh, where the public rejected a proposed scheme (Saunders, 2005). Therefore, an accurate economic analysis is crucial to ensure balancing revenue generation as well as congestion reduction and social equity.

New York City, known for its dense population and high levels of traffic congestion, faces significant challenges in managing its transportation system, particularly its Central Business District (CBD) (Congestion Pricing in New York a Toll Structure Recommendation from the Traffic Mobility Review Board, 2023). Implementing cordon pricing in such an area could help manage such issues by charging vehicles entering the most congested zones, thus reducing traffic volume and encouraging a modal shift to public transportation (Ghassabian et al., 2024). Given the city's economic and social importance, cordon pricing could not only alleviate traffic congestion but also generate revenue for infrastructure improvements. The economic effects of such a policy are crucial, as they would balance the costs of implementation with the benefits of reduced congestion, lower emissions, and improved accessibility, ultimately enhancing the city’s overall economic productivity and sustainability.

Despite extensive research on cordon pricing in various cities, including New York, there has been less attention to its economic impacts. While the focus is mostly on traffic reduction and environmental benefits, a comprehensive evaluation of its financial implications—such as its effects on businesses, commuters, and the overall urban economy—has not been fully explored. Considering the importance of economic feasibility in policy acceptance and implementation, further research is needed in this area (A. Abulibdeh, 2012). A deeper understanding of such impacts can provide decision-makers with valuable insights, making cordon pricing policies more practical, effective, and equitable, ultimately leading to better-informed urban transportation strategies.

This study aims to analyze the economic impacts of cordon pricing for the case of New York City, employing an activity-based model, titled the New York Best Practice Model (NYBPM). While previous research has focused on traffic reduction and environmental benefits, comprehensive evaluations of financial effects on businesses, commuters, and the urban economy remain limited. To bridge this gap, the study will define and analyze two pricing scenarios—high-toll and low-toll—to calculate the economic benefits. The results will be quantified from two key dimensions: time savings and emission reductions. By adopting a data-driven approach, this research aims to provide policymakers with robust and actionable insights, ensuring that cordon pricing strategies are both effective in traffic management and economically justified.

In light of these gaps in the literature, this study makes several key contributions to the understanding and practical application of cordon pricing. First, it offers a detailed economic evaluation of pricing impacts by monetizing both time savings—derived from reductions in Vehicle Hours of Delay (VHD)—and environmental benefits—based on emission reductions estimated through the Post-Processing System (PPS) model. Second, it conducts a scenario-based analysis comparing low- and high-toll pricing strategies using the NYBPM to simulate traffic behavior and system performance under varying conditions. Third, it integrates traffic and environmental outcomes to provide a comprehensive financial assessment, presenting annualized savings that offer actionable insights for transportation planners and policymakers. Additionally, the study highlights the importance of equitable implementation and revenue reinvestment strategies to support sustainable and socially responsible policy design.

The remainder of this paper is structured as follows: The next section presents a literature review, discussing previous studies on cordon pricing and its economic implications. Following that, the methodology section outlines the modeling approach, including the use of the NYBPM and pricing scenarios. The results section then provides findings from the simulations, followed by a discussion that interprets these results in the context of policy and urban planning. Finally, the conclusion summarizes key insights and highlights implications for future research and decision-making.

2. Literature Review

Extensive research has examined the economic evaluation of cordon pricing, with studies analyzing its effects on traffic congestion, revenue generation, and urban development. While many emphasize mobility and environmental benefits, accurately quantifying broader economic consequences, such as business activity, consumer behavior, and productivity changes, remains a challenge (Salas R. et al., 2009; Ubbels & Verhoef, 2006). Several cities have implemented cordon pricing, allowing researchers to assess its real-world economic effects. For instance, Givoni (2012) analyzed London’s congestion pricing system, introduced in 2003, which led to a 30% traffic reduction, a 10% drop in air pollution, and generated £200 million annually, reinvested into public transport improvements. The study highlighted distributional impacts, showing that businesses in central London benefited from reduced delays, while certain industries reliant on vehicle deliveries faced increased costs (Givoni, 2012).

Moreover, Menon et al. (2004) examined Singapore’s electronic road pricing (ERP) system, first introduced in the 1980s. Findings revealed a 15% decline in congestion and a 25% drop in air pollution, with toll revenues funding extensive public transport expansion. Their research emphasized demand elasticity, noting that higher-income travelers adapted by changing travel times, while lower-income groups shifted to public transit, highlighting economic disparities (Menon & Chin, 2004).

Additionally, A. O. Abulibdeh et al., (2018) conducted an empirical study in Abu Dhabi that utilized stated preference surveys to evaluate potential travel behavior responses to a hypothetical cordon pricing scheme. The results indicated a moderate reduction in private vehicle usage, with mode shifts toward public transport and carpooling. However, they also highlighted that lower-income travelers were less willing or able to modify their travel patterns, emphasizing the need for equitable policy design. Similarly, Maheshwari et al., (2024) developed differentiated congestion toll strategies in the San Francisco Bay Area that not only reduced overall travel time but also minimized cost burdens on low-income users. Their results emphasize how pricing systems can be adapted to achieve both efficiency and fairness by linking toll levels to user income or travel time flexibility.

In the case of Milan, both predictive modeling and empirical studies have been used to evaluate the impact of cordon pricing. The Area C policy, implemented in 2012, restricted vehicle access to the city center and imposed fees on high-emission cars. According to Beria et al., (2018) and Croci, (2016), the policy led to a substantial reduction in traffic volumes, improved air quality, and increased public transit usage. These studies emphasized the importance of reinvesting toll revenues into sustainable transport infrastructure. In a complementary empirical analysis, Gibson & Carnovale, (2015) used a natural experiment resulting from the temporary suspension of the Area C scheme. Their findings showed a 14.5% drop in vehicle entries and up to a 17% decrease in air pollution during active pricing periods. Importantly, they documented behavioral adaptations such as shifting travel times and routes, highlighting how cordon pricing can influence the spatial and temporal dynamics of urban mobility. Overall, Milan's case exemplifies the interplay between economic modeling and real-world observation in designing effective cordon pricing systems.

Similarly, a study on Oslo’s transition from a cordon toll system to cordon pricing applied macroeconomic modeling to forecast its impact before implementation. The study found that pricing adjustments led to significant economic benefits, including increased revenue and improved transportation efficiency. However, it warned that unequal toll structures could disproportionately affect small businesses and lower-income commuters, underscoring the importance of revenue reinvestment to mitigate these disparities (Odeck et al., 2003).

Recent empirical work by Baghestani et al., (2024) evaluated cordon pricing scenarios in a middle-income metropolitan context using before-and-after traffic data. Their findings confirmed that travelers responded by consolidating trips, shifting travel to off-peak hours, and using alternative modes. Importantly, they emphasized how such behavioral changes can substantially reduce peak-hour congestion and improve local air quality. Their study further supports the notion that real-world implementation leads to significant behavioral shifts that models must accurately account for to ensure policy effectiveness.

Both real-world case studies and simulation-based analyses provide valuable insights, but they differ in application (Whitehead, 2010). Empirical studies, such as those in London, Singapore, Milan, and Tehran, offer measurable economic data, demonstrating the direct effects of cordon pricing on business revenues, worker productivity, and consumer spending patterns. Predictive models, like those for Milan and Oslo, help anticipate economic outcomes before implementation, allowing policymakers to adjust pricing strategies to maximize benefits. However, simulations rely on assumptions about travel behavior and economic elasticity, requiring post-implementation validation.

Table 1 summarizes key features and findings of previous studies to contextualize the contribution of the current research.

Table 1. Comparison of Previous Studies on Cordon Pricing

Study	City / Context	Primary Focus	Key Findings
Givoni (2012)	London, UK	Traffic reduction, revenue use, distributional effects	30% reduction in traffic, 10% drop in air pollution, £200M in annual revenue reinvested in transit. It benefits most central businesses and increases delivery costs for some sectors.
Menon & Chin (2004)	Singapore	Modal shift, congestion, income-based responses	15% congestion drop; 25% emission reduction; high-income users shifted times; low-income users switched to transit.
Abulibdeh et al. (2018)	Abu Dhabi	Behavioral response, equity analysis	Moderate reduction in private car use; increased carpooling/transit use; lower-income users less adaptable.
Beria et al. (2018); Croci (2016)	Milan, Italy	Traffic flow, emissions, revenue allocation	Traffic and emission reduction post-implementation of Area C; stressed the importance of revenue reinvestment.
Gibson & Carnovale (2015)	Milan, Italy	Driver behavior, environmental impact	14.5% drop in vehicle entries; up to 17% emission cut; drivers adjusted routes and departure times.
Odeck et al. (2003)	Oslo, Norway	System-wide efficiency, socio-economic impacts	Projected efficiency gains; raised concerns over regressive impacts of flat tolling without mitigation.
Baghestani et al. (2024)	Tehran	Trip timing, modal shift, emission outcomes	Shift to off-peak travel and alternative modes; measurable emission reduction and congestion relief.

This study builds on these findings by using the NYBPM to evaluate the economic implications of cordon pricing in New York City's CBD. By incorporating high-toll and low-toll scenarios, the research seeks to provide data-driven insights into economic efficiency.

3. Case Study

New York County (Manhattan Island) has been widely recognized as a prime testbed for evaluating the impacts of cordon pricing on urban travel patterns due to its unparalleled complexity in transportation dynamics. Spanning just 22.96 square miles, Manhattan hosts a daytime population of approximately 3.94 million people—comprising 41% daily commuters, 37% residents, 10% out-of-town visitors, 9% local day-trip travelers, and 3% hospital patients and students (Moss & Qing, 2012). The city as a whole has long struggled with chronic traffic congestion, ranking second in the United States and third globally (Fix NYC Advisory Panel Report, 2018). Despite having one of the highest public transit usage rates in the country, New York's transportation system faces persistent inefficiencies due to overlapping travel demands, event-driven surges, freight movement, and the proliferation of for-hire vehicles. These pressures manifest in overcrowded facilities, undesirable travel times, excessive fuel consumption, and deteriorating air quality (NYMTC, 2017). Compounding the issue, recent street design changes—including the addition of dedicated bike lanes, bus lanes, and pedestrian plazas—have further constrained roadway capacity, prompting continuous efforts by policymakers to identify sustainable traffic mitigation strategies.

Over the past two decades, several proposals have been introduced to implement congestion pricing within the Manhattan CBD, beginning with Mayor Michael Bloomberg's 2007 sustainability initiative (Schaller, 2010). Although these efforts gained considerable public support, they were ultimately hindered by political opposition and concerns over transit access equity and toll fairness. Scholars have emphasized that local context and governance structures are critical in the design and implementation of pricing schemes (Peters &

Gordon, 2009). Currently, New York City employs limited road pricing through tolls on key bridges and tunnels to support infrastructure maintenance and transit funding. However, given the persistent traffic delays, economic disruptions, and environmental impacts observed in the CBD (Baghestani et al., 2020), the city provides a rich setting for exploring the effectiveness of demand management policies such as cordon pricing. Its institutional capacity, comprehensive transit infrastructure, and access to high-resolution regional travel data—particularly through models like the NYBPM—make it an ideal environment for scenario-based policy evaluation (Tayarani et al., 2020). As global cities seek to adopt adaptive and equitable pricing mechanisms, New York's ongoing experimentation offers critical insights into how congestion pricing can be both scalable and context-sensitive.

4. Methodology

Figure 1 illustrates the methodological framework of this study, outlining the process from scenario formulation to economic assessment. Two pricing scenarios, Low-Toll and High-Toll, are defined and integrated into the NYBPM for simulation. The model generates key outputs, including vehicle travel time and traffic volume, which serve as inputs for the PPS to estimate emission levels. These emissions, along with traffic data, are then used to calculate the economic benefits of cordon pricing. By integrating these results, the study provides a comprehensive evaluation of the financial and environmental impacts, ensuring a data-driven assessment of policy effectiveness.

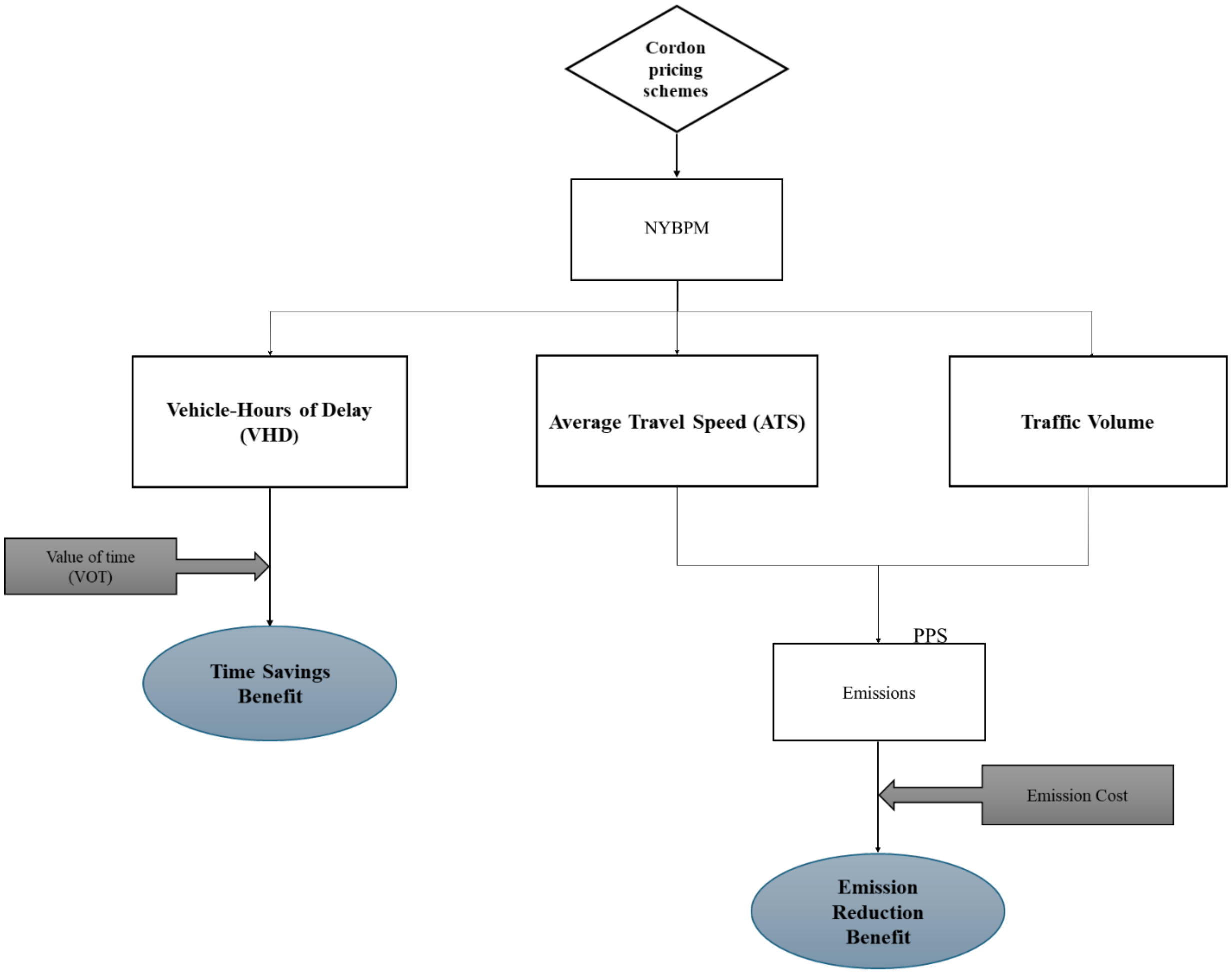

Figure 1. The proposed flowchart to evaluate the economic impacts of NYC cordon pricing

4.1. Pricing Schemes

A cordon-based pricing scheme is proposed for vehicles entering the CBD south of 60th Street. Two toll scenarios are defined: High-Toll ($20) and Low-Toll ($5) for passenger vehicles, with trucks charged double, at $44 and $11, respectively. This scheme aims to assess the economic and traffic impacts of different pricing levels. The suggested pricing scenarios are presented in Table 2.

Figure 2. Study area and cordon pricing boundary (Baghestani et al., 2020)

Table 2. Details of the proposed cordon pricing schemes

Vehicle Type	**Pricing Schemes**		
	Do Nothing	Low-Toll Scenario	High-Toll Scenario
Passenger Vehicle	-	$5	$20
Truck	-	$11	$44

4.2. Activity-Based Model

The NYBPM is a regional travel demand forecasting tool that simulates transportation patterns by incorporating land use, socioeconomic characteristics, and travel behavior. It is extensively utilized for assessing policy interventions—such as cordon pricing—by modeling traffic conditions under various scenarios (2010 Base Year Update and Validation of the NYMTC New York Best Practice Model (NYBPM) FINAL REPORT, 2014). In this study, the NYBPM is employed to evaluate the effects of two tolling strategies—$5 (Low-Toll) and $20 (High-Toll) for passenger vehicles, with truck tolls set at twice those rates. The model generates essential outputs, such as vehicle travel times and traffic volumes, which are subsequently processed through the PPS model to estimate pollutant emissions. These emissions, along with traffic data, are analyzed to quantify the economic benefits of cordon pricing. This integrated modeling framework offers a holistic view of both mobility outcomes and financial implications, yielding actionable insights for policymakers. Among the final outputs is average travel speed, a critical metric for evaluating traffic efficiency and congestion mitigation (Caliper Corporation., 2012).

The application of the NYBPM in this context is supported by its advanced micro-simulation framework, which models individual travel behavior at the household level. The model synthesizes population demographics using detailed datasets and applies a series of multinomial logit models to simulate key travel decisions, including car ownership, trip frequency, destination choice, travel mode, and intermediate stops (Ortúzar & Willumsen, 2011). It segments trips by time period and assigns them to the road and transit networks using user-equilibrium traffic assignment.

Calibration and validation are conducted with observed traffic and transit ridership data to ensure model reliability. In this study, tolls are embedded directly into the highway network's link attributes, rather than using origin-destination matrices, enabling the model's dynamic feedback mechanisms to more accurately reflect behavioral adaptations. This approach improves the predictive accuracy regarding how pricing policies influence travel demand, mode shifts, and network performance over successive iterations.

4.3. Air Quality Model (PPS-AQ)

The PPS is used to refine and analyze the outputs from the NYBPM, focusing on environmental and economic impacts. It takes key model outputs, including VHD and Average Travel Speed, and processes them to estimate emission levels such as CO_2, NO_x, Particulate matter (PM2.5), and Greenhouse gases (GHGs) (Cornell University PPS-AQ Post Processor Software for Regional Conformity Analysis, Cornell University: Ithaca, NY, USA, 2012.; Tayarani et al., 2020).

These emissions are then monetized using established economic valuation methods to assess the financial benefits of cordon pricing, including health cost savings and environmental improvements. By integrating traffic and emissions data, the PPS provides a comprehensive evaluation of how pricing strategies influence both urban air quality and overall economic efficiency.

4.4. Economic Analysis

Cordon pricing schemes can significantly reduce daily VHD, leading to substantial economic benefits by minimizing time lost in congestion. The financial gain associated with this reduction is represented by B_{ts} which is calculated by multiplying the annual decrease in VHD by the Value of Time (VOT) ($25) (Growth or Gridlock? Partnership for New York City. 2006). A higher reduction in VHD directly translates into increased economic savings, benefiting both individual commuters and businesses reliant on efficient transportation networks. By improving travel time reliability, cordon pricing enhances workforce productivity and reduces operational costs for industries dependent on timely deliveries, reinforcing its role as a strategic urban mobility solution.

$$B_{ts} = \text{VHD reduction} \times \text{VOT} \quad (1)$$

The parameters' units are as follows:
Time Savings Benefit (B_{ts}): Dollars
VHD: Vehicle.hour
VOT: Dollars/person.hour

Pollution reduction is a key advantage of cordon pricing, as lower traffic congestion leads to decreased vehicle emissions. The economic benefit of this reduction, represented by B_{er} is determined by multiplying the total annual emission reduction by the corresponding emission cost. By mitigating air pollution, cordon pricing contributes to lower healthcare expenses, reduced environmental damage, and overall improvements in urban livability. These benefits extend beyond immediate cost savings, supporting long-term sustainability goals and enhancing the quality of life for city residents.

$$B_{er} = \text{Emission reduction} \times \text{Emission cost} \quad (2)$$

The parameters' units are as follows:
Pollution Reduction Benefit (B_{er}): Dollars
Emission Reduction: Mass unit/vehicle.mile
Emission cost: Dollar/Mass unit

By summing these two components, B_T provides a holistic assessment of the economic impact of cordon pricing. Reduced congestion leads to lower travel times, enhancing workforce productivity and lowering business operational costs, while decreased emissions contribute to public health improvements and environmental sustainability. This integrated approach highlights the dual role of cordon pricing in fostering both economic efficiency and long-term urban resilience.

$$B_T = B_{ts} + B_{er} \quad (3)$$

5. Results

The simulation results from the NYBPM and the PPS provide a detailed assessment of the economic and environmental impacts of cordon pricing under Low-Toll ($5) and High-Toll ($20) scenarios. These scenarios influence several key components of the transportation system, including modal shift, the origin-destination (O-D) matrix, and overall travel demand, which in turn affect traffic assignment outcomes. While this study primarily focuses on the efficiency and economic outcomes of cordon pricing and does not examine demand-side effects in depth, those interested in a detailed analysis of demand adjustments can refer to Baghestani et al., (2020). The findings of the current study underscore the effectiveness of cordon pricing as a TDM strategy, revealing significant improvements in traffic efficiency, cost savings, and reductions in emissions.

5.1. Traffic Assignment Results

Table 3 summarizes the traffic assignment results, demonstrating the impact of cordon pricing on key performance measures. The High-Toll ($20) scenario achieves the most significant improvements, reducing VHD by 33%, and vehicle miles traveled (VMT) by 14%, while increasing average travel speed by 18%. The Low-Toll ($5) scenario also yields positive effects, with a 15% decrease in VHD, and a 5.5% drop in VMT, leading to a 7.74% rise in travel speed. Additionally, GHG emissions decrease by 7% (Low-Toll) and 18% (High-Toll), supporting environmental benefits. These findings indicate that higher toll rates yield greater efficiency and sustainability gains.

Table 3. Traffic assignment results

Traffic Performance Measure	Do Nothing (Baseline)	Low Toll ($5)	High Toll ($20)
Average Travel Speed (mph)	13.35	14.38	15.73
% Change in Speed	—	7.74	17.86
VHD (per day)	291,642	246,895	196,665
% Change in VHD	—	-15.34	-32.57
VMT (per day)	8,955,734	8,464,960	7,711,783
% Change in VMT	—	-5.48	-13.89
Emissions (Ton/day)	5,354	4,979	4,390
% Change in Emissions	—	-7	-18

5.2. Time Savings Benefit (Bts)

One of the key economic advantages of cordon pricing is the time savings, which directly enhances productivity and economic efficiency. Cordon pricing significantly reduces VHD by 15% in the Low-Toll scenario and 33% in the High-Toll scenario, resulting in substantial time savings for commuters and businesses reliant on efficient transportation. By multiplying the total reduction in VHD by the VOT, estimated at $25 per hour, the economic savings are quantified.

Table 4 demonstrates the calculations for the time savings benefit. In the Low-Toll scenario, the reduction of 44,747 hours of daily VHD translates to $1,118,675 in daily savings, while the High-Toll scenario, with a reduction of 94,977 hours, results in $2,374,425 in daily savings. Over the course of a year, these savings accumulate to $408,316,375 million and $866,665,125 million, respectively. Higher toll rates therefore yield greater time savings, reducing congestion-related economic inefficiencies and benefiting industries like logistics and services that depend on timely operations. These findings highlight the critical role of cordon pricing in optimizing urban mobility, enhancing economic performance, and improving overall travel reliability.

Table 4. Time savings benefit calculations

Scenario	Reduction in VHD (hours/day)	VOT ($/hour)	Daily Savings ($)	Annual Savings ($)
Low-Toll	44,747	25	1,118,675	408,316,375
High-Toll	94,977	25	2,374,425	866,665,125

5.3. Emission Reduction Benefit (Ber)

Cordon pricing not only improves travel efficiency but also offers significant environmental and public health benefits by reducing vehicle emissions. As congestion decreases, vehicles spend less time idling or accelerating in stop-and-go traffic, leading to lower emissions of CO_2, NO_x, and particulate matter (PM2.5). Table 5 illustrates the calculations for the time savings benefit In the Low-Toll scenario, greenhouse gas emissions are reduced by 7%, equivalent to 375 fewer tons per day, while the High-Toll scenario results in an 18% reduction, cutting 964 tons daily. Using a Social Cost of Carbon (SCC) of $50 per ton (Epa & Change Division, 2016; Paul Peter Howard & Schwartz, 2017), these reductions result in daily savings of $18,750 (Low-Toll) and $48,200 (High-Toll), equating to $6,843,750 and $17,593,000 in annual pollution-related savings, respectively.

Table 5. Emission reduction benefit calculations

Scenario	Reduction in Greenhouse Gas Emissions (%)	Reduction in Emissions (tons/day)	SCC ($/ton)	Daily Savings ($)	Annual Savings ($)
Low-Toll	7%	375	50	18,750	6,843,750
High-Toll	18%	964	50	48,200	17,593,000

Reducing NO_x and PM2.5 emissions is a critical factor in enhancing public health, as lower pollution levels contribute to a decreased incidence of respiratory and cardiovascular diseases. Improved air quality not only mitigates health risks but also alleviates the strain on healthcare systems, leading to broader societal and economic benefits. Beyond its role in optimizing traffic flow, cordon pricing serves as an effective strategy for fostering environmental sustainability and public well-being. Moreover, reinvesting toll revenues into sustainable transportation initiatives can further amplify these positive outcomes, creating a healthier and more resilient urban environment.

6. Discussion

Cordon pricing has emerged as a powerful strategy for managing urban congestion and mitigating environmental externalities; however, its success depends on more than improvements in traffic efficiency. While the system has the potential to generate significant revenue, the manner in which these funds are reinvested plays a crucial role in gaining public acceptance and ensuring long-term sustainability. A well-structured reinvestment plan should prioritize enhancements to public transportation infrastructure, ensuring that all commuters—especially those from lower-income groups—have access to affordable and efficient alternatives to private vehicle use. Additionally, complementary infrastructure investments, such as expanded transit networks, pedestrian-friendly environments, and cycling facilities, can further support sustainable mobility while minimizing any adverse effects on local businesses and communities.

Beyond financial reinvestment, the broader implications of pricing strategies on access and travel behavior must be carefully considered. Higher tolls, while effective in reducing overall traffic volumes and emissions, may restrict accessibility for vulnerable populations or those without viable modal alternatives. Although this study does not directly quantify suppressed trips or exact mode shift percentages, the improvements observed in traffic delay and emissions indicators—based on the NYBPM outputs—suggest meaningful changes in travel behavior, likely including shifts in departure times, modal choices, or trip frequency.

Therefore, adaptive policymaking is essential to ensure that cordon pricing remains equitable and responsive. This includes continuous monitoring of traffic and socioeconomic impacts, along with mechanisms such as targeted subsidies or exemptions for essential workers and low-income travelers. By fostering a data-driven and inclusive approach, cordon pricing can evolve into a socially equitable and economically resilient urban mobility solution.

7. Conclusion

This study examines the economic impacts of implementing cordon pricing in New York City's CBD using the NYBPM and PPS models. By defining and analyzing two toll scenarios, the research quantifies the effects of pricing on key economic indicators, including vehicle hours of delay, business operating costs, and overall transportation efficiency. The model outputs were further processed to estimate direct financial benefits, such as time savings and reduced fuel consumption, as well as broader economic implications, including improved workforce productivity and opportunities for reinvesting generated revenue into transportation infrastructure. The findings provide a data-driven assessment of cordon pricing's economic viability, offering insights into its potential role as a sustainable urban policy while emphasizing the necessity of equitable implementation strategies.

The findings of this study highlight the significant economic benefits of cordon pricing in reducing congestion-related costs and improving urban efficiency. By decreasing vehicle hours of delay by 15% in the Low-Toll scenario and 33% in the High-Toll scenario, businesses and commuters save $408 million to $866 million annually, enhancing workforce productivity and reducing operational expenses. Lower congestion also leads to reduced fuel consumption and vehicle maintenance costs, further easing financial burdens on businesses and individuals. Additionally, the revenue generated from tolls can be reinvested in public transportation and infrastructure, fostering long-term economic sustainability. These results underscore the role of cordon pricing in minimizing economic inefficiencies and enhancing urban mobility.

Beyond the empirical findings, this study also makes several methodological and analytical contributions to the broader field of urban estimates, facilitating more informed decision-making. The use of a scenario-based comparison highlights how different toll levels can lead to varying degrees of traffic efficiency and environmental improvement, offering valuable insights into the trade-offs associated with pricing strategies. Finally, the research proposes a methodologically integrated framework that connects traffic performance, environmental impact, and economic valuation, enabling a holistic evaluation of cordon pricing policies. This approach not only strengthens the empirical foundation for policy assessment but also supports the design of more effective and sustainable urban transport strategies.

While this study provides a comprehensive evaluation of the economic benefits of cordon pricing, certain limitations should be acknowledged. A key limitation is the absence of a detailed cost analysis, as this study focuses on the benefits without accounting for implementation expenses, operational costs, and enforcement mechanisms. Understanding the financial feasibility of cordon pricing requires a more comprehensive assessment that includes infrastructure investments, administrative costs, and potential economic disruptions for businesses and commuters. Additionally, this study does not consider long-term economic dynamics, such as shifts in real estate values, business location decisions, or changes in consumer behavior that could influence the overall economic impact of congestion pricing.

Future research should adopt a holistic cost-benefit approach, incorporating both direct and indirect costs to determine the net economic effect of cordon pricing. Moreover, revenue reinvestment strategies should be explored to ensure that the generated funds are effectively allocated to public transportation improvements, road maintenance, and economic development initiatives that enhance urban accessibility and equity. Further studies should also examine the distributional effects on different income groups and businesses, ensuring that pricing policies are designed to support economic sustainability while minimizing unintended negative consequences. Moreover, future research should explore the integration of AI-based demand forecasting and dynamic pricing optimization to improve the precision and adaptability of cordon pricing systems. Leveraging artificial intelligence can provide real-time insights into traffic patterns and traveler behavior, allowing for more responsive and equitable pricing strategies. By integrating these considerations, future research can provide more comprehensive insights into how congestion pricing can serve as a financially viable and socially equitable tool for urban mobility management.

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