THE UNINTENDED CONSEQUENCES OF INEFFECTIVE PUBLIC POLICIES:
INCREASING AUTO SALES BY RESTRICTING TRAFFIC

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ABSTRACT

Urban development is possibly one of the most obvious outcomes of public policy initiatives. Individuals deal with mass transit, roads, bridges, and traffic patterns every day of their lives. How a government decides to make their communities more livable, accessible, and productive, has direct consequences on the people in those communities in the short- and long-run. This is especially true in developing countries that are implementing significant urban change through public policies affecting their citizens. As cities in these countries attempt to manage their rapidly growing populations and increased demands by a larger middle class,² their policy decisions are straining infrastructure, economic growth, and the environment. The central frustration in urban planning in many of these cities is traffic. Poor infrastructure, lack of mass transit, and increasing vehicle ownership overburden roads and prevent people from getting to their jobs, seeing their friends and family, and engaging in economic activity. Policymakers are furiously pursuing mechanisms to alleviate this problem, generally focusing on expanding existing infrastructures or investing in mass transit. Yet limited financial resources restrict the options available to policymakers in these cities. In some cases, the policies and laws chosen as remedies may actually exacerbate the problem by encouraging more, rather than fewer, cars on a limited number of roads. Using Bogotá’s Pico y Placa traffic congestion law as a case study, I examine the use of quantitative restrictions by developing country urban areas as a public policy solution to traffic congestion. In this essay, I consider the effect of such laws on the sales of automobiles, which may result from attempts to circumvent the legal restrictions of the law itself. I find that quantitative restrictions tend to increase demand for vehicles, thereby circumventing the policy and potentially worsening traffic, an unintended outcome.

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² Rodrigue and Slack (“The urban population has increased considerably over the last 50 years and about 50% of the global population was urbanized by 2010 (about 3.5 billion people).”). Available at http://people.hofstra.edu/geotrans/eng/ch3en/conc3en/ch3c2en.html
Commuting from home to work in a major metropolitan community can be challenging. On an individual level, one of the most valuable things a government can do for its constituents is to make their commute to work easier. In fact, the solution seems self-evident to many—build more and better roads while increasing mass transit options to reduce transit times, congestion, and pollution. In the short term, this approach can lead to all of those things. And, given that politicians tend to facilitate policies for the short-term, this expansion approach is the preferred option of many policymakers in urban centers around the world today. Yet an evaluation of this approach in Latin America suggests that short term fixes such as this can exacerbate long-term traffic and pollution problems.

The problem of traffic congestion has existed since the mass production of cars. Cars give people more options in where to live and where to work, greatly expanding their labor mobility. They expand urban centers to allow workers to live further from their places of employment. And they increase economic opportunities for small businesses that may not be able to locate in the commercial areas of an urban center by giving customers the means to access their store.

In developed countries, economic factors such as more effective tax collection, revenue from vehicle registrations, and revenue from traffic enforcement actions, allow governments to invest more in infrastructure. This has facilitated better and more extensive roads, mass transit systems in most cities, and maintenance of these transport systems. Their task is made easier by the relatively stable number of vehicles on the road, the condition of those vehicles, which preserves roads longer, and effective long-term public policy planning.

Yet commutes in developed countries remain difficult for many, and governments are pressured to act. Actions have included major initiatives, such as building a new highway or mass transit line, but have more often focused on regulation of commuters on existing roads. These smaller initiatives include adding fast lanes for high-occupancy vehicles; creating dedicated toll lanes with congestion pricing; and using signaling and cameras to control traffic patterns. The result is not commuter nirvana, but rather a manageable system.

Policymakers in developing countries cities confront a different economic and commuting environment than those in developed country cities. In many cases, they have inadequate infrastructure to accommodate their rapidly growing population; increasing traffic resulting from rapid urbanization and increasing access to vehicles; and far weaker revenue collection through taxes and traffic law enforcement, making investment in infrastructure

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4 High Occupancy Vehicle (HOV) restrictions are a second solution frequently implemented in developed countries. These are usually dedicated lanes (sometimes entire highways) for use only by vehicles that have multiple passengers, often two but in some cases three passengers. Rather than paying a toll to utilize these roads, drivers take receive free access in exchange for reducing the number of drivers on the road by car-sharing. Drivers that use these lanes without the proper minimum number of passengers face significant fines.
5 Congestion pricing is a concept that allows governments to control the level of congestion on certain roads by adjusting the toll that a user must pay to utilize that road. During peak hours, the toll can be substantial, leading many drivers to choose alternate routes, share their commute with other passengers to disperse the cost, or to take mass transit, if available. This approach appears to have several positive effects, including reducing commuting time for drivers on these toll roads and encouraging car-sharing and use of mass transit for those who do not use the toll roads. But it also appears to promote economic discrimination by making it more difficult for those drivers with limited financial resources to use the toll roads to more easily access their destinations.
difficult. The result is worsening traffic on deteriorating roads and increasing commuter frustration.

The public policy response of these governments has generally been to reduce congestion by employing quantitative restrictions on access to roads. This is a low-cost fix that theoretically reduces the number of vehicles permitted on the road at any one time by restricting access, usually at peak commuting hours. Rather than investing substantial sums in long-term projects such as mass transit systems or more extensive road networks, quantitative traffic restrictions provide an immediate solution that policy makers can point to as their signature initiative for reducing commuter angst.

Enforcing quantitative restrictions requires a government to invest in some type of monitoring mechanism. In some developed countries, similar restrictions have been implemented employing an automated monitoring system that captures every offender. One of the more effective approaches is an automated system that relies on commuter registration and traffic cameras. This system was employed in London in 2003.

London faced significant traffic congestion in the 1970s and 1980s. Several studies were conducted, each pointing to the need to enact some type of congestion regulations. The most recent study was carried out in 1995 and concluded that a charge on commuters entering London would be a highly effective solution to increasing congestion. Two years later, the Road Traffic Congestion Act of 1997 was passed, granting the Mayor of London the authority to implement congestion pricing schemes to improve traffic conditions. London Mayor Ken Livingstone introduced a draft plan to charge commuters five pounds to enter the city, a proposal that was quickly challenged by the Westminster City Council on the grounds that it restricted freedom of movement. The claim was rejected by London’s High Court and the measure was implemented in 2003.

The congestion-pricing scheme utilized in London charges all commuters, with a limited number of exceptions, entering the city of London between 7am and 6pm on weekdays. Cameras installed at all city entry-points capture images of drivers’ license plates and funds are deducted from the commuter’s account. Overall revenue from the scheme has approximately 2.6 billion pounds through 2013. The impact of the London measure on traffic has been small but noticeable. A ten-year post-implementation study found that traffic in London had dropped by approximately 10% from the baseline measurements in 2003.

A developing country may find London’s model less feasible given the limited resources available to invest in technology to monitor commuters entering major metropolitan areas and given the difficulty in collecting fees or fines from users and violators, respectively. Mistrust of government exacerbates this problem by limiting the number of commuters willing to link bank or credit card accounts to their vehicle registration, making charges for commuters difficult to collect.

As a result, developing country cities facing congestion problems, such as Bogotá have turned to manual enforcement of congestion restrictions. During peak traffic hours, vehicles bearing certain license plate numbers will be blocked from entering a city. Random checks will

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be conducted by law enforcement officers who typically fine the driver and prevent the car from being driven until the peak hour restriction has ended. Unlike the automated system employed in cities like London, the manual system is ripe for evasion by drivers who ignore the restriction altogether knowing the limitations of law enforcement resources, as well as those who believe that fines can be avoided through bribery of the enforcement officers. But in addition to these evasion techniques, there is legal mechanism available to those who can afford it—purchasing additional vehicles.

When a consumer purchases a vehicle, they receive a new license plate. That license plate will be subject to restrictions under a quantitative congestion scheme. But if the plate issued differs in its restrictions from another plate already owned by that consumer, the consumer gains additional access to restricted roads. In some cases, the consumer can designate the plate number he desires, making legal evasion that much easier. The result is a congestion policy that restricts road access to those who can afford only one vehicle, but offers an avenue for evasion for those with financial resources to purchase multiple vehicles.

The anticipated result of the limited and non-automated quantitative congestion scheme is a reduction in traffic; however, the perceived result appears to be non-existent. However, an interesting externality has arisen from this policy—car sales in these cities appear to be rising. And while many factors can be considered as drivers of increasing vehicle sales, one that may not have previously been considered is the passage of congestion laws, which ironically, were meant to reduce traffic.

A. CAUSES OF CONGESTION

Traffic congestion typically results from too many vehicles on too few roads. The condition of those roads also plays a role in limiting their effectiveness by slowing traffic and often reducing lane access.

The infrastructure problem results in part from the rapid urbanization of developing countries. Reductions in domestic agricultural dependency and weaker terms of trade for the sale of agricultural products has forced many developing country residents to seek employment in cities. This has led to an urbanization process that has outpaced the ability of the government to respond. The result has been a transportation system that is overburdened and unprepared for the modern economy.
In Latin America, increasing wealth has brought with it increasing demand for cars. Combined with free trade agreements that give access to low-cost imported cars, access to a variety of low-cost foreign vehicles has made ownership of one or more cars widely possible. According to a United Nations study on urban congestion, though poor roads and ineffective mass transit may lead to increased road congestion, the most significant cause is the number of cars.  

With an extensive bus system in most major metropolitan areas, one apparent solution would be to encourage more bus ridership. However, two major factors reduce the effectiveness of this solution. The first is status. As a hierarchical society, Latin Americans tend to shun the bus system as their incomes permit them to avoid it. The second is safety. Enclosed spaces with excessive numbers of riders present a risk of crime for some, and the driving habits of bus operators cause fear in others.  

Commuting by car to work, school, or to engage in commerce, is one of the least desirable activities that most people engage in. Under normal circumstances, time spent in a car during peak commuting times is time wasted. These delays affect businesses in a number of ways. Commute times may deter some consumers from traveling to certain localities to shop, dine, or engage in other forms of commerce. Employees that live far from their workplaces and face difficult commutes may arrive late due to delays or may seek alternative employers closer to home. A firm’s decision to open in a bustling downtown area is often driven by the central location that it offers; but if that location becomes artificially blocked from the firm’s customers, the firm may choose to relocate in less congested areas, potentially driving down its revenue potential.  

Policymakers in urban centers are well aware of this problem and have taken steps to minimize the negative externalities associated with congested roads. These policymakers have passed laws that attempt to reduce the number of cars on roads, expand access to mass transit,  

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11 Thomson at 111.
and expand route options with new or wider roads. Keeping firms centrally located not only increases their revenue potential; it also increases the local government’s potential tax revenue.

A variety of potential traffic reduction schemes have been implemented in one form or another around the world. Many, such as those in London, Singapore and some cities in the United States, have effectively reduced traffic congestion while increasing government revenue through transit fees. Solutions implemented in these locales have commonalities, such as technology, advanced economic development, and effective tax and fee collection.

Some solutions, however, have had the opposite effect by worsening traffic. Researchers from the University of Toronto and the London School of Economics studied attempts in urban centers in the United States to reduce congestion by expanding roadways or investing in mass transit. Their study found that these solutions, while offering short-term relief, are quickly overcome with more cars that return the newly expanded roadways to previous high levels of congestion. They also found that these solutions worsen environmental conditions as more cars are being driven on the expanded roadways.12

In cases in which long-term solutions such as those offered with high-tech license-plate monitoring and effective fee collection are not feasible, and where short-term relief from expanded roads or mass transit improvements are out of reach, there exists a third avenue toward relief. Quantitative traffic restrictions attempt to reduce congestion by restricting the number of cars that are permitted to be on the road at given times, usually during peak traffic hours. The goal of such an approach is to provide short-term relief at minimal cost to the government.

The quantitative approach of congestion control is followed by many Latin American countries. However, in these developing countries, two unexpected results have been observed. First, as access to purchasing vehicles becomes easier due to low-rate financing, increased economic resources, and lower-cost vehicles, some families are purchasing multiple cars to secure more options for avoiding restricted travel days. Second, especially in lower-income families, commuters are opting for motorcycles rather than cars, which are often exempt from travel restrictions. Both of these outcomes suggest that traffic will not dissipate, strain on infrastructure will grow, and pollution will increase as more vehicles are on the road.

Economies in developing countries are growing rapidly, giving broader access to vehicles and more demand for driving. In Latin America, owning a vehicle today is considered a sign of economic success. Hence, more new cars are being purchased and driven, and used cars are becoming more affordable for less wealthy families, multiplying quickly the total number of vehicles on the road.

At the same time, urban centers are transforming into economic hubs, attracting domestic and international companies in search of increasingly wealthy customers. To sustain this growth, cities must invest in infrastructure for these new businesses, security for their customers and products, and perhaps most importantly, access to allow potential customers (and workers) to visit them. That is the subject of the next section of this article.

Congested roads limit potential customers from visiting businesses that are located in areas that would be difficult to access. All businesses located in urban areas, but especially small businesses, face the negative impact of traffic congestion. And while higher traffic can mean more exposure of their storefront or marketing materials, it can also mean fewer customers willing to suffer long waits to visit the store.

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12 Duranton and Turner, 2011.
Traveling to and from a store to purchase a good or service is one part of the equation. A second part is the impact that traffic has on businesses that deliver their good or service. A recent report by TomTom Research in London found that over 90% of delivery service drivers reported arriving late to customer appointments due to traffic. "Traffic congestion puts significant pressure on mobile workers, causing missed deadlines, disruption to the work schedule and disappointment among customers," said Managing Director of TomTom Thomas Schmidt.13

**B. THE PUBLIC POLICY RESPONSE**

With more people living outside major city centers but working in city centers, an efficient transport system becomes essential to maintain economic growth. In some Latin American cities, this has led the government to invest in public transportation and a more extensive road network. As a point of comparison, we will look at the case of Santiago, Chile.

The government in Santiago established an underground metro system in 1975, beginning with 12 stations and ultimately expanding to 27 stations in 2010. By the late 1990s, economic growth prompted many people to purchase cars and drive in the city rather than utilizing mass transit. The Santiago bus system, which connected metro stations and provided much broader access to the city than the limited underground metro system did, was decaying and in some cases dangerous. In 2000, the government issued the 2000-2010 Santiago Urban Transport Plan. Using a technical assistance grant from the World Bank and a grant from the Multilateral Investment Fund of the Inter-American Development Bank, they implemented this plan, which modernized bus stations, created dedicated bus lanes, and restricted older cars from being driven in the city, among other things.14

Today, though Santiago has one of the most advanced transit systems in Latin America, including extensive mass transit options, automated toll lanes on major highways, and a well-maintained network of roads, it continues to face congestion problems. In 2014, the Chilean President released plans to expand two metro lines in Santiago as well as to establish metro systems and add a cable car system in two other Chilean cities. This $4.2 billion investment will be applied starting in 2016.15

Chile’s capital city shares the privilege of a metro system with capital cities in Brazil, Venezuela, Peru, Mexico and Argentina. Yet in Bogotá, a city that shares a similar economic growth rate with Santiago, reforming the urban transport system remains a seemingly impossible task.

Bogotá is a city of more than eight million inhabitants. The transport situation is particularly challenging in Bogotá, where urbanization is most concentrated. Because the city is built alongside a mountain range, and because informal settlements occupy much of the available land, many Colombians choose to live outside the city and commute to work. While not uncommon in large cities, the number of workers residing outside the city center is substantial in Colombia.

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15 FoxNews Latino, Chile Unveils Plans to Invest $4.2 bn in Public Transportation Projects (Nov. 5, 2014).
Urbanization and a changing economic landscape have brought many benefits to residents of developing countries like Colombia. In general, per capita gross domestic product (GDP) has increased, economies have diversified, and foreign direct investment from developed countries has grown. In the case of economic growth in Colombia, growth has been steadily positive since 2003 and is expected to continue growing in the future. GDP per capita in 2003 was just over US$2,000 per capita to just under US$7,000 per capita in 2012.

Bogotá maintained a loosely connected bus system operated by independent drivers through 2000, when Mayor Enrique Peñalosa approved a plan for a rapid bus transit system called Transmilenio. The system opened in 2003 and is still in a period of expansion to connect...
the increasingly distant enclaves of commuters. The overcrowded and expensive Transmilenio is not considered an adequate solution for most commuters. Accordingly, Mayor Gustavo Petro initiated a 12-month study to establish an underground metro system in Bogotá. The study was completed in October 2014 and set the cost of developing the metro system at US$7.5 billion, far higher than the initial estimates. It is unclear whether Bogotá, which must contribute 30% of the project development costs, will be able to go forward with this long-term plan.

In the interim, Bogotá has opted for the most economical and least politically taxing solution to the problem of high traffic congestion—quantitative restrictions on road use. These restrictions limit which vehicles are permitted on any roads in the city during certain periods by prohibiting cars with license plates ending in certain numbers from accessing those roads. Drivers caught violating these rules are fined.

Since the first iteration of Bogotá’s “pico y plaza” congestion law was implemented by mayoral decree in 1998, revisions have been added to further restrict access. However, despite the rigidity of the decrees, congestion has not improved on Bogotá’s roads and commuter frustration remains high. One possible explanation for the failure of this approach is that rather than reducing the number of commuters, it has instead led to more commuters to purchase multiple cars or to utilize motorcycles or taxis, which are not affected by the law. This article uses data from relevant Colombian ministries combined with studies from other countries to assess the effectiveness of this congestion scheme and to assess its unintended effects. To begin, I will explain the origins of the law.

C. THE PICO Y PLACA DECREE

To combat the substantial increase in traffic congestion resulting from urbanization, the city of Bogotá passed District Decree 626 (Decreto Distrital 626 de Julio 15 de 1998), commonly known as Pico y Placa (“Peak and Plate”). This law restricted traffic entering, transiting, or leaving Bogotá between the hours of 7:00 – 9:00am and 5:30 – 7:30pm. Only cars that were not prohibited, as identified by the last digits on their license plates, could travel into, through or out of the city at that time legally. This first law restricted two out of every ten vehicles from entering.

Initially, the law was passed with the following goals in mind:

- Increase traffic flow into, out of and through Bogotá
- Reduce motorist accidents
- Reduce pollution

The law was enforced with random checkpoints, resulting in minimal diversion. Subsequently, the Pico y Placa law changed almost annually to adapt to the increasing number of cars present in the city. Restricted hours were expanded and restricted license plate digits were increased in an effort to minimize the number of people attempting to use their car in the city. The most recent law as of this writing is Decree 25 of 2012, which restricts traffic from 6:00am until 8:00pm for cars bearing one of four final digits, which rotate each day.

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16 Peak and Plate.
The Colombian Constitution guarantees the freedom of movement for its inhabitants. However, this freedom is subject to regulation by the government in the interest of the security and comfort of the people. Law 769 of 2002 delegated authority to the Mayor of Bogotá to use whatever means are necessary to reduce road congestion and promote public order (Ley 769 de 2002). This law gave the mayor the ability to limit certain transit activities in the interest of public order.

District Decree 190 of 2004 laid out further objectives for an efficient system of movement within Bogotá. Among other things, it sought:

- An efficient and competitive road system and traffic control
- Consolidation of urban areas
- Increase in access to and from peripheral areas
- Reduction of pollution from traffic
- Reduction of travel time and costs for vehicles

(Decreto Distrital 190 de 2004).

Bogotá implemented their Master Plan for Transport (Plan Maestro de Movilidad para Bogotá Distrito Capital) in 2006, which clarified the city’s goal of establishing a regime for sustainable transport. This included the responsibility for the vehicle user to bear the negative social costs of using their vehicles (para. 8).

Decree 25 of 2012 imposed the most rigid restrictions on transit thus far. This law prohibits vehicles from entering, transiting, or leaving Bogotá between the hours of 6:00am and 8:00pm, Monday through Friday. Vehicles are restricted based upon the last number of their license plate (placa), and this number changes every day with every number repeating twice each week (Decreto Distrital 025 de 2012). Exceptions to this rule are the following: presidential caravans; diplomatic and consular vehicles; funeral vehicles; government security vehicles; emergency vehicles; disabled person vehicles; public service vehicles; tow trucks; motorcycles; escort vehicles; and related government function vehicles.

The Pico y Placa law may be seen as a restriction on the right to work, which is guaranteed by the Colombian Constitution in Article 25. However, the Administrative Tribunal of Bogotá issued an opinion in 2000 stating in no uncertain terms that the Pico y Placa law is not a limitation on the right to work; it merely changes the way in which you may need to get to your work. (Fallo 707 de 2000, Tribunal Administrativo de Cudinamarca).

The most recent iteration of the law was issued in October of 2014. Decree 444 (Oct. 14, 2014) expands coverage for the quantitative restrictions to vehicles that provide collective public transport, such as buses operated by independent operators.

**METHODOLOGY**

I collected primary and secondary data from the Colombian Chamber of Commerce, Colombian statistical agencies, the World Bank, and other researchers, to answer two questions:

1. Is Colombia’s pico y placa law achieving its intended purpose of reducing traffic congestion in the metropolitan region of Bogotá?
2. What risks result from the implementation of second-best quantitative restrictions on traffic congestion in developing countries such as Colombia?
To answer the first question, I will rely on secondary data from a recent governmental study of Colombia’s congestion law, similar studies by international organizations, and primary data gathered from the Colombian Chamber of Commerce on vehicle sales. To answer the second question, I again turn to my primary data on vehicle sales to assess trends prior to and after the implementation of and subsequent revisions to the traffic congestion law. I also explain the high-risk of aversion in this section of my analysis.

ANALYSIS

According to a 2010 study by the Mayor’s office in Bogotá, the Pico y Placa law is not having the desired effect of reducing traffic and increasing the security and comfort of transit.

**FIGURE 4. GROWTH IN NEW CAR SALES, EXCLUDING MOTORCYCLES (2002-2011).**

The study examined a number of factors in reaching their conclusion that the law was ineffective. One measure that was assessed was the change in velocity for vehicles. Presumably, if there are fewer vehicles permitted on the roads, there will be less congestion. With less congestion, traffic will move at a higher velocity. Yet this is not what the results suggest. On the contrary, according to the report, between 2002 and 2010, average velocity for vehicles in Bogotá stayed constant, and even dropped between 2009 and 2011 (although this was attributed to major road construction). (See Report at 36).

Economic growth tends to lead to more access to private car ownership. In major developing country urban centers, this growth in car ownership can diminish the benefits of the very economic growth that led to the rise in car ownership in the first place by straining commerce and reducing the quality of life. Policymakers are tasked with finding a balanced solution that provides safe and efficient movement between residences, workplaces, and places of business; that minimizes the negative impact on the environment; and that is affordable given the limited resources most developing countries have budgeted for transport.

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11 http://www.movilidadbogota.gov.co
In a matter of speaking, economic growth presents certain opportunities to developing country inhabitants that may actually result in barriers to the expansion of that growth. Effective public policy must recognize this inherent dilemma and take steps to maintain economic momentum.

Congestion leads to externalities that fall unequally on low-income families. Congestion leads to slower travel times for buses; more pollution that can lead to health problems and associated costs for addressing those problems; and increasing bus fares as more buses are needed to accommodate more passengers seeking alternatives to driving.

One alternative for low-income families is to resort to the more economical use of motorcycles. Data from the Bogotá Department of Movilidad report suggests that sales of motorcycles since passage of the laws has increased substantially.

**Figure 5. Motorcycle Sales in Bogotá (2003-2011).**

In Bogotá, there is an average of 95 traffic accidents per day. Between 2002 and 2011, this average has changed little. However, of note for this analysis is the increase in the number of motorcycle accidents. From an average of 54 motorcycle fatalities in 2004 to an average of 125 in 2011 following a steady incline each year. Fatalities from cars are far lower and have not changed significantly in recent years.

It is interesting to note that the highest average number of accidents occur on Saturdays, when *Pico y Placa* restrictions are lifted and Bogotanos leave the city to visit other regions for the day. Sunday has the lowest incidence of accidents during the week.
D. EFFECTS OF PICO Y PLACA ON AUTO SALES IN BOGOTÁ

Evading the restrictions of the pico y placa regulations is becoming increasingly common due to gaps in enforcement and as well as the structure of the regulations. The law is meant to reduce traffic by quantitatively limiting the number of cars that are permitted on the road at given times. As discussed above, this limitation is implemented by permitting only those drivers with cars bearing particular numbers on their license plate (“placa”) from using those roads at those times.

In Colombia, when a car is purchased from an auto dealer, that dealer provides the buyer with a new license plate for the car. The license plate can be randomly selected or the buyer can designate a particular numeration on that plate if they wish. For those buying an additional car to one they already own, this is highly advantageous because it permits the buyer to access restricted roads more often. This is especially useful for those who live in areas where public transport is not a viable option and for ride sharing services, such as private taxis.

The effect of this evasion has been to undermine the purpose of the law. Rather than limiting the number of cars on the road, the increasingly restrictive regulations appear to be increasing the number of cars owned in Colombia and having little or no effect on the number of cars on the road during peak hours. This finding is dramatic because it suggests that the only measurable effect of the traffic reduction law was to increase the sale of cars, a counterintuitive (but economically pleasing) result.

Demand for cars in Colombia has been substantial in recent years, outpacing per capita economic growth. A recent report from research firm BBVA noted with respect to the Colombian congestion law, “[t]he demand for transport is not shifting from the private car to public service; instead the demand is for more vehicles to evade the restrictions.”\(^{18}\) The increasing demand appears to be timed in close association with the passage of new traffic

\(^{18}\) BBVA Research, Automotive Outlook: Colombia (2013).
restrictions. With each new iteration of the law making access more limited, demand for vehicles appears to rise.

Between 2000 and 2011, car ownership in Bogotá has increased by 138%. This is an increase from 662,123 registered vehicles in 2000 to 1,572,711 registered vehicles in 2011. The chart below shows how increasing car ownership relates to increasing GDP per capita. Growth in car ownership has far outpaced growth in GDP per capita.

**Figure 7. GDP Per Capita and Car Ownership in Colombia (2000 - 2011).**
The figure above represents the sale of all vehicles, not only personal vehicles. During the recessionary period including 2009, personal vehicle sales dropped by roughly 16,000 units. The rest of the loss in sales that year comes from reductions in the sale of utility and other work-related vehicles. The following year, personal vehicle sales again surged by 27,000 additional units.

Rising car sales in Colombia could be the result of multiple factors, including rising GDP per capita, falling import prices for vehicles, and reduced tariffs on vehicles from the United States through the free trade agreement between those countries that entered into force in 2006. However, GDP per capita, as represented in Figure 7 above, has not risen fast enough to account for the tripling of auto sales since 2003, when the most restrictive congestion regulations were implemented in Bogotá. The graph below represents the paths of per capita GDP growth and personal car sales in Colombia.
The data suggest that despite the relatively smooth trajectory of increasing GDP per capita, car sales for personal use have bounced up and down, dropping significantly in 1998 and ultimately rising to levels more than 300% in 12 years. For our purposes, the 1998 inflection point where car sales drop by 23% is our focus.\(^\text{19}\) In 1998, GDP per capita continued its steady climb, growing by 12% over the previous year. Yet fewer cars were being sold to these increasingly wealthy Colombian citizens.

One possible reason for the drop in personal car sales was the passage of the initial traffic congestion law, \textit{pico y placa} in 1998. There was uncertainty about the extent of the restriction, talk about improved public transit opportunities, and intense enforcement. Consumers feared the effects of the law and reacted by reducing their demand for cars.

This fear continued through the first two years of the laws existence, with sales ultimately dropping by 54% between 1997 and 2000. However, as it became clear that the law could relatively easily be avoided and the perceived risk of enforcement was much higher than the actual risk, car sales began to pick-up again starting in 2001. They continued to rise until 2008, when they again reached an inflection point.

Data collection for use in assessing the effectiveness of congestion laws in Latin America poses certain unique challenges. In most Latin American countries, response to congestion is disorganized largely because responsibility for managing transit is divided among numerous agencies and, in some cases, the private sector. This means that uncoordinated policies and laws can impact other aspects of the larger transit system inadvertently. (See CEPAL at 115). Another issue is the incremental approach to policymaking with respect to transit. Small steps are followed by further small steps that provide short-term political gains yet fail to address the broader public policy of efficient urban transport.

\(^{19}\) Sales in 1997 of personal autos were 74,501. In 1998, they were 57,149.
In the transportation study report discussed earlier, several alternatives to the law that may remedy the current inefficiencies in the *Pico y Placa* system are proposed:

- Create two different restrictions and divide them among drivers. Half will be restricted between 5:00am and 8:00pm and half will only be restricted at ultra-peak hours between 5:00am and 9:30am and also between 4:00pm and 8:00pm. This will have the effect of spreading out the flow of traffic, much as staggered work schedules might do.
- Keep the restrictions currently in place but expand them to include five rather than four restricted numbers each day.
- This option takes the previous option but changes the hours of restricted travel to 6:00am to 8:30am and 3:00pm – 7:30pm.
- This option adopts the previous option but expands the restricted digits to six. Only cars with one of four possible digits would be allowed into, through or out of the city during peak hours.
- This option consists of changing the hours of peak travel to 5:00am – 10:00am and 4:00 – 8:00pm, and restricting cars with four digits.

Some authors have suggested that laws such as *Pico y Placa* in Bogota have resulted in improvements in congestion. “Over the years the programme has helped significantly in reducing peak-hour congestion in Bogotá. While congestion has reportedly worsened in the hours before and after the restriction period, peak hour travel times have reduced by 40–50% and car users have managed to change their schedules, car pool, or use taxis.” (A. Mahendra, at 116).20 These authors have attributed negative externalities to inefficient management of the road network rather than a rise in car ownership and usage.21

**CONCLUSIONS AND RECOMMENDATIONS: BEST PUBLIC POLICY SOLUTIONS**

One strategy that some western countries have implemented to reduce traffic congestion is to charge drivers to use roads based upon the level of traffic currently on that road. In other words, to use a given road, drivers will pay based upon the time of day and the number of cars currently using that road. This demand-side approach has been implemented successfully in London, Oslo, Stockholm, Singapore, and in parts of the United States.

The economics behind this approach are relatively straightforward. People will make better decisions if they are aware of the actual costs and benefits involved in their actions. Thus, setting the optimal congestion tax means balancing the social costs and benefits for drivers. If it is essential for you to get to work on time to attend a meeting, you will likely pay the fee to utilize the road with the least congestion, which will likely be the road with the highest fee. (Congestion Pricing for Latin America).

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21 According to Mahendra, “The inefficient management of the road network is considered responsible for much of the problem; not growing car ownership.” at 118.
Congestion pricing has led to significant reductions in traffic where it has been implemented. London saw a 26% reduction in congestion delays and the U.S. has experienced a 5.7% reduction in vehicle kilometers traveled.22

In London, drivers that wish to enter or leave the city during the day (7:00am – 6:30pm) must first pay a congestion fee, which can be accomplished by Internet, at kiosks or by telephone. The fee was raised to £11.50 in 2009. Other cities, such as Stockholm and Singapore, vary pricing based upon the level of traffic at the time. Cameras are employed to catch and fine (often significantly) drivers who failed to pay the congestion fee.

This approach is not without its own problems. Congestion pricing may cause an equitable access problem, allowing wealthier drivers will be more equipped to pay fees to utilize the fastest routes into the urban areas. However, this might be overcome with subsidized low-cost passes for certain drivers, or by having employers purchase discount passes for their workers.

There may also be an enforcement problem as significant investments will need to be made to install monitoring devices, cameras, and the like. Administrators will also need to effectively fine violators. The cost of doing so may be prohibitively high. However, significant resources are already devoted to the enforcement of *pico y placa* laws and this would be a shift from one enforcement regime to a more effective one, relieving the burden from police and creating a more automated system and one that may be economically self-sustaining due to the revenue received from the tolls.

My analysis suggests that the approach of quantitative restrictions based upon license plate identifiers applied in Bogotá has not had the desired effect of reducing traffic congestion. However, I have also shown that this restriction has led to significant economic activity in the automotive sector, including increased sales and service of vehicles, once the law’s initial fears were surpassed. This unintended consequence of the law has likely undermined the intent of the law itself and must be analyzed alongside the limitations of the law.

Quantitative restrictions generally produce deadweight loss where certain outcomes yield no benefit at all from the restriction and are made worse off as a result. In the international trade context, quantitative restrictions on imports (quotas) meant that available supplies were prevented from matching existing demand and yet the losses that resulted from that mismatch were never captured. Sellers would be forced to find alternate solutions to get their goods to market including, in some cases, circumvention of the law itself. In the congestion context, it appears that the quantitative restrictions are attempting to stop the supply of cars from accessing available roads. This forces some cars off the roads, achieving the goal of the restriction. But those gaps are quickly filled by other cars purchased in many cases to circumvent the restriction. Those who can only afford one car will face the brunt of this law, whereas those with unrestricted resources will find the law less burdensome. And no government revenue is collected as a result.

In the trade context, quantitative restrictions were outlined in 1995 by the World Trade Organization. They were deemed inefficient and wasteful. There is little doubt that the same is true of quantitative restrictions on road access. In order to function more effectively, cities must find a solution that avoids quantitative restrictions that result in deadweight loss and that produce inequitable results.

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In the case of Bogotá, one was to avoid the equity problem would be to restrict availability of license plate variation. Currently, license plate numbers are randomly generated, preventing direct circumvention of the law through the selection of numbers. However, with enough vehicles, chances increase of having at least one compliant vehicle for use each day. The Department of Mobility should consider restricting families to a single final digit for all plates issued to that family to ensure that the addition of a vehicle has no effect on the restriction faced by that family. This ensures that families with one car are treated the same as those with five cars.

This solution does not resolve the deadweight loss problem associated with quantitative restrictions. Accordingly, I propose adding automated tolls to all major roads leading into Bogotá that adjust based upon the number of vehicles on the road at that time. Until the city is able to provide either a comprehensive mass transit alternative or enough alternate routes that some could be tolled and others not, commuters with limited resources should be given subsidized commuter passes that allow them reasonable road access.

Finally, any congestion law that limits vehicles should apply equally to motorcycles. As noted above, these are a dangerous alternative to cars or mass transit and quantitative restrictions appear to encourage more expansive use of these machines. Accordingly, it would be wise to ensure that they are included within the law.
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