Employee Transportation Benefits in High Transit Mode Share Areas

University Case Study

David Block-Schachter and John Attanucci

Employers large and small in urban areas are beset by steadily increasing costs of providing heavily subsidized parking for their employees. Motivated by this problem and by creating a more sustainable policy for their institution, a group of graduate students and faculty participated in a special studies course during the spring 2007 semester at Massachusetts Institute of Technology (MIT). The resulting proposal is currently under consideration by MIT's administration to help control costs for the university and increase the use of public transportation to campus. This paper first reviews previous research into group transit purchase programs. In these programs employers become the purchasing agent for transit passes for all their employees. Rather than paying the full cost of a pass for each employee, they pay on the basis of current transit usage at the work site. Traditionally, these programs have been implemented in low transit mode share areas. In higher transit mode share contexts, the motivations for employees and employers to participate are substantially altered. Different variations on these programs are explored before arriving at what is being called a mobility pass, which combines the parking and transit benefits programs offered by many employers into a single program. The class proposed that a mobility pass be implemented for MIT. It is predicted that this will result in significant reduction in single-occupancy vehicle mode share and a more sound financial footing for the university with respect to its growing transportation benefit subsidy. It is concluded that a program with a phased design would help control the university's costs in the long run and reduce the cost of more than 80% of students' and employees' commutes. The type of phasing that is required to implement these programs is also examined. Although these issues are explored in a university context, it is believed that the conclusions reached apply broadly to other organizations and their employees.

Traditionally, employers outside the core downtown areas of large U.S. cities, including universities, have provided transportation subsidies to their employees through free or significantly reduced rates on parking. These costs can range from less than $1,000 per year for surface lots to more than $10,000 annually for underground parking, with attendant effects on the livability of the local landscape. Free or heavily subsidized parking is viewed as a de facto benefit of employment, and employers are understandably hesitant to simply remove parking subsidies. Employers are thus burdened with the ever-increasing cost of providing parking, with no reasonable way to pass these costs on. This paper explores the issues of parking and transit subsidies via a case study of a major urban university, the Massachusetts Institute of Technology (MIT) in Cambridge. It is believed that this work applies to other large employers as well.

Although employer subsidies for employees' transit passes hold promise for reducing demand for parking, and thus controlling costs, they suffer from a number of problems.

1. Traditionally, transit is at a disadvantage in regard to total commute time. For example, more than 70% of those who currently drive to MIT would add 15 min or more to their daily commute if they switched to transit. Although it might be argued that people may prefer to ride on a commuter train or express bus to work—because travel time can be more productive on transit than while driving—the increased access time of transit may discourage employees from getting out of their cars and onto trains and buses.
2. Whereas the marginal costs of transit are evident—fares are paid at a gate at each use—many of the costs of driving are either sunk costs or are not perceived as costs. If parking costs are free or paid on an annual basis through payroll deduction, drivers have little incentive to occasionally use transit; the only perceived saving is the cost of gas, which despite recent price increases, is usually still cheaper than transit fares for the same distance.
3. The average subsidies that employers are willing to provide for transit are traditionally not high enough to induce mode switch. For example, the Federal Transit Benefits program, the most common employer transit subsidy, also applies equally to pretax deductions for parking costs. Employer parking subsidies are often significantly higher in total dollars per person than transit subsidies (at MIT they are almost $100 per month higher on average). These parking subsidies are often derived from the ownership of real property, which also increases in value. Thus employers may see parking lot subsidies as an investment rather than a cost. Transit subsidies are recurring monthly costs that are paid to another agency; they cannot be recovered and do not provide potential future "value" to employers. For subsidized parking lots the moment of truth comes when the lot has to be redeveloped to capture its increase in value; the total value of the space is then the value of the building to be erected on top of the lot minus the cost of replacing the parking.

Group transit purchase programs (GTPPs) can, in many cases, solve the employer's problem as to how to allocate a limited or fixed subsidy between employees who drive and those who take transit. In these programs employers become the purchasing agents for the

D. Block-Schachter, Massachusetts Institute of Technology, and J. Attanucci, Center for Transportation and Logistics, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA 02139. Corresponding author: D. Block-Schachter, dcbs@mit.edu.

Transportation Research Record: Journal of the Transportation Research Board, No. 2046, Transportation Research Board of the National Academies, Washington, D.C., 2008, pp. 53–60.
DOI: 10.3141/2046-07

transit passes for all their employees. Rather than paying the full cost of a pass for each employee, they pay based on current transit usage by all employees at that work site.

Because GTPPs have been put into place in low transit mode share areas, their traditional funding has come almost exclusively from employers. Brown, Hess, and Shoup's (*1*) seminal work on universal access passes at universities focuses on areas that have relatively low transit mode shares. For example, the University of California, San Diego, averages only eight unlinked trips per person per year—the equivalent of a less than 2% mode share—and thus it was able to implement a program that cost only $5 per student per year as of 2001. In areas in which transit mode share approaches 40%, common in urban campuses in cities with a heavy rail system, such as Boston, Massachusetts; New York; or Chicago, Illinois, the number of annual unlinked trips per person can be expected to be between 175 and 200. At a full fare of $1.70 (the fare in Boston) this would mean an annual fee of between $300 and $350; clearly a different situation. One hundred percent subsidies are less viable for all but the most enlightened (or parking constrained) employers in medium to high transit mode share areas. In this context, employers must coordinate their parking policies with their transit policies to provide a viable transit benefit; such a program would not work financially if parkers were allowed to forgo participation.

Despite Brown, Hess, and Shoup's (BHS) reference to GTPPs at universities that started almost 40 years ago, these programs exist only in one of the 10 largest transit agencies. However, they are prevalent in university cities and college towns. Although these programs have been set up predominantly to serve students, a number of these programs include access for faculty and staff. In addition, two transit agencies, the Denver Regional Transit District and Metro Transit in King County, Washington, have programs tailored to non-university employers. Hester explains in her unpublished thesis (*2*) that the U in UPass is easily extended from university to unlimited or universal. That is, programs that work for students can and have also worked for employers.

BHS summarize the benefits of these programs quite succinctly for low mode share areas: they reduce parking demand and increase access, while improving transit service. This then helps universities attract and retain students by lowering the perceived cost of attending the university. The comparison between the cost of providing a transit pass and that of providing a parking spot is particularly striking, especially given an extension beyond the university setting. BHS show that the cost of a transit pass program at the University of California, Los Angeles (UCLA), for 35,000 students is the equivalent of servicing the debt on 375 new parking spaces during a 27-year period. In other words, if a university pass program can reduce demand by 1% at UCLA, it pays for itself in saved parking.

In 2003, BHS evaluated the BruinGO service (*3*), a universal access pass implemented at UCLA. They conclude that it increased transit mode share by up to 11 percentage points and decreased solo driving by up to 8%. The implication is that the fare elasticity of transit demand is −0.28 and the cross price elasticity of solo driving with respect to transit fare is 0.1 in the first year after implementation. This program was funded by daily parking fees and monthly parking permits and does not assess any additional costs. The relatively low transit mode share at UCLA makes that possible, but these costs are likely to be significantly higher in higher transit mode share areas. The authors also indicate that one of the benefits is noncommuting use. At UCLA the perceived cost of this additional benefit is next to nothing because noncommuting usage is low. In places such as Cambridge, Massachusetts, "occasional" nonpass usage for nonwork trips by drivers, walkers, and cyclists is quite high. At MIT, it is found that occasional users of transit currently spend up to 35% as much on transit each month as people who regularly take transit to work and hold a monthly pass. This increases the costs of GTPPs.

BHS also focus on the three common implementations of the program: opt in, opt out, and universal coverage. As they show, the first of these can suffer from what they call "adverse selection," in which only frequent riders are incentivized to participate, significantly driving up the cost per rider. They focus only on those programs that provide universal coverage, because it avoids the problem of adverse selection. Although universal or required coverage has the lowest cost per rider because it compels even those who never take transit to participate, it can be difficult to impose on employees if a higher payroll deduction is required. In a later section of this paper a description is given of a program that attempts to minimize adverse selection by allowing people to opt out, thus making it more suitable for nonstudent populations.

For the transit agencies BHS studied, the university is often their largest customer. Thus, the university's participation can be a significant portion of the local transit agency's revenue. In this context, and with low mode share to begin with, the transit agency has incentive to give a "good deal," reducing the average fare in exchange for double or triple volume. In more established urban systems, this is no longer the case, and many transit agencies already face congestion and crowding issues. The "big customer discount" is not only unlikely to materialize, it is against the transit agency's interest. In this context the transit agency has an incentive to add customers only at full fare or at off-peak hours when there is excess capacity.

BHS indicate that universal pass programs should be extended outside the university context in those settings in which excess capacity exists or parking construction costs are high. However, in high mode share areas with rail transit and ubiquitous bus networks, it is difficult to argue against any program that increases usage, especially if the equivalent full fare per ride is guaranteed to the transit agency.

BHS also point to how universal pass programs are complemented by daily parking fees, in that they impose a marginal cost on parking at the same time as the universal pass removes it for transit usage. In the rest of this paper, that aspect will be the focus, and an attempt will be made to predict the effects of such a policy on all stakeholders—the university (in the present case study, MIT), the users (students, faculty, and staff), and the transit agency [the Massachusetts Bay Transportation Authority (MBTA)].

This paper updates the previous work of Hester, whose 2004 master of science in transportation thesis at MIT first proposed a universal pass program for the Boston area, to be piloted at MIT and Harvard. Although it has not yet been implemented, her analysis has served as a framework for the analysis that follows.

EMPLOYER PASS PROGRAMS

In many metropolitan areas employers have traditionally offered to subsidize the normal monthly cost of transit passes to encourage higher transit usage (and decrease the need to provide parking), although few employers provide large enough subsidies to tip the scales heavily toward transit. In contrast, in universal pass programs, the employer is obligated to purchase and distribute a monthly or annual pass to all of its employees, but can choose to pass on those costs however it prefers. The price paid for those passes by the employer is based on total anticipated usage of transit by all of its employees and on a per employee basis is generally much lower than the "retail" price for a monthly or annual pass. Location is often used as a proxy for actual mode share; areas well served by transit have a higher price per person than those less well served. Money spent by employers and employees on these programs qualifies as tax free under the Federal Transit Benefits Program. Denver's and Seattle's discounts range from 75% to 95% off the normal price of a monthly pass for participating employers, implying existing transit mode shares of 5%–25%.

Issues with Universal Pass Programs in High Transit Mode Share Areas

Employers have willingly absorbed $50–$100 per employee per year to provide transit passes in low mode share areas. The value inherent in providing these passes—including meeting the required provisions of local transportation demand management programs and a "green aura" designation—is real net benefits that help attract a talented workforce. However, the costs are not trivial in higher mode share areas. Because these passes are designed to be at least revenue neutral for the transit agency, they must also cover "occasional" usage by current nonpassholders.

As indicated earlier, it has been estimated that in high transit mode share areas transit fares per employee can easily exceed $300 annually ($25 per month) and perhaps even approach $50 per month. To implement a universal pass for its employees in these areas, an employer must then decide whether (*a*) to absorb a substantial transportation subsidy increase or (*b*) pass along some or all of its employees' costs of transit usage on an equal basis across its entire employee base. Furthermore, in cases in which transit mode share is high (i.e., population densities are relatively high), there may be a significant contingent of people who walk or bike to work. Although many of these people may use transit occasionally for nonwork purposes, if the costs of a GTPP are distributed equally across all employees, some people in this group may perceive that they are contributing more money to these programs than they receive in benefits. That is, they are "subsidizing" other employees' regular transit use, while not adding to an employer's cost by using subsidized parking or needing a transit pass for the commute to work. Although even pedestrians may benefit to some degree from less local congestion, it is unlikely that avid walkers or bicyclists will perceive a net advantage after paying for a universal pass. Similarly, some employees have no reasonable choice other than to drive to work alone and park (due to their home location or other travel required on the way to or from work, such as picking up or dropping off a child at school). If these employees are already paying near market rates to park, they will quite likely be upset with absorbing another $25 or more per month to receive a transit pass they may never use.

Intersection of Transit and Parking Policies

Whereas in lower transit mode share areas employers may be motivated by environmental concerns or state or local regulation to reduce single-occupancy vehicle (SOV) travel, the high cost of providing parking becomes more important in the denser areas associated with higher transit mode shares. Because land tends to be at a premium, it costs more to provide parking, whether that cost is the opportunity cost inherent in surface lots or the real cost of constructing or leasing spots in an underground garage. Assuming some level of subsidy for parking (that is, the employer charges less per space than it costs to own and operate or lease), a decrease in the number of drivers on a daily basis means a real dollar savings for employers.

Opt-Out Passes

Allowing employees to opt out of this program solves many of the issues with universal passes in high transit mode share areas. If an employer starts with a baseline fee that covers a public transportation pass and "the right to park" and then adds on additional costs for parking (ideally on a daily basis), this has the effect of keeping in the program most of those people who will not or cannot take transit. Therefore, only those people who neither drive nor take public transit to work will be able to opt out. This remaining group is highly correlated with high transit mode share for noncommute trips (especially the "walkers") and thus quite likely will have less incentive to opt out.

However, if parking is not subsidized by the employer these opt-out programs will probably be ineffective. There are two scenarios that must be dealt with here. In the first scenario, the employer sets the rate for the universal pass and then adds on parking costs such that the total cost of parking—including the transit pass—is equal to what it was previously. Although this reduces the incentive for parkers to opt out of the program, the employer is subsidizing the full cost of transit passes for those employees. This may serve to reduce parking demand somewhat—in that it reduces the cost of switching to transit to zero—but the reduction comes at a high cost. Because the employer previously passed the full costs of providing parking along to its employees, it saves nothing from the employee's mode shift. Thus, this is merely an added employer subsidy; it increases rather than decreases costs.

In the second unsubsidized parking scenario, the employer requires that all employees who park in its lots also participate in the transit pass program. In this case people who drive to work regularly, have little incentive to participate. They may just as easily choose to park in nearby commercial lots. Because nonemployer lots do not require participants to purchase a transit pass, they are now cheaper than the employer-provided parking. Absent disallowing the use of pretax dollars for nonemployer parking (which is of questionable legality), the only carrot that the employer has to convince drivers to participate is the promise of convenient parking. If parkers opt out of the program, the costs for all the remaining participants is driven up. This increase in costs then causes people who do not use transit on a regular basis to opt out on purely economic terms, further driving up the costs, until there is a return to the baseline scenario, in which a transit pass costs exactly what it would without the program. In other words, parking must have been previously subsidized to some extent for GTPPs to be able to save both employers and employees money.

Additional Complications

For many smaller employers, or for remote locations from the main campus for institutions, parking is tied to the lease of a building and cannot be disposed of separately. In this scenario there are fewer options for controlling parking costs if the lease cannot be renegotiated. That is, there is no opportunity for the employer to save on parking costs, even if parking demand significantly decreases, unless there is high demand for parking from other tenants at the same site or nearby sites. Although this may be the case in the short to medium term, in the long run this may be negotiable. In this case, it may behoove the institution to implement a change in policy before lease renewal and use the lowered demand for parking to enhance its negotiating position. For larger institutions, leases are often staggered, and thus only a portion of the savings associated with these programs may be actualized before all the leases have been renegotiated.

Table 1 summarizes the distribution of benefits to the various parties for the previously discussed employer transportation subsidy programs.

BOSTON AND MIT

MIT's main campus, located in Cambridge, Massachusetts, across the Charles River from downtown Boston, serves as a base for approximately 8,000 employees and 10,000 students and is well served by the Massachusetts Bay Transportation Authority (MBTA) subway and bus systems. For MBTA as a whole, there were on average 1,291,494 unlinked trips each weekday, as of 2005. In Cambridge, transit mode share was 25.1% in 2000 (*4*). MBTA charges $1.70 per subway trip and $1.25 per bus trip if users have a CharlieCard (smart card) and $59 for a monthly LinkPass that covers travel on buses and the subway system. MBTA also offers college and university students an 11% discount if they buy a semester pass, and it maintains a corporate pass program, which helps to facilitate employers' federal transit benefits programs. MBTA rolled out the CharlieCard smart cards along with a fare restructuring and increase in January 2007, which will allow more advanced tracking of passenger use.

MIT performs a commuting study of all employees and students every 2 years, which provides detailed data on the transportation patterns and usage. Transit and walk/bike mode share to the MIT campus for employees is high. Only 37% of employees drive alone; an additional 9% carpool, 33% take public transportation to work, and 17% bike or walk. Not surprisingly, students predominantly walk, with a 69% walk/bike mode share; 3% drive alone; 19% use public transit; and 3% carpool. This high transit mode share is partially a result of MIT's transit subsidy program, which covers 30%–65% of the cost of a monthly transit pass, depending on mode. The high walk/bike mode share leads to high occasional transit usage by employees who do not take public transportation for their work commute, but do take it quite often for their other trips. Employees and students who regularly drive to work take two round-trips per month using MBTA services. Walkers and bikers take six round-trips per month on average. Those who regularly commute via public transit take more than 20 round-trips per month.

In 1996, MIT began charging for parking and subsidizing transit passes for its employees. Having risen over the years from its initial level of $10/month, MIT's transit subsidy for qualified employees (those who are paid for at least half-time employment) and students ranges from 62% for a bus-only monthly pass, to 29% for the farthest commuter rail pass. Because MBTA operates commuter rail, urban rail, and urban and suburban bus services, MIT has been able to coordinate a unified transit subsidy program. MIT also participates in the Federal Benefits programs for parking and transit, allowing employees to deduct their commuting costs from their payroll checks at considerable tax savings.

MIT has a series of parking charges for different types of employees and students. Approximately 70% of its 4,814 spaces are used by employees during their daily commute. For these spaces, MIT charges $53 per month, available by annual subscription and payable through pretax monthly payroll deductions. The university also has a program in which employees can pay $30 per year and $3.50 per day to park up to 8 days per month. MIT's spaces range from just completed underground parking to surface lots. On average, it costs MIT a little under $200 per parking space per month in capital and operations costs. MIT is encouraged to build its new spaces underground when it does build because these spaces do not count against the floor area ratio of a new building and thus are essentially subject to $0 in land opportunity costs.

There are a number of construction projects under way at MIT that include the construction of new underground parking. It is estimated that the capital costs of building new underground parking at MIT are $100,000 to $125,000 (*5*). MIT has an informal policy of increasing its parking rates by 11% per year to decrease its parking subsidy. Despite this desire, MIT's subsidy—absent any other interventions—

TABLE 1 Distribution of Program Benefits to Employer Transportation Subsidy Programs

Program	Current Transit Riders	Drivers and Parkers: Who Switch to Transit	Drivers and Parkers: Who Do Not Switch	Bikers and Walkers	Employer
Increased subsidies for transit	+ Less money out of pocket	+ Savings on daily car use – Pay cost of transit	+ Fewer people parking, thus parking easier + Less congestion		+ Green Aura
Universal pass (unsubsidized)	+ Less money out of pocket	+ Savings on daily car use – Pay (reduced) cost of transit	– Increase in parking cost + Transit pass in hand for occasional use	– Increase in out of pocket cost + Likely to cost less for large % than actually spend on transit	+ No increase in costs + Green Aura + More switchers, thus future parking costs reduced
Opt-out universal pass	+ Less money out of pocket (but more than UPass)	+ Savings on daily car use – Pay (reduced) cost of transit (more than UPass)	– Increase in parking cost (more than previous) + Transit pass in hand for occasional use	+ If stay in, reduced transit costs + If opt out, no effect	+ No increase in costs + Green Aura + More switchers, thus future parking costs reduced + No need to coerce employees

is likely to increase in both percentage and real dollar terms in the next 5 years because new spots cost significantly more to build than the surface lots or structured parking they replace. Furthermore, because of construction, MIT is obligated to lease between 200 and 500 spaces at any given time at market rates, which are currently more than $230 per month per space.

PROPOSED MIT PLAN

The plan outlined below is the product of a class (1.963—A Sustainable Transportation Plan for the MIT Campus) held during the 2006–2007 academic year. This course was conceived by several graduate students in response to MIT President Susan Hockfield's "Walk the Talk" initiative to save energy and was run by a number of faculty and lecturers, as well as the administrator of the parking office.

The class defined sustainability as its goal and left the definition of "sustainable" as broad as possible, while still being actionable. As such the goal was to "optimize the provision of parking options in strategic locations and the incentives for the use of public transport while considering monetary expenditures and negative impacts on quality of life." To achieve this goal two main measurements of success were proposed: (*a*) decrease MIT's costs by reducing the need for leased and new underground parking and (*b*) increase transit usage and reduce SOV travel.

The class proposed a "mobility pass," which would provide all people on campus with an MBTA LinkPass (unlimited use of the bus and subway) and an occasional parking permit, allowing campus parking at a daily rate. Because the current MIT badge contains a smart card chip that can be programmed to allow access to any parking facility, the plan is simply to add the separately programmable MBTA CharlieCard chip in the form of a stick-on "fob." Also proposed was a demand-based parking system, in which there is a daily rate for parking and lots are differentiated by price based on desirability.

METHODOLOGY

In October 2006, MIT distributed a commuter transportation survey via e-mail to all students, faculty, and staff with an MIT e-mail address. The authors were provided with the data from this survey, stripped of any identifying information, as well as MIT records of what type of transit or parking permits each anonymous invitee purchased in October 2006. The survey had a response rate well above 50%.

A model was developed to predict the costs and mode switch of a GTPP program linked to a variety of parking proposals. Estimating the expected revenues from a tiered parking price system required modeling the number of people who switch to taking MBTA, walking, biking, or carpooling based on a tiered pricing structure. The projected impact on costs and revenue was then modeled based on expected daily usage of parking spaces from those who stay in the program. This has as its basis the survey results and takes into account scenarios of demand responsiveness for each alternative.

On the basis of geocoding survey respondents' street intersections, a prediction was made on the amount of time it would take all drivers to commute to MIT if they were to switch to transit using a GIS-based network model of the Boston region's road and public transit network (Murga, unpublished data, 2007). The difference was then calculated between their predicted transit time and their reported commute time for driving; additional access time for transit was added to correct for model deficiencies. The model of who could switch to mass transit from driving alone was based on that group that had access to mass transit (defined as those people for whom a switch would add less than 10–15 min to their commute). The model took as an input the remaining people as being able to switch to carpooling only.

A demand elasticity was then applied for transit with respect to the real price of parking. This allowed the calculation of a change in the price of parking that results either from a change in the price of the alternative or in the cost of parking itself. That is to say, in the model, a decrease in the average daily transit price of $1 has the same effect as an increase in the daily parking price of $1. On the basis of previous estimates of transit elasticities, a cross price elasticity of –0.2 was used, which translates directly to "real" price elasticity (i.e., transit minus parking price), a rather conservative estimate based on past studies of MBTA and substantially lower than that found by Brown, Hess, and Shoup in their BruinGO study. To err on the conservative side, it was applied only to those people who have access to transit (the present authors have access to a reasonable estimate of this population from the analysis of the survey). In the analysis fewer than 30% of drivers to campus on an average day have "reasonable" access to transit. This then implies that for a 10% increase in the real price of parking, there is a 2% increase in the number of SOV trips taken by people who have access to transit, switching to transit. Essentially what this result says is that even if the price of parking is doubled and the subsidy for transit is left unchanged, only 20% of the people who have access to transit will switch.

It is not essential to assume that the increase in transit demand is attributed to the same people on each day. That is, if a result is achieved that says demand for transit increases by 10%, it need not be assumed that 10% of people switch to transit 5 days a week, but rather it can be assumed that 50% of people switch to transit 1 day per week, or some other combination of the two.

Experience in Los Angeles has found that much of the gain in HOV share from differential pricing comes from reduced transit usage, as people who formerly took transit are "invited" by current drivers to drive to work with them. To mitigate this effect, the cross price demand for carpools is estimated with respect to the parking price only for those people who do not currently have access to transit. Because this population is exclusive to the population to whom the direct price elasticity for parking was applied, it should eliminate this potentially confounding phenomenon.

A review of previous literature did not reveal previously existing estimates of the demand elasticity for carpools with respect to the price of parking (*6*). Instead, a cross price elasticity of 0.05 is used to avoid overestimating any switch to carpooling based on a change in the price of parking. The implication of this elasticity is that a doubling of the parking price will increase demand for carpooling by 5%. This elasticity, again, was applied only to the approximately 70% of current parkers who do not have a reasonable public transit alternative.

Modeling employees under an opt-out regime is similarly straightforward. It is assumed that 50% of those staff and students who do not use transit, or whose fares currently amount to less than 80% of the cost of the program, will opt out. Because the cost of the program is tax-advantaged for employees, whereas their previous occasional spending on transit was not, it is felt that this 80% assumption is conservative. It has been assumed that the rest of those people who do not already drive or take transit to work will stay in because either (*a*) it is more convenient to have the pass for occasional usage, or both expect to increase their usage slightly or (*b*) it is more of a "hassle" to opt out than to continue participating in the program (*7*).

IMPLEMENTATION ISSUES, COSTS, AND BENEFITS

During Phase 1, all people who wish to park on campus would be required to participate in the mobility pass. More accurately, parkers would not be allowed to opt out. That is, the program would be designed so that all people on campus were automatically enrolled, but could opt out of the program if they never drove or took transit to campus (more specifically, only those who exclusively walked, biked, or were dropped off at work could opt out). By examining the distribution of transit usage at MIT, it was estimated that less than 10% of employees and students will opt out. Employees and students who did not currently have a transit pass or parking permit would receive a mobility pass for the first 2 months free, to smooth the transition. This subsidy of 7,700 people for 2 months would cost MIT approximately $270,000.

The mobility pass would be priced at $17.50 per month for students and employees and would be valid year-round. Participants would be able to purchase a monthly commuter rail or express bus pass for 50% of the normal additional pass cost above a LinkPass (covering subway and local bus services). To reduce the monthly charge from the $22 per person cost of a universal pass program that did not increase MIT's subsidy level to the $17.50 charge will cost MIT approximately $660,000 for Phase 1.

Parking would be priced at $2.50 per day for all gated lots, a reduction of $1.50 from the 2007–2008 occasional parking daily fee for the fewer than 20% of the regular parkers who currently hold a daily rate permit. Lot assignment would still be determined by the MIT parking and transportation office, but people with a regular parking permit could switch to an occasional permit and thus reduce their monthly costs (the monthly rate would be unchanged, approximately $60 per month). If parkers choose not to switch to a daily rate permit (and simply keep their annual permit), they would be required to pay the mobility pass charge on top of the current rate. On the basis of this model, it is projected that these rate changes will cost MIT an additional $160,000 during the initial implementation period, because people who park fewer than 17 days per month on the daily rate plan will actually be paying less per month, even including the cost of the mobility pass.

Thus, the total increase for Phase 1 of the proposal would result in an additional subsidy of $1.1 million by MIT, or less than 10% of its current transportation budget for the year. Although this model predicts that only 1% of drivers will switch from SOV to mass transit or carpooling based on this restructuring, it is believed that it keeps all parties from paying more, drivers and transit users alike.

In Phase 2 of the program, the mobility pass cost structure and usage would be analyzed based on CharlieCard reporting from MBTA. This reporting would determine whether the predicted usage of MBTA has materialized and whether the price of the mobility pass increase would need to change. Assuming that a change is unnecessary, the mobility pass will cost MIT $1.5 million. All new employees and students would receive the first 2 months of mobility pass ($35) free going forward and could opt out by November 1, at a cost to MIT of $130,000 annually.

During Phase 2, parking prices would be adjusted upward for high-demand lots. In addition, the daily fee for carpools would be eliminated, although carpoolers would still need to purchase a mobility pass. Overall, this would increase revenue from parking by $280,000 versus maintaining the current annual permit structure and would save MIT more than $400,000 by allowing the university to stop leasing approximately 150 parking spaces from commercial operators.

The total cost of the program would thus be an additional $1 million for the university for the first year versus the current program and would result in more than 5% of drivers switching to mass transit or carpools on a daily basis. Table 2 summarizes the distribution of the costs and benefits of the proposed MIT plan among the various current modal commuting groups.

SENSITIVITY ANALYSIS

The sensitivity of the model has been tested to the assumptions about the current demand for parking, elasticity of transit, and carpool demand with respect to the price of parking, the sensitivity of parkers to the "draw" of the low-priced spots available under each alternative, and the number of current drivers who have viable access to mass transit. Although mode switch is sensitive to many of these assumptions, total revenue as a result of these programs is not. If fewer people switch from parking to mass transit, this actually results in a small increase in revenue on average. The robustness of these results is encouraging.

In regard to the elasticity of demand for mass transit, it is found that a 25% decrease in this elasticity results in a decrease of 25% of SOV drivers switching to transit, but an increase in the required subsidy of only $20,000, or 0.2%. For demand elasticity for carpools it is found that a 50% decrease in this elasticity also decreases the number of predicted SOV drivers switching to a carpool by 50%; however, this increases MIT's subsidy by only $40,000.

For parking demand, it has been assumed that the low price and premium spots fill up first and then the middle spots. If this assumption is relaxed for the worst-case scenario for revenue (premium spots fill up last), 23% fewer people switch to mass transit, and 35% fewer people switch to a carpool, with the inverse result if the low-price spaces fill up last. That is equivalent to a $360,000 decrease in revenue, or slightly less than 4%.

Last, an average of the low, medium, and high estimates of the number of current drivers who have access to transit has been assumed. The transit mode shift is found to be very sensitive to this assumption. Using the low estimate results in a 57% decrease in mode shift from SOV to transit, although this is slightly mitigated by more carpool users. These changes, however, increase the required subsidy by less than $30,000 because these people are not parking on a daily basis.

FUTURE BENEFITS

As MIT continues to grow, it is expected that the demand for parking will increase. If MIT adds 500 new employees during the next 5 years, at the current mode share for driving an additional 185 spaces will be required. Furthermore, the most desirable buildable spaces on campus are the current surface parking lots and garages. It is estimated that this would require replacing approximately 200 current spaces based on the current ratio of employees to spaces. This then would require an additional 385 spaces to be constructed, which will most likely all be underground, at a cost of at least $100,000 per space. This will increase the annual costs for MIT from $11 million per year

TABLE 2 Proposed MIT Program Distribution of Costs and Benefits

Current Parking Permit	Current Transit Pass	Currently Drive to Work?	Switch to Occas. in Phase 1?	No. (Phase 1)	Phase 1 Costs and Benefits	Phase 2 Costs and Benefits
Resident and other exempt parkers	n/a	n/a	No	863	Price increase of $17.50/ month	No change
"Regular" parkers	No	Every day	No	1,638 (400 likely in Phase 2)	Transit pass in hand Price increase of $17.50/ month Transit pass in hand	$50 per month increase for mobility pass and guaranteed spot Transit pass in hand
		Every day	Yes	1,033	Price increase of up to $2.50 per month (if park 46 weeks per year) Transit pass in hand	Option to have no increase in costs Otherwise, more options on where permitted to park
		<18 days per month	Yes	605	Save money Transit pass in hand	Transit pass in hand
Occasional parkers	Yes	n/a	n/a	861	Daily parking price decreases from $4 to $2.50 Transit pass price decreases	
	No	n/a	n/a	513	Daily parking price decreases from $4 to $2.50 per day Have transit pass in hand No cost increase if park 10 days per month	
No parking permit	Yes	n/a	n/a	4,150	Transit pass price decreases Have right to park on campus for only daily fee	No change
	No	n/a	n/a	8,821 (2,122 opt out)	First 2 months free Can now park on campus Can opt out if not financially beneficial	No change

to approximately $15 million per year. In addition, 430 underground spots are already under construction, at a capital cost of approximately $43 million. Thus, the total annual costs for parking in the 2012–2013 fiscal year can be expected to be approximately $19 million per year. If MIT keeps the same total dollar subsidy, this would require raising rates approximately 270%, or 30% per year. If, however, MIT follows its stated policy of increasing rates at 11% per year, its total parking subsidy would increase by $6 million per year by 2012, an increase of 75%, while still increasing the percentage of total parking costs subsidized by MIT from 73% to 74%.

If MIT institutes the recommendations from Phases 1 and 2, drive-alone mode share can be expected to decrease to approximately 33%. This 33% mode share is conservatively high, because it assumes that higher transit subsidy levels will not affect the location choices of employees, which is clearly not the case. In this scenario only 165 new spaces need be constructed for new employees, and MIT needs approximately 200 fewer spaces for current employees. Because MIT still needs to replace the spaces lost from the construction of new buildings, it needs to build 220 fewer spaces than in the business-as-usual scenario; a cost savings of approximately $2 million per year. The cost for implementing Phase 2 of the program is less than $1.4 million per year, even given no savings from leased parking. Thus, under this scenario, MIT can save at least $600,000 per year during the next 5 years while providing the same benefits outlined above (a transit pass in everyone's hands and a small incentive to switch from driving alone to mass transit or carpooling), savings that can be passed along to its employees. Further, the pricing structure in Phase 2 creates a pattern that allows new underground lots to be brought on-line at a significantly higher daily rate. This will allow MIT to increase its return from new parking construction, without affecting the rates at existing spaces. In effect, if the rates are $6.50 (in real dollar terms) at all new underground lots, MIT will maintain the current subsidy level. If MIT wishes to change the subsidy level at all new underground lots to meet its desired goal of 65% subsidy, a $14 per day parking charge would be required. If MIT were to charge this rate for its underground lots, it could maintain rates of $3.50 per day at its garages and $2.50 per day at its surface and low-demand lots and garages.

In other words, even during the course of just 5 years, there are significant opportunities for cost savings for MIT and for its employees. It is also important to keep in mind the flexibility that daily pricing provides. A small change now—even if it is revenue neutral to MIT vis-à-vis an annual price increase—allows for lots to be differentiated by price to reflect demand at some future point. This can increase the utilization of lots and help MIT get the most out of its existing assets.

CONCLUSIONS AND RECOMMENDATIONS

Although previous researched has focused on group transit purchase programs in lower mode share areas, the focus in this paper has been on areas with higher transit mode shares, using MIT and its Cambridge, Massachusetts, campus as a case study. It has been shown that with a small increase in short-term costs, MIT can implement a program that provides all its students and employees with a transit pass and its attendant benefits. By combining parking and transit benefits into a single transportation benefit, which is called in this paper a mobility pass, institutions can avoid Brown, Hess, and Shoup's adverse selection problems, in which all people who regularly drive to campus would opt out of the program. The costs of the program are due to the phased implementation process constructed to advantage as many people as possible. In the interest of a sounder long-term financial footing, it may be palatable for institutions to increase their short-term subsidies. As has been shown, this will decrease MIT's total costs significantly in as short a time span as 5 years. The authors believe that if these programs are to succeed, it is critical that they be instituted thoughtfully and that they not appear punitive to drivers. Drivers, too, have an interest in seeing fewer people driving to their work sites, even if they themselves continue driving; decreased local congestion is a real benefit, especially in congested urban areas.

Although universities are a natural setting for these programs, they are clearly applicable to other environments as well. Current work is ongoing with medical institutions in both Chicago and Boston to evaluate the possibilities of piloting this program outside a university setting (*8*). Especially in Boston—with more than 200,000 college and university students and numerous major medical institutions—the mobility pass has the real possibility of increasing revenue and ridership for MBTA and decreasing costs for institutions and the supermajority of their population.

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The Transportation Demand Management Committee sponsored publication of this paper.